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Strategic Environmental Assessment for the central Namib Uranium Rush

Main Report

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Table of Contents

EXECUTIVE SUMMARY

Introduction

Mining for various minerals has been ongoing in the central Namib since 1901, with the first uranium mine, Rössing, being commissioned in 1976 and the Navachab Gold Mine starting up in 1989. In addition, numerous small mines for tin, semi-precious stones, copper, rare earths and dimension stone have commenced at various times over the past century only to close down a few years later.

Over the past 30 years, prospecting for uranium has occurred at a relatively low intensity, but this changed recently when it was estimated that the global supplies of both primary and secondary uranium would be unlikely to meet projected nuclear reactor requirements world-wide in the short-term (next five years). These concerns about uranium supplies could result in uranium prices rising. This favourable outlook has triggered renewed interest in uranium exploration, with 36 exploration licences for nuclear fuels being granted in the central part of the Erongo Region (central Namib)[1] by 2007 (Figure 1).

This sudden scramble for prospecting rights in the central Namib resulted in the Namibian government placing a moratorium on further uranium prospecting licences in 2007. This was to ensure that the authorities and other stakeholders could consider how best to manage the "Uranium Rush". The most useful tool to do this is a Strategic Environmental Assessment, which allows decision-makers to integrate the full spectrum of environmental[2] considerations within the planning process.

Thus in 2009, the Southern African Institute for Environmental Assessment (SAIEA) was contracted by the Government of the Republic of Namibia, with funding provided by the German Government through the German-Namibian Technical Cooperation Project of the German Federal Institute for Geosciences and Natural Resources (BGR) and the Geological Survey of Namibia (GSN), to undertake a Strategic Environmental Assessment (SEA) for the so-called "central Namib Uranium Rush".

Mindful of the legislative and policy gaps on uranium mining and radiation protection in Namibia, the strong emphasis on sustainability being exerted by global players such as the Mining and Minerals Sustainable Development Project and the World Nuclear Association, and the lack of a coherent development vision in the Erongo Region, the Terms of Reference required the SEA to deliver the following:

- Develop and assess ***viable scenarios*** of mining and associated developments as a basis for subsequent decision-making and formal planning.
- Provide ***recommendations*** on accepted strategic approaches for sustainable mining development in the Erongo Region.
- Provide ***guidance for overall solutions*** on crucial (cumulative) impacts and challenges stemming from the mining operations.
- Outline a ***Strategic Environmental Management Plan*** (SEMP).

[1] The 'central Namib' forms part of the Erongo Region, one of the administrative regions of Namibia. Most of the uranium mining interests are located in the central Namib (Figure 1).
[2] Note that the term 'environment' encompasses all aspects of the biological, physical, social and economic environments.

The SEA provides a big picture overview and advice on how to avoid negative cumulative impacts, as well as how to enhance opportunities and benefits within the uranium sector and between mining and other industries. It provides practical, outcomes-based tools for achieving best practice – some of these based on what is already being done in the Namib by current operators.

It also proposes ways in which the operators in the industry can collaborate to achieve a common approach towards long term management and monitoring – in some cases well beyond the life of individual mines (e.g. aquifer monitoring, tailings dam maintenance, etc.). This is useful even for existing mines, but even more valuable for those mining companies that have not yet started their operation.

Through this SEA and the implementation of the Strategic Environmental Management Plan (SEMP), it is hoped that the 'Namib Uranium Province' will be a living example of how mining can contribute significantly to the achievement of sustainable development.

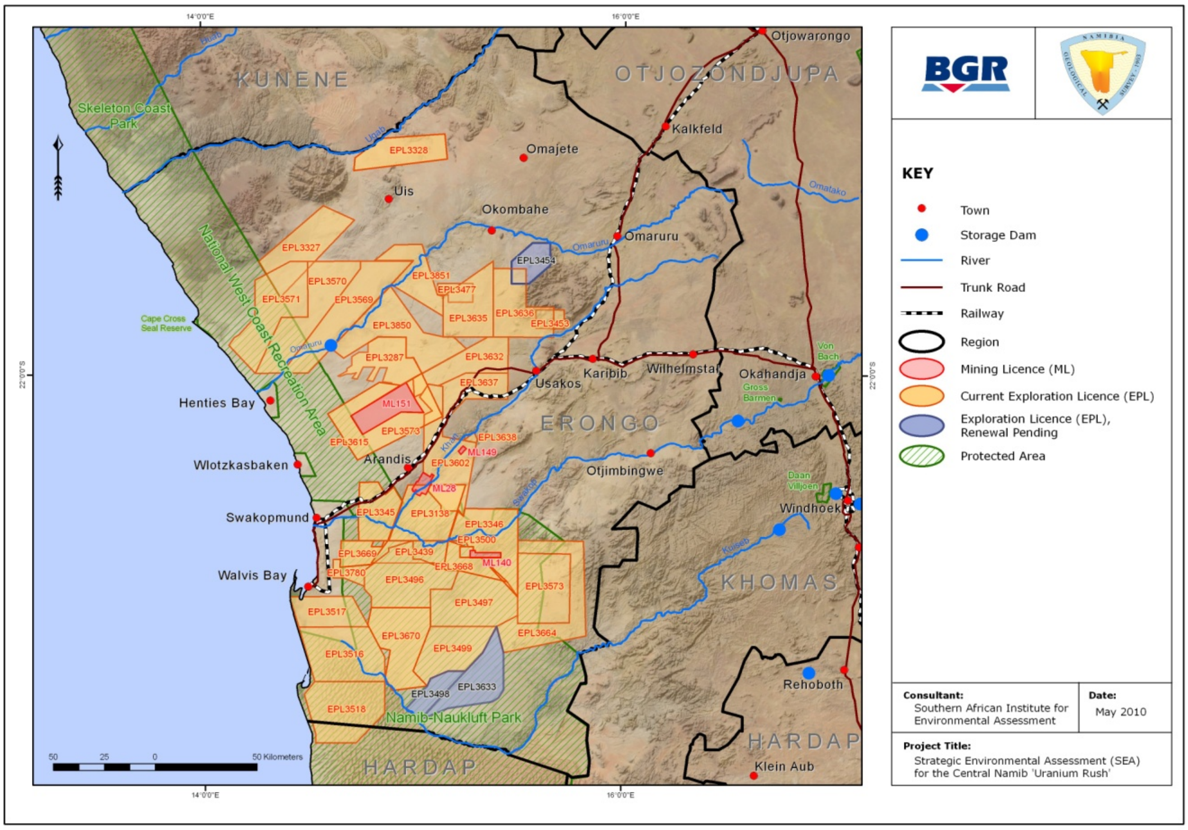

Figure ES-1: Uranium EPLs in the central Namib (Erongo Region)

Environmental context

The Erongo Region (Figure 1) is characterised by its aridity, vast desert landscapes, scenic beauty, high biodiversity and endemism and heritage resources. It has the second largest economy in Namibia, with fishing, tourism, mining and transportation being the main economic activities. Walvis Bay is the second largest town in the country with a population of over 43,000. Swakopmund, located on the coast some 40 km north of Walvis Bay, is the fifth largest town with a population of nearly 24,000 (figures from 2001). However, the population of Swakopmund swells considerably during the holidays and peak tourism seasons due to its popularity. Large parts of the Region, especially along the coast are under active conservation in the form of national parks and community conservancies.

Strategic Environmental Assessment

For the purposes of analysis in this SEA, we constructed four possible scenarios of mine and associated industrial development up to 2020. Scenario 1 represents the current situation with two operating mines (Rössing and Langer Heinrich) and two other mines under construction (Trekkopje and Valencia).

Scenario 2 includes these four mines (and their expansions) plus two others; the projects which are the most advanced at this stage are Bannerman's Etango project (formerly known as Goanikontes) and Extract Resources' Rössing South or Husab project. These projects are likely to be accompanied by the construction of NamWater's desalination plant, an emergency diesel power plant, a 400 mw coal-or gas-fired power station and two chemical plants to supply the mines with reagents.

Scenario 3 builds on Scenario 2 with further expansion of those mines and the addition of at least two more mines, possibly Reptile Uranium's Omahola Project and West Australian Metals' Marenica Project, but this is mere speculation and there could be other projects appearing as better candidates over the next few years.

The fourth scenario is a 'boom and bust' scenario and could happen to any of the three scenarios described above, probably triggered by a significant drop in uranium prices. Under this scenario, it is assumed that most or all of the mines will close down at a similar time on an unplanned basis, leaving an unrehabilitated legacy of mine infrastructure, mass unemployment and excess capacity in all public and private infrastructure.

As time has progressed from the beginning of this SEA, it is evident that Scenario 2 is looking very likely. The opportunities, constraints and threats of the Uranium Rush, as manifested under each of these scenarios, are discussed below.

Opportunities

The Uranium Rush offers a number of opportunities and benefits which, if translated into actions, could result in a range of **positive** impacts:

- Significantly increased government revenues;
- Accumulation of foreign reserves;
- Economic stimulus to the Namibian economy;
- Employment and skills development;
- Infrastructural development and upgrading;
- Public – private partnerships for social, environmental and economic development;
- Greater awareness of radiation risks, and upgraded health care facilities;
- Improved implementation of the Transformation of Economic and Social Empowerment Framework (TESEF);
- Enhancement of Namibia's international standing and reputation.

Increased government revenue

The Uranium Rush could become a significant source of government income. While the existing uranium companies contributed about 3.2% to total government revenue in the form of royalties, pay-as-you-earn, non-Namibia resident shareholders tax and corporate taxes in 2008, this share can increase to 6.2% (Scenario 1) or 8% (Scenario 3) in 2015. In the case of full production, government could benefit in 2020 from additional revenue from the uranium mining industry ranging between N$2.6 - 5.3 bn in Scenarios 1 and 3 respectively.[3]

The benefits of this revenue stream could be severely compromised if any more of the mines are granted EPZ status, thereby exempting them from several taxes and other burdens.

Based on the National Accounts for 2008, uranium mining contributed about 4% to total GDP. Assuming mining companies operate on average at 90% of full capacity, the contribution of uranium mining companies to GDP could almost double in Scenario 1 from about N$3,000 m to some N$5,126 m in 2020, and increase almost fourfold in Scenario 3, to over N$11,476 m.

[3] Note that uranium oxide is priced and traded in US Dollars and therefore Namibian production is very susceptible to fluctuations in the N$: US$ exchange rate. The rate used throughout this document was stated in Table 7.9.1 (as well as other assumptions relating to the economic analysis) and is N$8 = US$1.

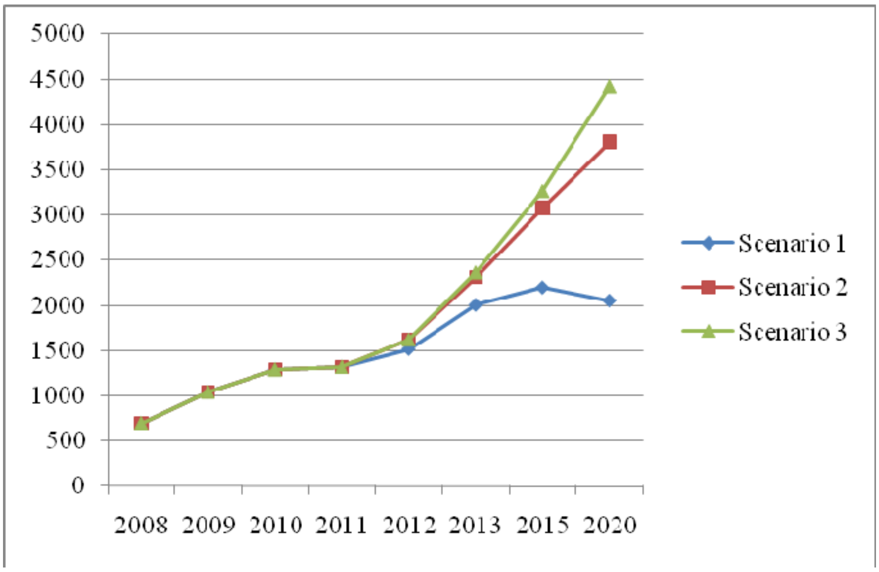

Figure ES-2: Estimated total contribution by uranium mining to government revenue (N$ millions).

Traditionally, government revenues from mining go directly to the state revenue fund and are included in the national budget. It should be used by government to meet the Millennium Development Goals (MDGs) and other development objectives set out in Vision 2030. Whilst increased revenues is a benefit, there is a major opportunity for the Namibian government to create a special 'Uranium Fund' for long-term sustainable social and economic development in Namibia, similar to the Botswanan Pula Fund or the Norwegian Petroleum Fund. The latter was set up to ensure that petroleum revenues were used, not only by the current generation, but also for the benefit of future generations. This rational and prescient use of uranium revenues would place Namibia into the select group of countries which are not afflicted with the so-called 'Resource Curse', such as Nigeria and Angola, but can consider themselves 'Resource Rich' in the widest possible interpretation of the term – socially, environmentally and economically.

Accumulation of foreign reserves

The value of uranium exports is expected to increase from N$5.4 bn in 2008 to at least N$12 bn (Scenario 1) or up to N$26 bn (Scenario 3) by 2020 assuming a contract price of US$70 and that the mines run at 90% of their production capacity. Even with the most modest scenario (Scenario 1), export earnings are expected to double. On the other hand, imports will increase due to the demand by additional uranium mining operations. About 33% of intermediate consumption of mining activities is imported, which accounted for roughly 2.2% of total imports in 2008. This share is expected to increase to between 5.0% (Scenario 1) and almost 11% (Scenario 3) in 2020 unless it becomes profitable to produce more inputs locally, such as chemicals.

The increase in exports will boost Namibia's foreign reserves and hence help maintain the currency peg of the Namibia Dollar to the South African Rand and improve the import cover.[4] The improved balance of payments will also increase Namibia's credit rating and thus the country's ability to raise development loans from international financial institutions.

Economic stimulus to the Namibian economy

Not only will Namibia benefit from substantial amounts of Foreign Direct Investment from the development and operation of uranium mines, there will also be a huge boom in the economy in general, due to the growth of secondary industries, support services and the retail sector to meet the cumulative demands of the new mines and their employees. Since much of this economic activity will be located in urban and industrial centres close to the mines, the greatest impact will be felt at local authority level. An increase in local municipal tax revenues and spending will provide a major economic stimulus to the towns of Walvis Bay, Swakopmund and Arandis, and to a lesser extent, Usakos and Henties Bay. Windhoek, as the nation's capital, will also benefit from the overall increase in economic growth. An increase in the municipal income stream should result in improved service delivery in these towns, revitalisation of town economies (e.g. Arandis and Usakos) and higher spending on community facilities and services to the benefit of all residents.

Employment and skills development

It is expected that the uranium mining sector and directly related new industries will employ between 1,700 – 4,000 (Scenario 1) and up to 10,000 workers (Scenario 3) – see Figure 3. In addition, a significant number of new jobs will be created in other sectors of the economy due to increased demands for goods and services by the uranium mining sector.

[4] The Bank of Namibia is required to back-up every Namibian coin and banknote that it issues by foreign currency, be it South African Rand or any other convertible currency. The favourable foreign reserves allowed the Bank of Namibia to maintain a lower repo rate during 2008 and the first half of 2009 than the South African Reserve Bank.

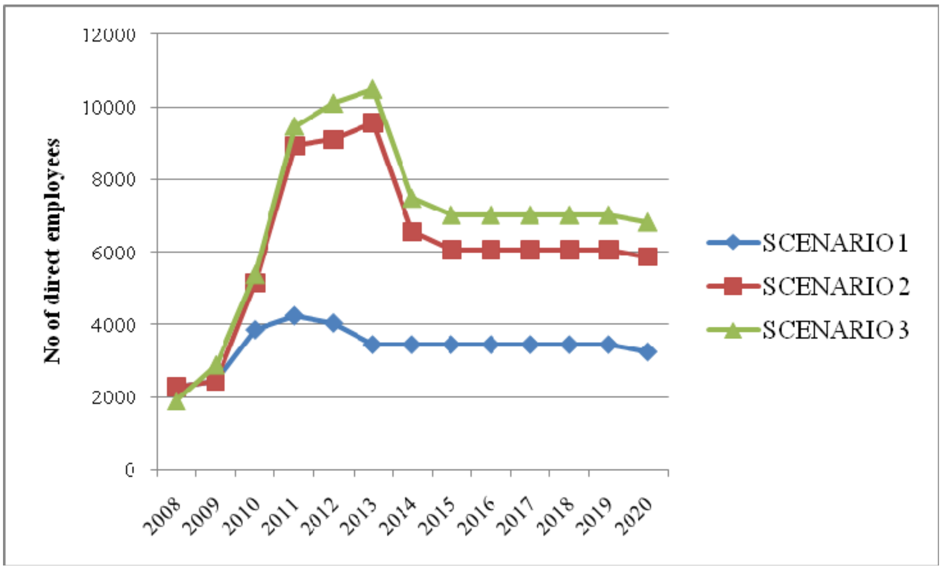

Figure ES-3: Estimated direct employment as a result off the Uranium Rush.

Furthermore, wages and salaries in the mining sector are usually above average and therefore contribute to additional consumer demand and government revenue from taxes on income. Since the industry employs mainly skilled and semi-skilled workers, the additional demand for labour could drive up wages. Last but not least, employees in the mining sector often support their families in the northern rural areas and hence their transfers contribute to poverty alleviation.

Not only would the Uranium Rush create direct and indirect employment, there is an opportunity for the mines to embark on skills development programmes to improve the skills levels of their employees at all levels, including management, which will have long-term benefits for the country.

An increase in employment and disposable income often leads to many other social benefits such as improved health care and education for the employee and all his/her dependents, all of which contributes to the attainment of the MDGs and other Vision 2030 goals. An increase in wealth, especially in the lower socio-economic bracket, can also go a long way to reducing Namibia's high GINI co-efficient.

Infrastructural development and upgrading

Another potential benefit of the Uranium Rush is that the crumbling and overstretched physical infrastructure at the coast may be improved. Major road upgrading is required to reduce the congestion and dangerous driving conditions currently prevailing on several roads at the coast, especially the B2 between Walvis Bay and Swakopmund, the B2 from Swakopmund to Arandis, as well as the C28, up to the Langer Heinrich turnoff. The expected increase in traffic (between 60% -80% on the major roads), justifies the need for significant spending on road upgrading. If the D1984 from Walvis Bay to Swakopmund behind the dunes is tarred and designated as the main through route for all heavy vehicles, it would have a significant benefit for the users of the coastal road, including a reduction in the number of accidents. The B2 from Swakopmund to Arandis will experience more than a 50% growth in traffic volumes (under all scenarios), particularly in the numbers of heavy vehicles and commuter buses. Widening and resurfacing this road would help to relieve congestion and reduce traffic accidents. Alternatively, an opportunity presents itself to build a commuter rail link between Swakopmund and Arandis, with a transport hub at Arandis providing transport to Valencia, Rössing, Rössing South and Trekkopje mines. This would help relieve the pressure at peak times on the B2 and would present several business opportunities in Arandis.

Photo: The Uranium Rush is causing an increase in road traffic on roads in the Erongo Region, resulting in road deterioration, public inconvenience and greater accident risks (Photo Rössing and A. Erasmus).

The demand for rail transport for bulk goods such as fuel, acid and other chemical reagents used on the mines, could stimulate a much-needed upgrade of the current rail infrastructure and rolling stock. Again, the potential exists for Arandis to become a railway junction, with spur lines leading to the various mines, and/or a bulk materials transfer point for mine-bound products from rail to road.

Another benefit for the coastal economies from the Uranium Rush is that the electricity grid will be strengthened by the addition of a new ring-feed line and there will be an increase in generating capacity at the coast, through the construction of an emergency diesel plant, as well as a gas- or coal-fired power station. These developments will combine to provide coastal users with a more stable and reliable power supply and will reduce dependence on Eskom and the Southern African Power Pool.

Finally, the Uranium Rush has created the economies of scale required to construct desalination plants at the coast. The use of desalinated water by the mines will relieve pressure on the alluvial groundwater aquifers of the Kuiseb and Omaruru rivers, which are currently being over-exploited. Furthermore, the traditional constraint on coastal development – not enough water – will be removed if desalination proves successful without any long-term negative consequences for the marine and coastal environment.

The need for government spending on major capital projects, such as those described above, will in itself, create jobs, promote secondary industries and stimulate the Namibian economy.

Public – private partnerships for social, environmental and economic development

Traditionally, responsible mining companies throughout Namibia have developed their own Corporate Social Responsibility (CSR) programmes, which have benefitted the recipient communities to a greater or lesser extent. For example, the Rössing Foundation undertakes a number of activities relating to governance, education, health, poverty alleviation, innovation, the environment and enterprise development. Much of its success can be ascribed to the partnerships that it has formed with local, regional and national government bodies and NGOs.

The Uranium Rush could see up to six companies operating uranium mines by 2015 (Scenario 2) and up to eight under Scenario 3. While it would be laudable for each company to set up its own CSR programme, it would be a missed opportunity to capitalise on the economies of scale that could be gained by the creation of one Foundation to which all mines would contribute. Such a Foundation would be able the apply the joint funds on a more holistic basis to a range of deserving projects, across several sectors such as health care, education and training, conservation, scientific studies, social development, entrepreneurship, governance etc.

Greater awareness of radiation risks, health and safety

The Uranium Rush has the potential to raise public and worker awareness about radiation risks. Increased understanding will empower people to understand and manage their risks to exposure in an informed way. It is also likely that coastal hospitals will be better equipped to detect occupational health problems.

In addition, most mines run wellness programmes which aim to improve awareness in the workforce about a range of health and safety issues, both on the mine and at home. Topics covered in these programmes typically include: fitness, nutrition, smoking, substance abuse, safety in the home etc. The cumulative effect of these programmes on a substantial number of people – up to 7,000 direct employees and their dependents (up to 28,000), will have a significant positive spin-off in terms of improved health, lower work absenteeism and reduced pressure on health care facilities.

Implementation of Namibia's TESEF Policy

The Uranium Rush presents an opportunity for the Namibian government to roll out its Transformation of Economic and Social Empowerment Framework (TESEF) in a structured, rational way. The aim of TESEF is for historically disadvantaged Namibians to obtain company ownership, board positions and equity in management positions. Companies will score points based on their own corporate demographics and their procurement from local companies who are also TESEF-compliant.

Enhancement of Namibia's international standing and reputation

Even under Scenario 1, the envisaged uranium production will catapult Namibia to an internationally recognised major uranium producer. Assuming all other countries' production remains constant, uranium production under Scenario 2 would mean that Namibia will produce around 32% of the world's uranium and under Scenario 3, this could increase to a maximum of 37%. This in itself would significantly enhance the country's reputation in the mining world, but if the development of these mines was also being done along the principles of sustainable development for the extractive industries, with a Uranium Fund dedicated for long-term social development, then Namibia's international reputation would be substantially enhanced.

Constraints

It can be seen from the discussion above that the potential benefits (positive impacts) of the Uranium Rush for the Namibian economy and the country's reputation are significant, but there are a number of constraints, which if not adequately and timeously addressed, could delay the flow of benefits into the economy, or even worse, could mean that the benefits may not be realised at all. The main constraints relate to:

- The timely availability of desalinated water;
- Availability of skills;
- Sufficient social amenities and services;
- The capacity of physical infrastructure;
- Environmental and heritage protection; and
- The capacity of government at all levels to cope with the Uranium Rush.

The timely availability of desalinated water

First and foremost of these constraints, and on the critical path, is the need for sufficient desalinated water to be produced by 2011 to meet the demand from the uranium mines (excluding Trekkopje mine which has its own desalination plant at Wlotzkasbaken). A second desalination plant is planned by NamWater, but current estimates indicate that this plant will not be operational until 2014 at the earliest. However the demand for water from the mines will increase dramatically from its current level of about 5 Mm^3/a to approximately 11 Mm^3/a (Scenario 1), 25 Mm^3/a (Scenario 2) and almost 30 Mm^3/a (Scenario 3) by the year 2014. Thus the 25 Mm^3/a desalination plant being planned by Namwater will not have sufficient capacity to supply the demand under Scenario 3 after about 2014.

While some of this demand can be met in the meantime from other sources such as groundwater (limited availability), surplus from the Areva plant (6 Mm^3/a) and possibly 4 Mm^3/a from the proposed Gecko Chemicals plant from about 2012, there will still be insufficient water available to meet the Scenario 2 and 3 mining demand from 2013 onwards. This poses a major risk to investors, who will have to decide whether to delay mine development until water is assured, build their own desalination plants at great cost, threatening their profitability and Internal Rate of Return, or cancel their projects in Namibia.

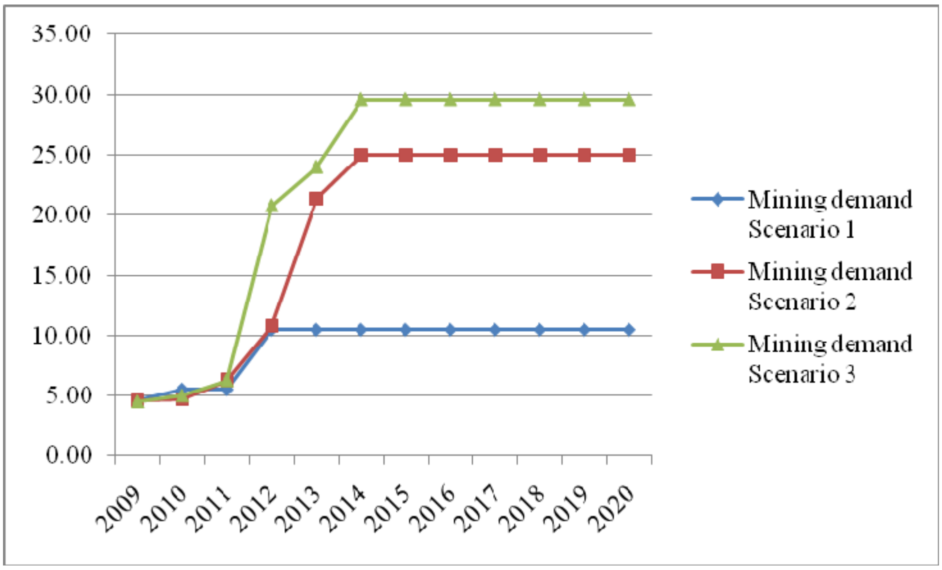

Figure ES-4: Water demands by mines (excluding Trekkopje) in m^3 annum.

It is therefore imperative that the NamWater desalination plant is fast-tracked so that it can be completed by 2013. A quicker and more economic solution would be to re-enter into negotiations with Areva to use their intake structures (designed and built for double capacity) and add another module to the Wlotskasbaken desalination plant. This option is highly recommended by this SEA for a number of environmental and economic reasons. It must be noted however, that even with the two proposed desalination plants water will remain the key limiting factor for development at the coast.

Availability of skills

During construction, the demand for labour will peak at over 10,000 for Scenario 3, 9,500 for Scenario 2 and about 4,200 for Scenario 1. Direct employment numbers on the mines and related industrial developments will level off at about 7,000, 6,100 and 3,400 for the three scenarios respectively during operations. Many of these workers will need to be skilled or semi-skilled and there is already a shortage of artisans in Namibia and indeed in SADC generally. Thus although the uranium mines will create a substantial number of direct and indirect employment opportunities, it may not be possible to meet this demand locally (Erongo Region) or even nationally. Even with skills development programmes in place at the new mines, NIMT and the proposed Millennium Challenge Account-funded COSDECs, the immediate need for skills may have to be met by non-Namibians. This will reduce the local economic benefits that would come if the majority of employees were Namibians.

A further constraint is the high rate of HIV/AIDs prevalence in the target workforce which has a number of consequences for the mines and society in terms of work efficiency, absenteeism, high staff turnover, burden on health care facilities and transmission of the disease to non-infected members of society.

Social amenities and services

It is clear from the above that many employees will need to move to the Erongo Region to meet the demand for skilled and semi-skilled labour and management positions. Many employees may move their families to the Erongo Region, thus placing a demand on affordable housing, health care facilities, schools, policing, amenities and municipal services (water, waste management, sewerage etc). If these demands cannot be adequately met, the area will not be able to attract the required skills and calibre of personnel, which in turn will make it difficult for the mines to function efficiently and compete effectively in the global market.

Thus it is important that the local municipalities and relevant government departments proactively plan and budget for the increased demands for social amenities and services, now.

The capacity of physical infrastructure

At present the road, rail, power and port infrastructure at the coast is at the limits of its capacity to meet current needs, let alone those envisaged due to the Uranium Rush and associated industrial developments. A significant amount of government spending is required upfront to upgrade this infrastructure on a proactive, rather than reactive basis. One of the aims of this SEA is to analyse the potential cumulative effects of the Uranium Rush on aspects such as infrastructure, so that the GRN can proactively plan its infrastructure budget for capital projects and ongoing maintenance. Unfortunately, this spending is required in advance of the full tax and royalty revenue stream from the mines being realised.

While a crumbling and over-stretched infrastructure (power, roads, rail, port) may not in itself delay or prevent the Uranium Rush from happening, it could become a hindrance to the efficiency of the mines. Unreliable and expensive power, potholed, dangerous and congested roads, port and rail delays could individually and together cause reduced production. This in turn will mean that the profits, employment, government revenues and all the possible positive impacts will not be optimised. Indeed, failures in infrastructure could lead to a premature, planned closure if the costs and frustrations of doing business in Namibia are too high. This would undermine all the long-term sustainability benefits that would accrue from a long-term uranium industry in the country.

Environmental and heritage protection

Most of the existing and proposed uranium mines are in or adjacent to national parks and protected areas. These areas are protected because of their special landscapes, biodiversity and heritage resources. While the Policy on Mining in Protected Areas allows mining and prospecting in Protected Areas, it is also possible in terms of the Nature Conservation Ordinance 4 of 1975 for MET and MME to agree to withdraw certain areas from mining. One of the recommendations of this SEA is that certain biodiversity, tourism and heritage hotspots should be given “Red Flag” status which means that the area is by default unavailable for mining and prospecting unless an extraordinary mineral deposit of national importance occurs in the area. This could limit the expansion of the uranium mines into certain areas in future, but at present there are numerous, extensive ore bodies which do not fall in the proposed Red Flag areas.

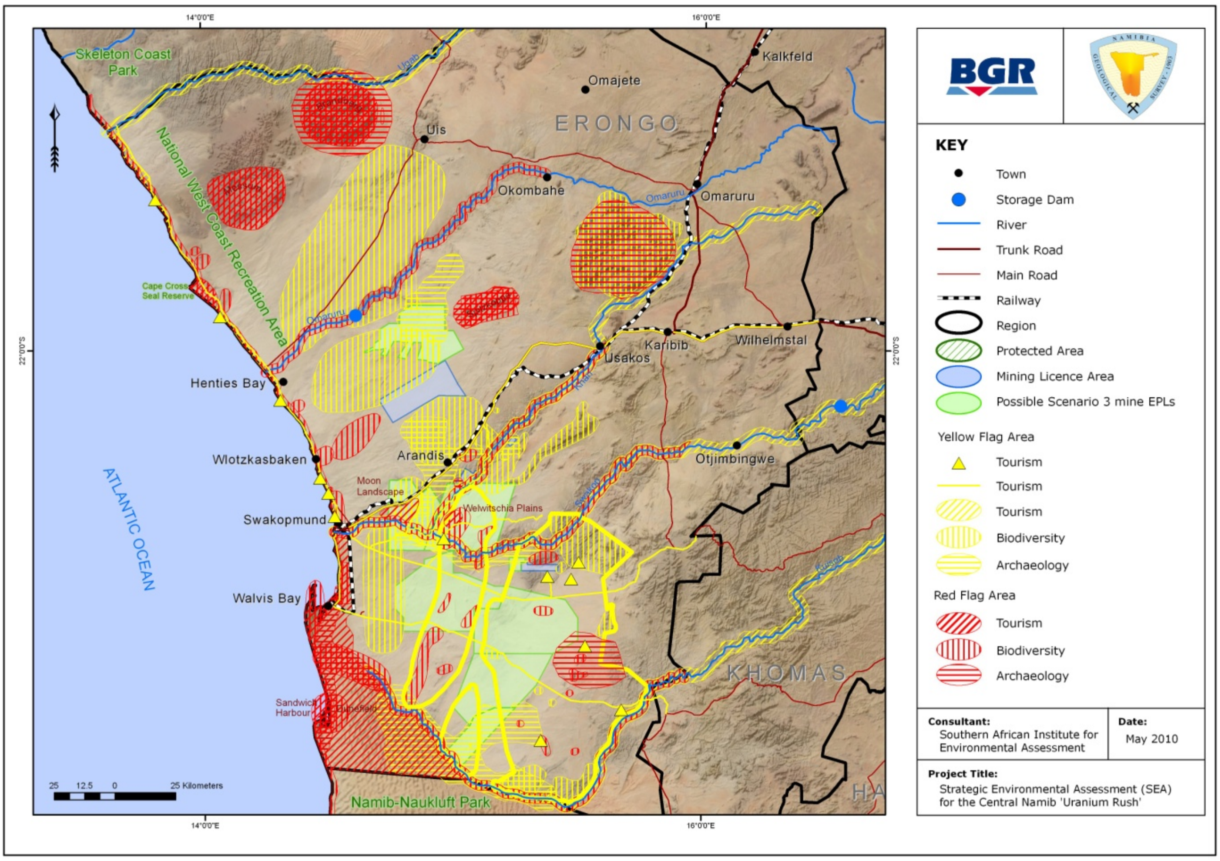

Figure ES-5: Combined Red and Yellow Flag areas for tourism, biodiversity and archaeology

The capacity of government to cope with the Uranium Rush

All of the constraints relating to water, skills, social services and amenities and infrastructure can be readily removed or minimised with a combination of political will and money. However, there are several constraints within GRN and the parastatals which may hamper the full realisation of the potential benefits of the Uranium Rush. Firstly, our analysis shows that there is inadequate capacity in GRN and the parastatals to administer the additional burden of the Uranium Rush in terms of implementing, contracting and building the necessary infrastructure, as well as permitting, licensing, authorising, enforcing and monitoring the mining companies and all related developments. To ensure that all the necessary social and physical infrastructure is in place in time to meet the needs and demands of the uranium mines, relevant GRN ministries and parastatals will need to increase their staff complements, budgets and other resources (computers, vehicles etc). The consequences of delays in issuing permits and licences, work visas, company registrations, providing erven and municipal services, building schools, skills training and health care facilities, and training/employing the necessary staff to run these facilities, will all cause frustrations and lead to mining companies delaying investment, or pulling out of Namibia altogether.

Another constraint for effective governance is that the legal framework is incomplete, with the following either not yet enacted or finalised:

- Water Resources Management Act, 24 of 2004;
- Environmental Management Act, 7 of 2007;
- Parks and Wildlife Management Bill of 2009;
- Urban and Regional Planning Bill;
- Pollution and Waste Management Bill.

These shortcomings mean that Namibia is still implementing outdated and inadequate legislation (e.g. the Water Act, 54 of 1956), or there is a complete lack of the necessary legal instruments to control activities (e.g. the Environmental Management Act (EMA)). Furthermore, some of the Acts which have been promulgated have shortcomings which make them difficult to implement as originally intended (e.g. there is no requirement to compile EMPs in terms of the EMA). A weak legislative structure has two major consequences: it allows for weak or ineffective control and enforcement and secondly, it attracts less scrupulous mining companies who cannot/will not comply with more stringent legal requirements elsewhere. Neither situation is desirable in Namibia.

Threats from cumulative impacts

The Uranium Rush will inevitably have a number of negative impacts on the environment (in its widest sense), both at the scale of individual mines and at a regional level due to the cumulative effect of several mines operating within a relatively small area with similar construction and operating timeframes. The individual EIAs for the new mines and the environmental management systems in place at the existing mines deal with the impacts caused by the individual mines. This SEA however, has been able to consider the cumulative spatial and time-crowding effects of various possible Uranium Rush scenarios. The cumulative impacts or threats identified in this SEA can be categorised under the following headings:

- Impacts on natural physical resources;
- Impacts on biodiversity and heritage landscapes;
- Impacts on health;
- Stress on physical infrastructure;
- Impacts on public recreation and tourism;
- Impacts on towns and social structures; and
- Stress on government ministries and parastatals.

Impacts on natural physical resources

Many of the known impacts on water resources caused by mining operations are extremely localised and it will be the responsibility of each mine to control these impacts through their own mine-specific EMPs. However, there are two major potential cumulative effects on water resources that may result from the Uranium Rush: pollution of, and/or over-abstraction from the alluvial aquifers of the Swakop and Khan Rivers.

However, following specialist groundwater studies conducted for this SEA, two major factors have been identified which will militate against the downstream migration of pollution plumes: the first is that the alluvial aquifers are compartmentalised by bedrock outcrops at or near surface, which inhibit the groundwater flow to the downstream compartment. Secondly, recharge of the aquifers by surface flow is only occasional – a situation made worse by the construction of dams on the upper reaches of the Swakop River. The combination of these two factors means that water within the alluvial aquifers in both the Khan and Swakop Rivers moves downstream extremely slowly, as demonstrated by the long residence time (several decades) of water found in these aquifers. Thus if a pollution event were to occur, it would not be able to migrate downstream far enough to affect any of the lower Swakop River users.

Should any of the EPLs along the Omaruru or Kuiseb be developed into mines in the future, extra care will have to be taken to ensure that no pollution whatsoever reaches the primary aquifers, as these supply all domestic users in the coastal region.

The second potential cumulative impact relating to water is the possible lowering of the groundwater table in the river beds. If each mine is allowed to extract its permitted maximum from the alluvium, this may result in a general decline in groundwater levels within the affected compartment. Over-abstraction above the sustainable yield in a given compartment would affect the vegetation of that river reach and all the dependent ecosystems, as well as borehole yields of the farmers who abstract water from that given compartment.

It is imperative therefore that the abstraction permits granted to the mines take into account the cumulative rates of abstraction to ensure that the permitted amount is within sustainable limits. A comprehensive water balance model has been developed as part of this SEA and this must be referred to before any abstraction permits are granted.

Impacts on biodiversity and heritage

The main threats from the Uranium Rush on biodiversity and heritage include the direct loss of species or sites through landscape disturbance; and the indirect loss of species through habitat loss, degradation and fragmentation.

Part of the problem in quantifying the threat of the Uranium Rush on biodiversity and heritage resources is that in spite of sporadic research over the years (usually mine-site specific and short-term), our information about species, ecosystem functioning and the archaeological history of the central Namib is poor, with many gaps in the data base. Thus our understanding of species and processes is incomplete and it is therefore impossible to quantify the cumulative impacts of the Uranium Rush in terms of numbers of species lost, habitats fragmented and archaeological landscapes disturbed.

Nevertheless, it has been possible as part of this SEA to provide a **preliminary** delineation of the sensitive biodiversity and archaeological areas (Red and Yellow Flags) and to identify which exploration and mining companies are currently active in areas where these sensitive sites occur. It would seem that all the companies are, or could impact on one or more of these sensitive sites. Furthermore, even if they do not cause direct destruction, impacts such as noise, general disturbance, poaching, road kills, illegal collecting of species and artefacts and pollution, could all directly contribute to the loss or displacement of species. The direct loss of heritage sites means that there will be a permanent loss to the record of human history in the central Namib.

In addition to the direct impacts on species and habitats through land disturbance by the mines themselves (up to 577 km^2 may be disturbed), another major threat is posed by the proliferation of infrastructure (roads, railways, powerlines and pipelines) throughout the central Namib. While the cumulative actual ground disturbance caused by the construction and future existence of this infrastructure is relatively small (compared to the mining footprint) at about 14 km^2, the greater impact lies in the barrier effects to animal movement and habitat fragmentation. Furthermore, the construction of this infrastructure will increase dust levels throughout the region – which will impact both fauna and flora, and it will also inadvertently introduce more people into the wilderness areas.

Therefore the Precautionary Principle needs to be applied by the authorities in granting future exploration and mining licences in the central Namib. A proposed decision-making process for dealing with the Red and Yellow Flag areas has been proposed in Chapter 8 of this SEA. Furthermore, each prospecting or mining company must address these sensitive sites in detail in their EIAs and EMPs to ensure that as far as possible, sensitive areas are avoided in the first instance, and if they cannot be avoided, that all the necessary mitigation and control measures are put into place to minimise negative impacts. This will also require rigorous monitoring and enforcement on the part of all relevant authorities.

Impacts on health

There are four potential impacts on human health that could be caused or exacerbated by the Uranium Rush, namely: an increase in sexually transmitted and other diseases; an increase in road accidents; possible increase in public radiation dose; and a potential for an increase in inhalable dust.

As mentioned above, the Uranium Rush will increase the levels of employment in the country in general and in the Erongo Region in particular. Unfortunately, people with cash earnings tend to use alcohol in social contexts, which increases the likelihood of unprotected sex and the spread of HIV. The influx of job seekers may also increase over-crowding in the urban areas, which is conducive to the spread of diseases such as TB.

An increase in traffic on deteriorating road infrastructure is likely to result in an increase in accidents. This risk is heightened by the differential speeds and journeys on the affected roads, with a combination of slow moving heavy vehicles, tourists, faster moving commuters and delivery vehicles. On single-lane roads in foggy or dusty conditions, inappropriate overtaking is a frequent cause of accidents on the coastal area roads. With the predicted increases in traffic loads, the accident rate is likely to rise, but it will be exacerbated if the GRN does not carry out the necessary road upgrades to improve traffic flows and driving conditions.

The specialist studies on air quality, groundwater quality and radiation that were commissioned for this SEA identified potential sources of radiation, transport pathways and receptors (farmers, urban residents, game animals) who may be affected. The **preliminary** findings of the groundwater studies showed that there is no evidence of mine-related pollution in the groundwater of the Khan and Swakop Rivers. The groundwater study also showed that if a pollution event did occur, the downstream migration of a contamination plume would be very slow and hindered by the presence of natural barriers (bedrock) along the rivers. Therefore the potential for exposure to additional radiation via groundwater pathways is extremely unlikely.

The **preliminary** findings of the specialist study of airborne radiation risk showed that the cumulative exposure risk of the *farmers* to airborne radiation from the inhalation of radio-active particulates and radon increases slightly with each scenario (i.e. with more mines), but the doses are all still well below the internationally accepted public exposure limit of 1 mSv/a. The study found that the contribution of the mines to the radiation dose of *residents* in the coastal towns is insignificant. Even in the town of Arandis, which is closest to the mines, the highest radiation exposure for residents is still below 0.3 mSv/a, even for Scenario 3. The potential for health risks from radiation from mining related activities is therefore very low.

The air quality study showed that the major contribution to dust in the region is from natural wind erosion of the desert surface and from traffic on the gravel roads. Even under Scenario 3, these two are the main contributing factors to dust. The amount of *inhalable dust* (PM10) will increase, especially at Goanikontes (by 34% in Scenario 3 over baseline), but at the other towns the increases in PM10 are predicted to be less than 13%, even under Scenario 3. Thus there could be an increase in respiratory problems for residents in the vicinity of Goanikontes.

The impact of the mines on *total particulates* in the towns is negligible, except at Goanikontes, where a 15% increase in nuisance dust levels may be expected in Scenario 3.

Stress on physical infrastructure

The components of physical infrastructure which will be most affected by the Uranium Rush are the roads. The main cumulative impacts arising from the increases in traffic (as mentioned above) are:

- Higher wear on the roads, necessitating more maintenance, especially on the gravel roads; if the maintenance is not sufficient to handle the increased traffic, roads will degrade (potholes and erosion along the edges of the tarred surface) and become very dangerous;
- Higher loads on the roads which were not built for such weights. This also results in road deterioration;
- Greater pressure on emergency response vehicles, ambulances, traffic police, etc.;

- Congestion causing delays for road users, which can also negatively impact on the competitiveness of the various trade corridors.

The potential increase in rail traffic on existing lines will have a few cumulative impacts. These would include:

- Localised and intermittent noise from an increased number of trains on existing lines;
- Increased potential for spillages of diesel and oil (from train locomotives);
- Increased risk of accidents resulting in major chemical spills;
- Congestion in shunting and loading yards causing delays.

Even if the proposed Gecko Chemical plants supply the mines with process chemicals locally, there will be a demand for increased port capacity to import sulphur, coal and other bulk raw materials to meet the expected higher demands from the mining industry. This could have an impact on port activities, handling times and port infrastructure.

Increasing congestion will require NamPort to expand the harbour facilities if it wants to continue to attract shipping for local and continental customers. This will have several negative impacts on the environment, which are being documented in a separate EIA for the expansion project (CSIR, 2009). One of the options to relieve this pressure is to build a bulk goods jetty north of Swakopmund to supply the proposed Gecko Chemicals plants.

Although NamPower is not currently in a position to meet the predicted electrical energy demand of the Uranium Rush from existing sources and Power Purchase Agreements (PPAs), it is actively investigating a number of additional generation and PPAs within the Southern African Power Pool to meet power demand in the short-, medium- and long-term.

Impacts on public recreation and tourism

Residents and tourists to the coastal zone define their quality of life as being enhanced by opportunities for sport, exploring the desert by vehicle, relaxing on the beach, angling or adventure activities. Tourism products in the central Namib include adventure tourism (e.g. parachuting and quad biking), business tourism (e.g. workshops and conferences), consumptive tourism (e.g. hunting and fishing) and ecotourism (excursions into the desert). There is also the use of the desert landscapes for filming of documentaries, adverts and feature films. In the context of public recreation and tourism, the main impacts likely to result from the Uranium Rush are: visual impacts, leading to compromised natural beauty and deteriorating sense of place; and loss of access to recreation and tourism destinations.

The **natural beauty and ambience** of the desert will be compromised by the Uranium Rush, because even with the best environmental management plans in place, prospecting and mining will result in visually intrusive infrastructure, dust and noise, and will scar the Namib for decades or longer. At present, the largely undisturbed desert with its dramatic landscapes, interesting biodiversity and sense of place and space attracts numerous tourists very year. The tourism sector is of considerable importance to the Namibian economy, providing over 18,000 direct jobs (5% of total employment), and N$1,600 million pa in revenue (3.7% of GDP). The sector has seen significant growth over the past fifteen years, with tourist arrivals increasing more than threefold between 1993 and 2006 (NTB 2007).

The proliferation of mining related infrastructure (e.g. powerlines, pipelines, roads and railways), added to the alienation of land for mining of areas previously used for public recreation and tourism, effectively means that mining may displace tourism if not properly managed, resulting in significant losses for the whole tourism industry.

In addition to the erosion of aesthetics and sense of place, the existence of EPLs and mines, and their right to **exclude locals and visitors** from their areas, limits the places available for tourism and recreation. For example, the popular Moon Landscape and Welwitschia Flats may both be compromised by nearby mining of the Etango and Rössing South mines respectively. This may be partially remedied by the development of new tourism products (e.g. mine tours) and the creation of new tourist and public roads, and alternative viewpoints and campsites, so that there would be no net loss in terms of tourism and recreation opportunities.

Photo: Two areas of concern are the Moon Landscape and the Welwitschia Drive – both feature prominently on local tourism and public recreation routes (photo P.Tarr).

Impacts on towns and social structures

The large influx of people to the coastal towns, drawn directly or indirectly by the Uranium Rush, will inevitably change the current ambience and structure of the coastal towns.

Stakeholders expressed concern about the cumulative impacts of increased mining on the town of Swakopmund, which is marketed as a leisure and tourism destination. They stress the need to maintain the aesthetically interesting architecture, holiday ambience and peaceful nature of the town. There was a concern over the influx of mining personnel, as well as ancillary industries already established, and to be established in Swakopmund to support the Uranium Rush. It is expected to change the ambience to a more industrialised, busy centre.

Some social and cultural norms in Namibian urban society are not necessarily desirable. Rapid urbanisation tends to lead to a loss of community, a weakening of social networks and often an increase in crime (Speiser, 2009). Thus the influx of people will inevitably lead to an escalation in crime – not just in proportion to the increase in population, but because aspirant job seekers may resort to crime until they can find a job and crime syndicates may move in, attracted by the amount of disposable income, assets and cash in circulation.

The influx of people will also place a demand on housing and erven and because there is a shortage of properties and erven in some economic brackets, the price of properties will be driven upwards. While this could be seen as a benefit by property owners, it will force entrants to the property market to look elsewhere, rent or settle for something less expensive (and less desirable).

More people in towns will place pressure on the ability of GRN to provide the necessary school and health care facilities and staff. A possible additional 20,000 school-aged children may be expected in a region which currently accommodates 27,000 in its schools with some difficulty. Thus there is a need to build at least 10 more schools.

The Uranium Rush is likely to result in a larger revenue stream for local authorities. While this is a major benefit by itself, it needs to be translated into service delivery such as the provision of waste management services, sewerage, water and power distribution networks and the development and maintenance of public amenities such as parks, gardens, sports facilities, beach front promenades etc. The quality of life in the coastal towns could deteriorate significantly if the municipalities do not increase spending on service delivery. However, this could be difficult to achieve if staff and physical resources are not augmented.

Conclusions

Mining, being an extractive industry, is in itself not sustainable, but there are a number of ways in which mining can leave a net positive legacy, if it is managed correctly by all parties. The first step is to understand the nature of the potential cumulative impacts at a regional scale and to try and predict unintended consequences of the proposed actions. This analysis forms the core of this report. As this study is strategic in nature it offers proactive guidance for decision makers ahead of development. Decision makers will have to weigh up the considerable benefits which could accrue from the Uranium Rush against the significant negative impacts that mining will have on the landscape and biodiversity of the central Namib.

This SEA has shown that the Uranium Rush has the potential to contribute significantly to long-term sustainable development in the country, particularly in the spheres of social development and economic viability. However, under any of the mining scenarios envisaged, these benefits will be at the cost of the biophysical environment which will be a net 'loser'.

The Uranium Rush is partly located in a proclaimed national park and one of the most popular tourist hotspots in the country. Unless it is well managed and the necessary safeguards are in place, the Uranium

Rush will negatively affect the environment – both at individual mine level and on a cumulative basis, which in turn will affect sense of place, tourism, lives and livelihoods.

To ensure that the Uranium Rush results in sustainable development for Namibia, the GRN, mining companies, local authorities and civil society must work together to implement the Strategic Environmental Management Plan (SEMP), which has been formulated with considerable input from many stakeholders during this SEA process. The SEMP provides a wide range of recommendations to ensure that the positive impacts on sustainability are enhanced and the negative impacts are avoided, reduced, controlled or offset as far as possible, to minimise the threats to the environment and all those who depend upon the central Namib for their livelihoods.

Political will, technical capacity, enabling policies and laws, and mutually-beneficial partnerships are needed to ensure that adequate capacity exists. In combination with strong capacity, transparency and consistency in decision making will ensure that the Uranium Rush is a blessing and not a curse. The bottom line is the need for good governance.

SEA TEAM

A large team of persons contributed to the compilation of the "Uranium Rush" SEA. Whilst the majority of experts listed below were part of the SAIEA team, others were contracted by GSN-BGR part-way through the process to fill knowledge gaps. Important to note is that a number of staff from BGR and GSN contributed substantially to various chapters in the report, since they have expert knowledge in terms of geology, mining and related subjects. This partnership between the Client and the Consultants was an efficient way of using available resources in a country that has limited expertise.

SEA Study Team

Name	**Organisation**	**Area of responsibility or expertise**
Dr Peter Tarr	SAIEA	• Project Manager and Team Leader. • Tourism and recreation. • Institutional capacity. • SEMP. • Report writing. • Stakeholder engagement.
Ms Bryony Walmsley	SAIEA	• Mining. • Scenario development. • Cumulative impact analysis. • Report writing. • Stakeholder engagement.
Mr Morgan Hauptfleisch	SAIEA	• Stakeholder engagement. • Housing and property. • Coastal town infrastructure and services.
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Ms Hanlie Liebenberg-Enslin	Airshed Planning Professionals	Air quality.
Mr Willem Odendaal Mr Peter Watson	Legal Assistance Centre	Legal and policy assessment.
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Mr Japie van Blerk	Aquisim Consulting	Air quality and radiation.
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Name	Organisation	Area of responsibility or expertise
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Mr Steven Stead	VRM Africa	Visual assessment.
Ms Katharina Dierkes	Map Room	GIS mapping.
Dr Gabi Schneider Ms Kaarina Ndalulilwa Ignatius Shaduka Secilie IipingeMs Rosina Leonard Mr Israel Hasheela Ms Alina Haidula	GSN - MME	• Geology of Namibia • Mining in Erongo • SEA Youth debate • Groundwater and air quality studies • SEMP
Dr Rainer Ellmies	BGR	• Project management BGR/GSN • Forces and dynamics of the uranium rush • Geology and Mining • Groundwater baseline study • SEMP

Dr Barry Dalal-Clayton (IIED, UK) was the external reviewer of both the process followed, and the contents of the SEA report.

Additional external review was provided by Dr Detlof von Oertzen on all information concerning radiation.

Members of the Steering Committee and the public (many of whom are experts in various ways) that provided comments on the SEA are listed in the acknowledgments section of the SEA report.

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A Steering Committee chaired by the Director of the Geological Survey of Namibia, Dr Gabi Schneider, was appointed to oversee the SEA. The Steering Committee is acknowledged for its leadership, guidance, technical input, facilitation, support, flexibility and understanding. An SEA cannot be done according to a rigid formula or recipe, and the committee readily supported the need for additional studies, time and financial resources. The members of the Steering Committee are listed in Appendix B.

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GLOSSARY

Alaskite/Leucogranite - a granitic rock with a low percentage of dark minerals; light-coloured granite.

Alluvium – unconsolidated material deposited by flowing water.

Alpha particle - subatomic particle occurring as part of the nuclear decay process, consisting of two protons and two neutrons, nucleus of the Helium atom.

Antagonistic impact – in the context of this SEA, an antagonistic impact occurs when two or more impacts (usually a positive and a negative impact) conflict with each other and trade-offs need to be made.

Aquifer - a geological formation that can hold water in sufficient quantities to be abstracted.

Arid – a condition of the natural environment where the mean annual rainfall is seasonal, low, highly variable, unreliable, erratic, and unevenly distributed and unpredictable while the evaporation is high and the vegetation cover is sparse.

Atomic mass number (A) - Total number of protons and neutrons (together known as nucleons) in an atomic nucleus

Atomic number (Z) - Number of protons found in the nucleus of an atom

Best Available Technology - (1) the most advanced, economically feasible technology available to minimize the environmental impact of a particular activity; (2) a standard of environmental impact, equivalent to the impact which would be produced if the industry in question was using the best available technology. The concept may be applied as a benchmark in *environmental assessments* or to set *regulatory* standards. The terms "best practicable technology" or "best practicable option" may also be used.

Beta particle - high-energy, high-speed electrons or positrons emitted by certain types of radioactive nuclei as part of nuclear decay process

Betafite - a yellow, brown, greenish or black uranium bearing mineral in the pyrochlore group, with the chemical formula $(Ca,U)_2(Ti,Nb,Ta)_2O_6(OH)$. Betafite typically occurs as a primary mineral in granite pegmatites.

Biomagnification - The process of accumulation leading to progressively higher concentrations of a contaminant at higher levels in a food chain or web. The concentration of a contaminant magnifies when higher species ingest quantities of a contaminant previously accumulated in their prey. The terms "biological magnification", "biological amplification" or "bioamplification" may also be used.

Borehole – a hole drilled into the earth in order to obtain a borecore giving information about subsurface geology or equipped with casing and pumps to abstract groundwater from an aquifer.

Calcrete - a limestone consisting of surficial sand and gravel cemented by calcium carbonate precipitated from solution and re-deposition through infiltrating water. The calcite content in the sediments is >50%.

Carbonate - a mineral compound composed primarily of the ion CO_3^{-2} (e.g. Calcite and aragonite, $CaCO_3$). Carbonate sediments form from the biotic or abiotic precipitation from aqueous solution of carbonates of calcium, magnesium or iron.

Carnotite - a radioactive, yellow to greenish-yellow potassium uranium vanadate mineral with *chemical formula:* $K_2(UO_2)_2(VO_4)_2{\cdot}3H_2O$. *It is an ore mineral of uranium and vanadium.*

Carrying capacity - The maximum number of organisms that can be supported in a given ecosystem or habitat.

Catchment – an area from which runoff flows into a common terminus.

Command and Control Approach - An approach to environmental protection which is based on the premise that environmental damage can be prevented or minimised by controlling the amount, frequency, or location of pollution. Regulation based on the command and control approach defines precisely what can be done where and when, and consists of standards for the production and disposal of all hazardous substances and pollutants, administrative monitoring and prosecution of offenders.

Contaminated Site Liability - Civil or regulatory responsibility for the costs of cleaning up contaminated land.

Contamination – is when the characteristics of a medium are deteriorated by the introduction of another substance.

Cradle-to-Grave Regulation - A seamless regulatory approach to the management of hazardous or polluting substances from creation to destruction or permanent disposal. Whereas end-of-pipe standards are concerned solely with the discharge of waste, and other regulatory regimes may apply at other times (for example, during the transportation of a hazardous substance, a statute specifically governing the transportation of dangerous goods may apply), cradle-to-grave regulation controls the entire life of a specified substance.

Craton - is an old and stable part of the continental crust that has survived the merging and splitting of continents and supercontinents for at least 500 million years.

Cumulative Impact - The sum of the environmental impacts of human activities on one particular environment or ecosystem.

Dam – a structure built across a river to impound water or a structure built to contain water.

Daughter - decay product of radioactive decay from 'parent'.

Desalination – any process where dissolved solids are removed from water.

Discounting - In economics, a method of calculating the present value of future benefits. Because of the existence of interest rates, a benefit is more valuable in the present than in the future. The concept of discounting, when applied to environmental law, requires devaluing future environmental benefits. For instance, a decision-maker may be called upon to weigh the value of a clean river in twenty years' time against the economic cost of more stringent effluent controls. According to the principle of discounting, a clean river twenty years hence is less valuable than a clean river today because it is a future benefit. The decision-maker should therefore discount its value.

Diversity - A measure of the variety of particular elements in an ecosystem. The term often is used to refer to the diversity of species, but there are several kinds of diversity indices.

Due Diligence - (1) Defence to strict liability environmental offences. (2) Steps in a commercial, real estate or loan transaction, such as performing an environmental audit, that protect a buyer or lender from contaminated property (see ***latent defect***), or environmental liability (see ***contaminated site liability***; ***lender liability***). (3) Ongoing procedures in the operation of a business to ensure that environmental damage is not occurring. Evidence of these procedures is often required to establish the defence in (1).

Ecological Share - An individual portion of ***sustainable environmental impact***; the environmental impact which each human member of an ***ecosystem*** could inflict without producing permanent ecosystem change; a proposal for a definition of environmental ***damage***. Ecological share is calculated by estimating the capacity of the ecosystem to absorb impact then by dividing that capacity by the number of human inhabitants of the system.

Ecology and Ecosystem - Ecology is the study of relationships among organisms, among species, and between organisms and their non-living environment. It is the study of ecosystems, which are the fundamental units of ecology. An ecosystem is a "community of organisms and their physical environment interacting as an ecological unit."

Economic Analysis and Externalities - In economic terms, ***environmental harm*** is a symptom of inefficient resource allocation. An externality is the social cost imposed by a private activity. Environmental externalities occur because there is no private cost for using common resources, such as air and water, and competition compels utilization of the lowest cost option. The economic solution to environmental harm is to internalize the externality.

Effluent – a liquid that has been used and is disposed of.

End-of-Pipe Standards - A type of environmental ***regulation*** that restricts discharge of contaminants to a specific level. Such standards are usually substance-specific, and may also be target-specific and/or location-specific.

Environment - The definition of "environment" varies depending on the statute. There are two main variations. The first limits "environment" to ecological components. The second includes ecological components but also ***incorporates human considerations such as social, economic, cultural and aesthetic elements.*** The latter, all-inclusive definition is commonly accepted and understood in Namibia.

Environmental Assessment - (1) A statutory procedure to evaluate the potential ***environmental impact*** of a proposed activity, to decide whether the activity will be permitted and, if so, to determine whether any conditions are to be imposed to mitigate the anticipated effects; (2) a study of potential environmental effects undertaken prior to the formal statutory process; (3) a report or statement indicating the results of such a study, which is commonly submitted by the proponent.

Environmental Audit - An investigation or inventory of the actual and potential environmental problems at a site or with an operation. The term "environmental site assessment" may also be used.

Environmental Bottom Line - The level of environmental impact which no activity may exceed.

Environmental Impact and Environmental Harm - Environmental impact refers to the effect of an event in environmental terms. Environmental harm is an adverse environmental impact, permanent ecosystem change caused by human activity.

Environmental Liability Insurance - Insurance is a contract in which the insured pays agreed amounts, called premiums, in exchange for the insurer's promise to indemnify the insured against particular kinds of loss.

Environmental Offences - Criminal and regulatory wrongs punishable by fine or imprisonment.

Ephemeral – lasting only a few hours or days.

Epidemiology: The study of epidemics and the patterns of the occurrence of disease; the statistical study of populations exposed to environmental contaminants; "the study of diseases as they affect population, including the distribution of disease, or other health-related states and events in human population, the factors (for example, age, sex, occupation, economic status) that influence this distribution, and the application of this study to control health problems.

Equilibrium - A steady state. Traditionally, the natural or undisturbed state of an ***ecosystem*** is thought to be one of equilibrium.

Erratic rainfall - the intensity and magnitude of the rainfall event is variable.

Evaporation – when water changes from a liquid to a gas.

Expropriation of property - The taking of private property by the state for public uses. Such expropriation may produce the right to be compensated by the state for the loss. A loss of the property rights where no land is taken may amount to an expropriation, known as an injurious affection.

Fissile isotope - An isotope capable of sustaining a chain reaction of nuclear fission.

Fission - nuclear fission is a nuclear reaction in which the nucleus of an atom splits into smaller parts, emitting energy in the process.

Gamma particle - not a particle but a photon of radiation occurring as part of the nuclear decay process.

Geohydrology – the study of groundwater, also known as Hydrogeology.

GINI-coefficient –is a measure of statistical dispersion developed by the Italian statistician Corrado Gini. It is commonly used as a measure of inequality of income or wealth.

Groundwater – water found in an aquifer and any other water below the surface of the ground.

Half-life - measure of radioactivity, giving the time it takes for half of the substance to undergo radioactive decay.

Holocene - the last 10 000 years, following the Last Glacial Maximum.

Hydrology – the study of surface water.

Impermeable – a medium that cannot be penetrated by water or other liquids.

Infiltration – the movement of a liquid through a permeable medium.

Inselberg - is an isolated hill or small mountain that rises above the surrounding flat plain; it is characteristic of an arid or semi arid landscape in a late stage of the erosion cycle.

Intergenerational Equity - The obligation of the present generation to protect the environment for the benefit of future generations. Under the principle of intergenerational equity, the earth is the subject of a planetary trust in which each generation is both a beneficiary and a trustee.

Ion - Atom that has either gained or lost one or more electrons.

Isotopes - elements with the same atomic number (Z) but with different atomic mass number (A). Different isotopes of a chemical element are identical from a chemistry point of view.

Joule - unit of energy.

Land Use Planning - The regulation and management of real property development. Land use planning typically is a function assigned to the local government. Local authorities formulate land use plans that stipulate the kinds of uses to which land within the area may be put, such as building density, height, size, and shape, and whether the use may be residential, commercial, industrial or public. These limitations are often expressed through zoning rules.

Last Glacial Maximum - the period between 16,000 and 10,000 years BP, corresponding with a maximum drop in sea level to about -110 m.

Mafic rock - a dark rock that is rich in magnesium and iron.

Micron - micrometer (µm).

Neutron - uncharged subatomic particle in the atomic nucleus.

Nucleon - subatomic particles in the nucleus, i.e. protons and neutrons.

Nucleus - centre of the atom, containing nuclei, i.e. protons and neutrons.

Parent - first element of a radioactive decay chain resulting in ‘daughters’ or ‘progeny’.

Pegmatite - is a very coarse-grained igneous rock.

Perennial – an event that continues for longer than one year, often used in reference to continuously flowing rivers or plants which persist for year to year.

Persistence - The capacity of a substance to remain chemically stable.

Phreatophyte – a deep-rooted plant that obtains water from the water table. Phreatophytes are often found in an arid environment.

Pleistocene - the last 2 million years of the geological record, prior to and including the Last Glacial Maximum.

Plio-Pleistocene boundary - the commencement of the Pleistocene, about 2 million years ago.

Pluton - is an intrusive igneous rock body that crystallized from a magma slowly cooling below the surface of the Earth.

Policy - a statement of intent.

Polluter Pays Principle: A principle of liability that, whenever possible, the actor that causes pollution damage should pay for restoration, compensation and future prevention. It can be interpreted as a principle of non-subsidization, cost internationalization, and/or strict liability.

Pollution – is the alteration of the properties of a medium by the introduction of a foreign substance that reduces the quality of the medium.

Precautionary Principle - A presumption of environmental risk. (1) The precautionary principle is an expression of environmental sanctity which requires prevention and reduction of environmental impact even in the absence of scientific or legal proof of adverse effect or risk of harm. (2) in the absence of sufficient data to take a decision the most conservative assumption will be made.

Primary uranium deposit – uranium mineralisation by magnetic processes; leucogranites hosted deposits for example.

Primary uranium supply – uranium mined from the earth.

Progeny - decay products of radioactive decay from ‘parent’.

Radionuclide - atom with an unstable nucleus.

Ramsar site - A protected area designated under the Ramsar Convention on Wetlands of International Importance, particularly as a Wild Fowl habitat.

Recharge – to replace a used resource, used in ***geohydrology*** to refer to the process of replenishment of aquifers by infiltration of rainwater or river flow.

Regulation - Subordinate legislation that contains detailed rules which give effect to the purpose of the enabling statute.

Resilience - A measure of the ability of ***ecosystems*** to maintain relationships between system elements in the presence of disturbances.

Restoration - Remediation of environmental harm; a remedy obtained in the form of an order for such remediation. Environmental regulatory statutes often allow the court to make a restoration order upon conviction of a regulatory offence.

Rio Declaration - The United Nations Declaration on Environment and Development (1992).

Riparian – associated with a river bank.

Riparian Rights - The common law water rights of a land owner or occupier bordering a lake, river or stream. In common law, an owner or occupier has the right to a natural flow without sensible diminution or increase and without sensible alteration in character or quality. This right is limited by rights of upstream users who are entitled to as much water as they required for domestic purposes. They may use the water for industrial purposes, including waste disposal, as long as the use is reasonable. This requires a balancing of interest in the context of the conflict, including the character of the waterway and the nature of the water users. Riparian rights are usufructory, meaning that the riparian land owner has the temporary right to use the flow of water without having title to it. There are no riparian rights in groundwater. Remedies for damage to groundwater must be pursued in nuisance or negligence.

River – a natural channel in which water flows.

River bank – the sides of a natural channel in which water flows.

River bed – the floor of a natural channel in which water flows.

Runoff – rain that accumulated and is flowing.

Secondary deposits of uranium – uranium that has been weathered from or leached out from ***primary deposits*** over time and has been redeposited in another geological environment e.g. ***in calcrete-hosted deposits***.

Secondary supplies of uranium – uranium sourced from decommissioned nuclear warheads, uranium stockpiles, spent nuclear fuel and mill tailings.

Spring – a place where groundwater flows out on the surface.

Stability - A measure of the ability of an ecosystem to recover from a disturbance and re-establish its equilibrium state; the more rapidly it returns and the less it fluctuates, the more stable it is.

Surface water - is water open to the atmosphere

Sustainability – 1) Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development 1987); 2) Development that aims to improve the quality of human life while living within the carrying capacity of supporting ecosystems (IUCN, UNEP and WWF 1991).

Sustainable Development - The multi-faceted concept consisting of three main components of development: ecological sustainability, social sustainability and economic sustainability. It is not merely an environmental concept, but incorporates the ideals of good governance, social justice and well-being, and qualitative improvement in living standards. It is based on the principles of ***inter-generational equity***. The concept questions the "straight line" version of economic growth, the industrial assumption of ever-increasing expansion and consumption, and the infinite capacity of the environment to supply raw material and absorb waste. It is in conflict with the principle of ***discounting*** and the calculation of present value in economic theory. It is based on the (difficult) principle of balancing the short-term benefits of development with the long-term requirements for environmental sustainability.

Sustainable Yield - The maximum extent to which a renewable resource may be exploited without depletion.

Synergistic impact – in the context of this SEA, a synergistic impact refers to when two impacts compliment each other leading to a win-win situation.

Synergy - The interaction of two or more chemicals or other phenomena producing a greater total effect than the sum of their individual effects; the combined environmental effect of two or more pollutants that react together in such a way as to affect living organisms different from the way either or any of them would alone, or all of them would if their individual effects were added together.

Topography – the surface features of the landscape.

Toxicology - The science and study of poisons and their effects. A substance is toxic if it is harmful to living organisms.

Tragedy of the Commons - A model which illustrates the inevitability of the overuse of common resources. The model may be used as an abstraction of the problem which environmental legislation should be designed to solve.

Trespass to Land - Intentional, direct invasion of real property.

Tributary – a small river that joins a larger river.

Uraninite - is a radioactive, uranium- mineral with a chemical composition that is largely UO_2.

Uranium-238 - isotope of uranium with atomic mass number 238.

Water table – the underground surface of water.

Water work – any structure built for the purpose of utilizing a water resource.

Weir - a structure across a river, used to manage (impound, divert, measure) runoff.

Well – a hole made in the ground to get access to groundwater.

LIST OF ABBREVIATIONS AND ACRONYMS

°C	Degree centigrade
a	annum
AQG	Air Quality Guideline
AEB	Atomic Energy Board of Namibia
AEM	Airborne Electro-magnetic (survey)
amsl	above mean sea level
ANTA	Association of Namibian Travel Agents
ARC	Association of Regional Councils
ATC	The Arandis Town Council
BETD	Basic Education Teacher's Diploma
BFS	Bankable Feasibility Study
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe
BMC	Basin Management Committee
BMZ	(German) Federal Bundesminiterium für Wirtschaft Zusammenarbeit und Entwicklung
bn	billion
Bq	becquerel, unit of radioactivity (1 Bq = 1 disintegration per second)
CARAN	Car Rental Association of Namibia
CBD	Central Business District
CBM	Community based management
CBO	Community Based Organisation
CCD	Counter Current Decantation
CETN	Coastal Environmental Trust of Namibia
Ci	curie, unit of radioactivity (1 Ci = 3.7 x 10^{10} disintegrations per second)
CIX	Continuous Ion Exchange
CNA	Central Namib Area
CNG	Compressed Natural Gas
CNWSS	Central Namib Water Supply System
CO_2	Carbon dioxide
CoM	Chamber of Mines
COSDECs	Community Skills Development Centres
CSIR	Council for Scientific and Industrial Research in South Africa
d	day
DEA	Directorate of Environmental Affairs
DEM	Digital Elevation Model
DRFN	Desert Research Foundation of Namibia
DRWS	Directorate of Rural Water Supply
DWA	Department of Water Affairs (now DWAF) (Namibia)
DWAF	Department or Water Affairs and Forestry (now DWA) (South Africa)
EIA	Environmental Impact Assessment
EITI	Extractive Industries Transparency Initiative

EMA	Environmental Management Act
EMIS	Education Management Information System
EMP	Environmental Management Plan
EPL	Exclusive Prospecting Licence
EPZ	Export Processing Zone
EQO	Environmental Quality Objective
ESIA	Environmental and Social Impact Assessment
ESKOM	Electricity Supply Commission (South Africa)
ETSIP	Education and Training Sector Improvement Programme
FENATA	Federation of Namibia Tourist Associations
GDP	Gross Domestic Product
GHG	Green House Gas
GIS	Geographical Information Systems
GLC	Ground Level Concentration
GRI	Global Reporting Initiative
GRN	Government of the Republic of Namibia
GROWAS	Groundwater Information System
GSN	Geological Survey of Namibia
GWe	Giga Watt of energy
h	hour
HAN	Hospitality Association of Namibia
HERS	Health, Environment and Radiation Safety
HEU	Highly Enriched Uranium
HPA	Health Protection Agency
HS & E	Health Safety and Environment
I&APs	Interested and Affected Parties
IAEA	International Atomic Energy Agency
IBA	Important Bird Areas
ICMM	International Council on Mining and Metals
ICRP	International Commission on Radiological Protection
IDC	Industrial Development Corporation
IFRS	International Financial Reporting Standards
IGCSE	International General Certificate of Secondary Education
IIED	International Institute for Environment and Development
IMDG	International Maritime Dangerous Goods
IMF	International Monetary Fund
IPA	Important Plant Area
IPFM	International Panel on Fissile Materials
IPPR	Institute for Public Policy Research
IRBM	Integrated River Basin Management
ISC	Industrial Skills Commission
ITCZ	Inter-tropical Convergence Zone
IWRM	Integrated Water Resources Management
J	Joule, unit of energy
JSC	Junior Secondary Certificate
k	kilo, a thousand, $\times 10^3$

kg	kilogram
km^2	square kilometres
kV	Kilo Volt
ℓ/ L	Litre
LA	Local Authorities
lb	pound (of weight)
LEU	Low Enriched Uranium
LHU	Langer Heinrich Uranium Mine
LLRD	Long-lived Radioactive Dust
LV	Low Voltage
LWR	Light Water Reactor
M	mega, million, $\times 10^6$
m	milli, one thousandth, $\times 10^{-3}$
m	metre
M	million
mbgl	metres below ground level
Mlb(s)	Million pounds (of uranium in the context of this SEA)
m/s	metres per second
MAR	Mean Annual Runoff
masl	metres above sea level
MAWF	Ministry of Agriculture, Water Affairs and Forestry
MAWRD	Ministry of Agriculture, Water and Rural Development (now MAWF)
MDG	Millennium Developmental Goals
MET	Ministry of Environment and Tourism
MFMR	Ministry of Fisheries and Marine Resources
mg	milligram
mg/ℓ/L	milligram/litre
MHSS	Ministry of Health and Social Services
min	minute
ML	Mining Licence
MLGHRD	Ministry of Local and Regional Government, Housing and Rural Development
MLR	Ministry of Lands and Resettlement
mm	millimetres
mm/a	millimetres per annum
Mm^3	million cubic metres
Mm^3/a	million cubic metres per annum
MME	Ministry of Mines and Energy
MMSD	Mining, Minerals and Sustainable Development Project
MoHSS	Ministry of Health and Social Services
MRA	Marine Resources Act
MRLGH	Ministry of Regional and Local Government and Housing
mSv/a	millisievert per annum
MTI	Ministry of Trade and Industry
MV	Medium Voltage
MW	Mega Watt
MWTC	Ministry of Works, Transport and Communications

N$	Namibian Dollar
NACOBTA	Namibia Community-based Tourism Association
NACSO	Namibian Association for Community Based Natural Resource Management Support Organisations
NAD	Namibian Dollar
NAMCOL	Namibian College of Open Learning
NAMPAB	Namibia Planning Advisory Board
NAMPORT	Namibian Port Authority
NamPower	Namibia Power Corporation
NamWater	Namibia Water Corporation Ltd
NANTU	Namibia National Teachers Union
NAPHA	Namibia Professional Hunters' Association
NCCI	Namibian Council for Commerce and Industry
NDP	National Development Plan
NEPRU	Namibian Economic Policy Research Unit
NER	Net Enrolment Ratio
NGO	Non Governmental Organisation
NHA	National Heritage Act
NHC	National Heritage Council
NHAG	Namibia Housing Action Group
NHE	National Housing Enterprise
NIED	National Institute for Educational Development
NIMT	Namibian Institute of Mining & Technology
NMCF	Namibian Mine Closure Framework
NMS	Namibia Meteorological Service
NNP	Namib-Naukluft National Park
NOx	Nitrous oxides
NPC	National Planning Commission
NRPA	National Radiation Protection Authority
NSSC	National Senior Secondary Certificate
NSX	Namibian Stock Exchange
NTA	Namibian Training Authority
NTB	Namibia Tourism Board
NWCRA	National West Coast Recreation Area
NWP	National Water Policy
PA	Protected Area
PAYE	Pay-As-You-Earn
Pb	chemical symbol for lead
Pers. comm.	Personal communication
R	roentgen, unit of radiation exposure
Ra	chemical symbol for radium
RC	Regional Council
RCD	Reverse Circulation Drilling
RED	Regional Electricity Distributor
RETOSA	Regional Tourism Organisation of Southern Africa
RMP	Radiation Management Plan

Rn	chemical symbol for radon
RoD	Record of Decision
RoM	Run of Mine
RPL	Recognition of Prior Leaning
RSA	Republic of South Africa
RUL	Rössing Uranium Ltd
s	seconds
SABS	South African Bureau of Standards
SACMEQ	Southern and Eastern African Consortium on the Monitoring of Education Quality
SACU	Southern African Customs Union
SADC	Southern African Development Community
SAIEA	Southern African Institute for Environmental Assessment
SAM	Social Accounting Matrix
SANS	South African National Standards
SAPP	South African Power Pool
SDI	Shack Dwellers International
SEA	Strategic Environmental Assessment
SEMP	Strategic Environmental Management Plan
SIA	Social Impact Assessment
SIAPAC	Social Impact Assessment and Policy Analysis Corporation
SME	Small to Medium Enterprise
SO_2	Sulphur dioxide
SPC	Stubenrauch Planning Consultants cc
SPSS	Statistical Package for Social Scientists
Sv	sievert, unit of equivalent dose
SWRO	Sea Water Reverse Osmosis
SX	Solvent Extraction
TASA	Tour & Safari Association of Namibia
TDS	Total Dissolved Solids
TEU	Twenty-foot Equivalent Unit
TFCA	Trans-frontier Conservation Area
Th	chemical symbol for thorium
ToR	Terms of Reference
TRENABA	Tourism-related Namibian Business Association
U	chemical symbol for uranium
U^{238}	Uranium, atomic mass number 238
U_3O_8	Uranium oxide
UK	United Kingdom
UN	United Nations
UNAM	University of Namibia
UNCHS	United Nations Centre for Human Settlements
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNISA	University of South Africa
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USC	Uranium Stewardship Council

USD	United States Dollar
VAC	Visual Absorption Capacity
VE	Visual Envelope
VTC	Vocational Training Centre
W	Watt
WASP	Water Supply and Sanitation Sector Policy (1993)
WBCSD	World Business Council for Sustainable Development
WE	Wind Erosion
WHO	World Health Organization
WHS	World Heritage Sites
WL	Working Level, unit exposure to radon progeny
WLM	Working Level Month, unit of cumulative exposure to radon progeny
WMA	Water Resource Management Agency
WNA	World Nuclear Association
WRD	Waste Rock Dumps
WRMA	Water Resource Management Act, 2004 (Act 24 of 2004)
WSASP	Water Supply and Sanitation Policy (2008)
µ	micro, one millionth, $\times 10^{-6}$
Zn	Chemical symbol for zinc

List of Figures

List of Figures

List of Figures

List of Figures

List of Plates

List of Plates

List of Plates

List of Plates

1 INTRODUCTION

The necessity for an SEA for the "Uranium Rush" was realised by the Chamber of Mines in 2007. The Geological Survey of Namibia within Namibia's Ministry of Mines and Energy took over the responsibility for commissioning the SEA after discussion with the Chamber. The SEA was made possible through the generous financial support provided by the German Government, through the cooperation project between the German Federal Institute for Geosciences and Natural Resources and the Namibian Geological Survey. Consequently, the Geological Survey of Namibia and the German expert responsible for the cooperation project provided management oversight for the SEA.

In 2009, the Southern African Institute for Environmental Assessment (SAIEA) was contracted by the Government of the Republic of Namibia (GRN), with funding provided by the German Government through the German-Namibian Technical Cooperation Project of the Geological Surveys of Germany (BGR) and Namibia (GSN), to undertake a Strategic Environmental Assessment (SEA) for the so-called 'central Namib "Uranium Rush".

Mining for various minerals has been ongoing in the central Namib since 1901, and the first uranium mine was commissioned in 1976. Over the past 30 years, prospecting for uranium was at a relatively low intensity, but this changed recently when it was estimated that the supplies of both primary and secondary uranium would be unlikely to meet projected nuclear reactor requirements in the short or medium term. This lead to concerns about the security of uranium supplies, which in turn, could see uranium prices rising. This has triggered renewed interest in uranium exploration; the sudden scramble for prospecting rights in the central Namib resulted in the MME/GRN placing a moratorium in 2007 on further uranium prospecting licences to ensure that the authorities and other stakeholders could consider how best to manage the "Uranium Rush". However, by that date, 36 exploration licences for nuclear fuels had already been granted in the central Namib (and a further 30 elsewhere in Namibia). Of these, 33 Exclusive Prospecting Licence (EPLs) were current and three were pending renewal (as of December 2009). As the moratorium does not prevent the GRN from upgrading an existing prospecting licence to a mining licence, the moratorium is not likely to significantly slow the 'rush' to develop new mines. At the time that the SEA was conducted, four mining licences had been granted: two mines were operational, the third was undertaking trial mining, and the fourth was beginning construction. Prospecting at three of the most promising new deposits was at an advanced stage. Thus, the "Uranium Rush" was, for practical purposes, already underway when the SEA was commissioned.

Nevertheless, the SEA was expected to provide strategic direction to the uranium industry, government and other stakeholders in the central Namib. This SEA differs from most others conducted elsewhere because the development in question is neither a policy, plan nor programme, but rather a collection of projects, each being conducted by individual companies that are not related to each other, and in many cases, undertaken in isolation of each other.

However, they collectively combine to produce cumulative impacts, with the public citing areas of concern as: loss of 'sense of place', over-abstraction and pollution of groundwater, short and long term radiation exposure of workers and the public, stress on physical and social infrastructure, opportunity costs on other, more sustainable industries (e.g. tourism) and reduced public access to the central Namib.

The flip side of the coin is that the “Uranium Rush” offers substantial opportunities for synergies, and the industry could stimulate critically needed development, which in turn enables growth in many other sectors. Examples include the construction of desalination plants, upgrading power supply, and investing in housing, schools and health facilities.

Recognising the opportunities and constraints presented by the “Uranium Rush”, the Chamber of Mines established the Uranium Stewardship Council (USC) to be the ‘spokesperson’ for the Namibian uranium industry both national and internationally (Chamber of Mines, 2009). In 2008, a significant milestone was achieved when the Namibian Stock Exchange (NSX) agreed that uranium exploration and mining companies could not be listed on the NSX unless they were members of good standing on the USC. All USC members are bound by the Chamber’s Constitution that commits them to upholding the Namibian uranium ‘brand’ and ensuring the highest standards of environmental and radiation safety management (Chamber of Mines, 2009).

Until legally binding Namibian regulations are introduced, the USC has adopted the World Nuclear Association’s document entitled “Sustaining Global Best Practices in Uranium Mining and Processing” as its official guideline document and Environmental Code of Practice. In March 2009 a Management Working Group was established to monitor compliance of all member companies to these standards. It is in this context, that the SEA was expected to provide a roadmap for improved practice and meaningful corporate social responsibility initiatives. In return, the mines would be well placed to compete in a market that is sensitive to environmental issues. By being part of a broader sustainability initiative they could perhaps negotiate better contract prices and possibly have an advantage over suppliers from other parts of the globe.

The Erongo Region has no coherent development vision and the Namibian government readily embraces a wide range of development proposals without necessarily assessing their implications at a strategic level. The SEA provides a big picture overview and advice on how to avoid antagonistic and cumulative impacts (see Glossary of Terms), as well as how to enhance synergies within the uranium sector and between mining and other industries. It provides practical, outcomes-based tools for achieving good practice. It also proposes ways that the operators in the industry can collaborate to achieve a common approach towards long term management and monitoring – in some cases well beyond the life of individual mines (e.g. aquifer monitoring, tailings dam maintenance, etc.). This is useful even for existing mines, but even more valuable for those mining companies that have not yet started their operation.

The overall objectives of the SEA were as follows:

- Develop and assess ***viable scenarios*** of mining and associated developments as a basis for subsequent decision-making and formal planning.
- Provide ***recommendations*** on accepted overall strategic approaches for sustainable mining development in the Erongo Region.
- Provide ***guidance for overall solutions*** on crucial (cumulative) impacts and challenges stemming from the mining operations.
- Outline a ***Strategic Environmental Management Plan*** (SEMP).

The SEA was supervised by a broad-based Steering Committee consisting of approximately 30 members from Government, parastatals, NGOs, the Chamber of Mines of Namibia, the tourism industry, local and regional authorities, the Mineworkers Union and the Atomic Energy Board (see list of members in the Acknowledgements). The primary task of the Steering Committee was to guide the SEA process and SEA team by integrating and streamlining the SEA with other existing strategic initiatives (policies, plans and programmes). The existence of some technical experts on the committee enabled systematic peer review of the products emanating from the SEA process. To assist it in this task, the Steering Committee appointed Dr Barry Dalal-Clayton (IIED UK) as an independent external reviewer with the objective of ensuring a process and product that meets international standards. The Steering Committee met eight times during the 20-month period required for completing the SEA, so they were able to maintain close involvement with the SEA team, the entire process and its key outputs.

The SEA report provides the reader with background information on the method employed (Chapter 2), an analysis of the forces and dynamics of the "Uranium Rush" (Chapter 3), an overview of the current and predicted exploration and mining activities as well as associated industries[1] in the central Namib (Chapter 4), a brief regional description of the affected environment (Chapter 5) and a summary of the legal, policy and institutional framework pertaining to the "Uranium Rush" (Chapter 6).

Chapter 7 presents the main analysis of the cumulative impacts of the "Uranium Rush" on various components of the central Namib environment. This analysis has been presented thematically because the impacts and solutions will, to a large extent, be addressed sectorally by the responsible line ministry or local government department. It must be remembered that the SEA is not an EIA and that standard impact assessment methodologies do not apply. The SEA aims to provide proactive guidance for a speculative set of activities at some unknown time in the future, rather than being reactive to a specific project as in an EIA. The cumulative effects analysis in Chapter 7 therefore strives to present the potential benefits and synergies of the "Uranium Rush" as 'opportunities' and the negative cumulative effects as potential 'threats' which need to be managed. Where possible the quantum of change is provided. The exact impact of the "Uranium Rush" will only emerge once the SEMP is being implemented and the relevant data are being collected and presented in an annual report.

Although the cumulative effects analysis (CEA) has been presented thematically, there are numerous cross-cutting inter-linkages, creating a complex series of causes and effects. The linkages between the impacts identified in the CEA are thus examined and discussed in section 7.15.

The Strategic Environmental Management Plan is set out in Chapter 8. This provides a set of environmental quality objectives (EQOs), expressed as a set of desired future environmental conditions elicited through the stakeholder consultation process. The SEMP sets targets and indicators on how to achieve the desired objectives and lists the parties responsible for implementation. This is the most critical part of the SEA and the extent to which it is implemented will determine the ultimate success of the SEA process in guiding the "Uranium Rush" towards a sustainable future.

[1] An associated industry in the context of this "Uranium Rush" is one which would not have come about except for the existing and future uranium mines.

The conclusions of the SEA, including an analysis of its sustainability, are presented in Chapter 9 and the recommendations arising from the study are set out in Chapter 10.

2 APPROACH AND METHODOLOGY

2.1 Background

The Mining, Minerals and Sustainable Development Project (MMSD) was initiated by the mining industry in 2002 to advise on how best the sector could contribute to sustainable development. In response, the mining industry is under pressure to improve its social, developmental, and environmental performance in order to ensure it has a 'social licence to operate' (IIED, 2002). Increasingly, mines are expected by society to do much more than meet basic legal requirements and earn profits for shareholders .

A core principle of sustainable development is to improve human well-being and to sustain those improvements over time. The goal is for children to have as good a life as their parents did, or better. This requires passing the means of survival on to future generations unimpaired and building, or at least not diminishing, the total stock of capital. It also requires the integration of social, economic, environmental, and governance goals in decision-making (IIED, 2002). Implicit in this definition is that sustainable development is not possible without equitable development (improving the distribution of wealth, more universal rights, access to resources and government services etc.). The extent of inequality in Namibia, as measured by the Gini Coefficient, highlights the importance for equitable and hence sustainable, development in Namibia.

The idea of 'capital' lies at the heart of sustainable development and has thus been thoroughly examined as part of this SEA. Capital has the following five main forms (IIED, 2002):

- Natural capital, which provides a continuing income of ecosystem benefits, such as biological diversity, mineral resources, and clean air and water;
- Manufactured capital, such as machinery, buildings, and infrastructure;
- Human capital, in the form of knowledge, skills, health, and cultural endowment;
- Social capital, i.e. the institutions and structures that allow individuals and groups to develop collaboratively; and
- Financial capital, the value of which is simply representative of the other forms of capital.

The IIED, 2002 Report on the MMSD Project argues that equivalent or increased amounts of capital must be passed to future generations, so they can develop as required. Nevertheless, it is inevitable that some resources will be consumed, even exhausted, and that they will therefore not be available to future generations. However, this can be justified if their exploitation is balanced by investments in other areas (e.g. human capital and sustainable industries) so that people have the foundations and skills to respond to, or create, new opportunities. IIED (2002) suggest that one way of understanding how to use the idea of 'capital' is to divide decisions into three groups:

- 'Win-win-win' decisions – some decisions advance all the goals identified by sustainable development simultaneously; they improve material well-being for this generation, spread that well-being more equitably, enhance the environment, strengthen our ability to manage problems, and pass on enhanced stocks of capital to future generations. These are obvious ‘wins’ and should be acted upon.

- ‘Trade-off’ decisions – other decisions will result in both gains and losses. If the gains are great enough and the losers can be compensated, the decision should be to proceed. This is the zone of trade-offs and requires an agreed mechanism for reaching a decision.
- ‘No-go’ decisions – a final group of decisions may go past some widely accepted limit, such as destroying critical natural capital or transgressing fundamental human rights. If these conditions hold, the decision should be not to proceed.

The SEA has identified the key cumulative impacts of the “Uranium Rush” so that decision makers understand the synergies (win-wins), the antagonistic effects (trade-offs) between uranium prospecting and mining on the one hand and actual or potential economic activities on the other, as well as the potential fatal flaws of uranium mining in the central Namib.

While it is critical to enhance the opportunities afforded by the “Uranium Rush”, inevitably there will need to be compromises or trade-offs: between different objectives and dimensions; between different groups of stakeholders; and between different generations. Long-term needs will need to be balanced against short-, or medium-term imperatives.

2.2 Strategic Environmental Assessment

Traditionally, a Strategic Environmental Assessment (SEA) is the application of impact assessment to policies, plans, and programmes. There are many different approaches to a SEA: one is the ‘EIA’ model where the impact assessment is carried out on a policy, plan or programme once it has already been developed (i.e. reactive). Another is an integrated and/or ‘sustainability led’ approach that strives to meet sustainable development objectives. This is more proactive and can be integrated into policy and planning processes. Importantly, SEA encourages an ‘opportunities and constraints’ type approach to development, where such things as natural resources and ecosystem services at landscape scale define the ‘framework’ within which development can take place and the types of development that could be sustained. Since two mines are already in operation, but several more may be developed at some point in the future, this SEA has had to combine reactive and proactive approaches.

However, the broad scope and low level of detail of the SEA must be complemented by the narrow scope and relatively high level of detail of the individual mine EIAs. Thus in order to ensure that projects meet the objectives of sustainable development, it is important that the impact assessment of a project is ‘nested’ within the SEA, thus ensuring that it is contextually sound and consistent with broader development objectives.

Where a particular geographic area (e.g. Erongo Region) is experiencing rapid development and/or additive impacts (as is the case with the “Uranium Rush”) the SEA provides a framework within which to evaluate the cumulative impacts of future development. Cumulative impacts are best addressed at a landscape, regional or sectoral scale through SEA, with project level EIAs providing greater focus and detail.

Impact assessment and decision making are influenced by international conventions, national policies and laws, and a host of socio-economic imperatives. However, it must be informed by both scientific and local knowledge gathered during the impact assessment process, (Figure 2.1).

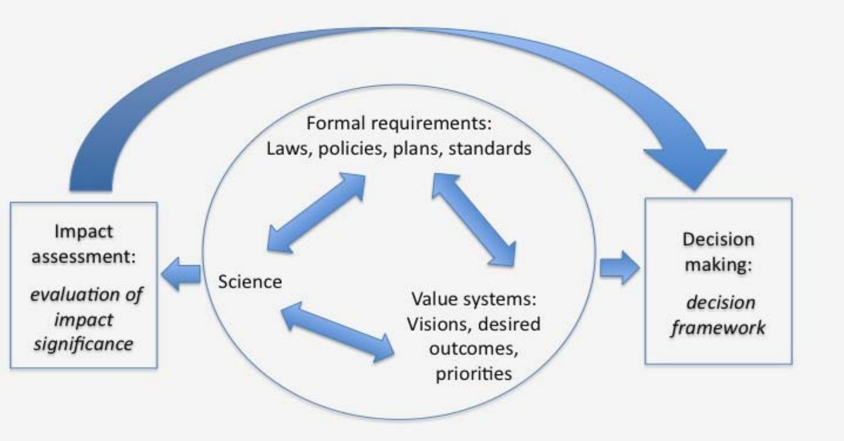


Figure 2.1: Science, values and regulatory frameworks (source: Brownlie *et al* 2009)

Theoretically, society's values are reflected by policies and laws, but value systems change in response to new information and evolving cultures. As noted by Brownlie *et al* (2009) and illustrated above, impact assessment and decision making must consider both science and value systems.

2.3 Limitations and constraints

The TORs for this SEA were very specific in that the focus should be on uranium prospecting and mining in the central Namib, despite the fact that many other non-mining developments exist or are being planned and built in the central Namib, such as chemical plants, tourism, airport and harbour expansions, seawater desalination, fishing, aquaculture, irrigated agriculture and urban expansion. Some of these are linked directly or indirectly to the "Uranium Rush", but others are not. Those that are directly linked[1], such as the desalination plants and chemical plants, have been taken into consideration in the assessment of the cumulative impacts in this SEA. Other indirect and non-mining developments, while important in contributing to the overall positive and negative impacts in the region, have not been assessed in this "Uranium Rush" SEA.

Even beyond the Erongo Region, there are many development activities throughout Namibia and elsewhere in SADC countries that impact on the central Namib, such as power generation and distribution projects, mining, import and export of bulk goods, farming and irrigation, and many others. However, extending the scope of the SEA to encompass the cumulative effects of the "Uranium Rush" on the broader Namibian economy, or even at SADC level, becomes speculative at best. Thus there is a practical need to stay focussed as articulated in the Terms of Reference (Appendix A).

[1] That is industries that would not have occurred if it had not been for the "Uranium Rush".

Originally, it was thought that the many EIAs[2] conducted in the central Namib would contain sufficient information to enable the completion of the SEA. However, it soon became apparent that regional-scale data for air quality, human health, radiation levels and subterranean water quality and quantity, were inadequate, necessitating further investigations. Thus, the Steering Committee overseeing the SEA commissioned (through the BGR/GSN project) additional studies on the above subjects[3].

Data for other aspects of the environment (e.g. biodiversity) are also inadequate, as there are many areas of the central Namib that have never been studied. Obtaining a comprehensive knowledge base for all aspects of biodiversity in the vast Namib Desert would take decades, even centuries.

In spite of these constraints, thematic studies were undertaken by experts to collate all available knowledge. Many of these studies were undertaken in May-July 2009, but such is the nature of the "Uranium Rush", that some of the data presented in these reports is already out of date. Nevertheless, the Thematic Reports were used extensively as input material (updated as necessary) for the cumulative effects analysis in Chapter 7, and will be made available by MME as a separate stand-alone document.

Thus in spite of the specialist studies and thematic reports commissioned especially for this SEA, as well the input of specialist knowledge on the Namib environment during the many workshops, there are still some significant gaps in information in this SEA, relating to:

- Detailed climatic data (needed for air quality and radiation modelling);
- Radon dispersion modelling;
- Long-term air quality monitoring data;
- Long-term water quality data sets;
- An analysis of the groundwater pathways for exposure to radionuclides and calculation of doses;
- Ecological processes and functioning in general and for key species in particular e.g. the Welwitschia;
- Archaeology;
- Cancer baseline for Erongo;

Perhaps the greatest limitation in this SEA was the fact that it had limited ability to consider alternatives, and so to fundamentally change the way the Erongo Region will develop. The "Uranium Rush" is a given (albeit the actual scope of it is not yet known), as are the associated industries and other development sectors. However, the implementation of many 'within sector' alternatives may be achieved, including:

- Acceptance of the need for 'red and yellow flag' areas, based on ecological, heritage, tourism and sense of place considerations;

[2] For various uranium and other mines, seawater desalination plants, power generation projects and powerlines, harbour expansion, township development.
[3] Regional scale studies on quality and quantity of groundwater resources, baseline air quality, baseline radiation and community health.

- Restricting mines and their supporting infrastructure (e.g, rail, road, powerlines and pipelines) to a confined area so that they occupy a limited impact corridor;
- Achieving critical mass through co-investment by the mines and other sectors in a range of desired social, economic and biophysical initiatives (e.g. education, housing, skills development, conservation), rather than individual proponents pursuing self-interest based, fashion-driven corporate social responsibility spending.

It was not possible, within the scope of this SEA, as specified in the ToR (Appendix A) to evaluate all the various infrastructure alternatives e.g. the relative merits of all the power and water supply options, various transportation alternatives and so on. Nevertheless, this SEA does make recommendations in some instances as to what might be considered a preferred option and indeed, some of these are already being considered by the relevant parties, e.g. clustering the chemical industries and the power station, 'piggybacking' the NamWater desalination plant on the Areva plant, and so on.

2.4 Methodology used in this SEA

As described above, this SEA report has been derived from a number of thematic reports and specialist studies. The methodologies used in those studies are detailed in the individual reports and are not repeated here. This section provides the reader with an overview of the overall approach and methodology used to compile this SEA report.

Figure 2.2 illustrates the sequencing of activities in the "Uranium Rush" SEA.

2.4.1 Understanding the "Uranium Rush"

Over the past few years, people have speculated about how many mines will open in the central Namib, how long they will last, who buys the uranium, whether other countries have banned uranium mining while Namibia is being exploited by multi-nationals, etc. Also, some wondered what the future might be for this sector given the implications of the ongoing global economic crisis. Since the future is uncertain, this SEA began by producing a paper entitled 'Forces and Dynamics of the "Uranium Rush"', and circulating this widely for comment. This paper was updated every few months, as more information became available. A summary of this paper may be found in Chapter 3 and the full report will be made available in a separate stand-alone document by the MME.

In parallel, the team compiled a 'Mining Report', which showed the areas under prospecting and mining, the nature of the deposits and thus the technology that would be used to mine and extract the uranium, the development stage of each operation, when they might commence/cease operations, the resources they would need to operate (e.g. personnel, power, water, transport), information on company ownership and as many corporate details as could be obtained. The companies, the Chamber of Mines and the MME assisted with this exercise and helped to verify the accuracy of the report. However, the report quickly became outdated as company profiles changed, acquisitions took place, and exploration results poured in. A summary of this paper is provided in Chapter 4 and the full report will be made available by the MME.

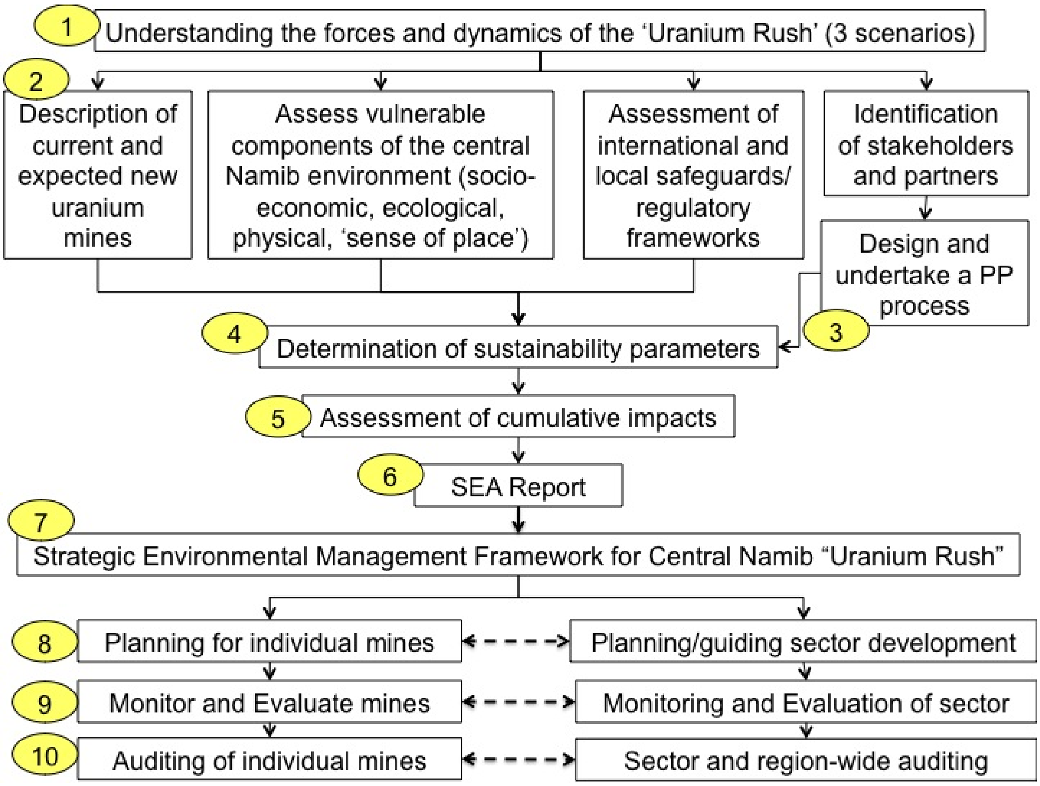


Figure 2.2: Sequencing of SEA activities

Based on the Forces and Dynamics paper, the Mining Report and expert opinion, the team constructed and tested four scenarios, which were used as the basis for the impact assessment. These considered both uranium mining and a more holistic overview of development in the Erongo Region. These scenarios are discussed in Chapter 4.

2.4.2 Baseline analysis

The next step was obtaining a thorough understanding of the current situation regarding the receiving environment, including biodiversity and heritage resources, the state of water, power and other resources, the adequacy of existing social and physical infrastructure (e.g. schools, roads, harbour, transportation, health facilities, etc.), the availability of human resources and skills, radiation and health levels, etc. As noted earlier, some of this work had already been done and recorded in the various mine-specific EIAs, in GRN and parastatal reports, and other studies. But as noted above, some new studies were commissioned by the BGR-GSN after it became apparent that there were certain regional data deficiencies.

Thematic Reports were compiled by a small team of people who are very familiar with the literature (or have written much of it) and who could be considered experts in that field. In most cases, they held small 'brainstorm' workshops with local experts to obtain additional data or verify preliminary findings. The Thematic Reports were peer reviewed by the SEA Steering Committee and are regarded as representing a reasonably coherent collection of knowledge for future reference. These reports will be compiled into a separate stand-alone volume, but the findings of these studies were used extensively in the cumulative environmental assessment (Chapter 7) and in compiling the SEMP (Chapter 8).

Plate 2.1: The SEA benefited from a number of brainstorm workshops, both internally within the team, with the Steering Committee and with focus groups (photo M.Hauptfleisch).

Plate 2.2: Limited fieldwork was required since recently completed EIA reports for mines and other projects in the area provided a substantial amount of information that was used in the SEA (photo M.Hauptfleisch).

2.4.3 Stakeholder engagement

The TORs expected the SEA to be widely publicised as early as possible, so that Interested and Affected Parties (I&APs) could participate meaningfully from the start and so that the SEA could benefit from their knowledge and insights. Good public participation is always required in impact assessment, but even more so in this case as the uranium industry is to some extent 'unknown' to the public and its impacts prone to misinterpretation and exaggeration. Providing credible information on an ongoing basis and running a legitimate process were non-negotiable pre-requisites. Furthermore, it was hoped that effective public involvement would build ownership amongst stakeholders of the SEA and SEMP process as well as stakeholder acceptance of their recommendations.

Stakeholder engagement for this SEA consisted of the following:

- Public meetings;
- Focus group meetings;
- One-on-one consultations with concerned organisations and individuals;
- Media interviews and newspaper articles;
- Questionnaires;
- Information sharing on the SAIEA website;
- The Youth Forum workshop and debate held on 6 November 2009;
- A multi-stakeholder workshop on the SEMP on 11-12 February 2010; and

- Discussions within the “Uranium Rush” SEA Steering Committee.

The stakeholder engagement process was initiated by compiling a comprehensive database of I&APs (see Appendix B). The many EIAs completed for various projects in the central Namib contained stakeholder lists (most overlapping) which were used as a basis. The list was expanded through recommendations from the client, SEA team members and the Steering Committee to be as inclusive as possible. It was acknowledged that the “Uranium Rush” would have local, regional and national impacts and consequently stakeholder engagement at all levels was encouraged.

Plate 2.3: Public meetings were held in a number of localities at various stages of the process, enabling people to obtain information and provide input. Participatory techniques were used to encourage effective public participation (photo M.Hauptfleisch).

A series of **public meetings** was held in order to:

- Introduce the public to the SEA process, create awareness of its purpose and limitations;
- Encourage and facilitate public enquiry about the process, and its possible outcomes;
- Provide a neutral platform for the public to communicate their hopes and concerns about the “Uranium Rush”;
- Stimulate debate over some of the concerns of uranium mining in the region;
- Identify stakeholders to engage further through focus group discussions and informal interaction to provide meaningful input to the SEA.

It should be noted that the public and focus group meetings held as part of the SEA process, were in addition to the numerous meetings held over the past few years as part of EIAs for various mines. Within those project-level EIAs, members of the public, including local communities, unemployed, mine worker unions, NGOs etc, raised concerns and expectations relating to each mine specifically, as well as the “Uranium Rush” generally. Thus, the SEA was able to capitalise on the large body of information contained in the individual EIAs.

Notices of the scoping meetings were advertised in the following media:

Type of notice	Where placed	Date: (2009)
Advertisement	Namib Times, Namibian, New Era, Republikein	20 February & 6 March
Public Announcement	NBC Afrikaans, NBC Oshiwambo, NBC Otjhiherero, NBC German, Kosmos Radio, Channel 7 Radio, Radio Wave, NamFM 99	9 March
Public broadcast interviews	Kosmos Radio, NamFm 99, NBC Afrikaans	6 March 9 March
Newspaper articles	Namibian	9 March
Partner organisations	Namibian Environment and Wildlife Society, Nacoma	23 February
E-mail	Identified stakeholders (through SEA team brainstorming), I&AP lists from Uranium mine EIAs, and other EIAs in the region, Namibian Environment and Wildlife Society Network, Nacoma I&AP network	23 February to 5 March
Follow-up articles ensuring awareness about public input, and stating contact details for further input	Republikein, Namibian, Namib Times	12 March, 16 March 10 March, 24 March 20 March

In order to facilitate access by all members of society to the SEA process, meetings were held at the towns listed below. The meetings in Arandis and Usakos were specifically held to ensure participation by local communities, mine workers, mine worker unions, local farmers and the unemployed.

Town	Date	Time	Attendance
Windhoek	9 March, 2009	18h30	58
Usakos	10 March, 2009	17h30	12
Arandis	10 March, 2009	17h30	40
Walvis Bay	11 March, 2009	18h30	8
Swakopmund	11 March, 2009	18h30	46
Henties Bay	12 March, 2009	10h00	7

At each meeting, the public were provided with an overview of the scenarios and key elements of the "Uranium Rush". They were then asked to express their main hopes (expectations for benefits) and concerns (about negative impacts) on individual cards. These were then clustered by the facilitators and discussed further. The minutes of these meetings are provided in Appendix B and the hopes and fears are summarised in Table 2.2.

Focus group meetings were convened by the SEA team with key stakeholders at various times in the SEA process in order to identify and debate issues relating to the "Uranium Rush" as well as collaboratively identify interventions to address issues. Table 2.1 summarises the focus group meetings.

Table 2.1: A summary of focus group stakeholder meetings

Focus group	Location	Organisation	Purpose of meeting
Mining (12 June 2009)	Windhoek	Valencia Mine	Understanding of SEA process, discussions on possible impacts on mining operations
Housing (July 2009- various)	*Telephonic* Walvis Bay, Swakopmund, Arandis, Usakos, Windhoek	Walvis Bay Municipality, Swakopmund Municipality, Usakos Municipality, Estate Agents	Impacts of SEA on the housing market in Erongo
Tourism (10 July 2009)	Windhoek	Tour and Safari Association	Understanding of SEA process, impacts on tourism
Housing (15 & 16 July 2009)	Walvis Bay & Swakopmund	Walvis Bay Municipality Swakopmund Municipality	Impacts of SEA on the housing market in Erongo
Tourism (16 July 2009)	Swakopmund (Longbeach)	NACOMA Contingency Management Committee	Issues and Impacts of the Uranium Rush relating to tourism
Biodiversity offsets (3 August 2009)	Swakopmund	Fauna and Flora International, Chamber of Mines, Uranium Mines, NACOMA, regional biodiversity specialists	Discuss the principle of offsets, and possible application to the Uranium Rush
Biodiversity (4 August 2009)	Swakopmund	Independent scientists, NBRI, State Museum, Gobabeb, NEWS, Nacoma, Environmental scientists, Tourism operators	Issues and Impacts of the Uranium Rush relating to tourism and biodiversity, possible offsets
Biodiversity (5 August 2009)	Windhoek	Namibia Environment and Wildlife Society	Understanding of SEA process, impacts on biodiversity
Mining (14 September 2009)	Windhoek	Langer Heinrich Mine	Understanding of SEA process, discussions on possible impacts on mining operations
Restoration and mine	Windhoek	Enviroscience,	Development of a

Focus group	Location	Organisation	Purpose of meeting
closure (22 September 2009)		Gobabeb, DRFN, DWAF, ASEC, Millennium Seed-bank Project	central Namib Restoration Unit to support SEMP implementation
Mining (2 & 30 October 2009)	Windhoek	Gecko Mining	Understanding of SEA process, discussions on possible impacts on mining operations
Mining (12 October & 17 November 2009)	Windhoek	Bannerman Mining	Understanding of SEA process, discussions on possible impacts on mining operations
Small scale mining in the central Namib (4 June 2010)	Karibib	Erongo Small-scale Miners' Association and stakeholder forum	Impacts of Uranium mining on small-scale miners in the region, possible synergies

One-on-one consultations were held with key individuals and organisations, as well as any group or individual requesting such a consultation. Groups that are known to be particularly sensitive about the "Uranium Rush" or especially vulnerable to its impacts (such as the tourism industry, landowners and conservation/environmental NGOs) were specifically encouraged to become involved in the process. In response, the Namibia Environment and Wildlife Society (the country's oldest and most representative environmental NGO) organised a consultative meeting so that its members could hear about the SEA and provide input. The landowners (a small group of farmers in the Swakop/Khan area) were particularly active in the EIA process for the mine that affected them most significantly (Valencia) and some of the farmers also attended some of the SEA meetings. They did not make use of invitations for additional meetings as part of the SEA process. Appendix B lists individuals who were consulted during the SEA.

Media interviews and newspaper articles were an important aspect of public participation to create an understanding of the SEA process and its outcomes. Newspaper articles appeared in The Namibian, Republikein, Allgemeine Zeitung and Namib Times, and radio interviews were held on an *ad hoc* basis with the Namibian Broadcasting Corporation, Radio 99 and Kosmos Radio. A Swedish film company interviewed the Uranium SEA team at a public meeting in Swakopmund as part of a documentary on the impacts of uranium.

Telephonic and face-to-face questionnaires were used to gather information and opinions on the following issues:

- Extent of tourism in the central Namib and possible impacts of the "Uranium Rush" on tourism;
- Current house market situation in towns of the central Namib, and the effect of the "Uranium Rush" on house and erven prices and availability.

Youth Forum: During November 2009, the GSN-BGR invited young Namibians, aged between 16 to 28 years, to a "Uranium Rush Youth Debate", to share their views and opinions on uranium mining in Namibia in general and their expectations on the booming uranium industry in the Erongo Region. The forty-nine people who attended the debate provided valuable input into the SEA, since it verified the validity of the Environmental Quality Objectives and enabled a refinement of the indicators. This was the first time that a forum specifically for the youth had been organised in Namibia as part of an impact assessment process.

Plate 2.4: Participants at the youth debate. This is the first time in an impact assessment process in Namibia that a forum was created especially for the youth. (photos R.Leonard).

The SAIEA website was used to disseminate information in the form of draft reports to steering committee members and selected key stakeholders. They were invited to comment on draft reports and their comments were addressed during report finalisation.

The Uranium SEA Steering Committee that was established at the start of the SEA consisted of representatives of key stakeholders in the Uranium Industry in Namibia (government, NGOs, parastatals, mining, tourism)[4]. This committee met eight times during the 16 month period during which of the SEA was conducted. Besides steering the SEA process, another function of the Steering Committee members was the dissemination of information within their institutions and networks and providing critical feedback to the SEA team. To assist them with the latter task, the Steering Committee appointed an internationally recognised External Reviewer, Dr Barry Dalal-Clayton (IIED, UK) to assess the extent to which the SEA was adequate in terms of both process and product.

The hopes and concerns about the "Uranium Rush" collated from all the meetings described above are summarised in Table 2.2 according to the main themes of the SEA. Note that these reflect public perceptions and attitudes and do not necessarily reflect what is, or what will actually happen. Where relevant, these hopes and concerns were taken into consideration by theme authors and addressed as part of each thematic assessment.

[4] See Acknowledgements at the beginning of this SEA for the full list of Steering Committee members.

Table 2.2: Summary of hopes and concerns about the "Uranium Rush" expressed by the public

Category	Hopes of the public regarding the "Uranium Rush"	Public concerns about the "Uranium Rush"
Economic	• The "Uranium Rush" (UR) will bring strong economic growth to the towns of the Erongo region and an improved quality of life; • Through careful stewardship of revenues and taxes from the UR, the GRN will be able to address poverty and improve the lives of all Namibians; • The UR will have a major impact on the macro-economic indicators of Namibia; • The UR will create many direct and indirect new jobs; • The UR will be the catalyst for a Namibian nuclear energy industry including the beneficiation of uranium for use in a power station and the construction of nuclear power stations.	• Mining is not sustainable; • Mining is extremely vulnerable to fluctuations in the exchange rate and Uranium prices; • There will be no added value to the country from uranium beneficiation; • All revenues will leave Namibia because of foreign ownership of the mines; • Escalating property prices will make houses unaffordable; • The UR will have a negative impact on the tourism industry thus affecting the livelihoods of many people at the coast.
Infrastructure	• The UR will result in improved/upgraded infrastructure such as roads, railways, port, water supply, waste disposal etc.	• The existing infrastructure will not be able to cope and the GRN will not be able to maintain it or upgrade it in time; • There will not be enough water; • The current waste disposal systems will not be able to cope with additional waste, especially hazardous waste, including radioactive waste; • Power will cost more and power outages will become more common.

Social and health	• The UR will result in more, well-equipped schools and health care facilities;
	• There will be more opportunities for skills development and training;
	• Farmers who may lose their land or livelihoods will receive adequate compensation;
	• There will be a radiation-free community;
	• The UR presents an opportunity to develop a thorough health baseline for Erongo and a National Cancer Register.
		• The influx of employees and their families as well as aspirant workers will cause a number of impacts on:
		  o The incidence of disease, especially HIV/AIDS and TB;
		  o Social cohesion;
		  o Crime;
		  o Informal housing areas;
		  o Crowding;
		  o Pressure on social services and amenities resulting in the deterioration of these services and facilities;
		• There is currently a lack of skilled people and training opportunities;
		• Farmers may lose their land or be unable to farm anymore because of mine-related impacts on their livelihoods;
		• Unethical companies may exploit workers;
		• 'Brain drain' to the mining industry;
		• The mines will impact on health

Category	Hopes of the public regarding the "Uranium Rush"	Public concerns about the "Uranium Rush"
		because of: o More dust; o Increased exposure to radiation; o Increased traffic causing more accidents; o Higher risk of spills of hazardous materials in transit; o Groundwater pollution. • There will be more noise and visual impact resulting in a loss of sense of place; • The UR will result in loss of access to favourite recreation and tourist areas in the Namib.
Environment and heritage	• Mines must employ best practice with regard to: o Water use e.g. recycling and conservation; o Energy use e.g. use of renewable energy and energy efficient technologies; o Rehabilitation and mine closure; o Pollution control (air, water, soil); o Tailings management; • Mining operations must endeavour to reduce their footprint; • Mines must put monitoring systems in place and provide regular reports to the public; • The UR presents an opportunity to fund scientific research and improve the body of scientific knowledge about the Namib environment and heritage resources.	• The mines, associated industrial developments and new infrastructure will have a negative, cumulative impact on: o Water resources; o Biodiversity including the lichen fields; o Air quality and radiation; o Soil; o The integrity of the National Park; o Marine environment (desalination plants); • There will be an increase in poaching, fishing and illegal harvesting; • Mines will not provide sufficient funding for adequate closure; • Mine closure will not be adequate in the long-term resulting in long-term impacts on the environment.

The outcome of the stakeholder engagement process is articulated in the Strategic Environmental Management Plan (SEMP) (Chapter 8) as a set of 'desired states', or visions as to how people would like to see the central Namib in the future. The SEMP is a management framework with a set of indicators that will be monitored to show whether the "Uranium Rush" is contributing positively towards the goal of sustainability in the area, or not. Moreover, it is designed to include the public and civil society organisations as part of long term monitoring and engagement.

A **SEMP Workshop** was held in Swakopmund on 11-12 February 2010 to discuss the SEMP in detail. A total of 45 people attended, representing a wide range of stakeholders from national and local government, parastatals, uranium exploration and mining companies, representatives of the tourism industry, NGOs and others. Each element of the SEMP was projected on a screen and discussed and amended in plenary. This allowed for a divergence of views to be aired, robust debate and consensus to be built.

Public disclosure and comment on the SEA: A final round of public meetings was held on 19-21 April 2010, at which the findings of the SEA were presented.

Table 2.3: Schedule of SEA public disclosure meetings

Town	Date	Time	Attendance
Swakopmund	19April, 2010	18h00	53
Arandis	20April, 2010	18h00	27
Windhoek	21April, 2010	18h00	39

The meetings were advertised in the following newspapers: Republikein (3 days), Allgemeine Zeitung (2 days), The Namibian (3 days) and the Namib Times (2 days). In addition, announcements about the meetings were made on both Kosmos Radio and NBC Radio on the 19th of April. Kosmos Radio also held interviews with one of the team members before and after the Swakopmund meeting and before the Windhoek meeting.

The final draft SEA was made available to the public through various means on 17 August, 2010, and the public had 3 weeks in which to comment.

2.4.4 Assessment of cumulative impacts

The thematic working groups of the SEA team and key stakeholders participated in various meetings to workshop the key impacts of various components of prospecting and mining against the EQOs. This analysis was assisted by the completion of an impact matrix. Once all the working groups had assessed the key impacts of prospecting and mining using the matrix, a workshop was held to brainstorm synergies, cumulative and/or antagonistic effects of the "Uranium Rush". This enabled the construction of the bigger picture, which is what sets an SEA apart from project level EIAs.

It should be noted that while it was possible to identify cumulative impacts using this methodology, no attempt was made to quantify the magnitude, extent, duration and significance of each impact using standard EIA assessment tools. The reason for this lies in the highly speculative nature of the "Uranium Rush". By its very definition, a cumulative impact is an impact that is contributed to by several causes/sources. In the case of this "Uranium Rush", there are numerous variables which may or may not contribute to each cumulative impact to a greater or lesser extent, for a variable length of time, with a higher or lower degree of significance. Thus the magnitude, extent, duration and significance of each cumulative impact will depend on for example, which combination of mines will happen and when, the timing, level and nature of response by GRN to upgrading roads, providing power and water etc, as well as the response by local government in addressing issues such as housing, municipal services, town planning etc. It will also depend on the degree to which the mines adopt 'best practice' and the rigour in which the permit conditions are enforced by GRN. With this number of unknowns, every identified cumulative impact could be widespread or localised, long-term or short-term, severe or minor, significant or insignificant, positive or negative. This therefore presents an infinite number of combinations of possible impacts, depending on a large number of variables, dependencies and unknowns and therefore any attempt to quantify these impacts becomes a fruitless exercise.

2.4.5 Strategic Environmental Management Plan

Implementation of an organic, dynamic programme as complex as the "Uranium Rush", will create challenges at all levels - regional, local, community, household, and individual. It will also create challenges at the strategic level, which the Strategic Environmental Management Plan[5] (SEMP) will identify and address (see Chapter 8). In formulating the SEMP, it was important for the team to understand the relationships between the forces and dynamics of the global uranium industry (Chapter 3) and the cumulative impacts of the "Uranium Rush" and associated developments on other land uses and activities within the Erongo Region.

The "Uranium Rush" occurs in an area that already has a number of other land uses, such as tourism, fisheries, lifestyle investments, import/export and film making. While each of these is dependent on a different natural resource base (the geological occurrence of uranium, a desolate desert landscape, rich marine resources etc), there are inevitable points of potential conflict, e.g. between mining and tourism; increased industrialisation and lifestyle investments and so on. While the 'pull' factors are firmly rooted in the natural attributes of the central Namib, the drivers (or 'push' factors) are global in nature (Figure 2.3). Clearly the SEA cannot influence global forces, but it can create a development vision for the central Namib which is consistent with national policies (e.g. Vision 2030) and which provides an enabling environment to facilitate equitable development: one which balances short-term socio-economic benefits with long-term environmental protection.

Once the economic drivers and the vulnerability of the receiving environment were understood, we analysed the need for strategic investments, which include good governance at all levels, an improved physical infrastructure (e.g. roads, port), efficient social services (e.g. schools, clinics), and careful planning to maximise benefits and minimise negative impacts and opportunity costs. Translating the above broad investments into practical actions required the development of a series of Environmental Quality Objectives (EQOs). These are broadly stated desired future outcomes that are based on a combination of public input, expert opinion, scientific research and an examination of policy, ethical and legal requirements. These informants constituted the **'input'** into the (EQOs) (Figure 2.3).

[5] Although the SEMP is called a plan, it is in fact a framework for developing and implementing detailed plans.

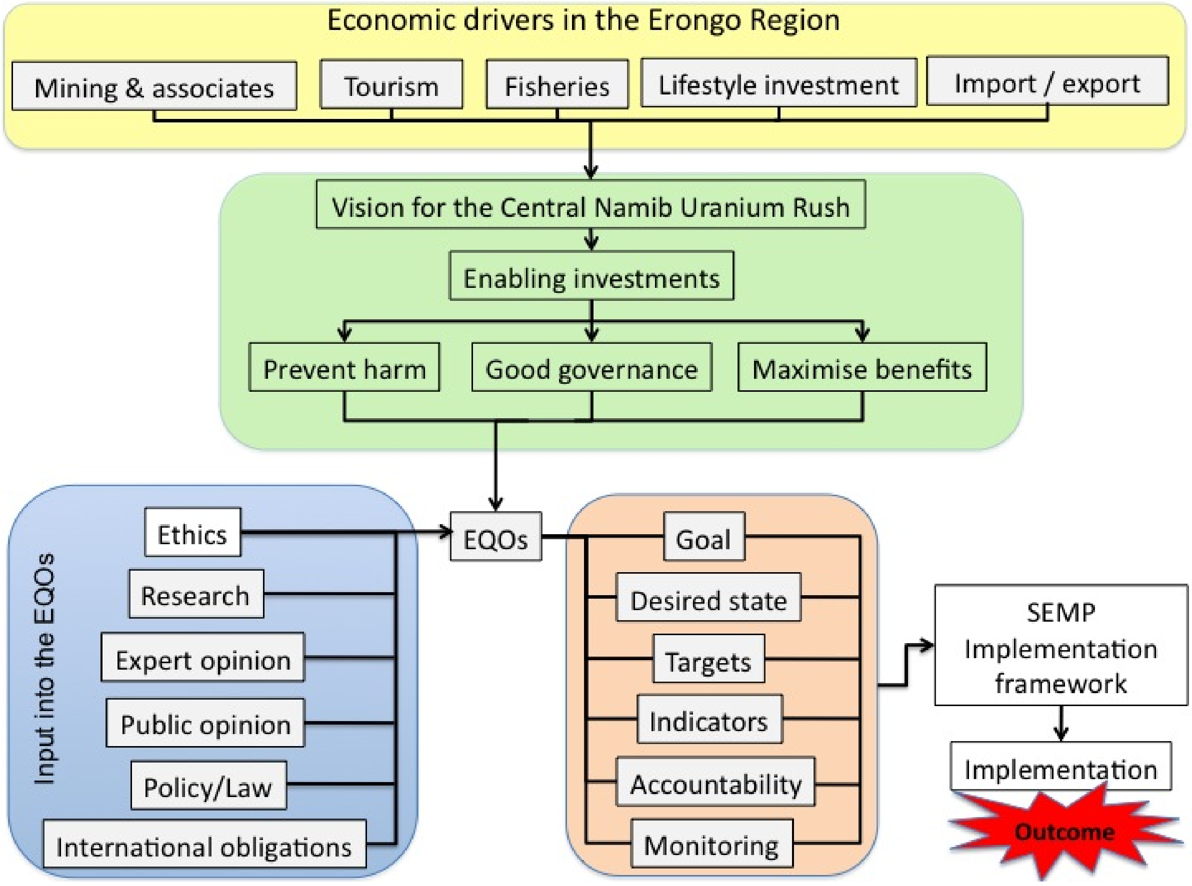


Figure 2.3: The broad sequence of activities that culminated in SEMP development

An EQO is typically a non-enforceable goal, which specifies a target for environmental quality which, it is hoped, will be met in a particular environment. In some cases, EQOs are a vague form of generally desirable objectives, but in other cases, they might be concrete quantitative measures. Wherever possible, they should be acceptable to all key stakeholders, quantifiable, verifiable and outcomes-oriented.

EQOs include a number of management objectives which are linked to one or more targets. These targets have been determined either by local and/or international laws (e.g. water quality standards), policy (e.g. National Park zonation), best practice guidelines (e.g. pupil: teacher ratio at a school), the markets (e.g. house prices) or societal choices (e.g. sense of place). The challenge in countries such as Namibia is that there are very different societal expectations from different cultural groups, meaning that great care was needed to reduce bias. Thus, determining the EQOs required a combination of research (e.g. what are the standards set by law?) and careful stakeholder engagement (see section 2.4.3 above). In this case, the public participation process was slightly different from conventional EIA work, as it required consensus building and visioning. The EQOs and indicators were finalised after eight months of public meetings, focus group discussions and expert input (see Chapter 8).

Implicit within all EQOs is a minimum management objective that states that any change to the environment must be within acceptable limits and that pro-active intervention will be triggered by the responsible party to avoid unwanted changes that breach a specified threshold. Achieving the desired outcomes specified in the indicators requires investments and actions by a range of stakeholders if Namibia is to succeed in managing the "Uranium Rush". There is thus a need to measure the progress of implementation, outputs and outcomes. This would best be done by a central 'SEMP Office' which would be responsible for coordinating all the monitoring duties and data and compiling the information into an annual report to inform the stakeholders about progress in implementing the recommendations of this SEA. Naturally, any shortcomings identified through monitoring will be documented and will require corrective action by the relevant party.

The EQOs that were identified are regarded as a proxy, which collectively indicates whether the "Uranium Rush" is moving the central Namib along a pathway towards or away from the goal of sustainable development. These EQOs collectively make up the SEMP, which is the ***framework*** within which individual projects need to be planned and implemented. If individual projects are well planned and implemented and they collectively contribute towards the sustainable development of the Erongo Region, then the desired **outcome** has been achieved (Figure 2.4).

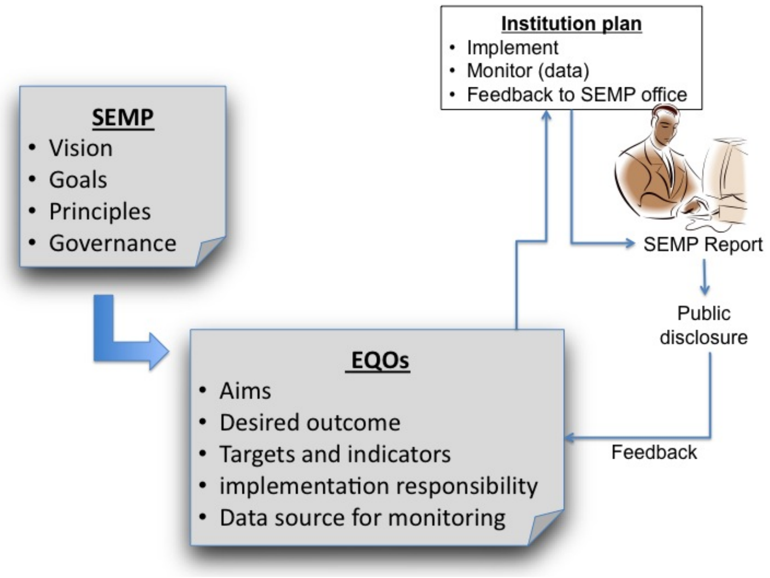


Figure 2.4: Key components of the SEMP and the link to annual reporting and public disclosure

3 FORCES AND DYNAMICS OF THE URANIUM RUSH

3.1 Power Demand

3.1.1 Global Growth in Electric Power Demand

The current uranium rush in Namibia is driven by various global forces as well as some local forces. Global forces behind the uranium rush operate at different levels of the global economy and energy economy. Until the economic crisis of 2009, the world had experienced a period of continued economic growth, fuelled in recent years by the fast expanding economies of threshold countries like China and India. Global economic growth, in turn, has driven growth in global energy demand, although world primary energy consumption has grown more slowly than world economic output. This “de-coupling” of primary energy demand growth from economic growth, first triggered by the oil shocks in the 1970s, has continued to date, as a result of steady gains in the energy productivity of aggregate economic activity (i.e. the economic output generated per unit energy input) in most national and regional economies.

On the other hand, the proportion of secondary energy that is consumed in the form of electricity has continued to rise worldwide, such that growth in global *electric* power demand has outpaced global primary *energy* demand growth, approximately keeping pace with global economic growth. Meeting growing electricity demand worldwide has required continuing expansions in global electric power generating capacity, as well as motivated efforts to use existing generating capacity more efficiently, as reflected in rising average capacity factors of nuclear power plants.

Whether global primary energy demand will continue to grow in the coming 10-15 years (and if so, at what rates) will depend on a number of factors including: the form, speed and extent of the current recovery from the worst financial and economic crisis since the Great Depression; the rate at which energy prices will continue to rise; and, depending on the economic recovery and energy price rises, the extent to which the past trend of decreasing energy intensity (increasing energy productivity) of aggregate economic activity will continue. Similarly, whether global *electric* power demand will continue to grow faster than overall *energy* demand (and if so, at what rates) and what mix of power sources will come to be deployed to meet future electric power demand, will depend on a number of factors, such as:

- The extent to which the past trend of increasing electricity shares in secondary energy supply mixes continues;
- Changing energy end use patterns;
- The rate at which electricity prices will continue to rise;
- Changing relative power generation costs for alternative power generation technologies;
- Changing perceptions of the relative environmental, safety, and security risks of different power supply systems and technologies.

3.1.2 Global Nuclear Power Capacity

In recent years, nuclear energy has made a comeback as a relatively 'clean' (carbon-free) and relatively abundant source of base load power. This comeback has been triggered and propelled by a combination of factors, including:

- Concerns about global climate change and meeting greenhouse gas (GHG) emission reduction targets (mostly among developed countries and especially in Europe);
- The prospect of rising energy prices, especially for fossil fuels, and declining fossil fuel supplies and related energy security concerns - particularly in some countries with few if any domestic energy resources and hence few if any energy supply alternatives to importing fossil fuels;
- The need for meeting fast growing energy/power demand - above and beyond likely further improvements in energy efficiency and productivity (this refers, in particular, to populous, fast growing threshold countries, like China and India); and
- Ambitious nuclear power expansion plans in traditionally pro-nuclear developed and threshold countries.

These factors have helped to bring about a marked change in the dynamics of the global commercial nuclear power market. Since the turn of the millennium, orders for nuclear power reactors have resumed (after 15-20 years of relative nuclear power market paralysis and shrinkage) and a significant number of new nuclear power plants, corresponding to about 15% of current global nuclear generating capacity, are currently under construction (Figure 3.1). However, the nuclear power renaissance has yet to start translating into actual increases in installed nuclear capacity on the ground, as new nuclear plant builds and re-connections to the grid of already existing nuclear power plants have so far been offset by nuclear plant retirements.

Above and beyond the 45 nuclear power reactors (40 GWe of nuclear generating capacity) currently under construction worldwide, another 112 nuclear power reactors (131 GWe of generating capacity) are 'on order or planned' throughout the world, as summarized in Table 3.1. Of the 112 reactors on order or planned, more than half are in Asia: 33 are in China, 13 in Japan, 10 in India and 7 in South Korea. On top of that, 276 nuclear power reactors (300 GWe of capacity) are currently "proposed" (WNA, 2009), but these numbers are very uncertain. Longer term growth is expected to remain centred in Asia, in particular China.

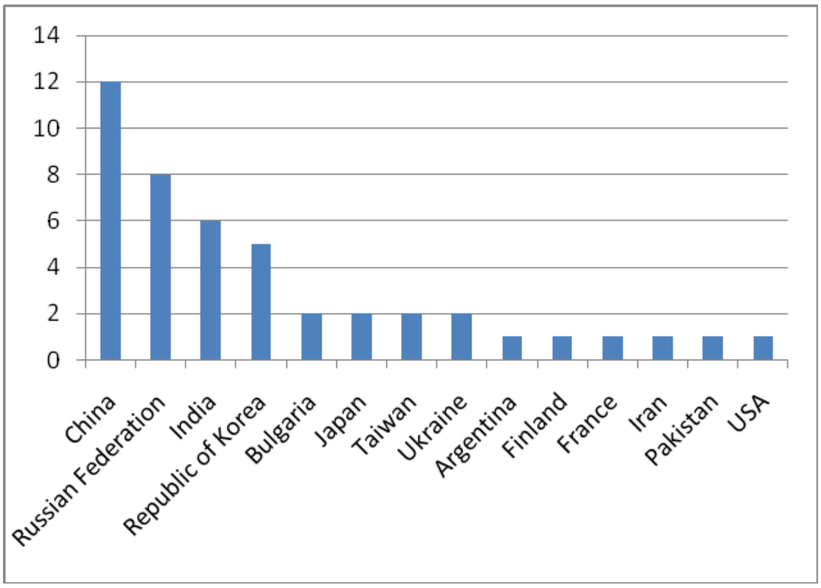


Figure 3.1: Nuclear power reactors under construction worldwide (Source: European Nuclear Society)

Table 3.1: Global nuclear power generating capacity – current and future (Sources: ENS, WNA)

	No of nuclear reactors	Installed capacity (GWe)
Operating nuclear plants	436	372
Under construction	45	40
On order or planned	112	131
TOTAL	**593**	**543**

On the other hand, many of the older operating nuclear power reactors are having their operating licences extended – e.g. most of the 104 operating reactors in the US have had or will have their operating licences extended from 40 to 60 years – and this is likely to lead to net increases in installed nuclear power generating capacity, as the number of reactor retirements drops below the numbers of new builds and re-connections over the next 10-15 years. Whether these rather modest anticipated net increases in nuclear capacity over the next 10-15 years will be sufficient for nuclear power to maintain its global share of electric power supply at the current 14%, remains to be seen. In the longer run, maintaining this global share would certainly require a massive effort in nuclear plant construction only to replace retiring reactors, let alone adding new reactors.

Notwithstanding the current nuclear renaissance, the longer-term prospects for nuclear power remain uncertain. For nuclear power to become or remain competitive, energy policies will have to be favourable, regulatory regimes for nuclear power will need to be streamlined to shorten construction periods, and various uncertainties and risks will need to be addressed and managed effectively. These uncertainties and risks include: the need for strong and consistent government support and the extent to which this support will materialise; the complex and uncertain economics of nuclear power; safety, security and environmental risks of nuclear power; the degree of political and public acceptance of nuclear power; and the emergence, strong growth, and increasing competition from alternative power generating systems.

While the current generally more propitious climate for nuclear power has contributed to a positive dynamic and improved outlook for the global uranium market, it cannot by itself explain the current global uranium market rush, given the rather modest anticipated short- and medium-term increases in global nuclear power capacity and associated uranium requirements and given the remaining uncertainties and risks associated with nuclear power. This suggests that the main global forces behind the current uranium rush, in Namibia and worldwide, do not originate from the positive outlook of the nuclear power market, but rather from developments within the global uranium market itself.

3.1.3 The Global Uranium Market

Still further down in the hierarchy of the world energy economy is the global nuclear fuel market that meets the uranium fuel requirements of the current global fleet of nuclear power plants and will help to underpin the future role of nuclear power by delivering the necessary quantities of uranium fuel supplies in a timely and secure fashion. These global uranium fuel markets have undergone profound change as well in recent years. Subdued by chronic uranium oversupply in the 1980s and 1990s, the then lethargic buyer’s market started turning into an increasingly buoyant seller’s market around 2003, seeing uranium spot prices climbing to unprecedented levels in 2007 (before levelling off to current lower levels) and triggering a global wave of renewed uranium exploration activity and investments in new uranium production capacity (Figure 3.2).

This profound change in the dynamics of the global uranium market may be seen, in part, as a reflection of the renewed attention given to nuclear power and anticipated modest expansions in commercial nuclear power capacity since 2000. But more critically, the current uranium market dynamics appear to be driven by forces emanating from concerns about the security of uranium supply.

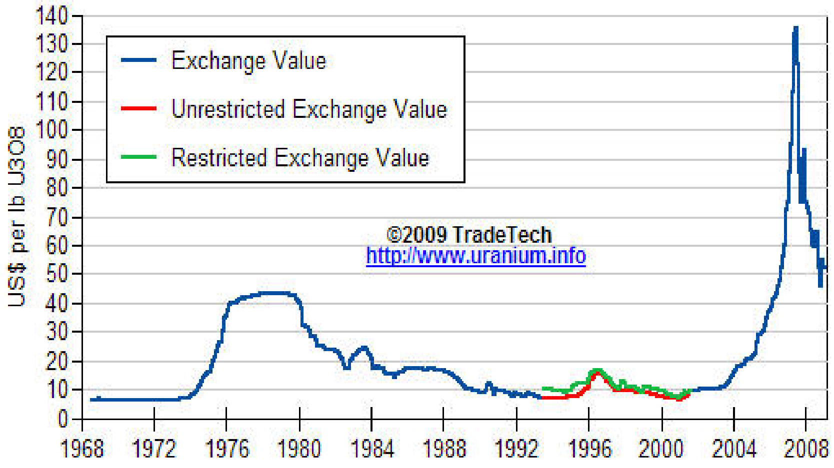


Figure 3.2: Uranium spot market price over time (Source: TradeTech, 2009)

3.2 Uranium Supply

3.2.1 Primary uranium supply: nuclear reactor requirements versus mine production capacity

About 200 tons of natural uranium concentrate are required annually to fuel a 1 GWe light-water reactor (LWR) operating at a capacity factor of 90 percent (IPFM, 2009). This implies that each 1 GWe LWR annually requires approximately 0.47 Mlb U_3O_8 (yellowcake). Therefore, the annual uranium fuel requirements of the entire global fleet of nuclear power plants are roughly 175 Mlb U_3O_8 or about 79,545 tonnes.

Primary uranium supplies, i.e. newly mined and processed uranium, currently cover only 55% of nuclear power reactor requirements. With secondary uranium supplies diminishing in absolute terms in coming years (see section 3.2.2), primary uranium production will have to expand significantly in order to be able to meet future supply requirements, which by 2020 will likely be at least equal to and possibly up to 40% higher than current requirements. This means that there are likely to be supply shortfalls in coming years unless new uranium production capacity is developed and deployed in the near future (Figure 3.3). However, long lead times from the discovery of uranium deposits to the beginning of production make it exceedingly difficult to develop and quickly deploy new production capacity from new mines or expansions of existing mines.

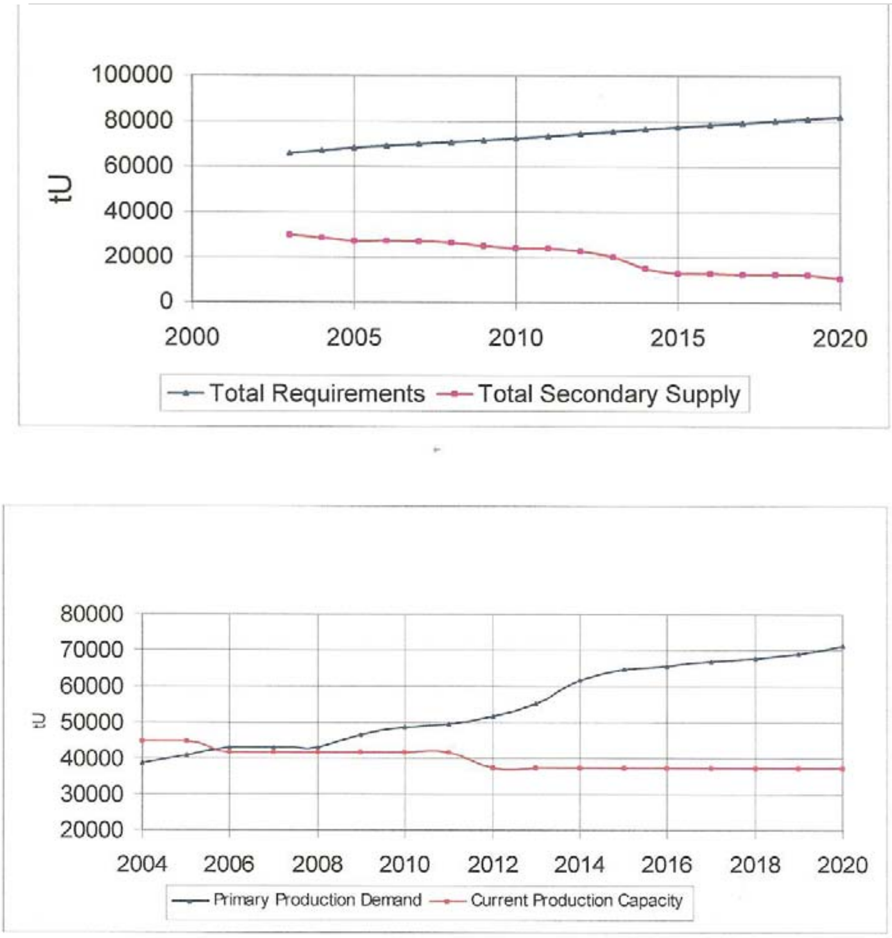


Figure 3.3: Primary and secondary uranium supply and primary uranium production capacity (Source: McMurray, 2005)

The current challenge for nuclear power producers is, therefore, to develop new uranium production capacity in order to prevent possible supply shortfalls in coming years. Higher uranium prices since 2003 have significantly increased available uranium reserves i.e. economically recoverable uranium resources, which are now sufficient to meet current nuclear power reactor needs for at least the next 100 years.

3.2.2 Secondary uranium supply

Another ‘anomaly’ of the uranium market has been the existence of very substantial streams of secondary uranium supplies entering the market, currently meeting some 45% of the total uranium requirements of nuclear power plants worldwide. The secondary supply, which displaces equivalent quantities of primary supply from mines, comes from various sources (McMurray, 2005):

- Highly enriched uranium (HEU) recovered from dismantled Russian nuclear warheads and transformed into low enriched uranium (LEU);

- Uranium stockpiles set up by governments, producers and/or utilities to store accumulated excess uranium for later use or sale;
- Plutonium recovered from spent nuclear fuel and recycled into mixed oxide fuel (MOX);
- Recovering uranium from spent nuclear fuel for re-use in nuclear power plants.

Of these sources of secondary uranium, the "Megatons to Megawatts Programme" (recovery and down-blending of HEU from dismantled Russian warheads) has been by far the most significant one since the late 1990s, when it reached a stage of full-scale implementation. Currently, this source accounts for approximately two-thirds of all secondary uranium. Should the HEU/LEU Agreement between the US and Russia expire in 2013, then secondary uranium supplies from the other sources are projected to meet only about 15% of total uranium requirements in 2020. In the more likely event of the HEU/LEU Agreement being extended beyond 2013, secondary supplies could still only cover an estimated 22% of total requirements by 2020 (McMurray, 2005).

3.3 Namibia and the Supply of Uranium

Namibia is currently the fourth largest producer of uranium in the world, producing 4,843 tonnes of uranium oxide (U_3O_8) in 2008 and forecast to exceed 5,100 tonnes in 2009, as Langer Heinrich ramps up production (see Table 3.2). However, depending on the number and timing of new mines coming into production in the next decade, Namibia's production could outstrip Canada's by a considerable amount. Under Scenario 1 (see section 4.5), which only considers the existing mines plus the two under construction, uranium oxide production could double to about 11,000 tpa (±24.3 Mlbs/a), making Namibia the largest producer in the world. Under Scenario 2, with 6 mines in full production in 2015, annual output (approximately 21,500 t U_3O_8 or >47 Mlbs/a) could be over 4 times that of 2008, and under Scenario 3, output from Namibia's 8 mines (26,900 t U_3O_8) could account for more than half of the entire world production in 2017, (excluding further development worldwide). This certainly puts into perspective the scale of the uranium rush in Namibia.

Table 3.2: 2008 world production of uranium by country

Country	**Tonnes U**	**% of world production**
Canada	9,000	20
Kazakhstan	8,521	18.5
Australia	8,430	18.5
Namibia	4,843	10.5
Russia	4,366	9.5
Niger	3,032	7
Rest of the world	7,060	16
Total	**45,930**	**100**

The current uranium oxide requirement to meet global reactor demand is approximately 80,000 tonnes and depending on a number of global forces, this demand could increase by anything up to 40% by the mid-2020s (i.e. a total of 113,200 t would be required). As described in section 3.2 above, the demand is supplied from two sources: primary and secondary, but the future of the secondary supplies is uncertain, depending on whether the HEU/LEU Agreement is renewed or not. The worst case from a uranium supply:demand perspective is as follows:

Maximum projected increase in reactor requirements (40%) (t U_3O_8)	113,200 t
Secondary supplies if HEU/LEU Agreement is *not* renewed	11,000 t
Current supplies from primary sources (no further increase)	46,000 t
Therefore the shortfall would be:	56,200 t

If however, the HEU/LEU Agreement is renewed (a more likely scenario), the situation given maximum reactor demand would be:

Maximum projected increase in reactor requirements (40%) (t U_3O_8)	113,200 t
Secondary supplies if HEU/LEU Agreement is renewed	34,000 t
Current supplies from primary sources (no further increase)	46,000 t
Therefore the shortfall is	33,200 t

The projected supply of uranium oxide (t) from Namibia under the three mine development scenarios is:

Scenario 1:	11,000
Scenario 2:	21,500
Scenario 3:	26,900

Given that it is extremely unlikely that there would be no other increase in uranium oxide production worldwide, there is a real risk of possible world uranium over-supply under Scenario 3. The risk would be especially serious if the HEU/LEU Agreement is renewed in 2013 and if the net increment in nuclear power reactor capacity by 2020 turns out to be small (<40%). In this case, additional global primary uranium requirements might only amount to 25,000 t of U_3O_8 by 2020, and almost all of this could be covered by additional supplies from Namibia (under Scenario 3).

Namibia might be more affected by these risks than other uranium producers, given the low ore grades and higher production costs of Namibian mines. In any case, global uranium market development would likely undergo re-adjustments over time, depending on actual (versus projected) global nuclear power development, global secondary supply development, mine closures, possible mine accidents, etc. All this highlights the uncertainties and risks associated with investments in uranium mining capacity over the coming 10-15 years. GRN should be aware of the risk that Scenario 3 might well be an unrealistic scenario in that Namibia could easily over-supply the global uranium market (global supply security concerns might turn into global over-supply concerns) with corresponding downward pressure on global uranium prices and possible delays in mine openings or even closures of active mines – leading to the possibility of a boom and bust situation, as envisaged in Scenario 4.

The principal reason why Namibia may be more affected by the worldwide uranium rush than most other developing or developed uranium-producing countries is that Namibia is seen by the international nuclear and uranium mining industries as a politically stable, 'uranium exploration/ mining friendly' and 'foreign investor friendly' country with good infrastructure, a reasonably competent, principled and well functioning civil service, reasonably efficient and transparent regulatory procedures (permitting and licensing processes), and no major anti-nuclear or anti-mining opposition.

Some of the main local forces and factors behind the uranium rush in Namibia include:

- Namibia's long-standing experience with mining dating back to colonial times and the country's active interest in mining since Independence, with the current mining sector being one of the strongest, most diversified and export-oriented within the Namibian economy;
- Namibia's significant past experience with and information generated by uranium exploration (accumulated during early international interest in the late 1960s, 1970s, and early 1980s) and uranium mining (the Rössing uranium mine has successfully operated for over 30 years) – which provides an information and operational basis on which current uranium exploration and mining activities can build;
- National development and poverty reduction policies and plans (Vision 2030, NDP3, etc) emphasizing foreign investment as a mechanism for employment creation and enhanced national economic development growth.

It seems plausible to assume therefore that the uranium rush worldwide and particularly in Namibia will continue for as long as supply security concerns drive the global uranium market. Factors like the typically long (and uncertain) mine development lead times, especially for the "super-rich deposits" in Australia and Canada, and the possibility of recurring production interruptions at existing mines e.g. in Niger, taken together, suggest that the current uncertain uranium supply situation is unlikely to fundamentally change over the next 10-15 years. A fundamental shift away from nuclear power that could destabilize the global uranium market before 2020 is conceivable only in the rather unlikely event of a cataclysmic global incident or development.

4 BACKGROUND AND HISTORY OF URANIUM MINING IN AFRICA

4.1 Regional Context – Uranium Mining in Africa and SADC

Uranium deposits are found throughout Africa and currently, exploration is being carried out in 30 countries on the continent, 10 of which are members of the Southern African Development Community (SADC). However, there are only a few mines in actual operation at present. According to the uranium mining website, www.wise-uranium.org, these are:

Table 4.1: Operating uranium mines in Africa (as of 11/11/09)

Country	Mine name	Major shareholder
Malawi	Kayelekera Mine	Paladin Resources Ltd
Namibia	Rössing Uranium Mine	Rio Tinto
Namibia	Langer Heinrich	Paladin Resources Ltd
Namibia	Trekkopje (pilot stage)	Areva
Niger	Arlit	Areva
Niger	Akouta	Areva
RSA	Ezulwini	Ezulwini Mining Co (Pty) Ltd
RSA	Vaal River Area Mines	AngloGold Ashanti

However, with the worldwide increase in the demand for uranium, there are a number of projects throughout the continent which are in an advanced stage of development, especially in Niger, Central African Republic, Namibia (see section 4.3 below), South Africa, Tanzania, Malawi and Zambia. The large, near-surface deposits in Niger are relatively high grade (>0.1% U) and therefore there remains significant interest in this country in spite of the political difficulties that often beset the mines.

In South Africa, uranium is most usually associated with gold or copper ores. Up until the recent surge in the price of uranium, the generally low grades of uranium at the gold and copper mines did not make uranium extraction a commercially viable proposition. Therefore, it has been discarded as waste rock or in mill tailings. Thus, although the grades are typically low, ranging from 0.002 – 0.08% U, the resources are easily and cheaply extractable, which makes their future exploitation more attractive.

As in South Africa, the Zambian uranium ores are usually associated with copper, but due to a combination of public opposition to the development of a uranium processing industry in the country, and the lack of a national policy framework for uranium mining, Zambia only started to issue new licences in early 2009.

In addition to the operating mines and uranium projects which are currently under development, as described above, there is extensive exploration being carried out throughout the continent: for example, Niger issued more than 100 exploration permits in the last 2 years and Botswana issued 138 exploration licences for nuclear fuels in the same period. On the other hand, although Namibia granted 66 Exclusive Prospecting Licences (EPLs) for nuclear fuels up until 2007, the Ministry of Mines and Energy (MME) put a moratorium on granting any more EPLs until a policy on uranium exploration and mining has been developed.

Regionally, Namibia appears to be popular amongst the exploration companies for a range of technical, financial and regulatory reasons. The ore bodies are all found on or close to the surface which allows open cast mining; while the ore grades are not as high as those found in Niger, they are high enough to make large-scale mining economically viable; the infrastructure, although stretched, is considerably better than that found in many other African countries; the mines are located close to a port facilitating the import of process chemicals and the export of yellow cake; and there is a relatively straight forward regulatory framework in place to manage and control uranium mining and all related impacts.

Negative factors however, include an inadequate supply of naturally-occurring water in the central Namib and desalinated sea water will be expensive; regional power shortages; crumbling road infrastructure (many of the roads in the area were not built to accommodate heavy vehicles); port congestion and delays; overburdened health and educational facilities in the local towns; and a shortage of skills and government structures which have limited capacity to cope with the uranium rush. Many of these constraints can be addressed through a combination of political will, policy coordination, competent governance, proactive planning and government spending.

4.2 Types of Uranium Deposits in Namibia

The uranium deposits in the Erongo region are mainly confined to the Central Zone of the Damara Belt. Two main types of deposits are found, namely the 'granite type' sheeted leucogranite / alaskite-hosted primary deposits and the 'calcrete type' superficial secondary deposits (Figure 4.1).

The predominant primary uranium mineral in the leucogranites is uraninite (UO_2), however, betafite might be a major phase in some places. Beta-uranophane is usually the dominant secondary mineral in these granites. These uraniferous leucogranites, known as alaskites, occur preferentially in and around anticlinal and dome structures along the Khan and Swakop River valleys to the east of Swakopmund.

Secondary uranium deposits are found in the calcretes which occur in the coastal plain of the Namib Desert. The main uranium-bearing mineral in the calcretes is carnotite, a bright yellow potassium-uranium vanadate mineral. These deposits are related to fluvial environments within palaeo-valleys of ancient rivers that flowed westwards from the Great Escarpment during the upper Cretaceous and the lower Cenozoic periods (88 to 25 Ma). The carnotite is usually found in calcretised fluvial channels as thin films in cracks, disseminations and as coatings on sediment grains, it also occurs along grain boundaries forming a cavity fill, and is best developed in regions of high porosity (LHU, 2009; Roesener and Schreuder 1992).

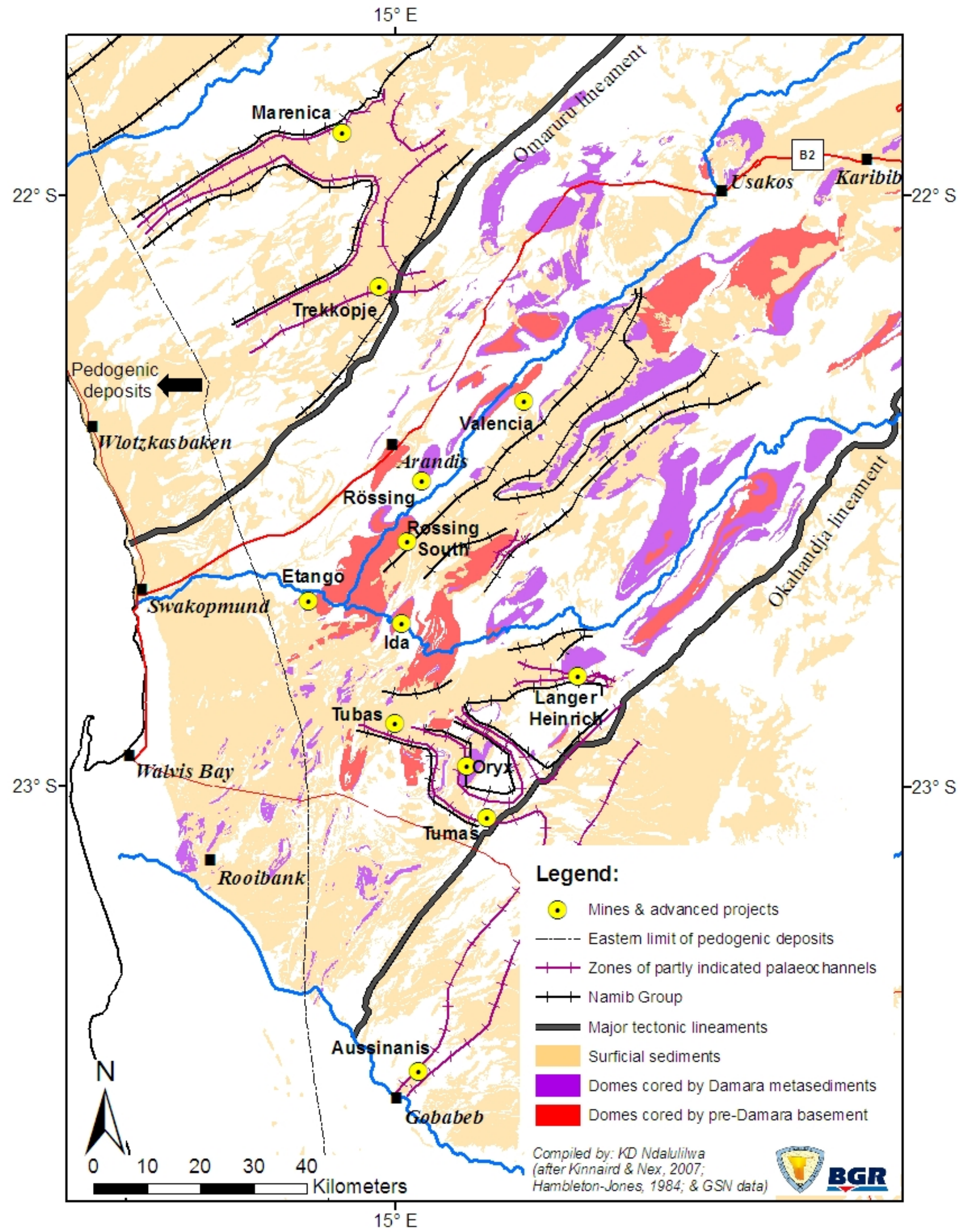


Figure 4.1: Part of the Central Zone of the Damara Belt showing domes and the location of the known uranium deposits (Geological Survey of Namibia, 2010).

4.3 History of Uranium Exploration and Mining in Namibia

Captain Peter Louw discovered radioactivity in the vicinity of the current Rössing mine in 1928. Anglo American Corporation subsequently carried out exploration in the area, but it was not until Rio Tinto acquired the exploration rights in the 1960s that a number of low-grade alaskite ore bodies were identified along the north side of the rugged Khan valley. After extensive test work, construction of the current Rössing mining plant and the development of the open pit started in 1974, with commissioning taking place in 1976 (Plate 4.1). Full production was only achieved in 1979 due to major teething problems in the plant.

Plate 4.1: Rössing, with almost 35 years of production, is the most established uranium mine in Namibia. In this photo, an ore truck passes under a scanner to determine the ore grade (photo Geological Survey).

Following the discovery of Rössing and the global increase in the demand for uranium for nuclear energy production during the 1960s and 1970s, several international mining companies actively started prospecting for uranium in Namibia e.g. Falconbridge and Elf-Aquitaine in addition to Rio Tinto. Furthermore, during the 1970s, the South African government had secretly embarked on the development of 6 atomic bombs under the guise of nuclear fuel enrichment. Thus there was significant interest in Namibia (then a South African Trust Territory) from South African mining companies to find primary sources of uranium to supplement the low-grade output from the South African gold mines. Thus companies such as Anglo American, General Mining and Gold Fields carried out extensive exploration for uranium in the central Namib up until the 1980s, but no new mines were ever developed. Thereafter the uranium price slowly declined and even the well-established Rössing Mine considered early closure several times during the 1990s and early 2000s (see Figure 3.2 in Chapter 3).

In addition to uranium, sporadic exploration and mining has been carried out in the central Namib for decades for a variety of minerals, notably gold, tin, copper, lead, zinc, fluorspar, tungsten, graphite, gypsum, lithium, semi-precious stones and dimension stone. Most of these mines were small and widely spread, both geographically and over time (Figure 4.2). Unfortunately, none of these mines was properly rehabilitated and evidence of mining in the form of tracks, debris, concrete plinths, excavations and waste rock dumps can still be seen today (Plate 4.2).

Plate 4.2: The Namib, like many other places in Namibia, carries debris and scars from mines that have long closed and now lie abandoned (photo Geological Survey).

4.3.1 Current mining activity in the Central Namib

Currently, there are three large mines in operation in the Erongo Region (Rössing Uranium Mine, Langer Heinrich Uranium and Navachab Gold Mine), and two uranium mines are under construction (Trekkopje and Valencia). In addition, there are nine licensed, small dimension stone operations throughout the region and artisanal mining operations are being carried out in the Spitzkoppe area targeting semi-precious stones (e.g. tourmaline, aquamarine, garnet, topaz and rose quartz). There are also two large salt works, one located north of Swakopmund and the other lies south of Walvis Bay, as well as six other smaller salt mining licence holders (Figure 4.2). The output, number of employees or contractors for the smaller mining operations in the region e.g. the gemstone and dimension stone mines, are unlikely to contribute significantly to the cumulative impacts of the Uranium Rush. However, the cumulative impact of their activities on the landscape and their contribution to the degradation of landscape quality is an important factor to be taken into consideration in this SEA.

The three large operating mines in the Erongo Region (Rössing, Langer Heinrich and Navachab) contribute a significant amount to the Namibian economy through employment, sub-contracting, wages and salaries and taxes (Table 4.2). The combined employment at these mines in 2008 of 1,834 represents almost 3.5% of the economically active working population of the Erongo region (based on 2001 census figures).

Research by Ashby (2009) at the Langer Heinrich mine found that the dependency ratio for workers:dependents on the mines is higher (1:4.3) than the average for the Erongo Region as determined in the 2001 census (1:3). Thus the number of dependents benefitting from employment at the 3 larger mines is approximately 7,886. The 2008 combined wages and salaries bill comes to N$453.3 million, but according to research work conducted at Langer Heinrich (Ashby, 2009), an average of N$919 of a worker's salary is remitted 'home' to the northern communal areas of Namibia. Even so, approximately N$451.6 million is spent in the Erongo Region per year. From these 3 mines alone, the Namibian government collected N$876.4 million in taxes and/or royalties in 2008 and the mines had a collective annual turnover of N$5,635 million (2008).

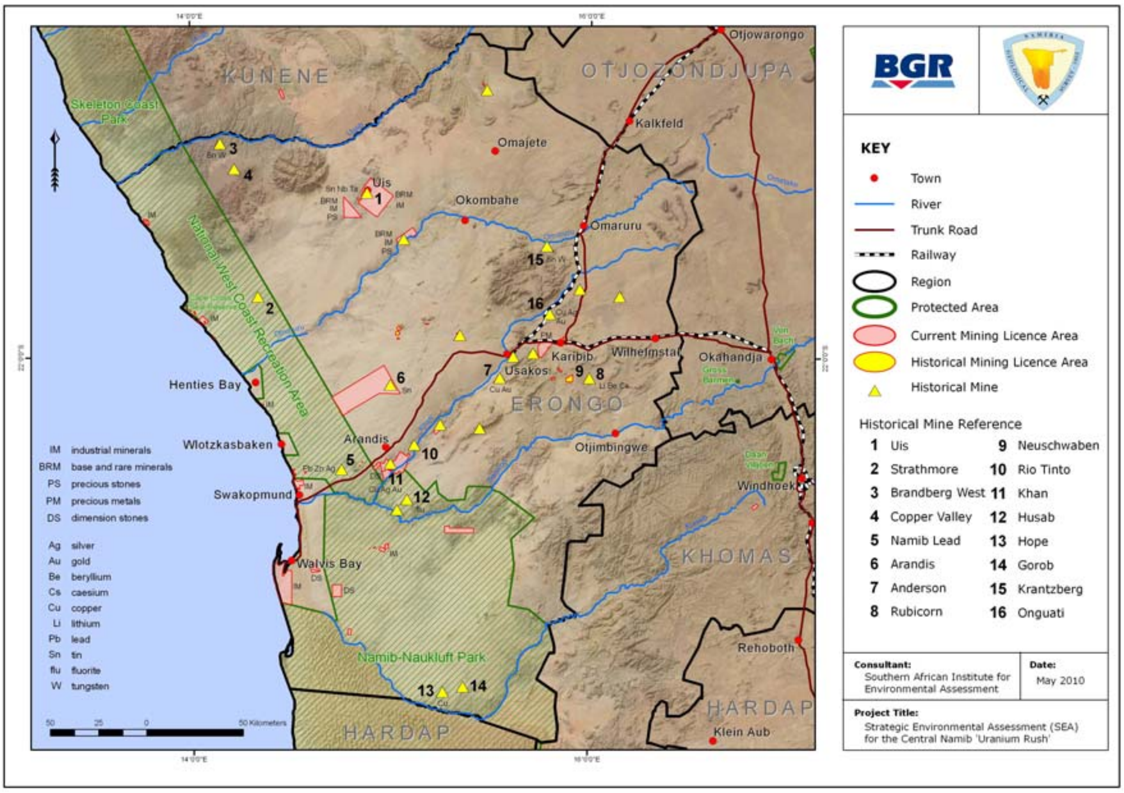


Figure 4.2: Current Mining Licences and Historical Mines in the Erongo Region

The two operating uranium mines produced a total of 4,843 t (10.7 Mlbs) of U_30_8 in 2008, elevating Namibia from the world's fifth to fourth largest producer (see Table 3.2). A target of 5,180 t (±11.6 Mlbs) U_3O_8 is expected in 2009 as Langer Heinrich ramps up production.

Table 4.2: Key statistics for the three large mines currently in operation in the Erongo Region for 2008

Name of mine	Owner	Start date	Projected closure date	Product output*	No of employees*	No of sub-contractors	Turn-over mill N$	Wages and salaries mill N$	Royalties and/or taxes mill N$
ML28: Rössing Uranium Mine	Rössing Uranium Ltd	1976	2020	4,067 t or >9 Mlbs of U_3O_8	1,307	1,154	4,492	319.4	786.9
ML140: Langer Heinrich	Langer Heinrich Uranium Ltd (Paladin Energy)	2006	2024	776 t or 1.7 Mlbs of U_3O_8	167	415	713	50.7	16.8
Sub-total Uranium mines				*4,843 t or >10.7 Mlbs*	*1,474*	*1,569*	*5,205*	*370.1*	*803.7*
ML31: Navachab	Anglogold Namibia (Pty) Ltd	1989	2016	2,126 kg gold	360	138	430	83.2	72.7
TOTAL				-	**1,834**	**1,707**	**5,635**	**453.3**	**876.4**

* 2008 figures as reported in the Chamber of Mines 2008 Review

A brief overview of the three large operating mines and the two uranium mines currently under construction is given below.

4.3.1.1 Rössing Uranium Ltd

Rössing Uranium Ltd (RUL) mines uranium ore from 500 million year old granitic rock in the Namib desert about 70km north-east of Swakopmund (Figure 4.2). The mining licence covers an area of 18 km^2 and the ancillary works area covers a further 5.95 km^2 giving a total mine footprint of 23.95 km^2 (Plate 4.3) (Rössing Annual Report, 2007). Uranium occurs in very low concentrations at Rössing (0.03% uranium) and therefore the mine has to operate on large tonnages. The open pit measures 3 km long, by 1.2 km wide and 345 m deep. In 2008, Rössing produced more than 9 Mlbs of uranium oxide (U_3O_8), which comprises about 7.7% of the world's production of primary produced uranium (www.rössing.com). The uranium ore requires a sulphuric acid leach process to liberate the uranium from the host rock. In 2008, Rössing employed 1,307 people and had 1,154 sub-contractors working at the mine (Chamber of Mines 2008 Review).

During 2006, exploration began on known uranium occurrences within the mining licence area, with particular emphasis on the area known as SK, lying directly to the east of the current open pit. Development of the SK ore body and/or extending the existing pit could extend mine life to at least 2026 at the current level of production.


Plate 4.3: Aerial views of Rössing mine and part of the Rössing plant. Much of the total footprint of 24 km^2 is taken up by waste rock dumps (photo SAIEA and Rössing).

4.3.1.2 Langer Heinrich Uranium (Pty) Ltd

The Langer Heinrich Uranium Mine (LHU) is located some 80 km east of Walvis Bay and Swakopmund (Figure 4.3). Uranium mineralisation at Langer Heinrich is associated with the calcretisation of valley-fill fluvial sediments in an extensive palaeo-drainage system. The Cenozoic uranium mineralisation occurs as carnotite. The deposit occurs over a 15 km length in seven higher grade areas within a lower grade mineralised envelope. Mineralisation is near surface, between 1 to 30 m thick and is 50 to 1,100 m wide depending on the width of the palaeo-valley.

Site works began in September 2005 and the first commercial product shipment occurred in December 2006; Langer Heinrich thus became the second operating uranium mine in Namibia. The uranium is liberated using a tank-based alkaline leach process followed by an ion exchange process and roasting to produce the final U_3O_8 product.

Work is now nearing completion on the Stage II Expansion which will lift production from 1.7 Mlbs/a to 3.7 Mlbs/a. On 30 June 2009, Paladin announced Board approval of the Stage III Expansion, which will increase production to 5.2 Mlbs/a U_3O_8. The original target was 6 Mlbs/a, but uncertainties and likely delays in the construction and commissioning of the NamWater desalination plant has necessitated this reduction in the production target.

A fourth expansion is also planned, which will allow the mine to produce about 10 Mlbs/a U_3O_8 by 2014. This would require the installation of a second water pipeline and an upgrade to the existing power supply line (www.wise-uranium.org).

In 2008, Langer Heinrich employed 167 people and 415 subcontractors (Chamber of Mines 2008 Review).

4.3.1.3 Navachab Gold Mine

Navachab Gold Mine is located 170 km north-west of Windhoek, 10 km south-west of Karibib and 135 km north-east of Swakopmund (Figure 4.2). It is wholly owned by Anglo Gold Ashanti Namibia. Production commenced in 1989 on ML31, with a life of mine to 2016. However ongoing drilling programmes and a feasibility study into extending the pit and constructing a new DMS plant has extended the life of mine to at least 2023. Gold is found in replacement skarn and sheeted quartz veins in the Damaran Orogenic Belt. Ore is mined from an open pit and treated in a typical cyanide leach plant (Plate 4.5). Production in 2008 totalled 2,126 kg of gold bullion (68,000 oz), slightly down on the 2007 total of 2,496 kg. The Navachab Mine employed 360 people in 2008 and 138 sub-contractors (Chamber of Mines 2008 Review).

Plate 4.4: Navachab Gold Mine open pit (photo Geological Survey).

4.3.1.4 Trekkopje Uranium Mine

The Trekkopje deposit owned by Areva Resources Namibia, located some 70 km north-east of Swakopmund (Figure 4.3), is a shallow, high tonnage, low grade uranium deposit hosted by calcretised palaeo-channels. The main mineralisation covers an area of approximately 16 km by 4 km. Trekkopje will be a shallow, open pit mining operation using conventional truck and shovel methods with limited drilling and blasting. Proven reserves have been estimated at over 300 Mt U_3O_8 at an average grade of 150 ppm (Uramin, May 2007), yielding an estimated 8.5 Mlbs of uranium oxide per annum. At full production, the Trekkopje Mine will be processing 100,000 tonnes of crushed ore per day, based on the stripping ratio of 1:15.

The process route for the Trekkopje ore is via an alkaline heap leach process. Commissioning of a pilot plant commenced in July 2008 and full production is anticipated to commence in 2011 with a life of mine initially estimated to be 11-12 years. Currently Areva Resources Namibia employs 140 people, but it is expected that approximately 320 more jobs will be filled by the end of June 2010 (www.cogema.fr).

The Trekkopje mine is currently under construction, as shown in Plate 4.5.

Plate 4.5: Trekkopje mini heap leach pad and storage tanks for the 'pregnant leach', during early trial stages of the mine design and construction in 2008 (photo Geological Survey).

3.3.1.4 Valencia Uranium (Pty) Limited

Valencia Uranium (Pty) Limited, a wholly owned subsidiary of Forsys Metals Corporation listed on both the Canadian and Namibian Stock Exchanges, is currently finalising the definition of the open pit of the Valencia Uranium Mine (Plate 4.6). The site for the proposed mine is located on the privately owned farm Valencia (No. 122), approximately 80 km inland from Swakopmund, 25 km from Rössing Uranium Mine and 50 km south-west of Usakos (Figure 4.3). The Mining Licence (ML149) was granted in August 2008 and is valid for 25 years.

The proposed Valencia Uranium Mine will utilise traditional surface mining techniques of drilling and blasting in an open pit to extract the low grade alaskite uranium ore. Most probably the pit will develop to a maximum size of approximately 1,400 m long, 700 m wide and 360 m deep. The preliminary geotechnical surveys and pit design work at Valencia Uranium have defined a probable reserve of 117 Mt of ore (at an average grade of 125 ppm) and 122.4 million tonnes of waste rock (Snowden, 2007). Haul trucks of 150 t will typically be used to haul waste rock to spoil sites and ore to the crusher. The operation will have a run of mine (RoM) capacity of one million tonnes per month with a life of mine of only 9 years, based on proven resources (Digby Wells and Associates, 2008). Construction is currently on hold pending funding and so the earliest date of commissioning is now expected to be in 2012.

Plate 4.6: Percussion drilling samples during definition of the proposed pit of Valencia mine (photo Geological Survey).

4.3.2 Current exploration activity in the central Namib

In terms of exploration activity, the database of the Ministry of Mines and Energy (MME) lists a total of 78 exclusive prospecting licences (EPLs) for nuclear fuels in Namibia. Of these, there are 33 current EPLs in the central Namib and 3 applications are pending renewal (Figure 4.4). A further six EPL application decisions are pending, but as mentioned earlier, no new EPLs have been granted by MME since 2007. The companies with the most advanced projects are described briefly below.

4.3.2.1 Bannerman Resources Ltd

Bannerman Resources Ltd is an Australian company, listed on both the Namibian and Australian stock exchanges. The company has interests in two key properties in Namibia: their principal and most significant asset is their 80% interest in the Etango Project (EPL 3345) situated on the south bank of the Swakop River near Goanikontes (Figure 4.5); and the second prospect is EPL3346, known as Swakop River, which is located at Bloedkoppie east of Langer Heinrich mine (Figure 4.4).

Bannerman is currently focused on accelerating the feasibility study on the Etango Project. This EPL measures 500 km^2 and is located some 35 km east of Swakopmund in an area known in the tourist trade as the 'Moon Landscape'. The EPL contains 8 prospects, known as: Anomaly A, Ompo, Oshiveli, Onkelo, Ombepo, Anomaly B, Rössingberg, and Ombuga. Drilling is being conducted on most of these prospects, but sufficient work has been done on Anomaly A, Oshiveli and Onkelo to allow a preliminary feasibility study to be undertaken. As of February 2009, the total resource from Anomaly A and Oshiveli was estimated to be 126.6 Mlbs U_3O_8, with an indicated JORC Code[1] resource of 195.5 Mt grading at 207 ppm (89.2 Mlbs of metal) and an inferred resource of 87 Mt at 195 ppm U_3O_8 (37.4 Mlbs of metal). Drilling is continuing on the Oshiveli, Onkelo, Rössingberg and Ombuga prospects, but more drilling is planned for Anomaly A to define the resource at depth and along strike to the north and south, where indications are promising.

The uranium throughout this prospect is found in alaskites, similar to those found at Rössing. The mineralisation is also low grade and therefore the development of this prospect is likely to be a large tonnage operation similar to Rössing. Several process route options are being considered: an acid leach, heap leaching and flotation. The pre-feasibility study was completed by December 2009, and the Bankable Feasibility Study was completed by mid 2010. Projected mine commissioning is in 2013 and a mining licence has been applied for.

[1] The Australasian Joint Ore Reserves Committee (JORC) is sponsored by the Australian mining industry and its professional organisations. The Code for Reporting of Mineral Resources and Ore Reserves (the JORC Code) is widely accepted as a standard for professional reporting purposes. It was first published in 1989, with the latest revised version being published late in 2004. Since 1989 and 1992 respectively, it has been incorporated in the Listing Rules of the Australian and New Zealand Stock Exchanges, making compliance mandatory for listing public companies in Australia and New Zealand (www.jorc.com).

4.3.2.2 Extract Resources

Extract Resources is an Australian and Toronto Stock Exchange listed uranium exploration company, whose primary interest is in Namibia. Rössing Uranium Ltd holds almost 20% of the shares. The Company's principal asset is its 100% owned Husab Uranium Project which contains two known uranium Prospects: Rössing South and Ida Dome (Figures 4.4 and 4.5) (www.extractresources.com). The Rössing South deposit (EPL 3138) is interpreted as being an extension of the same stratigraphy that hosts the Rössing mine, and striking from Rössing mine 15 km onto the Husab Project, buried under some 30 m of desert sands.

The Rössing South deposit was initially drilled in 2007 and chemical assay results in February 2008 confirmed the discovery. By February 2009, Zone 1 of the deposit was found to contain an initial resource of 108 Mlbs at 430 ppm U_3O_8 and Zone 2 was expected to show 69-106 Mlbs U_3O_8.

Additional zones of high grade alaskite confirm that Rössing South is the highest grade, granite-hosted uranium deposit in Namibia and possibly one of the largest deposits in the world (Extract Resources, February 2010).

4.3.2.3 Reptile Uranium Ltd

Probably the next most advanced project in terms of resource definition and effort is that of Reptile Uranium Namibia (Pty) Ltd (RUN). RUN is a wholly owned subsidiary of Deep Yellow Ltd, an Australian and Namibian stock exchange listed company. It is interesting to note that Paladin Energy Ltd owns a 19.29% stake of Deep Yellow and therefore future linkages with the Langer Heinrich operating uranium mining project are possible.

RUN holds 100% of four contiguous Exclusive Prospecting Licences (EPLs) covering 2,681 km^2 and three additional adjoining EPLs covering 1,323 km^2 where it is earning 65% in JV with Nova Energy Namibia. The areas contain historical discoveries of gypcrete, calcrete and sand-hosted secondary uranium mineralisation. Exploration by RUN has increased the extent of these and also delineated new areas of primary alaskite hosted and skarn hosted uranium (and iron) mineralisation.

The deposit types, processing and products (roughly in order of development) can be summarised as follows:

- Inca uraniferous magnetite - primary mineralisation in hardrock; requires drill and blast and crushing/milling followed by processing in an acid plant. Products uranium and iron.

- Tubas Red Sand - secondary uranium mineralisation in free-digging and milling sand and gravel, with processing in an acid or alkali plant. Products uranium and vanadium.

  Together these two prospects are known as the **Omahola Project** with a projected annual U_3O_8 production of 2-3 Mlbs, with about 2-3 Mlbs of vanadium and 100,000-300,000 tonnes of iron as by-products.

- M62 Iron Project was discovered from airborne magnetic surveys and subsequent limited RC drilling and diamond drilling to 500 metre depths indicated that it may be a substantial source of magnetite/iron. Beneficiation tests as part of a scoping study are being undertaken and given that it is located between 25 and 30 km from Walvis Bay it may be economically viable to export.

- The Eastern palaeo-channels comprising Tumas, S-Bend, Oryx and Tubas contain secondary uranium mineralisation in free-digging and milling sand and gravel, or in cases where the material is too well cemented, drilling and blasting will be required. This would be followed by crushing/milling and processing in an alkali plant. From interpretation of airborne electromagnetic (AEM) surveys, the Tumas - Tubas palaeo-channel system can now be traced for a cumulative total of 80 km of which only about 15 km has been investigated in detail by drilling; an additional 35 km by previous explorers and/or RUN and 30 km remain untested. Products include uranium and vanadium.

- Aussinanis and Ripnes sheet-wash areas contain secondary uranium mineralisation in free-digging and milling sand and gravel, or in cases where the material is too well cemented, drilling and blasting will be required. This would be followed by and crushing/milling and processing in an alkali plant. Products include: uranium (between 1.5 and 2 Mlbs of U_3O_8 per annum) and vanadium (between 2-3 Mlbs/a).

4.3.2.4 Others

Other than the companies discussed above, the following companies currently hold EPLs for uranium in the Central Namib (see Figure 4.4 for locations):

Australian Companies:

Erongo Energy Ltd (EPLs 3453, 3454, 3477)

West Australian Metals (formerly Marenica Minerals) (EPL 3287)

Toro Energy Ltd (formerly Nova Energy) (now in a JV with Deep Yellow (Reptile) (EPLs 3668, 3669, 3670)

Swakop Uranium (owned by Extract Resources) (EPLs 3138, 3439, 3327, 3328)

Green Mineral Resources (70% owned by Africa Uranium and 30% Basters Foundation) (EPL 3664).

Canadian Companies:

Cheetah Minerals (owned by Manica, which is 51% owned by Pitchstone Exploration) (EPLs 3516, 3517, 3518)

Xemplar Energy Corp (formerly Namura) (EPLs 3569, 3570, 3571)

Dunefield Mining (owned by Forsys) (EPLs 3635, 3636, 3632, 3637, 3638)

Russian Companies

SWA Uranium Mines (owned by Arlan 75% and VTB Capital 25% with Atomredmetzoloto) (EPLs 3850, 3851)

Chinese Companies

Zhonghe Resources Namibia (EPLs 3600, 3602)

British Virgin Islands

Petunia Investments 3 (100% owned by Barlow Holdings Ltd) (EPL 3780).

Most of these companies are at the early stages of exploration, conducting airborne and ground radiometric surveys, geological mapping, radon surveys and reconnaissance drilling with variable effort. West Australian Metals is probably the most advanced, since they have recently started diamond drilling on their Marenica prospect, south-west of Klein Spitzkoppe.

There is a reasonable expectation that some of these exploration projects may actually be converted into operating mines, but there is considerable uncertainty as to which ones, how many and when. However, based on current information we have been able to build four possible development scenarios, as described in section 4.5 below.

Figure 4.3: Scenario 1 mines

Figure 4.4: Uranium EPLs in the Erongo Region

Figure 4.5: Scenario 2: Probable additional mines in yellow

4.4 Overview of Associated Industrial Developments

There are a number of industrial developments that are being built or planned to support the Uranium Rush. It is unlikely that these developments would have taken place in the absence of the uranium mines and so they are considered as part of the direct cumulative impacts of the Uranium Rush

4.4.1 Walvis Bay Power Station

In view of the expected increase in demand for electricity at the coast due to the uranium rush and other coastal developments, combined with the current electricity shortage within the SADC region as a whole, NamPower has recently investigated a number of new supply options. There are two possible alternatives to supply base load power on a long-term basis in the Erongo Region: generation of power by an Independent Power Producer from Compressed Natural Gas (CNG) imported to Walvis Bay from the Kudu Gas Field; and a coal-fired power station at Walvis Bay. NamPower has conducted several investigations into the coal-fired power station option, looking at several different locations and sizes. For the sake of scenario planning for this SEA, we have assumed that a 200 MW station would be sufficient to meet the demands of Scenario 1 mines; a 400 MW station would be needed for Scenario 2 and an 800 MW station would be required for Scenario 3 (see section 7.5).

4.4.2 Desalination Plants

Areva Resources Namibia has commissioned a desalination plant at Wlotzkasbaken, approximately 30km north of Swakopmund - a first for Southern Africa – that supplies sufficient water to support the mining operations at Trekkopje Mine, approximately 40 km inland. The plant has the capacity to produce 20 Mm^3/a of potable water. State-of-the-art technology was introduced which entails screen filtration, ultra filtration, reversed osmosis and chemical treatment.

NamWater is also investigating the possibility of constructing a desalination plant near Mile 6 on the northern outskirts of the Swakopmund municipal area. The plant is expected to be commissioned in 2012 and will have a capacity to produce 25 Mm^3/a of potable water. This water will be expensive but the water will be allocated to all the existing and future mines.

The Trekkopje desalination plant was designed and built to accommodate a second intake pipeline and space for modular extensions to the plant in anticipation that NamWater would ‘share’ the facility. Unfortunately, NamWater has pulled out of negotiations with Areva for various reasons and is still pursuing its own desalination plant at Mile 6. All the proposed new mines, except Trekkopje are dependent on being supplied with water by NamWater, but there are insufficient freshwater resources available. Thus the development of these mines is completely dependent on Namwater completing the construction of its desalination plant before they can start full operations.

Since Valencia, Etango and Rössing South plan to start production in 2012/2013, there is not much time left to build a new desalination plant (see section 7.4). From a strategic perspective, where one of the goals of this SEA is to minimise the footprint of all developments and to optimise the use of facilities, and given that water supply is on the critical path, it is strongly recommended that NamWater re-considers the joint use of the Wlotzkasbaken desalination plant.

4.4.3 Gecko Mining and Chemicals

The Gecko Group envisages a substantial investment in Namibia that, to a large extent, is directly linked to the central Namib Uranium Rush. The project in its entirety encompasses several different mines for a variety of minerals throughout Namibia and in its territorial waters, several factories for the manufacture of chemicals, loading and offloading facilities at the Port of Walvis Bay, the transportation of raw materials and products, and all associated infrastructure such as power, water, access roads etc.

The primary products proposed to be supplied to the uranium mines comprise:

- Sulphuric acid from a 3,600 t/d acid plant near Swakopmund using imported sulphur prills;
- 150,000 tpa soda ash and 175,000 tpa bicarbonate from a soda ash plant near Swakopmund using salt mined near Cape Cross; and
- Caustic soda from a plant to be built at Arandis using soda ash mined at Otjivalunda as the input.

The support industries described above (power station, desalination plants and chemical plants) will require power, water, import/export facilities, rail and road transportation routes, and skilled and unskilled labour. They will also contribute to air pollution, noise, dust, waste and traffic. Thus they will collectively add to the cumulative impacts of the uranium mines and will largely be competing for the same limited resources and services. It is for this reason that we have included these industries in the scenarios set out below.

4.5 Uranium Rush Mining Scenarios

From the analysis of the forces and dynamics of the Uranium Rush presented in Chapter 3, we may assume that the main short- to medium-term drivers behind the uranium rush, (namely concerns about uranium supply security due to diminishing secondary uranium supplies and typically long lead times involved in expanding primary uranium production capacity), are unlikely to go away over the next 10-15 years. It is also reasonable to assume that the rate at which new uranium production capacity is brought on stream in Namibia by 2020 will depend primarily on how fast each individual project manages to make progress towards getting the feasibility study and environmental impact assessment completed and approved, obtaining a mining licence and commencing mining operations. This, in turn, will depend on a range of project-specific factors including the attractiveness of the project, the seriousness of the investor, the quality of project management, the degree to which the project manages to establish good working relations with and be accepted by local stakeholders, etc.

Thus bearing in mind the global forces and from an analysis of the current mining and prospecting situation, we have developed four possible scenarios for the purposes of this SEA. The scenarios are not restricted to the number of uranium mines, but rather a more holistic picture of development has been described for the Erongo Region, including other large-scale mines and mining-related industrial developments.

<u>Scenario 1: 'Below-expectations'</u> (1-4 mines operating by 2020)

In addition to the two uranium mines already in operation, the two other projects which have received their Mining Licences, Trekkopje and Valencia, will commence operation in 2010-12, but no further mines will be started up before 2020. Under this scenario, it is also assumed that some of the planned mine expansions will not take place during the forecast period due to depressed uranium prices. The uranium mines in Scenario 1 are shown on Figure 4.3 and include:

- Rössing
- Langer Heinrich (Stages I and II only)
- Trekkopje
- Valencia

In addition, cognisance needs to be given to the other large mining projects in the area, which under this scenario is only Navachab Gold Mine. With regard to other related industrial developments directly linked to the Uranium Rush, the projects already under construction or most likely to proceed will include:

- Trekkopje desalination plant; and
- 200 MW coal-fired power station at Walvis Bay.

In this scenario, it is unlikely that the NamWater desalination plant would be built, nor would it be economic for Gecko to develop its mining and chemical plant.

Under Scenario 1, the joint production of Rössing, Langer Heinrich, Trekkopje and Valencia will keep output at about 23-25 Mlbs/a U_3O_8 up to 2020 and beyond (see Table 4.3 and Figure 4.6). Direct employment in the region will reach about 4,000 during the period 2011-12, boosted by the construction phases of Trekkopje, Valencia, and the power station, but it will reduce to less than 3,500 for the rest of the period (Table 4.4 and Figure 4.7).

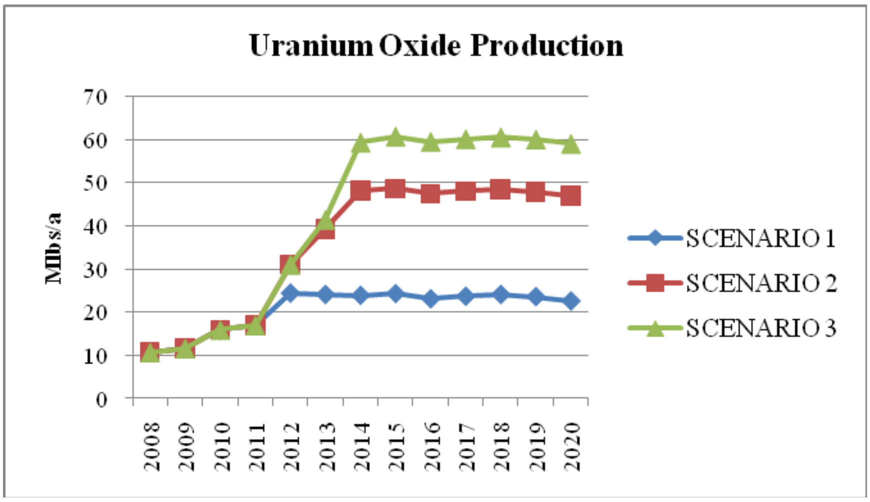


Figure 4.6: Uranium production per scenario over time

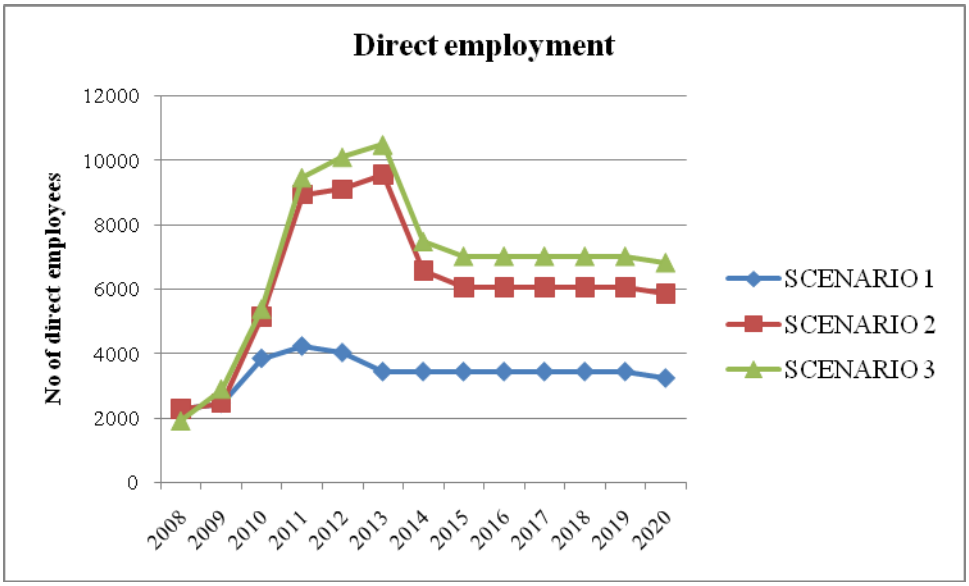


Figure 4.7: Direct employment arising from construction and operation of uranium mines and associated industries per scenario over time

<u>Scenario 2: 'In-line-with-expectations'</u> (5-7 mines operating by 2020)

In addition to the 4 mines with Mining Licences identified under Scenario 1, one or two more companies will successfully bring their mines on stream by 2013. It is also assumed that uranium prices will be buoyant and that the existing mines will press ahead with their significant expansion projects. The mines and expansions under this scenario are shown on Figure 4.5 and include:

- Rössing plus expansion
- Langer Heinrich (Stages I, II and III only)
- Trekkopje
- Valencia
- Rössing South (Husab Project)
- Etango project.

Under this medium growth scenario, it is possible that only one more non-uranium mine (e.g. Kalahari Minerals' re-commissioning of the Namib Lead mine) may be developed in the Erongo region by 2020 in addition to the existing Navachab Gold Mine.

Under Scenario 2, there is a strong possibility that several of the related industrial developments will be commissioned to meet the increased needs from the uranium mines. The envisaged projects will or might include:

- Trekkopje desalination plant;
- NamWater desalination plant;

- 400 MW coal-fired or CNG power station at Walvis Bay;
- Gecko Mining and Chemicals operations.

From Table 4.3 and Figure 4.6, it can be seen that there will be a significant increase in uranium oxide production from 2012, when Langer Heinrich implements its Stage III expansion. Uranium oxide output is expected to peak at over 48 Mlbs/a in 2014, when all 6 mines are at full production. This will drop off slightly if Valencia does not extend its current mine life beyond 2020, to around 47 Mlbs/a U_3O_8 (see Table 4.3 and Figure 4.6).

Under Scenario 2, there will be a massive demand for employment from 2010 (>5,000), rising to around 9,000 in the period 2011-13, due to the simultaneous construction of 4 mines, a power station, the NamWater desalination plant, the Walvis Bay power station and the Gecko Chemicals plants. This number will decrease once these facilities are in operation to around 6,100 (Figure 4.7 and Table 4.4). Compared to the 2008 direct employment figure in the uranium mining industry in the central Namib of some 1,834, these numbers represent a significant increase. It should also be noted that many other jobs will be created in a range of service industries and other sectors e.g. the Port of Walvis Bay, housing construction, banking, schools, clinics, shops etc. If a multiplier of 8 is assumed[2], the total number of new jobs generated in the economy could be much higher, possibly in the order of 48,000.

Scenario 3: 'Above-expectations' (8-12 mines operating by 2020)

In addition to mines which may be operating by 2015 (as per Scenario 2), at least two more companies may be successful in bringing their uranium deposits into production before 2020 and the existing mines will increase production from expansion projects. It is not clear at this point which of the current EPLs might be developed into a mine before 2020, but at present, the most likely combination is shown on Figure 4.8 and includes:

- Rössing plus expansion
- Langer Heinrich (Stages I-IV)
- Trekkopje and extensions
- Valencia and extensions
- Rössing South (Husab Project)
- Etango project
- Omahola Project (Inca and Tubas Red Sand)
- Marenica.
- Other developments on Reptile EPLs.

[2] Gerrie Muller (Metago), pers comm.

Table 4.3: Cumulative uranium oxide production in million pounds per annum per scenario over time

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SCENARIO 1	**10.7**	**11.6**	**15.9**	**17**	**24.4**	**24.1**	**23.9**	**24.3**	**23.1**	**23.7**	**24.1**	**23.6**	**22.6**
Rössing Uranium Ltd	9	9	9	9	9	9	9	9	9	9	9	9	9
Langer Heinrich (Stage I & II)	1.7	2.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Trekkopje	0	0	3.3	4.4	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Valencia	0	0	0	0	3.3	3	2.8	3.2	2	2.6	3	2.5	1.5
SCENARIO 2	**10.7**	**11.6**	**15.9**	**17**	**31**	**39.2**	**48.2**	**48.6**	**47.4**	**48**	**48.4**	**47.9**	**46.9**
Rössing plus expansion	9	9	9	9	10	11	11	11	11	11	11	11	11
Langer Heinrich (Stages I, II & III)	1.7	2.6	3.6	3.6	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Trekkopje	0	0	3.3	4.4	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Valencia	0	0	0	0	3.3	3	2.8	3.2	2	2.6	3	2.5	1.5
Etango	0	0	0	0	4	4	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Rössing South (Husab) (Zones 1 & 2)	0	0	0	0	0	7.5	15	15	15	15	15	15	15
SCENARIO 3	**10.7**	**11.6**	**15.9**	**17**	**31**	**41.4**	**59.3**	**60.7**	**59.5**	**60.1**	**60.5**	**60**	**59**
Rössing plus expansion	9	9	9	9	10	11	11	11	11	11	11	11	11
Langer Heinrich (Stages I to IV)	1.7	2.6	3.6	3.6	5.2	5.2	10	10	10	10	10	10	10
Trekkopje	0	0	3.3	4.4	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Valencia	0	0	0	0	3.3	3	2.8	3.2	2	2.6	3	2.5	1.5
Etango	0	0	0	0	4	4	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Rössing South (Husab) (Zones 1 & 2)	0	0	0	0	0	7.5	15	15	15	15	15	15	15
Omahola Project	0	0	0	0	0	2.2	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Marenica	0	0	0	0	0	0	3	4	4	4	4	4	4

Table 4.4: Direct employment from the uranium mines and associated industries per scenario over time

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SCENARIO 1	**2274**	**2460**	**3852**	**4232**	**4032**	**3442**	**3442**	**3442**	**3442**	**3442**	**3442**	**3442**	**3242**
Rössing Uranium Ltd	1307	1300	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
Langer Heinrich (Stage I & II)	167	360	432	432	432	432	432	432	432	432	432	432	432
Trekkopje	*140*	*140*	460	460	460	460	460	460	460	460	460	460	460
Valencia	0	0	*800*	*800*	600	600	600	600	600	600	600	600	400
Navachab	360	360	360	360	360	360	360	360	360	360	360	360	360
Trekkopje Desalination plant	*300*	*300*	*300*	30	30	30	30	30	30	30	30	30	30
200 MW power station	0	0	0	*650*	*650*	60	60	60	60	60	60	60	60
SCENARIO 2	**2274**	**2460**	**5152**	**8932**	**9097**	**9563**	**6563**	**6063**	**6063**	**6063**	**6063**	**6063**	**5863**
Rössing plus expansion	1307	1300	1500	1500	1600	1600	1600	1600	1600	1600	1600	1600	1600
Langer Heinrich (Stages I, II & III)	167	360	432	432	522	522	522	522	522	522	522	522	522
Trekkopje	*140*	*140*	460	460	460	460	460	460	460	460	460	460	460
Valencia	0	0	*800*	*800*	600	600	600	600	600	600	600	600	400
Etango	0	0	*1000*	*1000*	500	500	500	500	500	500	500	500	500
Rössing South (Husab) (Zones 1 & 2)	0	0	0	*1500*	*1500*	1000	1000	1000	1000	1000	1000	1000	1000
Navachab	360	360	360	360	360	360	360	360	360	360	360	360	360
Namib Lead mine	0	0	0	*800*	*800*	300	300	300	300	300	300	300	300
Trekkopje desalination plant	*300*	*300*	*300*	30	30	30	30	30	30	30	30	30	30
NamWater desalination plant	0	0	*300*	*300*	30	30	30	30	30	30	30	30	30
400 MW power station	0	0	0	*650*	*650*	116	116	116	116	116	116	116	116
Gecko Chemicals plant	0	0	0	*1000*	*2000*	*4000*	*1000*	500	500	500	500	500	500
Gecko caustic plant	0	0	0	*100*	45	45	45	45	45	45	45	45	45
SCENARIO 3	**1914**	**2900**	**5392**	**9472**	**10107**	**10491**	**7491**	**7031**	**7031**	**7031**	**7031**	**7031**	**6831**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Rössing plus expansion	1307	1300	1500	1500	1600	1600	1600	1600	1600	1600	1600	1600	1600
Langer Heinrich (Stages I to IV)	167	360	432	432	522	522	522	522	522	522	522	522	522
Trekkopje	*140*	*140*	460	460	460	460	460	500	500	500	500	500	500
Valencia	0	0	*800*	*800*	600	600	600	600	600	600	600	600	400
Etango	0	0	*800*	*800*	500	500	500	500	500	500	500	500	500
Rössing South (Husab) (Zones 1 & 2)	0	0	0	*1500*	*1500*	1000	1000	1000	1000	1000	1000	1000	1000
Omahola Project and M62 Iron ore	0	0	0	*800*	*800*	600	600	600	600	600	600	600	600
Marenica	0	0	0	*800*	*800*	600	600	600	600	600	600	600	600
Namib Lead mine		*800*	*800*	300	300	300	300	300	300	300	300	300	300
Trekkopje desalination plant	*300*	*300*	*300*	30	30	30	30	30	30	30	30	30	30
NamWater desalination plant	0	0	*300*	*300*	300	30	30	30	30	30	30	30	30
800 MW power station	0	0	0	*650*	*650*	204	204	204	204	204	204	204	204
Gecko Chemicals plant	0	0	0	*1000*	*2000*	*4000*	*1000*	500	500	500	500	500	500
Gecko caustic plant	0	0	*0*	*100*	45	45	45	45	45	45	45	45	45

Numbers in *italics* indicate construction employment

The increase in projects in Scenario 3 does not necessarily mean that there will be a concomitant increase in the number of processing plants because it is likely that the existing mines will seek ore body extensions (e.g. Langer Heinrich, Rössing, Trekkopje) and use their existing plants to process the ore. Furthermore, synergies could be established between say Trekkopje and Marenica as well as Reptile and Langer Heinrich, where the same type of ore might be toll processed at the existing plant, or where companies may form mergers and acquisitions to capitalise on economies of scale.

Under Scenario 3, it is assumed that the world will have recovered from the economic recession faster than predicted and that metals prices will be rising. It is possible therefore that in addition to the existing Navachab Mine and the likely development of the Namib Lead mine by Kalahari Minerals, another mine could be developed by 2020 (e.g. Kalahari Minerals' Ubib copper-gold project near Navachab, or Reptile's M62 iron ore project near the Omahola Project).

Under Scenario 3, the proposed (or actual) associated industrial developments will be essential to meet the increased needs from the uranium mines and other developments. The existing and envisaged projects will include:

- Trekkopje desalination plant;
- NamWater desalination plant;
- 800 MW coal-fired or CNG power station at Walvis Bay;
- Gecko Mining and Chemicals operations.

Under this scenario, there will be a period from 2015-2019 when there will be 8 mines in production, with an output of about 60 Mlbs/a U_3O_8 being attained (see Table 4.3 and Figure 4.6). Even considering a rapid increase in demand for uranium, it is unlikely that the market could sustain such an output and as a consequence there may well be an oversupply. This might trigger a drop in prices and more marginal (low-grade) mines may face closure as a result, or new deposits may not be developed. The ability of the market to absorb production may well be the main regulating force determining how many mines can be sustainable at a given time in Namibia.

Under Scenario 3, employment will peak at over 9,000 for the main three year construction period (2011-2013), thereafter it will stabilise at around 7,000, reflecting the full operation of 8 mines, 2 desalination plants, an 800 MW power station and 3 chemical plants. Although employment may drop off slightly after 2019, it will remain high (>6,000) for the foreseeable future (Figure 4.7 and Table 4.4).

Figure 4.8: Scenario 3 mines

<u>Scenario 4: "Boom-bust" scenario</u> (5-12 mines operating and then shutting down in a hurried, unplanned fashion before 2020).

The fourth scenario is termed the 'boom and bust scenario' whereby a number of mines first open and then shut down in a hurried, unplanned fashion, without any remedial or stabilisation measures, leaving the mines and all associated infrastructure behind. This scenario could be triggered by one or more global drivers such as a significant drop in uranium prices.

This scenario would also affect some of the associated industrial developments at the coast which will have been built specifically for the uranium rush. While alternative users could be found for, say, the power generated by the new power station (even through energy exports if economic), some industries may also have to close down e.g. the Gecko chemical plants, unless overseas buyers could be found for their products.

This would have devastating consequences for the thousands of people and businesses directly and indirectly employed in the uranium rush and would put a severe dent in Namibian GDP, foreign exchange earnings and income from taxes and royalties. It would also mean that the government will have over-capitalised on infrastructure (roads, power generation and transmission, water supplies) and community facilities (schools, clinics) etc.

4.6 Overview of Typical Mining Operations

4.6.1 <u>Description of prospecting activities</u>

Prospecting involves a range of activities which become progressively more intrusive as the ore body is defined to a greater degree of accuracy. The early stages of exploration include activities such as airborne radiometric surveys, radon cap surveys, and surface grab rock sampling. Once the site shows a degree of prospectivity, the next stage involves reconnaissance drilling on a fairly widely spaced grid. This requires the establishment and presence of a small exploration camp, usually located on or nearby the EPL and which comprises a few temporary structures e.g. caravans, shipping containers, and a core yard. The camp requires power (generators) and water (usually boreholes or water tankers) and generates a small amount of domestic and industrial waste. Issues include litter, local loss of vegetation, noise, poaching, localised pollution from diesel tanks and oil spillage.

If the reconnaissance drilling results look promising, a more intensive drilling programme will be pursued to more clearly delineate the lateral and vertical extent of the ore body. The drill hole spacings are on a 50 m grid and often more than one rig will be operating at a time. At this stage, the exploration company may take a bulk sample for detailed lab testing to determine the best metallurgical process route.

4.6.2 <u>Description of construction activities</u>

Construction of a large mine is a big operation, requiring land clearing, bulk earthworks, the establishment of a construction camp to house up to 1,500-2,000 workers, laydown areas, workshops and the entire area needs to be fenced off.

Once the bulk earthworks have been completed, all the structural, mechanical and electrical components of the plant need to be constructed e.g. crushing circuit, process plant, offices, workshops, etc. These activities are often noisy and generate a considerable amount of waste.

The uranium deposits will require the development of the open pit, with surface blasting, removal of overburden, construction of haul roads etc. The shallow secondary deposits will require slightly less work and may not require blasting during the initial stages. The impacts include noise, vibration, dust and light at night.

One of the biggest impacts is that every component required for the construction of the mine needs to be brought to site using existing roads, railways and ports. During the peak of construction this can result in hundreds of vehicles per day (see section 7.3). The impacts include: traffic congestion, increased accident risk, deterioration of the road surface, port congestion, vehicle fumes, dust, noise and so on.

Water is required during construction for mixing concrete, dust suppression, washdown, drinking, ablution facilities and change houses. Often this water is supplied from groundwater while the permanent water pipeline is being built. Excess groundwater abstraction can lead to a local drop in water table level and reduced yields for other local users, e.g. farmers.

The new mine will require both power and water which will be brought to the mine via transmission lines and water pipelines respectively. Infrastructure on site will include a substation and step-down transformers for the electricity supply and a bulk water reservoir and pump stations for the water.

A considerable amount of waste is generated on a construction site including hazardous and non-hazardous waste. Non-hazardous waste usually includes all office waste, canteen waste, as well as all industrial waste such as scrap metal, wooden pallets, offcuts, packaging, construction rubble, waste concrete etc. Much of this waste can be recycled but the rest needs to be disposed of in a properly constructed waste disposal site. Most of the hazardous waste on a construction site comprises tyres, vehicle batteries, fluorescent tubes, oily rags, contaminated soil, chemical containers, solvents and so on. Much of this can be recycled via the original suppliers, but the remaining waste needs to be removed from site to the registered hazardous waste site in Walvis Bay. Issues therefore include the safe storage of these wastes until they are removed from site and the capacity of the Walvis Bay hazardous waste cell to receive such wastes.

At peak construction there will be many different contractors working on site, each of whom will require skilled and unskilled labour. Some contractors may bring their own workforce, while others will hire local labour. At the peak, there may be up to 2,000 workers on the site.

In addition to the main building contractors, there will be need for a range of support services such as banking, legal, accounting, catering, cleaning, office equipment, telephony, computer services, accommodation etc. Most of these services will be sourced from local towns, but national and even international suppliers may be used in the absence of local contractors.

4.6.3 Description of mining and processing activities

4.6.3.1 Mining

In Namibia, both uranium ore types occur on and close to the surface in the central Namib and therefore can be mined from surface as open cast or open pit operations. The hard rock alaskites generally extend to depth and are typically mined in an open pit using drilling and blasting techniques. These pits can become quite large – for example, the current Rössing pit is over 3 km long, 1.2 km wide and about 345 m deep (Plate 4.7) (www.Rössing.com). The alaskite pits are developed *downwards* and will remain as permanent deep holes in the ground surrounded by huge waste rock dumps.

Secondary calcrete-hosted uranium mineralisation tends to occur at shallower depths but over larger areas and requires slightly less drilling and blasting because the surface material can be mechanically excavated in some circumstances. The Langer Heinrich pit for example will only reach a maximum of 30m deep and the Trekkopje pit (Klein Trekkopje deposit) is planned to be 15 km long by 1-3 km wide and up to a maximum of 30 m deep (Turgis Consulting, 2008). The shallower calcrete pits have much less waste rock and can be backfilled with tailings and overburden as the pit proceeds *laterally*. This has significant implications in terms of the total mine footprint, with the calcrete mines having a much larger area of disturbance during operations but with a smaller final footprint.

Plate 4.7: The Rössing pit is about 3 x 1.2 km in size, and 345 m deep. This, and the surrounding waste rock dumps, are permanent features that cannot be rehabilitated to the original landscape. The channel of the Khan river is visible top right (photo P.Tarr).

It can be seen from Figure 4.1 that the alaskite deposits are all aligned in a broad north-east to south-west corridor in the leucogranites associated with the Khan and Swakop Rivers. This zone has been referred to by some as ‘Alaskite Alley’. Development of these mines would have significant impacts on both the river valleys in terms of groundwater resources, and visual impacts, since the rugged topography associated with this same geology is a major tourism attraction (see section 7.6).

The secondary deposits on the other hand, are all associated with shallow palaeo- and current drainage lines which traverse the gravel plains to the north and south of the Khan-Swakop drainage system (Figure 4.1). These plains appear featureless, but they in fact support a relatively high biodiversity, including lichens, plants, birds, mammals and reptiles (section 7.7). Of particular significance is the occurrence of the protected, rare and ancient Welwitschia plants in these drainage lines (Plate 4.8).

The typical direct impacts resulting from open pit/cast mining are:

- Noise (blasting, hauling);
- Vibration (blasting);
- Dust (blasting, excavating, loading, hauling, waste rock dumps);
- Radon emissions (blasting, excavating, loading, low grade stockpile);
- Pollution of groundwater (runoff/seepage from waste rock dumps and open pit);
- Visual impact (open pit and waste rock dumps);
- Loss of biodiversity (open pit and waste rock dumps);
- Light.

Noise and vibration are localised and sporadic impacts, but dust, radon, groundwater pollution, loss of biodiversity and visual impact could all contribute to a regional cumulative impact, if not properly controlled through on-site environmental management plans. The visual impact might have an impact on tourism, especially where current tourism activities overlap with existing and proposed mines e.g. Etango (Moon Landscape), Rössing South (Welwitschia Flats), Langer Heinrich (Bloedkoppie) or where several mines may be located in a relatively small area: Rössing, Rössing South, Etango, and Tubas (Figure 4.8).

Plate 4.8: A Namib biodiversity icon, the Welwitschia plant, is found near proposed uranium mines . Etango and Rössing South are likely to have the greatest impact on tourists coming to the Namib to see this plant (photo P.Tarr).

Although Rössing Mine attracts some 2000 tourists per year (www.Rössing.com) to see the huge open pit, there are few additional opportunities for synergies between mining and tourism, and tourism offsets need to be investigated by each mine where current tourist activities will be affected. This presents an opportunity for future collaboration between mining, tourism and nature conservation to develop and protect new sites of tourist interest.

4.6.3.2 Ore processing

Irrespective of the rock type, the ore has to be crushed to a finer size before the uranium can be extracted. Typically, ore is delivered to the primary crushers from the open pit via haul truck although some mines may place the primary crushers in the pit and haul crushed rock to surface. Crushing circuits usually have several stages (typically up to 4) in which the ore is progressively reduced to a fine particle size. In spite of noise attenuation systems and dust extraction systems, crushers usually have noise, radon and dust impacts. All workers in the crushers have to wear respirators to minimise their exposure to radiation and particulates. These impacts are all localised and do not have regional implications.

4.6.3.3 Ore processing and refining

The other major difference between the alaskite ore bodies and the calcrete deposits lies in the processing method: alaskite ores require acid leaching, while the calcrete ores are extracted using an alkaline leaching process. These processes are briefly described below.

- **Leaching** in closed tanks or in open heaps with sulphuric acid or with sodium bicarbonate;

- **Cycloning and thickening** in tanks to separate the barren solids from the uranium-bearing solution (‘pregnant’ solution). The solids go to the tailings dam (see section 4.6.3.4 below);

- **Continuous ion exchange (CIX)** where the uranium ions in the pregnant solution are adsorbed onto specially formulated resin beads. The beads are then washed with an acid wash to produce a more concentrated uranium solution;

- **Solvent extraction (SX)** is where the acidic eluate from CIX is mixed with an organic solvent and then a neutral aqueous ammonium sulphate solution;

- **Precipitation** is where gaseous ammonia is added to the solution to raise the pH and thus precipitate the ammonium diuranate which is then thickened and filtered to form a yellow paste called ‘yellow cake’;

- **Final roasting** drives off the ammonia to leave uranium oxide (U_3O_8), which is packed into metal drums for shipment overseas for further conversion and enrichment before it can be used in power generation facilities.

Several new mines are investigating the possibility of using the ‘heap leach’ process whereby ore is placed onto a lined pad and acid or alkaline chemicals are sprayed onto the heap and the leachate is then collected from collection systems around the pad. Once the uranium has been leached out, the residue is removed from the pad and discarded on an engineered dump. In addition to the above, other process routes are being considered by Bannerman and Extract Resources as part of their feasibility studies.

4.6.3.4 Mining and process wastes and emissions

The mining and processing plants produce a variety of different waste streams in liquid, solid and gaseous forms. Liquid wastes include sewage effluent, grey water, contaminated runoff from the plant and mine area, process effluents, tailings dam return water and seepage. Most liquid waste can be recycled or re-used and all the mines in the desert environment of the central Namib should have a policy of zero liquid effluent. For example, Rössing has reduced its freshwater requirement per tonne of uranium oxide produced by 46% since 1981 due to continual increases in the use of recycled water through various technological advances.

Solid wastes generated from the mine include waste rock and tailings. The processing plant produces low-grade radioactive tailings or heap leach residues, baghouse dust and a range of hazardous and non-hazardous industrial wastes. Other wastes are generated in the workshops, offices, mine clinic and the canteen.

Several operations on a mine produce gaseous emissions, such as sulphur dioxide from the acid plant (if there is one), and roaster, as well as fumes (CO, CO_2 and NOx) from vehicles, chemical processes in the plant etc. Particulate emissions arise from wind action on unconsolidated surfaces such as the tailings dams, disturbed ground and gravel roads, as well as from vehicle entrainment of dust on gravel roads.

4.6.4 Closure and rehabilitation

On closure, all structural elements will be removed from site, including foundations and concrete plinths. Access roads will be ripped and graded over and all external infrastructure such as pipelines and powerlines will be removed. However, in the case of alaskite mines, the open pit, waste rock dumps, and tailings dam or heap leach residue facility will remain. In this desert environment, surface stabilisation by means of revegetation is a very slow process and therefore the mines must leave these facilities in a safe, stable and non-polluting state. One of the challenges with uranium mines is to minimise the radon exhalation and dust emissions from the tailings dam. This has been done at some mines by covering the surface and sides of the dam with a thick layer of waste rock, but the long-term effectiveness of this needs further research and monitoring.

In the case of the shallow calcrete mine pits, it is possible to backfill the pits with tailings (or heap leach residue) and waste rock as the pit progresses laterally, thus reducing the final footprint considerably.

Irrespective of the closure method employed, it will not be possible to utilise the closed mine sites for any future beneficial use and they will be permanently closed to the public on account of the radiation and safety risks inherent on such sites.

Planned closure of a mine should start during the planning and feasibility stages prior to mine commissioning to ensure that it is implemented in a logical, cost-effective and equitable manner. This includes ongoing planning of waste rock disposal to minimise the visual impact, use of future waste rock sites for the construction camp, ongoing rehabilitation of disturbed areas during construction and so on. Once the mine is in operation, the closure plans need to be regularly updated and the required actions implemented such as the timeous notification of closure to all employees, re-skilling programmes and a planned programme of retrenchment. Production is then progressively scaled down over a period of a year or two prior to actual closure.

In the event of Scenario 4: Boom and Bust, mine closure will be rapid and largely unplanned. Unscrupulous operators or those without a sufficiently large rehabilitation bond will tend to walk away from the operation without undertaking any of the costly rehabilitation work described above. This would leave the mine and process plant in an unsafe and polluting state. Furthermore, the workforce would not be given due warning of closure and retrenchment would be immediate. If all the mines were to close within a short period of time, the government would be left with a huge legacy of pollution and land degradation and the economies of the towns of Swakopmund and Walvis Bay would collapse. It would also mean that some of the industries set up to support the uranium rush (such as the desalination plants, the coal-fired power station at Walvis Bay and the Gecko Chemicals plants) would either have to close down or rapidly find other customers in order to survive. The cumulative effects would be extremely severe.

5 ERONGO REGION OVERVIEW

5.1 Physical geography

The Erongo Region is located in the central western part of Namibia (Figure 5.1). Landmark features of its boundaries include the Atlantic Ocean in the west, the Ugab River in the north, and the Kuiseb River as part of the southern border. Much of the region is occupied by the Namib Desert which stretches parallel to the coast for the length of the country, to about 120-150 km inland. The 'Uranium province' which is the focus of the present Uranium Rush lies entirely within the central Namib in the Erongo Region.

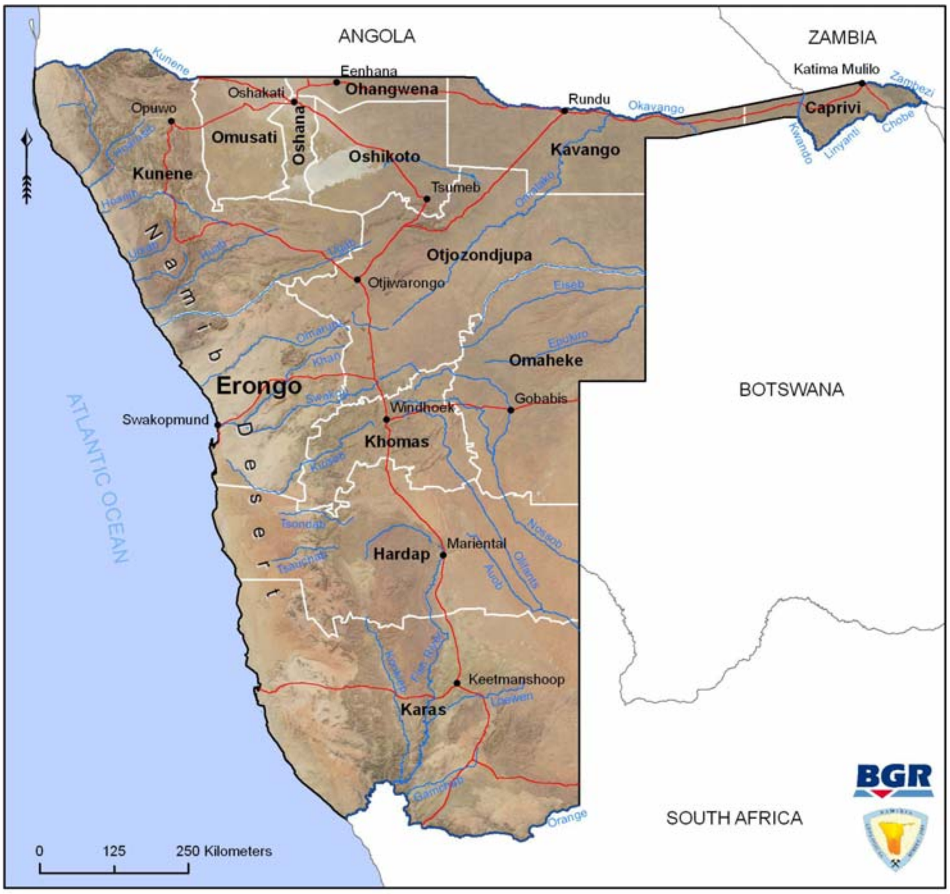


Figure 5. 1: Erongo Region in Namibia

5.1.1 Topography and hydrology

In the Erongo Region, the land rises steadily from sea level to about 1,000 m across the breadth of the Namib (Figure 5.2). The Namib land surface is mostly flat to undulating gravel plains, punctuated with occasional ridges and isolated 'inselberg' hills and mountains. Namibia's highest mountain, Brandberg (2,579 m), lies in the far northern part of the Erongo Region. The eastern edge of the Namib is marked by the base of the escarpment in the southern part of the region. In the northern part, the escarpment is mostly absent and there is a gradual rise in altitude to over 1,500 m. South of the Kuiseb River lies the central Namib Sand Sea, and sand dunes also form a narrow coastal belt between Walvis Bay and Swakopmund.

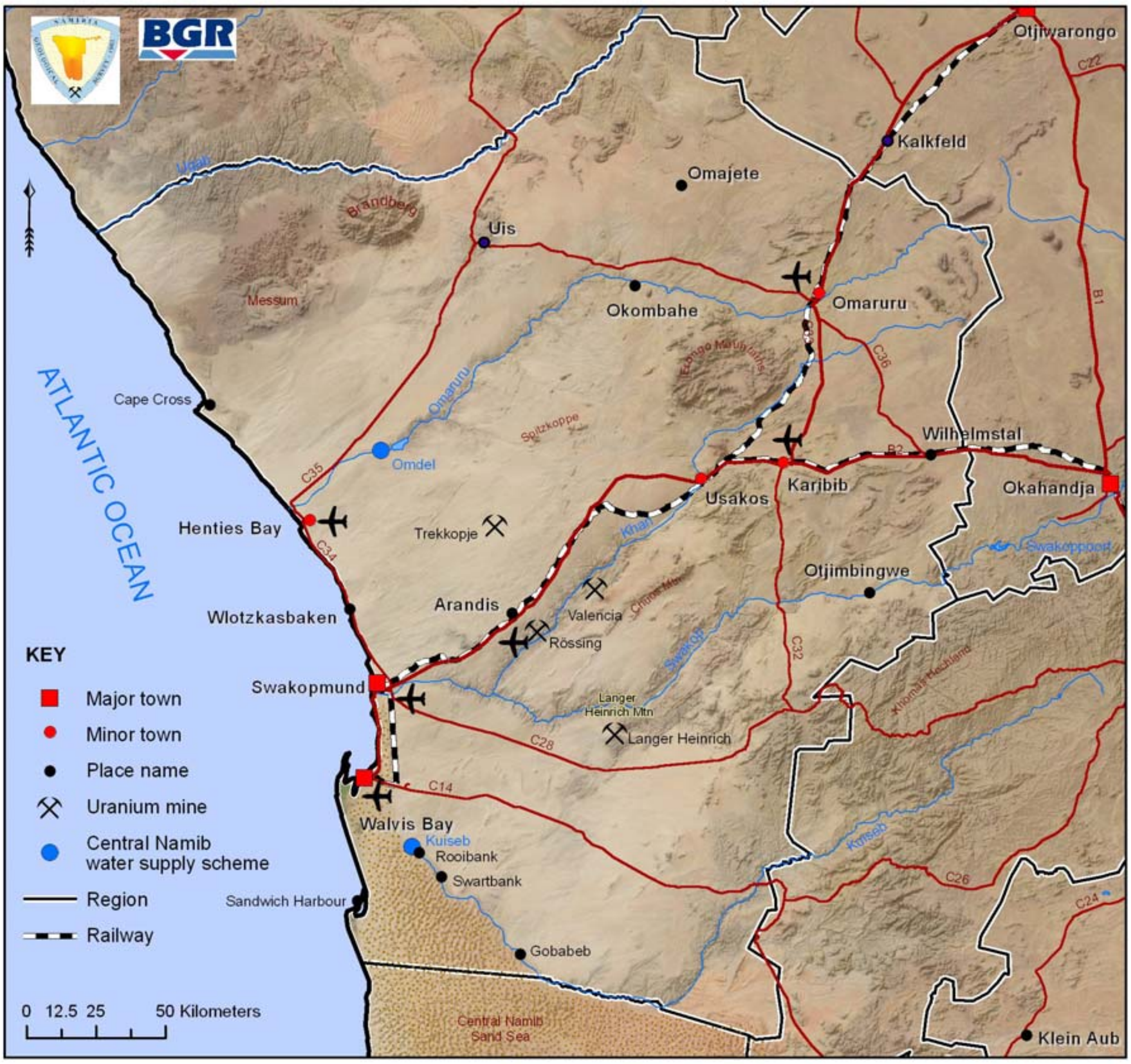


Figure 5.2: Main physical features of the Erongo Region

The Namib plain is incised by a few main ephemeral rivers that run seawards from wetter parts of their catchments further inland. Of the four main rivers in the Erongo Region, the Swakop (including its main tributary the Khan) and the Omaruru Rivers have approximately similar mean annual runoffs of about 40 million cubic metres per annum, although surface flows in the Omaruru reach the Omdel dam on average every second year, and only every fourth year in the Swakop (Heyns and van Vuuren, 2009). Mean annual runoff of the Kuiseb and Ugab Rivers is about half that of the former two.

However, while the surface flows are important, they are short-lived and the real value of the rivers lies in their alluvial aquifers (Heyns & van Vuuren, 2009). Palaeochannels in the Omaruru River about 40 km from the coast form the underground Omaruru Delta which is an important water source for the central Namib. Some alluvial water in the Swakop and Khan is abstracted for prospecting and mining. In the Kuiseb there are water supply schemes at Gobabeb, Swartbank and Rooibank, the latter two forming part of the Central Namib Water Supply Scheme.

5.1.2 Climate

The climate of the Erongo Region is characterised by aridity. Prominent features of the climate include:

- Very low rainfall, averaging about 300 mm in the north-eastern parts and less than 15 mm at the coast. The Namib proper, i.e. within roughly 120 km of the coast, has median annual rainfall less than 150 mm;

- Great variability in annual rainfall, with most years in the Namib receiving less than the average, and occasional years receiving very heavy rains (>100 mm);

- Coastal fog that brings moisture in frequent but small amounts, which moderates the heat and moisture extremes on the western side;

- A steep rainfall gradient across the short breadth of the Namib and relatively wetter areas in the eastern part of the region. The rain and fog gradients run in opposite directions, with the zone of low precipitation from both sources in the middle zone (see below);

- The wind regime which includes prominent southerly and south-westerly winds during the summer, and north-easterly winds in the winter that sometimes reach gale force and mobiles the entire desert surface (including tailings) (see Plate 5.1);

- Very hot temperatures can occur in the inland areas during the day, cooling at night is due to outgoing solar radiation under typically clear skies. Maximum and minimum temperatures at the coast are moderated by the effects of the cold Benguela current and the regular fog bank;

- Very high rates of evaporation which has significant implications for water balance management.

The climate of the central Namib can be divided into zones that run roughly parallel to the coast (Mendelsohn *et al*., 2009), (Figure 5.3):

- The coastal foggy zone extends about 20 km inland; it is generally cool and humid with frequent occurrence of fog in the late afternoon, night and early morning. Fog precipitation is more than double the annual average rainfall of 15 mm;

- The middle zone (roughly 20 – 90 km from the coast) experiences fairly frequent fog (less to the east) and average rainfall slightly higher than in the zone to the west, so that average fog precipitation is roughly in the same range as average rain precipitation. Humidity is lower than in the coastal zone, especially in winter when warm dry north-easterly winds predominate. This is the most extreme arid zone of the Namib;

- The eastern zone extends up to ~120 km from the coast. Fog is rare, and some rain falls in most years, averaging about 90 mm per year;

- Further inland lies the ‘Pro-Namib’ which is the transition zone to the more mesic climate of central Namibia.

Most rain in the Namib falls in late summer, between January and April (73%), while some rain falls in winter (22%) with the driest phase from September to December (Mendelsohn *et al.,* 2009). Wet years of >100 mm rainfall are very rare in the middle and coastal zones, and have been recorded only in 1934, 1976, 2000, 2006 and 2009. The increasing frequency of high rainfall events in the past decade may be a reflection of climate change or may be a short-term fluctuation. The important point is that variability of rainfall is very high and all mine and infrastructure designs need to take this into account.

Seasonality is not strongly developed in the Namib and the average temperature and humidity do not differ markedly in the course of the year. Average summer temperature in the middle zone of the Namib is 23.1ºC, and in winter is 19.2 ºC (Lancaster *et. al*. 1984).

5.1.3 Episodic events

The physical setting of the Namib is harsh and extreme episodic events are an important feature of the natural environment. While they are very rare, they can have a severe impact on the environment and on man-made infrastructures. The photos below illustrate some of the extreme events that have been recorded in the Namib in the recent past – events that are certain to recur in future.

5.1.4 Climate change

According to Turpie et al (2010), there is still considerable uncertainty regarding the accurate detection of future global and regional climate change scenarios. These doubts arise from:

- Uncertainty regarding future global GHG emissions*;*
- Limitations in our understanding of the dynamics of global climatic systems;
- Natural climatic variability displayed in the baseline data;
- Uncertainty pertaining to the CO_2 ‘fertilisation’ effect on plants; and
- Limitations in the downscaling techniques employed to produce Regional Climate Models from Global Circulation Models – simulations which, at best, produce only a possible evolution of future climate systems.

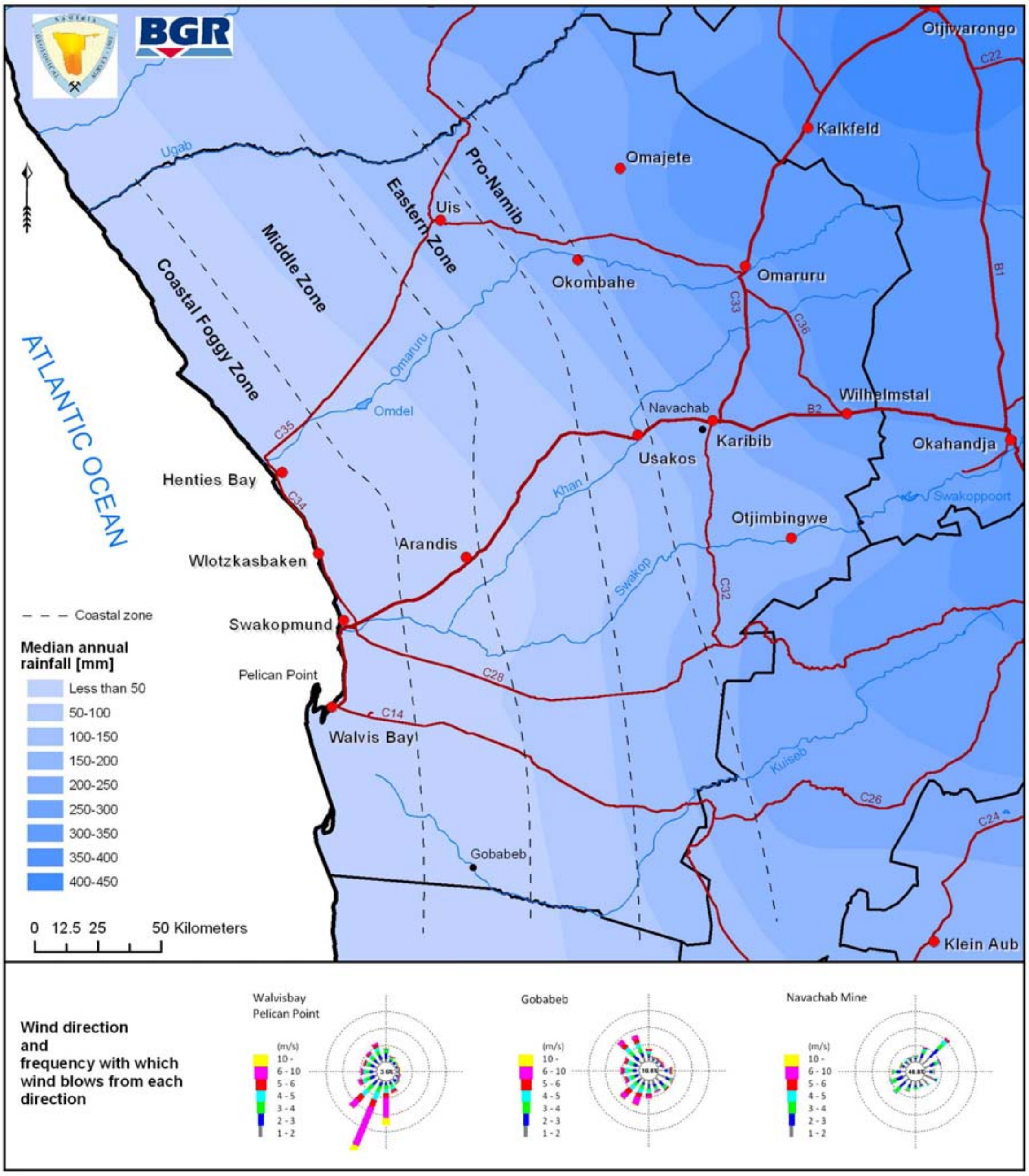
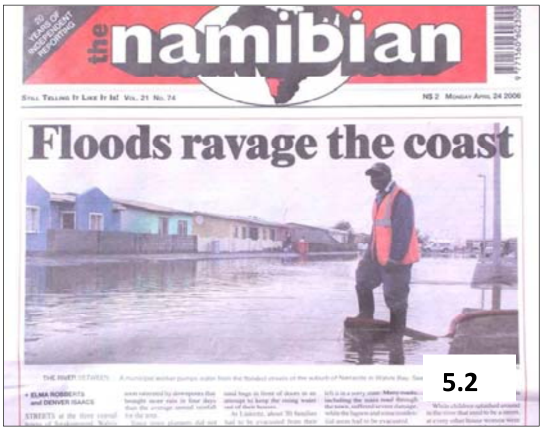


Figure 5.3: Main climatic features of the Erongo Region (adapted from Mendelsohn *et al.*, 1999)


the namibian

Floods ravage the coast

Plates: 5.1) Dust storm approaching Gobabeb 2005; 5.2) Flood damage at Walvis Bay 2006; 5.3) Khan River in flood 1998; 5.4) Tornado approaching Gobabeb 2008.
[Photo credits 1-Hartmut Kolb; 3-Dirk Heinrich; 4-John Guittar]

The paucity of hydro-meteorological stations in the country and the lack of homogenous, long term, high quality datasets, hampers the construction of plausible climate models and constrains the reliable assessment of potential scenarios, vulnerability and adaptation to climate change in Namibia (Warbuton and Schultze, 2005; von Maltitz *et al,*. 2005; Dirkx *et al.,* 2008).

In spite of data limitations, experts expect Namibia to experience an increase in temperature and evapo-transpiration at all localities, with the maximum increase in the interior. Warming is likely to be less along the coast than along the escarpment and inland regions (Turpie *et al.,* 2010). Also, most models predict that southern Africa and Namibia will become drier, that rainfall variability is likely to increase and that extreme events such as droughts and floods are likely to become more frequent and intense (Turpie *et al.,* 2010).

An important feature of Namibia's climate is the coastal fog system, which is known to be key for several elements of biodiversity, but there are unfortunately currently no credible projections of change for this system.

The implications of expected climate changes in Namibia for the Uranium Rush are that:

- Water availability will be an even more significant issue in future than it is now
- As a result of the above, it will be increasingly important for all users of water to use this scarce resource sparingly and efficiently, and to avoid polluting groundwater (both during life of mine and after closure and decommissioning)

- Design of tailings dams and other installations and infrastructure must assume regular or increased occurrence of 1/100 year floods, more extreme winds and unreliable weather patterns
- Natural rehabilitation of scarred areas will be extremely slow, and pro-active restoration will be required, and
- Current knowledge of sensitive areas, whether based on biodiversity or landscape attributes, will require regular updating.

5.2 Socio-economic status

5.2.1 Land use and people

Large parts of the Erongo Region are desert and owned by the State as protected areas under conservation management; these include the Namib-Naukluft Park (NNP) in the south and central area, and the National West Coast Recreation Area (NWCRA) in the north. The Namib-Naukluft-Park was originally established as a buffer zone in 1908 to protect diamond mining interests on the coast and due to the fact that the land was not suitable for agricultural land use. The Ministry of Environment and Tourism carries responsibility for management of these protected areas, and intends expanding the formal protected area to include the area around Walvis Bay and the dune belt running northwards to Swakopmund. This will proclaim the entire coastal belt of the country as the Namib Skeleton Coast National Park. Protected areas will then comprise almost exactly 33% of the Erongo Region (Figure 5.4).

Government land around Walvis Bay is presently under the control of MRLGHRD, but will fall under MET when it is amalgamated with the surrounding protected areas. Some inconsistencies in control of land, viz. around Arandis, Usakos and between the two towns, reflect unresolved or unclear delineations of communal land, conservancies, Traditional Authorities and Local Authorities.

Communal land makes up about one third of the region and lies to the east of the NWCRA. Most of it is under conservation management through the following conservancies: ≠Gaingu (centred around Spitzkoppe); Tsiseb (focused on Brandberg), Otjimboyo and Ohungu. East of these, the land is under freehold title (another third of the region) and is mostly used for commercial cattle ranching.

The arid nature of the landscape means that very little of the area has agricultural potential. Only 10 km² of the Erongo Region is cleared for cultivation (NPC, 2007); this includes the area of small-scale farming in the Swakop River bed, as well as small areas at Omaruru and Okombahe. Small stock farming is the most important agricultural activity in the region. This is mostly practised on the communal land described above, where goats and sheep are run on conservancy land. Also, Topnaar people living along the Kuiseb River in the NNP keep goats, cattle and donkeys.

Land under Local Authority responsibility makes up 1.5% of the total area of the region. Eighty percent of the Erongo population lives in urban areas; most of these are concentrated in Walvis Bay and Swakopmund. Table 5.1 shows the towns, the area of their townlands, and the population of each.

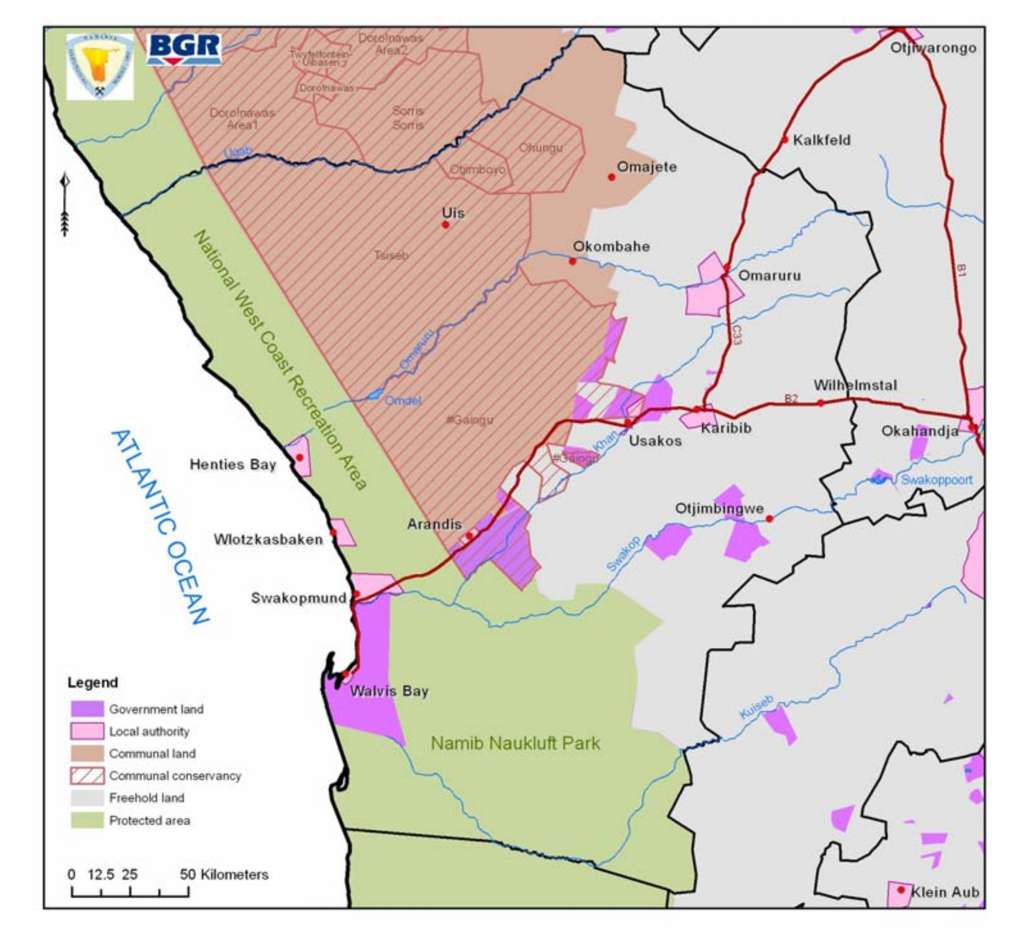


Figure 5.4: Land use and ownership in the Erongo region

Table 5.1: Statistics of the urban areas in the Erongo Region.

Town	**Townland area (km²)**	**Population**	**Source for population data**
Arandis	29	7,600	NPC, 2007
Henties Bay	121	3,300	NPC, 2003
Karibib	97	3,800	NPC, 2003
Omaruru	352	4,800	NPC, 2003
Swakopmund	193	42,000	2006 polio vaccination campaign, quoted in UraMin 2007
Usakos	58	3,000	NPC, 2003
Uis	10	?	
Walvis Bay	29	43,700	NPC, 2003
Total urban population		**108,200**	
Total estimated Erongo Region population		**135,250**	

The rural population is dispersed in the communal and freehold areas, and concentrated in small settlements such as Spitzkoppe, Otjimbingwe and Okombahe.

5.2.2 Economic activities and livelihoods

Erongo is a relatively prosperous region in Namibia, with the second highest per capita income (after Khomas) derived mostly from mining, fishing and tourism. Fishing and mining industries are the major employers, but industrial activity is limited and based mainly on the fishing industry (NamPower, 2009). The drivers of economic development in the region have been identified as the mineral sector, fisheries, tourism, NamPort and the Walvis Bay Corridor Group.

5.2.2.1 Commercial fishing and fish processing

The commercial fishing industry is the largest single employer in the Erongo Region, accounting for 33% of the economically active population in 1998 (Anonymous, 1999). Recent declines in fish stocks have led to fishing companies being granted smaller quotas and some fish processing factories closing.

Angling is an important recreational and livelihood activity for residents of, and visitors to the coast. Aquaculture (oyster cultivation) is practised in specific areas in the Walvis Bay lagoon and salt pans as well as at the Swakopmund salt works.

5.2.2.2 Mining

The mining sector in the whole country accounts for 20% of GDP and employs about 3% of the population (NEPRU, 2009). Uranium from the two operating mines contributed 4% of the total GDP in 2008 (NEPRU, 2009) and is likely to become the strongest contributor to GDP if Scenario 3 takes place.

In the region, important mining operations are concentrated on gold (Navachab Mine), dimension stone (numerous marble and granite quarries), salt (at Walvis Bay, Swakopmund and Cape Cross), stone and sand quarrying, and gemstones. Many old mines are now abandoned, such as various tin mines (e.g. Uis, Arandis, Strathmore), and mines for lead, lithium, copper and rutile (amongst others). There are two operating uranium mines, Rössing and Langer Heinrich, and two under construction, Trekkopje and Valencia (see Chapter 4 for more detailed information). The Uranium Rush is likely to not only see development of more uranium mines but also new or expanded mines for salt, phosphate, gypsum and marble that will feed the associated chemicals industry.

5.2.2.3 Tourism

Tourism is currently the third largest economic sector in Namibia and was expected to contribute 3.8% to GDP in 2007 (NEPRU, 2009). According to a survey conducted by World Travel & Tourism, the sector in Namibia is expected to grow by 6.9% annually over the next ten years – the eighth fastest growing tourist destination globally. Direct employment related to tourism is estimated at 18,800 jobs in the national economy, equivalent to 4.7% in 2006 (Bannerman, 2009).

Erongo's coastal area from Walvis Bay to Henties Bay is a major holiday destination, with many accommodation establishments and camping sites. Swakopmund is the main centre for tourism.

Accommodation capacity in the Erongo Region is 20% of Namibia's complete capacity, with over 247,000 beds available in August 2008 (NTB, 2009). The second most visited town is Swakopmund with 50% and Walvis Bay with 32% of all tourists visiting these towns. There is constant growth and development in the coastal regions to accommodate the increase in this demand.

Tourism usually employs less skilled workers than the mining industry and thus salaries are generally much lower, but it offers employment to a significant number of people, mainly women.

5.2.2.4 Transport hub

Walvis Bay, Namibia's main port, is situated at the end of the Trans-Kalahari Highway that links Namibia with Botswana and Gauteng Province in South Africa. Namibia's road network also connects Walvis Bay, via the Trans-Caprivi Highway, with the country's northern business centres, as well as Zambia, Zimbabwe and the Democratic Republic of Congo. The Port of Walvis Bay is the main focus and economic nucleus for these two highways. The Walvis Bay Corridor Group as an organisation and a public-private partnership, promotes the harbour in playing a crucial economic link to any economic centre in Southern Africa (Bannerman, 2009). Walvis Bay and Swakopmund are also linked to Windhoek on TransNamib's national railway system (see Chapter 7.3 for more detailed information).

6 POLICIES AND LAWS RELEVANT TO THE URANIUM RUSH

6.1 Introduction

Before examining specific policies and laws pertinent to the Uranium Rush, it is necessary to reflect on some broader principles and Namibia's long term vision.

Of fundamental importance to the concept of sustainable development and the application of environmental safeguard tools, is the precautionary principle, which states that if an action or policy has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus that the action or policy is harmful, the burden of proof that it is *not* harmful falls on those taking the action.

The principle implies that there is a social responsibility to protect the public from exposure to harm and in some legal systems (e.g. the European Union) the application of the precautionary principle has been made a statutory requirement. The precautionary principle is given weight in international law through the UN World Charter For Nature (section 11(b)) which states: *"Activities which are likely to pose a significant risk to nature shall be preceded by an exhaustive examination; their proponents shall demonstrate that expected benefits outweigh potential damage to nature, and where potential adverse effects are not fully understood, the activities should not proceed."* The most common tool used to effect the 'examination' referred to above, is environmental assessment (EIA) as required by the Environmental Management Act (2007).

In order to provide direction to government ministries, the private sector, NGOs and local authorities and to obtain an understanding of where the country is heading, a document entitled 'Vision 2030' was formulated by the Namibian government in 2001/02. 'Vision 2030' helps to guide the country's five-year development plans, while fully embracing the idea of sustainable development which, for the natural resource sector, states:

> *The nation shall develop its natural capital for the benefit of its social, economic and ecological well-being by adopting strategies that: promote the sustainable, equitable and efficient use of natural resources; maximize Namibia's comparative advantages; and reduce all inappropriate resource use practices. However, natural resources alone cannot sustain Namibia's long-term development, and the nation must diversify its economy and livelihood strategies.*

Vision 2030 is ambitious since it aims to both optimise Namibia's comparative advantages as presented by the wildlife and tourism sectors, whilst also fully exploiting the country's mineral wealth. The need for applying environmental safeguard tools (such as SEA and EIA) is emphasised in order that negative impacts and opportunity costs are minimised.

There are five sources of law in Namibia: the Constitution, statutory law, common law, customary law, and international law.

The Constitution is the Supreme Law of Namibia and all government agencies are therefore required to abide by it. Laws are valid only if they are passed according to the procedures described in the Constitution and consistent with the rights protected by the Constitution.

In terms of Statutory Law, Namibian legislation consists of pre- and post-Independence laws. Many of the 'old' laws have been repealed and replaced by Namibia's own domestic laws, while others remain in force.

Common law, also known as 'Roman-Dutch law' is the law developed over time through the decisions of individual court cases. Parliament can change the common law by passing statutes that say something different.

Customary law, which is not normally written down, is law that has developed over the years in different traditional communities in Namibia. Parliament can change customary law by passing a statute that applies to all communities in Namibia.

Article 66 of the Namibian Constitution provides that both the customary and common laws in force on the date of Independence shall remain valid unless they conflict with the Constitution or any statutory law. Subject to the terms of this Constitution, any part of such common law or customary law may be repealed or modified by an Act of Parliament.

International law includes the international agreements that Namibia has signed and ratified, as well as the rules of customary international law. Article 144 of the Namibian Constitution provides that unless otherwise provided by this Constitution or an Act of Parliament, international agreements are binding and shall form part of the law of Namibia.

In addition to the five sources of law in Namibia, national policies also govern and influence government activity with regard to the Uranium Rush. A policy is defined as the high-level overall plan embracing the general goals and acceptable procedures especially of a governmental body. While legislation is enforceable in a court of law, policies cannot be enforced by a court without implementing legislation.

Though government policies do not have the same legal weight as official statutes, courts consider policies when interpreting laws and deciding cases. When dealing with controversial or unclear cases, Courts will resort first to the Constitution as the supreme law and bear in mind its preponderance when interpreting parliamentary legislation. When cases are still unclear after analysing existing sources of law, courts utilise policies as persuasive authority to reach a final decision.

Apart from the legal significance of policies, governments generally abide by them as they often represent the consensus regarding a particular topic, and policy deviation usually attracts negative attention.

6.2 Overview of key policies and laws

The high importance of environmental protection in Namibia is borne out by the Namibian Constitution. There are provisions ensuring the sanctity of the natural environment (95(l)), mechanisms by which the government can investigate misuse of resources (91(c)) and mechanisms for the enforcement of sound management policy. The Constitution entitles an aggrieved stakeholder to seek administrative justice in the event the Government makes a decision that has an adverse impact on his or her substantive rights. Thus, it establishes that when the Government acts, it does so on behalf of the people, and that it should act with an effort to ensure both the rule of law and justice for each person. Moreover, Article 18 requires a fair, direct process for persons to challenge agency action.

Important in the context of the SEMP, is that Article 91 of the Constitution empowers individuals to monitor the treatment of the environment and to help ensure its continued vitality.

While the Constitution emphasises the need for sustainable development and human rights, Government is still required to make laws that are specific and enforceable. Since Independence the Namibian Government has enacted a number of laws and policies intended to protect fragile ecosystems, manage mining operations, and ensure that all commercial development projects eliminate or, at the very least, mitigate adverse impacts on the environment, people and wildlife. These laws establish clear mandates in some cases, but not in others. Consequently, many gaps remain in the enforceable regulatory structure.

For example, parks are established under the pre-independence Nature Conservation Ordinance of 1975 for the purposes of conservation and tourism by MET, yet the post independence Policy on Mining in Protected Areas allows prospecting and mining in protected areas under certain circumstances, which undermines conservation and tourism objectives and policies.

Also, article 95(l) of the Constitution requires management for sustainability, yet DWA gives permits for groundwater abstraction without knowing, for example, the sustainable yield of the aquifer, because the Water Act of 1956 does not make provision for this.

A major contributing factor to the inconsistency and conflict between different sectoral laws is arguably the fact that some laws are outdated and ignore the realities of the physical resources and socio-economic circumstances of modern-day Namibia. For example, the Water Act of 1956, ignores the hydrological reality of Namibia and fails to account for the natural environment's new status under the Namibian Constitution since it does not recognise the natural environment as a user of water nor as a provider of essential processes and services. Thus it cannot deal effectively with the challenges that a growing mining sector places on scarce water resources. On the other hand, the Water Resources Management Act which was passed in 2004, from a sustainable water management perspective, could deal with these challenges more effectively, but the Act is not yet enforced, due to lack of personnel capacity to do so.

As a result, Namibia continues to rely on outdated and ineffective legislation that is inconsistent with the provisions of article 95(l) of the Namibian Constitution. The enactment of the Environmental Management Act and the appointment of an Environmental Commissioner would operate as a control mechanism over ministerial decision making powers, harmonise inter-ministerial decision-making processes and create a platform of transparency and accountability to serve the needs of the citizens of Namibia.

The most important policies and laws in relation to the Uranium Rush are discussed briefly below.

6.2.1 Biophysical environment

The **Water Act, 54 of 1956** regulates groundwater abstraction for mining purposes. The passed, published, but not yet in force **Water Resources Management Act, 24 of 2004**, provides more specific procedures for water abstraction permitting that are much more tailored to Namibia's climate and geohydrology than the Water Act of 1956. Once enacted, it will supplant the Water Act.

In the context of groundwater aquifers, the Water Act appears to apply only to subterranean water control areas. Whilst no permit for groundwater abstraction can be lawfully issued without the above designation, a landowner may abstract subterranean water underneath his land, but s/he may not sell the water without a permit. Section 30(4)(a) allows a mine to abstract water without a permit when that water is necessary for the efficient carrying on of such mining operations or the safety of persons employed therein, unless the Minister otherwise directs. A permit is *only* required if a mine owner uses subterranean water from the mining land for any other purpose. However, if a mine abstracts groundwater from land other than the mine licence area, a permit is required.

The Water Act does not delineate any specific qualifications that applicants must meet before the Minister will issue a water abstraction licence. The uneven patchwork of regulations and the *ad hoc* approach to enforcement of the permitting scheme, coupled with the unfettered discretion vested in the Minister by the Water Act, No. 54 of 1956, means that Namibia's scarce water resources are not adequately protected from overuse. Also, the Act fails to create any incentive for compliance for large enterprises given that the threat of prosecution is negligible and the penalties are easily absorbed into the costs of doing business. For these and other reasons, the Water Act is unsuitable for modern-day Namibia.

It is expected that the Water Resources Management Act of 2004 will improve commitments by government to ensuring that water resources are managed and used to the benefit of all people and in furtherance of environmental needs and ecosystems functioning.

The **Namibia Water Corporation Act, 12 of 1997** enables the supply of bulk water so long as the required quantity and quality of water is available. This Act also imposes on the Corporation a duty to conserve and protect water resources and to take a long term view on the management of catchments and water.

The **Minerals Act, 33 of 1992** governs the granting of permits for prospecting and mining in Namibia. The Act states that the Minister shall not grant an application by any person for a mining licence unless the Minister is on reasonable grounds satisfied that the operation will ensure adequate protection of the environment. In the absence of specific EIA legislation, the Mining Act has been a useful tool in ensuring EIAs are done for mining projects. Thus, whilst the Ministry of Mines and Energy is not the designated authority for the protection of the environment, it clearly has responsibilities for the application of environmental safeguards as part of its licensing and oversight responsibilities.

Namibia's **EIA Policy** (1995) requires that all listed policies, programmes and projects, whether initiated by the government or private sector, be subject to an EIA. The purpose of the Policy is seen as informing decision makers and promoting accountability, ensuring that alternatives and environmental costs and benefits are considered, promoting the user pays principle, and promoting sustainable development. The **Environmental Management Act, 7 of 2007** (EMA) is not yet in force, but it will give legislative effect to the EIA Policy. The EMA will enable the establishment of the Sustainable Development Advisory Council and the appointment of the Environmental Commissioner and environmental officers. It is expected that these institutions will improve the management of impact assessment in Namibia. The EMA requires government agencies to work with a unity of purpose in ensuring sustainable resource management. Beyond this, it commands developers to gain clearance from the Environmental Commissioner (not yet appointed) before proceeding with plans. Criminal penalties for violating the conditions of a granted environmental clearance are stiff.

Section 3 of the EMA sets out principles of environmental management. Section 3(2)(k) of the EMA is particularly relevant for the mining industry, since it mandates a cautious approach, including the precautionary principle and the principle of preventative action. Section 3(2)(h) instructs generators of waste to use the best practicable environmental option and the 'polluter pays principle' is affirmed in section 3(2)(j). Taken together, these principles provide for impact avoidance, mitigation, and rehabilitation.

The Environmental Commissioner will review the EIAs and consult outside expertise if necessary before granting/denying the environmental clearance certificate. All EIAs and decisions regarding environmental clearance will be made public.

The **Parks and Wildlife Management Bill of 2009** (Parks Bill – in preparation), aims *"to provide a legal framework to provide for and promote the maintenance of ecosystems, essential ecological processes and the biological diversity of Namibia, and the utilisation of living natural resources on a sustainable basis for the benefit of Namibians, both present and future, and to promote the mutually beneficial co-existence of humans with wildlife, to give effect to Namibia's obligations under relevant international legal instruments, and to repeal the Nature Conservation Ordinance 4 of 1975."* Whilst the Bill envisages MET and MME agreeing to withdraw certain areas within parks from mining ('no go areas'), it should be noted that the Minister of Environment already has this authority under section 18 and 83 of the Nature Conservation Ordinance. There is concern that the new Act may be weaker than the old ordinance in this regard.

Apart from these 'no go' areas, mining within parks under the new Act would only be permitted with written authorisation from the Minister of MET. An applicant for a mining permit in a park will be required to pay a fee to MET, provide an EIA, an EMP, a rehabilitation plan, and a rehabilitation fee in accordance with the EMA. One of the outputs of this SEA is a recommended decision-making framework for MME and MET when awarding EPLs and Mining Licences in Protected Areas and very sensitive areas (see Chapter 8).

Environmental Investment Fund of Namibia Act, 13 of 2001 provides for the establishment of the Environmental Investment Fund of Namibia to support sustainable environmental and natural resources management in Namibia.

The Fund provides a mechanism to turn environmental crimes into positive protection for the environment. Fines paid in terms of the Environmental Management Act, and money made from the sale of property which is forfeited in connection with such crimes, will be paid into the Environmental Investment Fund. The money in the Fund could be used for:

- The sustainable use and management of natural resources;
- The maintenance of the natural resource base and ecological processes;
- The maintenance of biological diversity and ecosystems;
- Economic improvements in the use of natural resources for sustainable rural and urban development.

The **Forest Act, 12 of 2001** has some relevance to the Uranium Rush as the Minister (of Agriculture, Water and Forestry) may declare protected areas for the purposes of soil protection, water resources protection, protection of plants and other elements of biological diversity. The Minister may also declare any plant or species of any plant a protected plant and impose conditions under which it shall be conserved, cultivated, used or destroyed by any person. Of potential importance in the context of the Uranium Rush, is the fact that the Forest Act requires a permit before clearing any living vegetation within 100 metres of a river or stream. This has implications for existing and planned mines.

6.2.2 Heritage

This **National Heritage Act, 27 of 2004** replaced the *National Monuments Act, 28 of 1969,* and provides for the protection and conservation of places and objects of heritage significance. All archaeological and palaeontological objects belong to the State and once an artefact or fossil has been discovered, all mining operations must cease, the area must be cordoned off, and the National Heritage Council needs to be notified. A person who removes, demolishes, damages, despoils, develops, alters or excavates, all or any part of a protected place is liable to a fine of up to N$100,000 or to imprisonment for up to 5 years, or to both the fine and imprisonment. If damage is caused to a heritage place or object as a result of failure to comply with the Act, the person responsible must remedy the damage, failing which the Council may itself take the necessary action and recover the cost from that person. Declared World Heritage sites such as the Brandberg are required to have legal protection status according to Article 5 of the World Heritage Convention (of which Namibia is a party). Section 55 of the Act grants the Council the ability give an order to stop any activity or development that is being carried out in or on any area of land which is believed to be an archaeological or palaeontological or meteorite site.

6.2.3 Socio-economy, services and planning

There is no legislation in Namibia that requires the preparation of a coherent, national and regional land use framework but it is envisaged that this will be introduced when the Draft Urban and Regional Planning Bill is enacted. Currently the establishment of towns and the subdivision of land are regulated by the **Townships and Division of Land Ordinance of 1963** while the development and application of town planning schemes is regulated by the **Town Planning Ordinance, 18 of 1954**. Both these Ordinances must be read with the Local Authorities Act 23 of 1992.

The **Decentralisation Enabling Act, 33 of 2000** established procedures for decentralising governmental powers. The Minister responsible for regional and local government matters may transfer the responsibility of a specific government function from the 'line ministry' to a regional or local authority. The **Regional Councils Act, 22 of 1992** provides for the establishment of regional councils while the **Local Authorities Act, 23 of 1992** establishes local authority councils. It also sets forth the powers, duties and functions of such councils. Local authorities are given wide-ranging powers including: to supply water to residents; to provide and maintain sewerage and drainage systems; to provide waste removal services; to supply electricity or gas to residents; to establish and operate sand, clay, stone or gravel quarries; and to promote tourism. However, the Act does not oblige local authorities to address environmental conservation.

The **Namibian Ports Authority Act, 2 of 1994** establishes the Namibian Ports Authority (NPA) to undertake the management and control of ports in Namibia and the provision of related facilities and services. The **National Planning Commission Act, 15 of 1994** empowers the National Planning Commission to plan the priorities and direction of national development. In reality, individual ministries do their own sector planning, and coordination is minimal. The Ministry of Regional and Local Government, Housing and Rural Development is responsible for spatial land use planning at a regional level, while the Ministry of Lands and Resettlement is in charge of land use planning for communal land in rural areas. State owned land is controlled by the Ministry of Works, Transport and Communications but the Ministry does not routinely undertake land use planning. The Ministry of Environment and Tourism has on occasions undertaken land use planning in respect of areas designated as parks.

The **Town Planning Ordinance** makes provision for the preparation and carrying out of town planning schemes which, *inter alia*, must adequately address: drainage and sewage disposal; regulation or control of the deposit or disposal of waste materials and refuse; zoning of areas for residential, business, industrial, and other specified purposes; and the preservation of buildings or other objects of architectural, historic or artistic interest and places of natural interest or beauty.

The Namibia Planning Advisory Board (NAMPAB) advises the Minister of Local Government and Housing in relation to town planning matters. The **Draft Urban and Regional Planning Bill** provides for the establishment of national, regional and urban structure plans, and the development of zoning schemes. It also deals with a variety of related land use control issues such as the subdivision and consolidation of land and the establishment and extension of urban areas. The Bill will likely promote health, safety, order, amenity, convenience and environmental and economic sustainability in the process of development.

6.2.4 Radiation protection

6.2.4.1 National laws

Namibian legislation concerning ionizing radiation is contained in the **Atomic Energy and Radiation Protection Act** (Act No. 5 of 2005). The Act fills a gap that was created when the Minerals Act of 1992 repealed previous pre-independence nuclear energy and radiation protection legislation and it also amends the Hazardous Substances Ordinance (Ordinance No.14 of 1974), specifically with respect to hazardous substances that constitute radiation sources or radioactive materials. The Act provides for:

- Adequate protection of the environment and people in current and future generations against the harmful effects of radiation by controlling and regulating the production, processing, handling, use, holding, storage, transport, and disposal of radiation sources and radioactive materials, and by controlling and regulating prescribed non-ionising radiation sources – by means of 'authorisations', 'licences' and 'registrations' as administrative tools (chapter 4);

- The establishment of an Atomic Energy Board and its composition and functions (chapters 2 and 3); and

- The establishment of a National Radiation Protection Authority (chapter 5).

Chapter 4 of the Act lists all activities requiring authorization, licenses, and registration, including: possession of radiation sources or nuclear material; importation or exportation of nuclear materials; disposal of nuclear materials; operation or use of radiation sources; and storage of radiation sources. Licences are issued by the Director-General of the National Radiation Protection Authority, who is a secretary of the Atomic Energy Board (AEB). Licences can be cancelled by the Director General if registration or licensing conditions are no longer being met. Licensees are responsible for the protection of health, safety, security, and the environment and for respecting Namibia's international commitments.

Two sets of (draft) regulations have been drafted to assist in the implementation of the Act[1]:

a) **Regulations for Protection Against Ionizing Radiation and for the Safety of Radiation Sources** (MoHSS, 2008a); and

b) **Regulations for the Safe and Secure Management of Radioactive Waste** (MoHSS, 2008b).

Both of these Regulations are directly relevant to the uranium mining industry. Protection of workers and the public from additional ionizing radiation forms a major part of the public responsibility of the mines, and the management and containment of radioactive waste, both during operation and after

[1] Both sets of regulations are expected to be gazetted in the near future, possibly still in 2009.

closure of the mines, presents one of the environmental aspects which requires comprehensive management plans and monitoring programmes to be developed.

Both sets of regulations are envisaged to be finalised and promulgated in the course of 2009 (or early 2010), with inputs and advice from the Atomic Energy Board (AEB). Once promulgated, the regulations, along with the Act, will constitute a legal and regulatory basis for the National Radiation Protection Authority (NRPA) to enforce its provisions, including the licensing and monitoring of establishments (like uranium mines) working with sources of radiation.

The Ministry of Health and Social Services (MoHSS), the lead ministry for matters concerning atomic energy and radiation has developed the concept of a **Radiation Management Plan** (RMP) into an operational instrument that forms the basis of any licence applications and is the pre-requisite for any government authorisations under the Atomic Energy and Radiation Protection Act. Each operator handling radiation is now required to develop and submit a RMP addressing applicable aspects of radiation safety. The RMP is conceived as a comprehensive document describing organisational and technical arrangements to be put in place to satisfy the requirements of the Act and its Regulations. MoHSS has issued detailed guidelines for the development of a RMP in support of applications for authorisations under the Act (MoHSS, 2009).

Just like any other operator or practice handling radiation, each new uranium mine will now be required to prepare and submit a RMP for review and approval by the NRPA prior to the issuance (or refusal) of an authorisation and licence by the Authority – and to implement the RMP once approval has been obtained. The RMP will be the basis for ongoing monitoring and verification by the Authority. It can also be expected that each operating mine (RUL and LHU) will be required to submit a RMP in due course for purposes of ongoing monitoring and verification by NRPA. In their RMP, future and existing mines need to address the management of both occupational and public radiation exposures.

6.2.4.2 International organization(s)/networks

The **International Atomic Energy Agency (IAEA)** is the world's centre of cooperation in the nuclear field. It was set up as the world's 'Atoms for Peace' organisation in 1957 within the United Nations family. The Agency works with its Member States[2] and multiple partners worldwide to promote safe, secure and peaceful nuclear technologies. The IAEA's mission is guided by the interests and needs of Member States, strategic plans and the vision embodied in the IAEA Statute. Three main pillars - or areas of work - underpin the IAEA's mission: safety and security; science and technology; and safeguards and verification (www.iaea.org). It is under the aegis of the latter that IAEA conducts regular inspections of the uranium mines in Namibia. The codes of practice for both Rössing and Langer Heinrich have been inspired by the IAEA's International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (IAEA, 1996, 2004).

The **International Commission on Radiological Protection (ICRP)** is an independent Registered Charity, established to advance for the public benefit, the science of radiological protection, in

[2] Namibia is a member of IAEA.

particular by providing recommendations and guidance on all aspects of protection against ionising radiation. It is an advisory body, providing recommendations and guidance on radiation protection, but the responsibility for formulating specific advice, codes of practice, or regulations is left to the national protection bodies of each country. In the case of Namibia, this would be the newly formed Atomic Energy Board for example. While the ICRP has no formal power to impose its proposals on anyone, legislation in most countries adheres closely to ICRP recommendations (www.icrp.org).

The **World Nuclear Association (WNA)** is the global organisation that seeks to promote the peaceful worldwide use of nuclear power as a sustainable energy resource for the coming century. It advocates collective responsibility and commitment by all players to the safe and responsible management of the uranium product. The Chamber of Mines of Namibia supports the concept of stewardship, which involves the care and management of uranium throughout its entire lifecycle (CoM, Annual report, 2007).

6.2.5 Mine closure

The **Minerals (Prospecting & Mining) Act, No 33 of 1992**: stipulates in Sections 54 and 128 that the licence holder has to rehabilitate the land when it ends mining operations. The act also requires mining applicants to submit an environmental management plan prior to the granting of a mining licence but this does not include the closure plans. A fine of N$100,000 or five years imprisonment is imposed on any mining operator who fails to rehabilitate the mine upon closure.

The **Minerals Policy of Namibia, 2002** stipulates in sections 2.2.5 that mine closure should be well planned and communities should be involved while Government will ensure compliance to policies and guidelines during rehabilitation. Meanwhile contingencies will be provided by the Government in circumstances where, the mining company is forced to close in an unplanned manner (as in Scenario 4) and cannot be traced. This policy, just like the Minerals (Prospecting and Mining) Act of 1992, emphasises in section 53 the fact that mining companies should be responsible for their actions with the ‘polluter pays’ option, thus rehabilitation is a responsibility of the mining company while Government facilitates the process to ensure compliancy.

The **Namibia's Environmental Assessment Policy for Sustainable Development and Environmental Conservation, 1994** states that a binding agreement (based on the procedures and recommendations contained in the EIA report) to ensure that mitigatory and other measures recommended in the EA, and accepted by all parties, are complied with. This agreement should address the construction, operational and decommissioning phases in the mine closure process, as applicable, as well as monitoring and auditing.

Namibia’s Environmental Management Act 2007 requires mining companies to submit closure plans every three years and to provide guarantees for the rehabilitation of mining sites after closure.

6.3 Key conclusions and recommendations

Namibia has reasonably good environmental legislation, but the existing framework does not adequately protect the environment from abuse by some mining companies. However, the implementation of corporate responsibility programmes and environmental management plans by all companies should help to ensure a high degree of environmental awareness and best practice management. The following recommendations are suggested to improve the current situation:

6.3.1 Modification of Proposed and Existing Legislation

Strengthen the **Environmental Management Act 2007** by:

- Amending section 57(1) to allow existing projects only one year to submit an application for an environmental clearance certificate, removing the minister's discretion to grant any further extensions;
- Adding a provision that defines EIA circumvention as a form of corruption punishable by criminal law; and
- Adding a clause to the Act that requires the development of an Environmental Management Plan (EMP), which should be developed from the findings of the EIA.

Establish detailed and appropriate regulations to allow for the enforcement of the Environmental Management Act 2007. These regulations should include at a minimum the following provisions:

- Ensure that all life cycle costs are identified in the EIA report, including the cost of reclamation, closure, re-contouring, land stabilisation, post-closure monitoring and maintenance. Mine sites should be rehabilitated to their natural or pre-determined states or to a generally accepted level for future use of the area;
- Set minimum standards for an EIA, so that both process and content are of an acceptable quality, and the information presented is accurate, reliable and useful;
- The structure of Records of Decision (ROD) should be reviewed to include much more precise and detailed information, specifically with respect to: the criteria used in making the decision; reasons for arriving at a decision; transfer of rights and obligations if there is a change of ownership of the project or property; and specific conditions to protect the environment;
- Define a mechanism for the establishment and governance of a rehabilitation and restoration fund that will enable proper management of project closure; and
- Provide mechanisms for public or civil society involvement in monitoring of projects, whether in parks or elsewhere, so that vigilance is enhanced and broad based.

Improve and pass the **Parks and Wildlife Management Bill 2009** as follows:

- Create a legal mechanism for identifying and classifying parks to ensure their adequate protection;
- Establish protected areas or parts thereof that will not be available for prospecting or mining. Section 23(1) creates a discretionary process whereby the minister of the MET may agree in

accordance with the Minerals Act upon ‘no go’ areas, but the law should require that the minister must use this power;

- Create provisions whereby designations of areas declared off limits under section 25(1) may only be altered or revoked by an Act of Parliament.

Amend the **Minerals Act 1992**, requiring mining licence applicants to make, adequate and sufficiently liquid financial provisions for the costs of mine closure, including reclamation, long-term monitoring, and maintenance. Also, the Act must require MME to conduct background checks on corporations as well as individuals to look for history of prior environmental violations or other illegal practices. The Act must clearly establish the legal criteria applicable to proposals for mining within parks. At present, mining projects proposed for parks are treated the same as any other proposal.

6.3.2 Increase Enforcement and Proper Implementation of Current Law

The fees due for all permits and applications at present are both insubstantial and not effectively collected by the reviewing body, this leads to a general non-payment of fees.

There needs to be improvement in the way that DEA sets conditions that proponents must adhere to when they are authorised to proceed with their project. Currently, many RODs are vague and very short on detail.

Ensure quality control in the EIA guide and review process by screening unethical or unqualified EIA consultants out of the system.

Use independent experts to help with assessments, inspections, and audits to remedy any lack of technical expertise among ministry staff.

Appoint an Environmental Commissioner to enforce the EMA and, through that office, ensure that regular inspections are undertaken of projects in the field.

7 CUMULATIVE EFFECTS ANALYSIS OF THEMATIC ISSUES

7.1 Introduction

Chapter 7 presents a thematic analysis of the cumulative effects of the Uranium Rush on various components of the receiving environment of the central Namib, namely: public health, towns, transportation infrastructure, water, energy, recreation and tourism, biodiversity, archaeological heritage, macro-economics, education and skills, air quality, and institutional capacity and governance. These aspects represent the main areas of concern raised by the public and other stakeholders during the public participation process (described in Chapter 2).

The source data were taken from the specialist studies and theme reports prepared by the SEA team, which will be made available by MME. The information provided in these reports has been summarised in the following sections in order to provide:

- A concise statement of the issues relating to each environmental component;
- An analysis of the cumulative impacts on each environmental component;
- A statement, based on the Environmental Quality Objectives contained in Chapter 8, of the desired state of the environment during and after the Uranium Rush;
- A set of recommendations as to how to achieve this desired state, through the mitigation of the negative cumulative impacts and the enhancement of the beneficial effects of the Uranium Rush.

It should be noted that the intention of this chapter is to provide an analysis of the strategic or regional level cumulative impacts i.e. impacts felt beyond the Mining Licence area and thus the individual impacts which may be caused by each mine within their 'fence' are not specifically dealt with here – these are covered in each mine's EIA and EMP.

The cumulative effects analysis in this chapter is arranged topically as follows:

7.2 Towns	7.9 Macro-economics
7.3 Transport infrastructure	7.10 Education and skills
7.4 Water	7.11 Air quality
7.5 Energy	7.12 Radiation
7.6 Tourism and recreation	7.13 Community health
7.7 Biodiversity	7.14 Institutions and governance
7.8 Archaeology	7.15 Summary and discussion

7.2 Cumulative effects analysis on towns in the central Namib

7.2.1 Introduction

The Uranium Rush, particularly under Scenarios 2 and 3 (see section 4.5 for elaboration) is likely to impact on four key aspects of towns in the central Namib, namely sense of place, the incidence and type of crimes committed, the availability of affordable erven and housing, and waste management. Although each aspect is dealt with separately within this section, their combined influence in possibly creating undesirable, unaffordable, unsafe and unsustainable towns is implied.

7.2.1.1 Sense of Place

The concept of 'sense of place' is relative and highly subjective. To some people a specific place or town is unattractive, but to others it is the place where they choose to live or visit, and they may resist actions that cause its character to deteriorate.

In the context of the Erongo Region, Swakopmund is labelled 'beautiful with character, laid back and inviting'. This is evidenced by the fact that this is a popular tourist and holiday destination, sought after by property investors. The municipality requires new buildings to be 'consistent' with the ambience of the town so that sense of place can be maintained or enhanced and the centre of town has been declared a conservation area under the National Heritage Act. Henties Bay is even more of a holiday town, though there is no consistency in terms of architecture and planning, and a reduced sense of place. The same comment may be valid for the Langstrand/Dolphin Park areas.

Plate 7.2.1: Swakopmund has a coastal holiday sense of place
(Photo: courtesy of www.commons.wikipedia.org)

By contrast, Walvis Bay is regarded as an 'industrial town', since it has developed around the port and fishing industry (Plate 7.2.2). This implies that the authorities or indeed the public, are somewhat more tolerant of ‘ugly’ structures such as stacks, cranes, bulk-fuel reservoirs, coal heaps, shunting yards, etc. Also, the unpleasant odour from the fish factories is fondly dismissed as ‘the smell of money’. However, the municipality has tried to market Walvis Bay’s tourism potential, especially its prolific birdlife that includes charismatic species such as flamingos and pelicans. In this sense, one may think of Walvis Bay as having a ‘split personality’.

Plate 7.2.2: Walvis Bay is Namibia’s biggest port and has a more industrial sense of place (Photo Rössing).

In other towns, such as Uis, Arandis, Usakos and Karibib, sense of place is somewhat less nurtured. These towns are neglected, under-developed, poorly resourced and desperate for almost any kind of investment. In such cases, the authorities appear to work on an *ad hoc* basis, with no coherent plan or strategy.

The emerging consensus is that the Uranium Rush will almost certainly change the character of many Erongo towns. While urban development will be welcomed by many, particularly in the smaller towns of Arandis and Usakos, it was agreed that such development needs to be anticipated and properly planned.

7.2.1.2 Crime

It has been argued that crime is expected to increase in poor economic conditions and decrease in good economic times as a result of more jobs and income for people who would otherwise be tempted to commit crimes for economic gain (CS&CPC, 1996) (Bidinotto, 1995). However, much evidence points to the opposite, where improved economic conditions lead to an increase in crime (Lehrer, 2000). The expected influx of labour to uranium mines and the increase in revenue and disposable income for people in the area could therefore attract crime syndicates to the area.

Namibia’s overall rate of crime is relatively low compared to world standards. Its reported rates of theft and drug related offences are comparable to countries with the lowest incidences in the world. It does however have a relatively high rate of violent crimes such as assault and murder, but compared to other regions of Namibia, the Erongo region has a low rate of crime incidence (Shilongo *pers.comm.)*.

Incidence of crime is monitored for town districts in the central Namib by the Ministry of Safety and Security's regional police department. An analysis of crime incidents for this area over the period 2004-2009 revealed a decline in total crime[1] over the past five years (Figure 7.2.1). This is particularly evident for the last two years, and is reflected in Figure 7.2.2 which compares total crime for each town district individually.

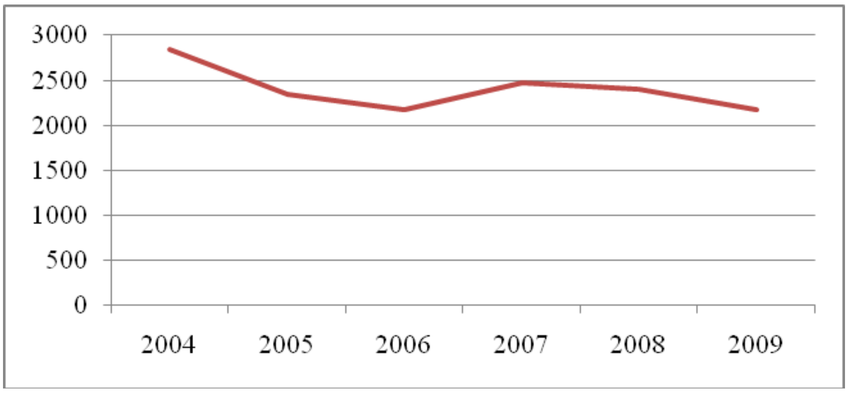


Figure 7.2.1: Total reported crime for central Namib town districts (Walvis Bay, Swakopmund, Arandis, and Usakos)

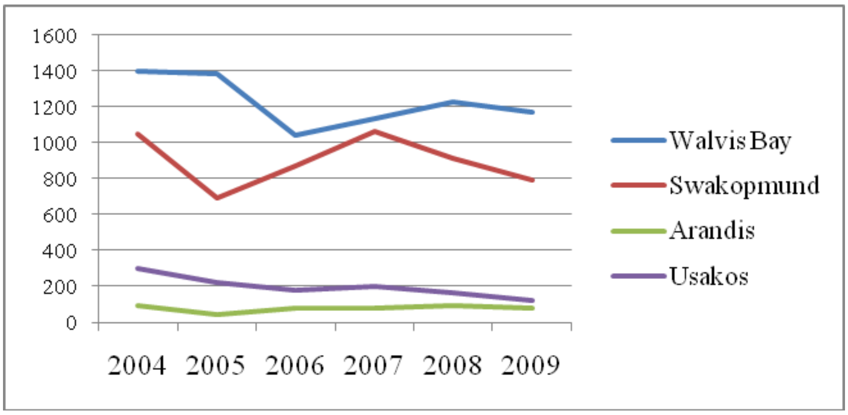


Figure 7.2.2: Total crimes reported for the four town districts in the central Namib

This improvement can be partly attributed to the increase in community policing which was initiated in 2007 (van Staden *pers. comm*). Communities partner police in patrolling areas of concern, and develop and implement crime prevention activities which complement official police operations. Changes in command in the regional structure since 2007 have led to greater efficiency in the use of available resources, which further contributed to the decrease in crime experienced over the past two years. The approach to law enforcement has changed from one of crime control to crime prevention (Shikongo *pers. comm*).

At the last census in 2001 it was calculated that there were 180 residents to each law enforcement official, and that this figure is still valid (Shilongo *pers. comm*). This compares favourably to the rest

[1] Crime incidents are categorized as: assault, drug-related crime, murder, robbery and theft.

of Namibia (average ratio 492:1). The average ratio for South Africa at the same time was 408:1 (ISS Crime index, 2000).

7.2.1.3 Property and erven availability in towns

Availability of land

Swakopmund is sought after for property investment, and sustained property price increases make this coastal resort largely unaffordable to low income earners. The municipality plans to make 2000 erven available to accommodate the expected influx of people due to the Uranium Rush, and to collaborate with the private sector (including mining companies) to develop the erven. The planning and servicing of new erven will take an estimated three years before they will be ready for construction of housing. In a special effort to accommodate low-income earners, the National Housing Enterprise (NHE) and the Municipality have entered into a contract to further extend Mondesa township, while discussions are underway to establish a Progressive Development Area for low cost housing. In addition, planning is underway for 850 erven to be developed in the so-called DRC township area. The Swakopmund Development Master Plan envisages the following intended housing extensions: Kramersdorf East, Northern Tamariskia Precinct, Northern Mondesa Precinct, Rossmund, and Mountainview Precinct. The Smallholdings will not be allowed to subdivide or be developed into housing estates in the short to medium term.

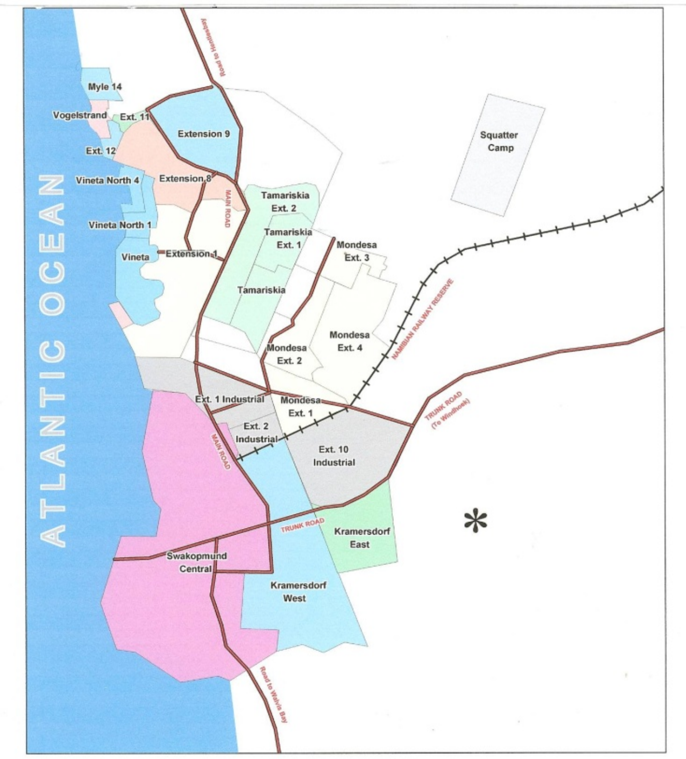


Figure 7.2.3: Swakopmund Structure Plan (SIAPAC, 2002)

Usakos has a stagnant economy and a small and relatively inactive property market. The municipality has approximately 200 serviced erven and an unknown number of unserviced erven that may be allocated to the mines for housing. The municipality has adequate land available but lacks financial resources to service the land. For low-income earners, the NHE has shown interest in providing the necessary support to acquire houses, while a Build Together Programme is administered by the municipality.

Walvis Bay is growing rapidly (5% per annum) as a result of current and proposed new developments. The Municipality recently allocated approximately 900 erven to the NHE to develop. Another 100 have been allocated to smaller groups (savings schemes) of local people. In Kuisebmond and Narraville approximately 300 erven are being serviced and made available. The Walvis Bay Municipality intends extending Meersig, Kuisebmond, Narraville and the CBD, and developing an upmarket golfing estate.

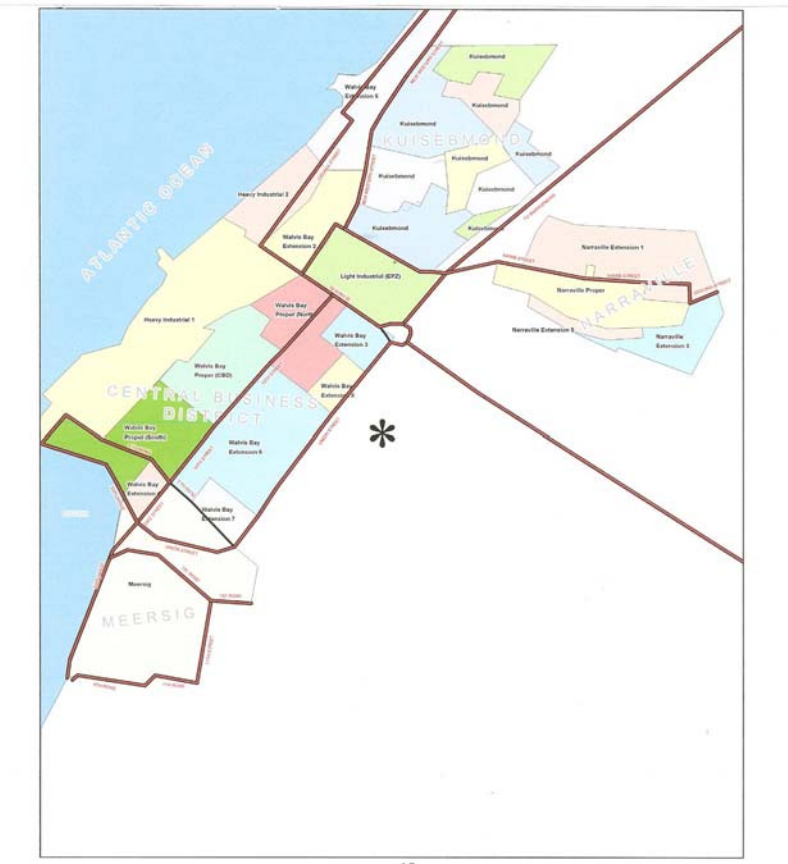


Figure 7.2.4: Walvis Bay Structure Plan (SIAPAC, 2002)

Plate 7.2.3: Servicing of erven in Kuisebmond, Walvis Bay (photo M. Hauptfleisch).

Arandis was established in 1976 by Rössing to cater for its low-income employees. The property market in Arandis is relatively inactive, but this is expected to change as more people move to Arandis because of the availability of affordable housing. The Town Council is trying to diversify its economy by providing additional plots for industrial, commercial and residential developments. Affordable land will be offered to mainly the lower and middle income segments of the community, and mining companies are being encouraged to initiate developments at Arandis (see section 7.2.2.1).

Table 7.2.1: Total available erven in towns and expected demand from Scenario 2 of the Uranium Rush

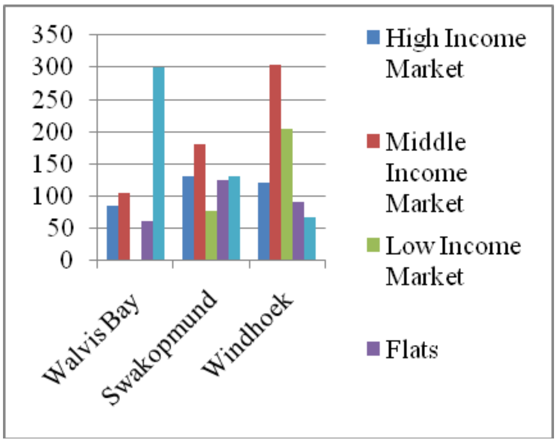
Town	Commercially available houses and erven (July 2009 survey)	Erven being made available by municipalities	Expected new erven required to service the Uranium Rush (estimated from scenario 2)	Percentage of demand met by current and planned erven and housing
Swakopmund	642	2,850	3,906	89%
Walvis Bay	550	1,300	516	100% +
Arandis		No formal plans	900	0 %
Usakos		200+	516	39%
Total	**1,192**	**4,350+**	**5,977+**	**93%**

Table 7.2.1 shows the planned availability of serviced erven in towns of the central Namib. As can be seen the expected demand of the Uranium Rush scenario 2 seems to be nearly met through available housing and planned developments. However disproportionate developments in different income categories of houses and erven, as well as a shortage of low cost housing in Arandis and Usakos, are a cause for concern. Section 7.2.2.3 below elaborates on this.

Property for sale and rent

The properties in the various categories for sale and rent in June 2009 are illustrated in Figure 7.2.5. These graphs show that the majority of available erven at the coast are mostly in the high and middle-income categories, while the poor majority continue to have an unmet demand. There was a shortage of low-income properties to rent in Swakopmund during the survey period, and none available in Walvis Bay.

The average waiting time for selling a property in mid 2009 was about 2-4 months. In Windhoek it was roughly the same, but it could take up to 12 months.



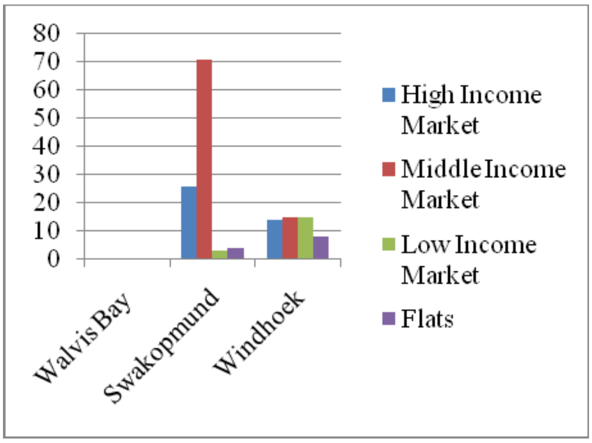


Figure 7.2.5: The number of properties for sale by town and category (left graph) and available for rent (right graph).

Trends in property prices

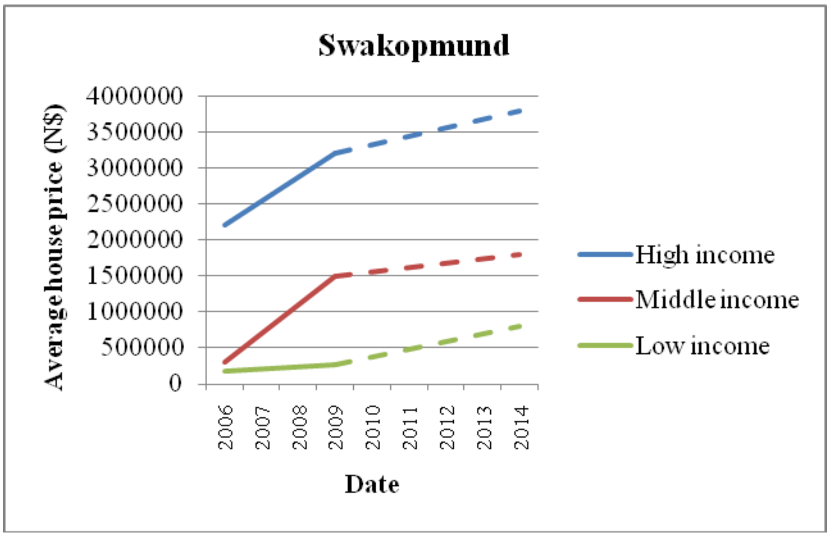
In all three towns, house prices in all categories have increased sharply over the past 3 years and are predicted to continue increasing in the future (Figure 7.2.6)[2]. Determination of house prices in the low income price category was difficult as there is not an active buy-sell market. This is partly as a result of buyers in this price category finding it difficult to get financing. Municipalities and programmes such as ‘Build Together’ and the National Housing Enterprise (NHE) are more influential in movements in low income housing than the free-market system.

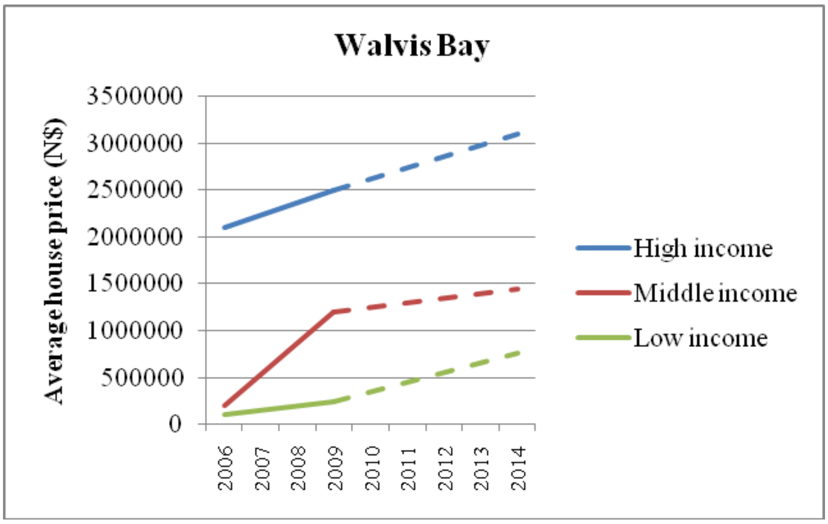
The price trends of **erven** were difficult to analyse because of the varying price regimes adopted by the market for this category of property. It was not possible to use the norm (price per square metre) because the market uses mainly auction, both public and silent, in handling erven. In Swakopmund, erven are sold by the municipality to private individuals only through public auction. Consequently

[2] Middle and high income category prices were determined through estate agent interviews, while low income category prices are based on average house price estimates by municipal development officials.

the average prices for erven shown in Figure 7.2.6 are a combination of the various methods used to value erven in the market.

The trend shown is a slow rise in prices in the past 3 years followed by a sharp rise for the projected 5-year timeline. The highest increases were expected for erven in the high-income category for Walvis Bay (N$525,000 to about N$1,600,000). A general observation was that erven are currently out of reach and will continue to be out of reach of the majority working class.





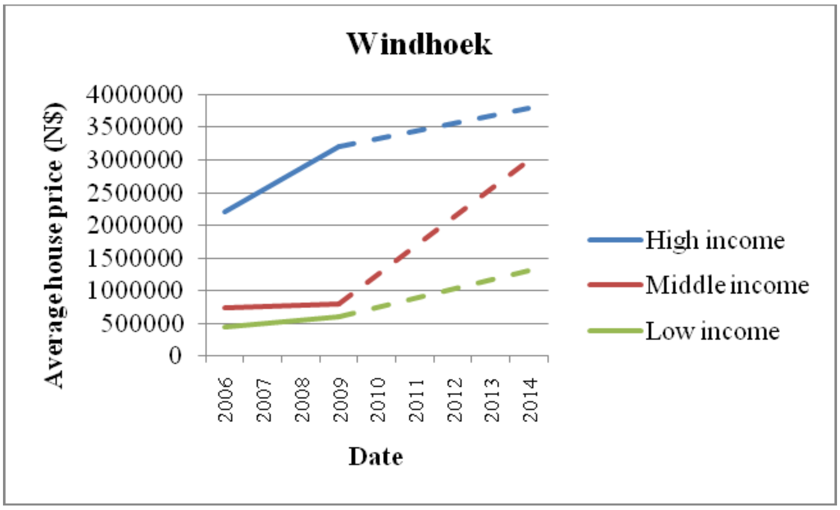


Figure 7.2.6: Past and predicted future price trends for houses

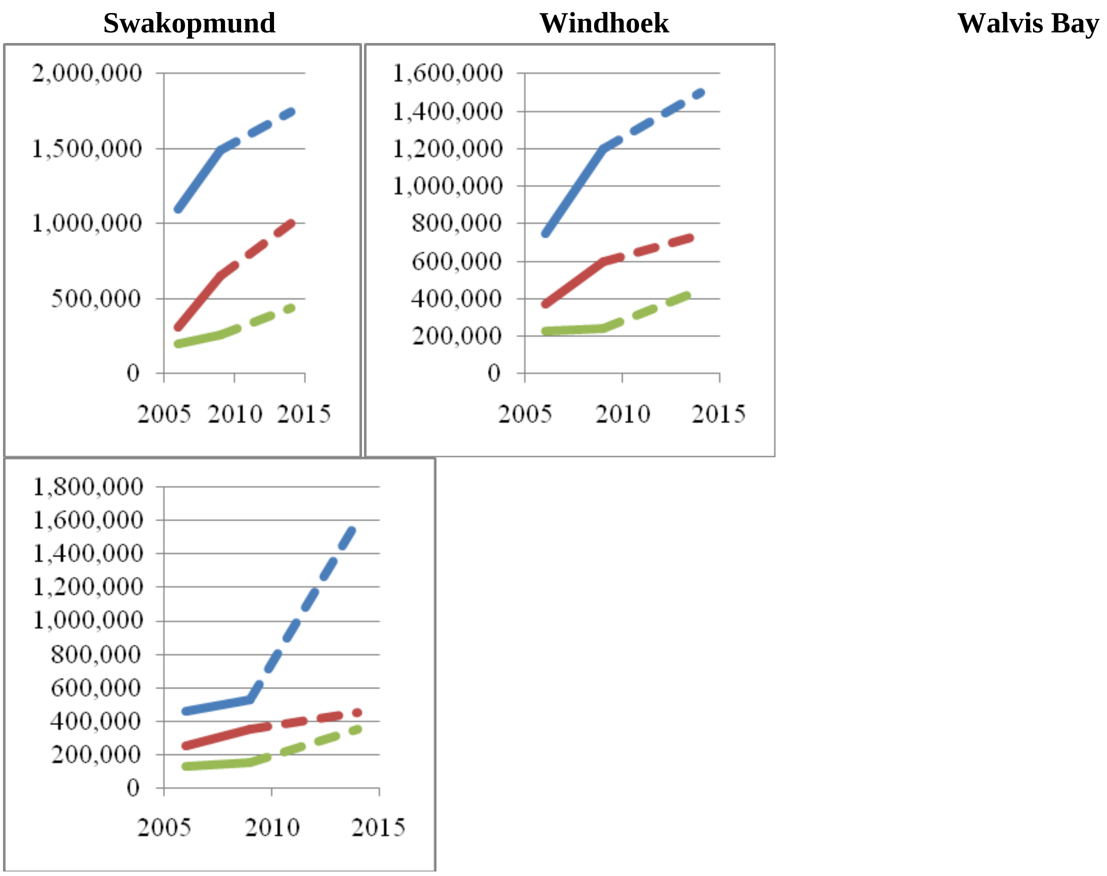


Figure 7.2.7: Long-term erven price predictions (blue/top line = high income areas, red/middle line = middle income and green/bottom line = low income).

7.2.1.4 Waste management

Waste likely to emanate from the mines and associated industries can be divided into three main types:

- General domestic waste, a broad category consisting of normal household waste from domestic sources as well as businesses and industry;
- Special waste, referring to large volume waste such as building rubble, obsolete machinery and garden refuse; and
- Hazardous waste, which refers to waste composed of hazardous substances defined in the draft Pollution Control and Waste Management Bill as '*any pesticide, herbicide or other biocide, radioactive substance, chemical or other substance and any micro-organism or energy form that has properties that, either by themselves, or in combination with any other thing, make it hazardous to human health or safety, or to the environment, and includes any substance, micro-organism or energy form defined as a hazardous substance in (future) regulations*'.

Although general domestic waste and special waste can both be classified as non-hazardous waste, the distinction between them is due to the fact that there are separate disposal facilities for these two types of waste.

Domestic waste

If the uranium mines practise recycling of all non-hazardous wastes such as paper, glass, plastic, wood, cardboard etc, then the remaining volumes of domestic waste which needs to be disposed of at official municipal landfills will be very small. However, there will be a significant increase in the number of people living in the coastal towns who will add to the municipal waste stream.

Special waste

High volumes of special waste in the form of discarded machinery, building rubble and scrap metal are produced by mines. Much of this waste is stored in salvage yards where it is reused on site or recycled through scrap metal dealers. Disposal sites for domestic and special waste exist in Swakopmund, Walvis Bay, Arandis and Usakos. These sites were designed to support the disposal of both these types of waste from the towns only and have not made provision for increased volumes of waste as a result of mines specifically. Walvis Bay is expected to have sufficient capacity to meet expected increases for the next 20 years but does not have a quantified estimate of waste volumes from the mines. The Swakopmund landfill is approximately 150,000m^2 in area, has sufficient capacity for the next 10 years and can expand at minimal cost and effort when required. Usakos has a landfill site which is currently uncontrolled and unfenced. No waste separation takes place at this site and there is a concern that even current volumes cannot be adequately contained.

Best practice requires that waste should be managed according to the waste management hierarchy of avoidance, reduction, recycling, treatment and disposal. This implies that low volumes are expected to be disposed of in landfills. Mines have on-site landfills for the low volumes of domestic waste, and salvage yards where special waste such as material off-cuts, and scrap metal are stored for re-use or reclamation by scrap dealers. To comply with the proposed regulations of the draft Pollution Control and Waste Management Bill, any on-site landfill for domestic waste would need to be licensed, or alternatively, waste needs to be taken to the nearest licensed municipal landfill site.

Hazardous waste

The uranium mines produce different types of hazardous wastes, such as explosives (e.g. old detonators), flammable liquids and solids (oil, solvents, sulphur dust), oxidising (e.g. sulphuric acid), toxic and infectious substances (e.g. medical wastes from the mine clinics), radioactive materials (mining and process plant wastes, depleted radioactive sources etc), corrosive substances such as caustic soda, sodium bicarbonate, and miscellaneous dangerous substances such as fluorescent tubes, tyres, vehicle batteries, etc.

Much of this waste is recycled either back via the suppliers e.g. spent chemical containers and depleted radio-active sources, or through specialist waste recycling companies e.g. oil, batteries. The large volumes of low-grade radioactive mining waste such as low grade ore, depleted tailings and heap leach residues are disposed of on licensed sites at the mines. The management of these radioactive mine wastes is governed by a new, separate policy and legal regime – the Atomic Energy and Radiation Protection Act, 2005 and its Regulations for the Safety and Secure Management of Radioactive Waste (see Chapter 6). At present there are only two hazardous landfills in Namibia: at Kupferberg near Windhoek and at Walvis Bay. The City of Windhoek is reluctant to accept hazardous waste generated in other parts of the country and hazardous waste is only accepted by prior arrangement.

The Walvis Bay waste disposal site is owned and managed by the Water, Waste and Environmental Management Department of the Walvis Bay Municipality, and comprises hazardous and non-hazardous sections. The Walvis Bay site is the nearest hazardous landfill for the waste which will emanate from the uranium mines and related industries in the central Namib and thus is the most critical in terms of capacity constraints.

The Walvis Bay hazardous waste landfill, built in 2001/02, was designed and constructed as an H:h landfill with a triple lining, leachate collection drains and pollution control systems. The site accepts all classes of hazardous waste except radioactive waste. There are strict controls at the site including security fencing, a weighbridge and all waste consignments are inspected and recorded on entry by a Hazardous Waste Inspector in terms of source, volume and types of waste.

The Walvis Bay site has a total volume of 4,500 m^3. It is currently about 25% full, (i.e. there are 3,375 m^3 available), but it has been designed so that it can be expanded upwards.

7.2.2 Analysis of cumulative impacts

7.2.2.1 Impacts on Sense of Place

As a result of the Uranium Rush, and particularly under Scenarios 2 and 3, it is highly likely that an industrial area will develop just north of Swakopmund, and include chemical and fertiliser plants, a desalination plant, salt and other mines (some already there), more powerlines and extended railway infrastructure. There will be housing developments to the north and east, and at least three new shopping centres, additional schools, increased traffic, less parking, more noise and congestion. Perhaps the ‘holiday’ atmosphere of central Swakopmund can be maintained, but the ambience in outlying areas will be different.

Walvis Bay will continue to grow rapidly as an industrial hub, with port expansion, new power stations, increased heavy traffic, and housing extensions both eastwards and northwards, inevitable. The pressure for more areas for beachfront properties will intensify and it seems likely that the Walvis Bay-Swakopmund coast will become more developed. Also, it seems probable that high-rise apartments will be constructed in this area as space becomes limited.

The volume of traffic on all Erongo roads will increase, with areas of greatest concern being between Walvis Bay and Swakopmund – a stretch of road already notoriously dangerous, the B2 to Windhoek and the C28 gravel road (see Section 7.3 for greater analysis).

Towns such as Henties Bay and Wlotzkasbaken will probably remain holiday destinations, but additional erven will be developed at both localities and their seasonal populations will increase significantly. By contrast, Uis and Karibib may not change much because they are further away from the zone of influence.

It is hoped that new investments will be made in Arandis and Usakos. These are the two towns where the Uranium Rush could radically improve socio-economic conditions, through for example:

- An increase in population and employment;
- Improved spending power;
- More shops and services (banks, garages, internet cafes);
- Improved health care facilities (clinics, ambulance services);
- Industrial developments, e.g. the proposed soda ash plant at Arandis;
- Increase in SMEs and support service industries
- Development of a transport hub at Arandis;
- Possible development of a recycling centre for the entire region at Arandis.

These developments and others are likely to transform towns like Arandis and Usakos and thus place their economies onto a more sustainable footing.

Plate 7.2.4: Urban expansion in Swakopmund (left) and construction of the jetty at the Wlotzkasbaken desalination plant (right). These examples of urban expansion are unavoidable consequences of the Uranium Rush, yet should be planned and designed for least negative impact (photo P.Tarr).

7.2.2.2 Impacts on crime in the central Namib

As mentioned above, the expected influx of labour to the uranium mines and the increase in revenue and disposable income for people in the area may lead to an increased incidence of crime in the following ways:

1. The populations of towns in the area are expected to increase. This is as a result of an influx of more than 3,000 direct mine employees under Scenario 1 (see Table 4.3 in Chapter 4), more than 6,000 employees under Scenario 2, and >7,000 employees in Scenario 3. With an average of four dependents per employee, a total increase of up to 28,000 people can be expected as a result of direct employment at uranium mines. In addition to this there is likely to be an influx of aspirant workers looking for employment opportunities in the area. Mining support industries, social services and retail businesses are likely to add to the population expansion as they increase their workforces to satisfy mining service industry requirements. The increased population is expected to cause a proportional increase in crime;

2. Unemployed job-seekers attracted to the area may become disillusioned if they do not find employment at the uranium mines, and may turn to crime;

3. The Uranium Rush will increase the amount of disposable income, assets and cash circulation and this is likely to attract organised crime into the region;

4. The increase in disposable income for mine employees may increase spending on social ills such as alcohol abuse and commercial sex (Trekkopje, 2008) for which recent trends are indicating an increase in incidence already.

In addition to an increase in crime, it is expected that the types of crimes committed may change. According to SADC (2004) most mining employees are males between the ages of 18 and 49 and are often migrant workers residing in isolated areas with few recreational activities, which encourages prostitution. This is especially true when workers are housed in hostels at the mines, rather than being integrated with their families in the local towns. .

7.2.2.3 Impacts on the availability of affordable erven and houses in towns of the central Namib

The expected influx of people into the Erongo region will include those employed in the formal and informal sector, as well as job-seekers. Those who cannot buy a house will rent, exacerbating the existing shortage of houses for rent. Given that rental prices in towns like Swakopmund are already prohibitive for mine workers of the lower grades[3], they and the unemployed will seek properties in low-income areas. Consequently, there is likely to be an increase in demand for housing in the smaller towns such as Arandis and Usakos, where fewer serviced erven/houses are available. This in turn could also lead to an increase in land and house prices in those towns.

The main concerns are that the low-income market is already too highly priced for this group, their spending power (at individual level) is limited and the Uranium Rush will result in increased demand. A further problem is that erven prices are unaffordable. Even if land is made available at a subsidised price, escalating building costs are inevitable. Even locally available materials (e.g. building sand) will likely double in cost in the near future (currently N$120/$m^3$) because local sources (the lower Swakop River) are depleted/ unavailable, and more distant, alternative sources may require expensive transportation.

Housing shortages and escalating prices will likely lead to an increase in the number of informal housing developments[4] and increased demand for services from the municipalities. In the long term, current property development plans will have been implemented, and prices will stabilise.

Middle and high-income employees will likely prefer to live in Swakopmund and Walvis Bay, where housing shortages are expected in the short term. In the long term, there should be a stabilisation and greater availability of property for these categories, as property owners and developers make properties available.

7.2.2.4 Impacts on waste management

The mines and associated industries themselves will not contribute much to the domestic/special waste streams of the local towns, but the likely significant increase in population (as described above) will mean that there will be a concomitant rise in the amount of domestic waste. This will put pressure on existing landfills at all the towns, as well as on the ability of the municipalities to cope with the greater waste stream in terms of staff resources, waste removal vehicles etc.

[3] For example, RUL grade 2-6 workers earn approximately N$6,069 – N$8,164, inclusive of housing allowance which ranges from N$2,230 – N$2,510; grade 10 and above earn N$13,967 – N$29,899 inclusive of housing allowance of N$3,479 – N$4,750

[4] These will be occupied by people who have been out-priced by the increase in the rental prices as well as those who have recently arrived in these towns.

No figures are available regarding the estimated quantities of hazardous wastes that may be generated by the mines directly and the amounts that may be generated by new or expanded related industries in the coastal area, and so it is unknown whether there is sufficient space available for the anticipated increase.

7.2.3 Desired state

The desired state in terms of sense of place is that towns in the central Namib develop as a result of the economic impacts of uranium mining, but do not lose their particular character or attractiveness, causing quality of life to decline. This implies that Swakopmund and Henties Bay retain their ‘holiday town’ ambience through creative planning and provision of adequate services. Distribution of economic and social benefits should be reasonably even throughout, ensuring that Arandis and Usakos gain sufficient economic and social benefits to become sustainable towns. To this end, mine worker hostels on the mines should be actively discouraged, such as those being planned at Valencia.

Towns in the central Namib should remain safe, or even become safer as a result of the Uranium Rush. Stable or even reduced crime incidence should be seen in the town districts of the central Namib despite an increase in the population of the region as a result of the Uranium Rush.

Erven and houses in towns of the central Namib should be available and affordable. Every Namibian should have a fair opportunity to acquire serviced land in the Erongo Region, and have access to acceptable shelter in a suitable location at a cost and standard which is affordable to the individual on the one hand and to the country on the other.

Every effort must be made to re-use, recycle and minimise the expected domestic, industrial and hazardous waste streams. This needs to be encouraged through the availability of recycling sites e.g. at Arandis, financial and other incentives. However, there will still be waste that needs to be disposed of in a municipal landfill. This waste needs to be managed in a safe, responsible and legally-compliant manner, meaning that there needs to be sufficient capacity in the existing licensed waste disposal sites to accommodate the amount of waste that will be generated by the mines and urban residents without causing pollution to the air, soil or water.

7.2.4 Recommended avoidance / mitigation or enhancement measures

7.2.4.1 Impacts on Sense of Place

Town planning should include zoning restrictions which need to be upheld to ensure that inappropriate and conflicting land-use and development is not allowed. In addition, planning safeguards need to be in place and enforced to avoid fast tracking and circumnavigation of due process. The use of EIA as a planning tool cannot be overemphasised.

Basic social infrastructure (shops, schools, sports facilities, parks, police, health facilities, ablutions, waste removal, sewerage systems) must keep pace with urban expansion. Competent town planning should be supported by the mining companies to ensure that social infrastructure remains adequate regardless of the increases in population expected under Scenarios 2 and 3. This is especially true for the smaller towns of Arandis and Usakos.

7.2.4.2 Impacts on crime

Recent trends of involving communities in crime-fighting initiatives have proven to be successful; any community initiatives should be promoted and supported by mining companies associated with the Uranium Rush.

Uranium mining companies should, as part of their initial planning phase, include community policing and crime prevention into their security and social structures. This should be done in collaboration with the regional police, local authorities and political parties, to ensure integration with and strengthening of crime prevention activities in the area.

7.2.4.3 Impacts on availability of erven and houses

The following recommendations are made to ensure that a sufficient number of houses and erven are available for purchase and rent respectively.

Town planning (Integrated Development Planning)

Integrated Development Planning is a key principle that should be used to ensure that town planning pro-actively makes available serviced erven for property development in all the Erongo towns. Zoning plans need to be drawn up to ensure that development is planned in an orderly fashion and that conflicting land uses are avoided.

Private-public development partnerships

To mitigate the impacts of increased demand for property from Scenarios 2 and 3 of the Uranium Rush, private property owners may not have a major role to play. The onus is on parastatals such as the National Housing Enterprise (NHE), the government run Build Together programmes and the uranium industry to provide affordable housing for particularly the low-income group. They need to work together with municipalities to ensure that serviced land is made available at reasonable cost to limit the negative impacts of the Uranium Rush.

Affordability of house prices

Estate agents need to advise their clients in a responsible manner about the sale price of their houses – typically within 10% of the bank valuation, to ensure that prices of houses remain affordable. This is a very difficult mitigation measure to implement in a free-market system, however trends in houses not being sold within four months of being offered, and house prices exceeding bank valuations by more than 10% would indicate artificial inflation of prices. Mining companies should not be allowed to dictate prices by monopolising preferred suburbs. Instead, social conscience should be pursued by investing in less desirable suburbs or towns (e.g. Usakos and Arandis), thereby aiding in improving the housing market in these areas.

Quality of housing

Municipal building inspectors need to ensure that houses built are structurally sound through appropriate design and professional building. Particularly with high volume low-income housing development there is a temptation to skimp on building quality in order to gain time and improve profits. This will require frequent inspections by the relevant authorities.

Availability of building materials

Raw materials (e.g. sand, stone, water) need to be readily available for development without causing undue environmental damage. Sand mines and stone quarries should be identified and established in appropriate areas using effective planning and EIA processes. The mining of these materials needs to take place in a formalised fashion with EMPs in place.

7.2.4.4 Waste management

It is recommended that the municipalities should proactively determine (in conjunction with each mine) the potential waste quantities which may be generated over the next 20 years and make plans and budget for an increase in disposal capacity – for all categories of waste.

All waste site managers need to be properly trained and competent and the municipalities must have sufficiently qualified staff resources to manage their waste sites in a safe, responsible and legally compliant manner.

All new waste sites (whether at the mines or in towns) must undergo an EIA and receive a licence to operate.

A sustainable waste recycling depot needs to be opened in the central Namib e.g. in Arandis, servicing the uranium mines and residents, in order to reduce the volumes of waste needing disposal.

7.3 Cumulative Effects Analysis – Transport Infrastructure

This analysis of the cumulative impacts of the Uranium Rush on transport infrastructure encompasses the following components: roads, railways, Port of Walvis Bay and airports.

7.3.1 Introduction

7.3.1.1 Roads

The national road network connects the Erongo region to the rest of the country via Okahandja, Windhoek and Otjiwarongo. The trunk roads between Windhoek, Okahandja, Swakopmund, Walvis Bay and Omaruru are tarred. Other major connections are gravel or salt roads (see Figure 7.3.1).

The roads in the central Namib are pivotal in several respects i.e.:

- Regional and national economy – Walvis Bay harbour forms a vital transport node on various international and regional trade routes. The main road from Walvis Bay via Swakopmund to Usakos (B2) forms part of the strategically important Trans Kalahari and Trans Caprivi corridors.
- Mining – roads link Walvis Bay harbour with the mines providing essential linkages for the import of raw materials and the export of uranium oxide. The roads are also the only link between the mines and the towns (accommodation, hospitals, schools etc.).
- Tourism – the majority of tourist destinations in the central Namib are in fairly remote locations and can only be reached by road or air. Most of the tourist activities are thus dependent on good quality roads, particularly the C14 between Walvis Bay and Solitaire, the D1982 between Windhoek and Walvis Bay over the Us pass, the C28 between Windhoek and Swakopmund over the Bosua pass as well as the B2 between Usakos, Swakopmund and Walvis Bay.

It is clear from the above that some roads are currently catering for a range of different traffic users:

The B2 from Walvis Bay to Swakopmund is highly congested with heavy port traffic, commuter traffic between Swakopmund and Walvis Bay, and tourists. In 2008, total traffic volumes on this road were estimated to be almost 4,700 vehicles per day and numbers have been increasing by 5% per year over the last 9 years. This is a tar road, with some passing lanes, but the differential traffic speeds and foggy conditions make this road very dangerous.

The B2 from Swakopmund inland up to Arandis and Valencia also carries a high volume of mixed traffic: heavy-duty port traffic, heavy-duty mine-bound traffic to Rössing, Trekkopje and Valencia, mine commuter traffic (buses and cars), delivery vehicles, and commuter traffic between Windhoek and the coastal towns. Traffic counts for the section of road between Swakopmund and Arandis show that the average daily traffic volume (light and heavy vehicles) in 2007 was 1,842. The counts are directional (eastbound), and it can be assumed that on average, the westbound daily directional volumes are similar. This road is tarred but it is deteriorating badly due to the increasing volumes of heavy traffic, especially on the stretch up to Arandis. There are no passing lanes and visibility along the first 50 km from the coast is often poor due to the fog.

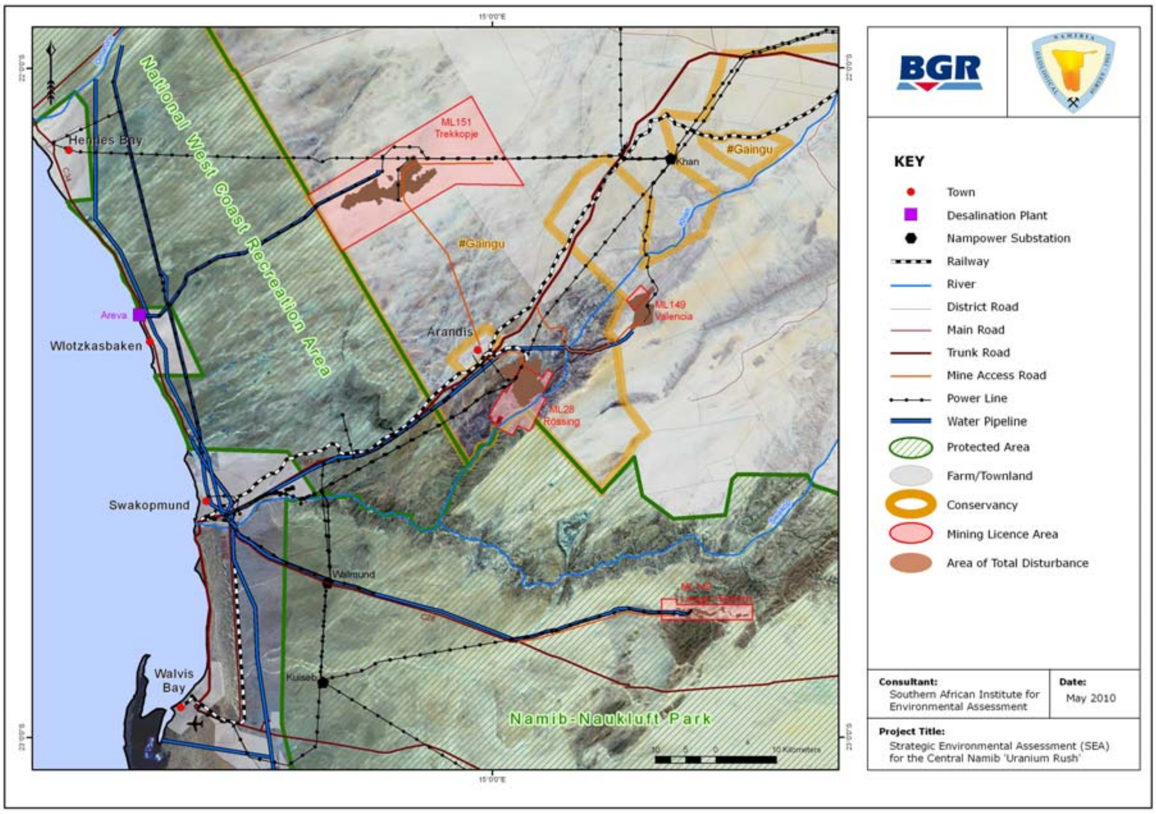


Figure 7.3.1: Scenario 1 – existing and planned infrastructure

The C28 from Swakopmund across the Namib-Naukluft Park to the Bosua Pass is busy from Swakopmund to the Langer Heinrich turnoff with a combination of heavy duty trucks making deliveries to and from Langer Heinrich, exploration drilling rigs and bakkies belonging to Bannerman, Reptile, Swakop Uranium and others, and tourists in self-drive and tour vehicles visiting the Moon Landscape and Welwitschia Flats. In 2008, an average of 177 vehicles per day was counted on this section of road. There is little through traffic to Windhoek. This road is a gravel road and therefore very dusty, but Langer Heinrich funded the tarring of 1 km long stretches to facilitate passing up to their turnoff. Although this road is on a scheduled grading and maintenance programme, the additional volumes of traffic from the Uranium Rush has meant that the road surface deteriorates quicker than it can be maintained, making it unpleasant and unsafe for tourists and other road users.

The C34 from Swakopmund north along the coast to Henties Bay is a salt road with an average of nearly 500 vehicles per day counted in 2008, due in part to an increase in heavy and light delivery traffic associated with the construction of the desalination plant at Wlotzkasbaken, uranium prospecting to the north, salt transport from Cape Cross, as well as tourists and recreational anglers.

It is clear from the above that the roads are struggling to cope with the current traffic volumes and some major construction work will be required in the next 3 years to accommodate the anticipated volumes of traffic during the construction of the mines and associated industrial developments. The projects currently envisaged by the Roads Authority (RA) over the medium term (5-10 years) are the following:

- Upgrade and surfacing of the C34 from Swakopmund – Henties Bay;
- Rehabilitation and widening of the B2 coastal road from Swakopmund – Walvis Bay;
- Upgrade and surfacing of the D1984 from Swakopmund to Walvis Bay (road behind the dunes) (Figure 7.3.1). This latter project is considered to be a priority in terms of this SEA. All heavy vehicles (except local traffic) should be directed to use this ‘new’ road, in order to relieve the congested and dangerous situation along the coastal road.

All of these projects will be subject to feasibility studies. A general guideline used to justify the surfacing of any particular road is when the daily traffic count exceeds 400 vehicles per day[1]. This however is only a guideline and depends on the composition of the traffic as well as the frequency of traffic peaks. At the moment, the RA does not anticipate any specific road upgrades to cater for the Uranium Rush. The strategy is to do regular traffic counts and to plan upgrading according to condition monitoring and the outcome of the traffic counts, i.e. reactive planning.

Unfortunately, it would appear that these upgrading projects may be too late for the peak construction period 2011-2013 and therefore there will be some significant cumulative impacts (see section 7.3.2).

7.3.1.2 Railways

The existing rail infrastructure traversing the project area consists of the single track linking Walvis Bay, Swakopmund to Usakos and then to Omaruru and Karibib respectively (Figure 7.3.1). This track is the only rail link from Walvis Bay to all inland destinations as well as several regional trade and

[1] Pers. Comm. Jean Nsengiyumwa, Roads Authority

freight corridors. The major function of this rail infrastructure is for the transfer of imported freight and fuel inland from Walvis Bay and export freight from inland to Walvis Bay.

A spur line connects the Rössing mine to the nearby mainline allowing the majority of freight to and from Rössing to be transferred by rail (Figure 7.3.1). The main commodities include: sulphuric acid, fuel, manganese and uranium oxide (product). The proposed new mines will also need to import bulk raw materials, the composition of which will vary according to each mine's process plant requirements. At present all reagents and fuel are imported through Walvis Bay harbour, but a private entrepreneur, Gecko Chemicals is currently conducting feasibility studies into the construction of various chemical plants to produce the required reagents, such as sulphuric acid, caustic soda, soda ash and bicarbonate. Irrespective of whether Gecko goes ahead or not, various options are being investigated by the mining companies to transport the bulk products to the process plants. One of the options being investigated is the use of rail. The possible new rail links being considered are shown on Figures 7.3.2 and 7.3.3 and include:

- A 28 km rail link between the existing line (east of Swakopmund) to the proposed Gecko chemicals plant (near Wlotzkasbaken) (see Section 4.4.3);
- A roughly 22 km rail link from the Rössing spur line to Rössing South;
- A roughly 30 km rail link between the existing railway east of the dunes to Etango;
- The potential to extend the above eastwards to the possible future Tumas-Tubas plant (at a site not yet determined).

Plate 7.3.1: Train transporting chemicals in the central Namib (photo Rössing).

The potential for rail-road and rail-pipe freight transport is being investigated, especially to those mines lying close to the existing railways i.e. Trekkopje, Valencia and Rössing South from the main east bound line, and Etango and Langer Heinrich from the north-south line behind the dunes. This would entail the construction of new sidings, shunting areas and rail-road or rail-pipe transfer facilities. The cumulative impacts of this proposed infrastructure are discussed in section 7.3.2 below.

7.3.1.3 Port of Walvis Bay

Walvis Bay has the only deep-sea harbour in Namibia and is of strategic importance for the south-west African coastline and many land-locked countries in southern Africa. The harbour is regarded as 'port friendly' due to minimal climate-related delays, relatively calm seas, low congestion, and reasonable handling efficiency. Strong growth has been experienced in the volume of cargo passing through the Walvis Bay harbour, most of this destined for Botswana and Zambia.

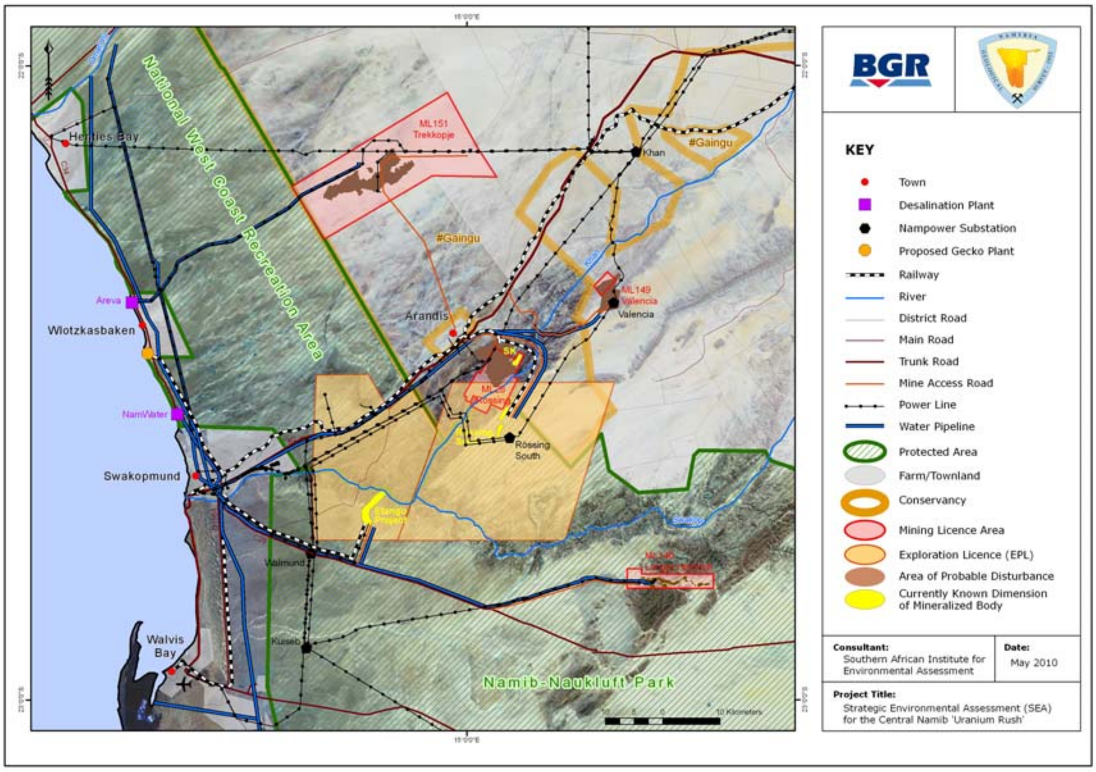


Figure 7.3.2: Scenario 2 Infrastructure (existing and planned)

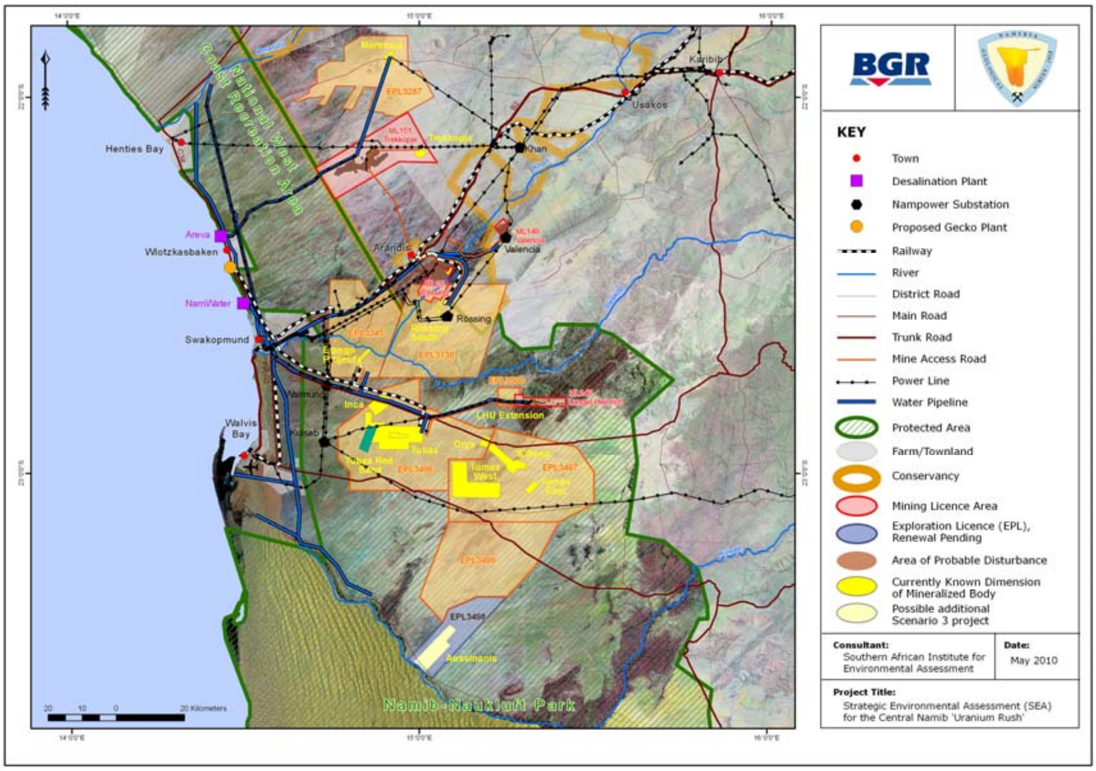


Figure 7.3.3: Scenario 3 Infrastructure (existing and planned)

Walvis Bay receives approximately 1,200 vessel calls each year and the port handles approximately 2.5 million tonnes of cargo per annum. The Port has experienced an increase of 37% in containers and a 13% growth in total freight tonnage over the last 5 years. The volume of chemicals imported for the mines as well as the volume of mined product (uranium) will increase proportionately with the accumulated production of all mines – indeed mine output could more than quadruple in the next 5-10 years (see Table 4.3 in Chapter 4). However, at present the volume of cargo associated with the uranium mines is relatively small compared to the total volume of cargo handled and shipped through the Port of Walvis Bay[2]. Even if the proposed Gecko Chemical plants supply the mines with process chemicals locally, there will be a demand for increased port capacity to import sulphur, coal and other bulk raw materials to meet the expected higher demands from the mining industry. This could have an impact on port activities, handling times and port infrastructure.

Another option being investigated by Gecko is the construction of a jetty between Swakopmund and Wlotzkasbaken. This jetty would only be for the import of bulk materials and would relieve congestion at Walvis Bay.

Nevertheless, NamPort is currently updating its Master Plan to cater for developments over the next 5-10 years, including the possibility of bulk coal imports for a coal-fired power station or a CNG terminal (see section 7.5). Possible projects include the deepening of the berths, turning basin and approach channels, as well as the expansion of the container terminal facilities to allow for larger container vessels at more berths. The need for this expansion is driven by the fact that the existing facility will reach its full capacity by 2011. The lack of availability of industrial land in the harbour (and Walvis Bay) is a major concern and any potential expansion will have to consider this limitation.

7.3.1.4 Airports

The main airport at the coast is the Walvis Bay International Airport and there are various other small public and private airstrips.

Since fresh fish is exported from Walvis Bay, the Walvis Bay airport has recently been upgraded to accommodate wide body aircraft flying directly to and from Europe. In addition, the airport is in the process of installing state-of-the-art, world class landing instrumentation that will enable flights to take off and land even during low cloud and foggy conditions, which frequently affect the airport.

The smaller airports (especially Swakopmund) service the tourism industry, which includes a growing number of tourists taking scenic flights over the desert and participating in extreme sports such as skydiving.

The proportion of air passengers and cargo related to the uranium industry is fairly small relative to overall air traffic in the region, therefore, the airport infrastructure is unlikely to be affected significantly by the Uranium Rush. Indeed, some of the smaller airstrips (e.g. near Arandis) may see some upgrades due to a potential increase in the number of mine-related private charters.

7.3.2 Analysis of cumulative impacts

The analysis of the cumulative effects of the Uranium Rush on the roads, railways, port and airports is described below and shown schematically in Figures 7.3.1, 7.3.2 and 7.3.3. It should be noted that the

[2] Pers. Comm. Elzevir Gelderbloem, Namport.

routes for all planned infrastructure are merely indicative at this stage to provide an idea of what impact the provision of infrastructure to the mines will cause.

7.3.2.1 Roads

The cumulative effects of the Uranium Rush on the roads essentially fall into two categories: increased volumes of traffic and demand for new road infrastructure.

Traffic volumes on the B2, C28 and C34 are expected to increase considerably as a result of the Uranium Rush, particularly under Scenarios 2 and 3, as shown in Figures 7.3.4, 7.3.5 and 7.3.6. These graphs compare current and projected normal growth in road traffic based on past trends and the cumulative increase of total construction and operations traffic. It can be seen in Table 7.3.1 that the highest increase in traffic volumes from the 2008 baseline will be on the C28, with a 72% and 80% rise in traffic numbers under Scenarios 2 and 3 respectively. As noted above, this road is unsurfaced and not built to withstand heavy loads and therefore it is likely to deteriorate very quickly. The volumes of traffic on the B2 between Swakopmund and Arandis may increase by 59% due to uranium-related traffic and normal traffic increases. However one of the biggest issues will relate to the number of buses during peak shift-change hours, given that there might be four mines using this road (Rössing, Valencia, Rössing South and Trekkopje).

Plate 7.3.2: Commuter buses on the B2 (photo Rössing).

Table 7.3.1: Percentage increase in traffic numbers (all traffic including uranium-mine construction and operations traffic) per road and per scenario

Scenario	B2 (Swakopmund to Arandis)[3]	C28 (Swakopmund to Langer Heinrich turnoff)[4]	C34 (Swakopmund to Wlotzkasbaken)
Scenario 1	54%	58%	44%
Scenario 2	59%	72%	47%
Scenario3	59%	80%	56%

The main cumulative impacts arising from this increase in traffic are:

[3] Assuming that access to Rössing South will be from the B2
[4] Assuming that access to Rössing South will be from the B2

- Higher wear on the roads, necessitating more maintenance, especially on the gravel roads; if the maintenance is not sufficient to handle the increased traffic, roads will degrade (potholes and erosion along the edges of the tarred surface) and become very dangerous;
- Higher loads on the roads which were not built for such weights. This also results in road deterioration;

Figure 7.3.4: Growth in traffic on the C28

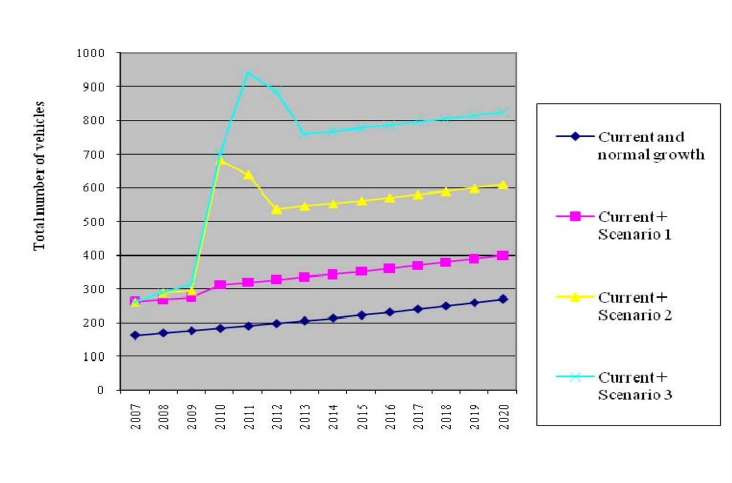


Figure 7.3.5: Growth in traffic on the B2

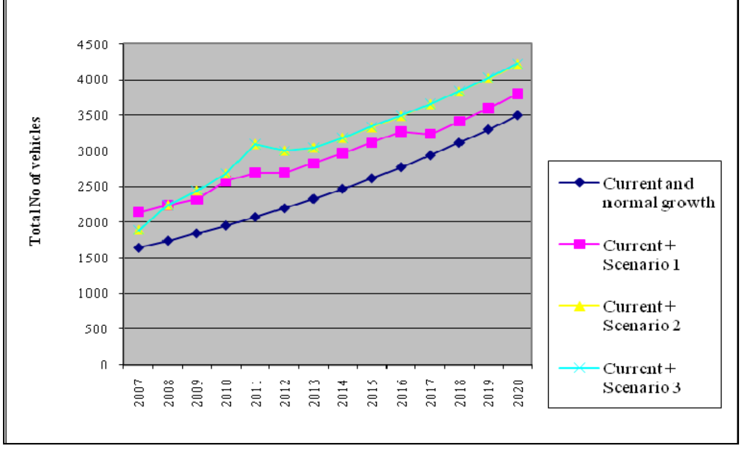
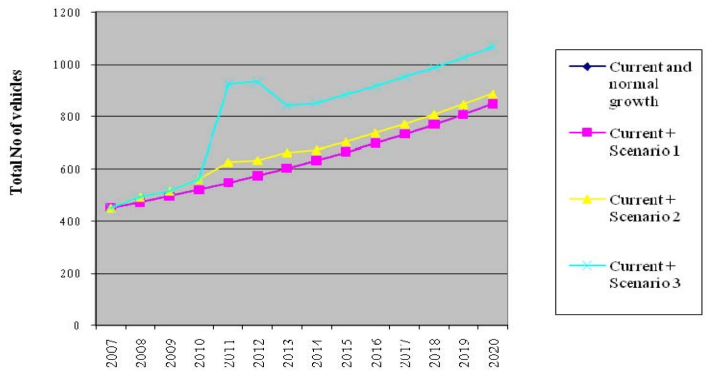


Figure 7.3.6: Growth in traffic on the C34



- More dangerous driving conditions. Since the majority of roads in Namibia are built for single lane traffic, these roads have to cater for all types of traffic i.e. passenger vehicles, light delivery vehicles, busses, heavy duty trucks etc often travelling at different speeds. With limited visibility under foggy or dusty conditions, passing can become very risky. Under certain circumstances, even vehicles passing in opposite directions can be risky;
- Greater need for traffic control and policing;
- Greater need for emergency response vehicles, ambulances etc.;
- Congestion causing delays for road users, which can also negatively impact on the competitiveness of the various trade corridors.

Plate 7.3.3: Heavy traffic, and particularly heavy loads, cause greater wear and tear on Namibia's roads and more hazardous driving conditions (photo J.Pallett).

The construction of new roads will contribute substantially to the cumulative impacts of the Uranium Rush in the following ways:

An estimated 106 km of new roads will be required to provide access to the new mines under Scenario 2 and approximately 113 km will be required for Scenario 3 (so long as the Tumas-Tubas and

Marenica plants are located close to the C28 and D1918 respectively). If it is assumed that the average width of disturbance for the construction of a 2 lane surfaced road is 30 m, then the total area of disturbance will amount to some 3.2 km^2 for Scenario 2 and 3.4 km^2 for scenario 3. This area, as a total of the region is insignificant, but the more important impact will relate to habitat fragmentation, rather than habitat loss as shown on Figures 7.3.2 and 7.3.3. The cumulative impacts on habitat are discussed in section 7.7, but recommendations to minimise these impacts are provided in section 7.3.4 below.

Additional cumulative impacts arising from increased traffic and new roads include: dust, noise, risk of pollution and an increased accident risk.

7.3.2.2 Railways

The potential increase in rail traffic on existing lines will have a few cumulative impacts. These would include:

- Localised and intermittent noise from an increased number of trains on existing lines;
- Increased potential for spillages of diesel and oil (from train locomotives);
- Increased risk of accidents resulting in major chemical spills;
- Congestion in shunting and loading yards causing delays.

Far more serious would be the cumulative effects of new railway lines, trains, sidings and product transfer points in the desert environment generally and in the NNP specifically. These impacts could include:

- An additional 80-110 km of new railway line, of which some 30-60 km would be in the NNP if new lines are constructed to Etango and Tumas-Tubas from the existing line;
- Additional fragmentation of habitat because railway lines require gradual gradients and cannot necessarily follow other infrastructure in a corridor;
- If the average width of disturbance for railway construction and an access road is say 15m, then some 12-14 km^2 of land will be disturbed, much of which will be in the NNP. As with the roads, the greater impact will be on habitat fragmentation and destruction, especially as it is difficult to run railway lines alongside existing roads due to the special horizontal and vertical alignments required (see Figures 7.3.2 to 7.3.3);
- The trains on the new lines will introduce intermittent noise and vibration into the environment, which can be heard and felt over many kilometres, especially at night. This would add to the loss of sense of place in the NNP already being caused by new mines, roads, pipelines and powerlines;
- The extension of railways into the region will increase the risks of hydrocarbon pollution from diesel locomotives (largely due to poor maintenance) and the risk of spills of process plant chemicals. This risk is greatly increased wherever the railway crosses a river e.g. the Swakop River south of Swakopmund (existing line) and the Khan River (possible route to Rössing South);
- It is conceivable that there could be up to three product transfer points (excluding offloading facilities at the mines and loading facilities at the port or at the Gecko Chemicals plant): at Arandis (for transfer to Trekkopje), near Valencia, and at a point south of the Swakop River

bridge on the existing north-south line east of the dunes. These transfer stations will require separate sidings, storage facilities, loading/offloading equipment, control rooms and offices, access roads, as well as pump and pipe infrastructure if the chemicals will be transferred to the mines by pipeline. This will contribute to the overall loss of sense of place, add to the area of disturbance and will substantially add to the risk of soil and groundwater pollution;

- The potential for increased rail transport will require additional locomotives and specialised rolling stock, which may not be readily available to TransNamib.

7.3.2.3 Port of Walvis Bay

Although the Uranium Rush may not add substantially to the current volume of cargo handled by the Port of Walvis Bay, it could contribute to port congestion and increased competition for space – more so if the Gecko Chemicals plant does not materialise and less so if Gecko does produce the required process plant chemicals locally. The impacts would be much less if Gecko decides to construct a bulk goods jetty north of Swakopmund. The quantum of the cumulative impact has not been calculated.

Increasing congestion will require NamPort to expand the harbour facilities if it wants to continue to attract shipping for local and continental customers. This will have several negative impacts on the environment, which are being documented in a separate EIA for the expansion project (CSIR, 2009).

There is also the possibility that if the port cannot efficiently handle bulk materials, Gecko Chemicals might construct a new jetty near its proposed chemical plant near Wlotzkasbaken (see section 4.4.3). This would certainly add to the cumulative development impacts along the coast north of Swakopmund – adding to the impacts associated with possibly two separate desalination plants, the chemical plant and all associated infrastructural developments. The individual impacts of the desalination plants are being considered in separate EIAs and Gecko would also commission an EIA if the jetty became a desirable and feasible option. However, at this early stage, the cumulative impacts of all these existing and potential structures on the marine environment cannot be evaluated.

7.3.2.4 Airports and air travel

There may be an increase in the number of scheduled commercial flights in and out of Walvis Bay to cater for the increased demand from the Uranium Rush. More flights to major destinations could be a major benefit to local coastal residents, however the negative impacts would include more noise along the main flight paths.

The other potential impact of the Uranium Rush on the air travel industry is that either scenic flight tourism may decrease because of the negative visual impacts of the mines and infrastructure, or new routes will be found e.g. to Spitzkoppe to avoid flying over the Trekkopje mine.

7.3.3 Desired state

The environmental quality objective relating to transportation is to ensure that key infrastructure in the central Namib is adequate and well maintained, thus enabling economic development, public convenience and safety, whilst minimising impacts on habitats and ecosystem functioning.

7.3.4 Recommendations

In order to minimise the cumulative impacts described above and to fulfil the desired aims and objectives, the following are recommended.

7.3.4.1 Roads

- The D1984 road to the east of the dunes must be upgraded to a two-lane tar road as soon as possible;
- All heavy traffic (except local deliveries to Langstrand and the coastal developments between Swakopmund and Walvis Bay) must be directed onto the upgraded D1984;
- The B2 between Swakopmund and Arandis must be upgraded to a 4-lane highway as soon as possible to facilitate traffic flow and increase road safety;
- The unsurfaced sections of the C28 up to the Etango turnoff should be tarred;
- Access to the Rössing South mine should be from the B2 (i.e. from the north) and not from the south (Figure 7.3.2);
- The road to the Welwitshia Flats should be restricted to tourist traffic only once the new Rössing South access road is in place;
- Certain tourist roads in the NNP should be restricted to tourist traffic only;
- The traffic police should stringently and regularly check vehicle weights at the existing weigh bridge in Walvis Bay to monitor vehicle loading;
- Additional traffic police will be required to maintain law and order on the roads;
- Additional ambulances and emergency response vehicles need to be purchased and be on standby to cope with road traffic accidents and chemical spills;
- Access roads to the mines should follow the shortest feasible route from the nearest existing road to minimise new disturbance (see Figures 7.3.2 and 7.3.3);
- Mine access roads need to be tarred to minimise dust and noise.

7.3.4.2 Railways

- A cost-benefit analysis needs to be conducted (which should include environmental 'costs' and 'benefits') to determine whether new railway links to the mines are desirable and/or feasible. Such lines would have to be privately built, owned and operated;
- If railways are desirable and/or feasible, the routes should, as far as possible, given vertical and horizontal alignment constraints, follow existing infrastructure such as roads and pipelines (see Figures 7.3.2 and 7.3.3);
- Careful thought will need to go into the siting of the rail-road or rail-pipe transfer facilities in order to reduce the visual and noise impacts and potential pollution impacts;
- State of the art loading and offloading facilities will need to be installed at the bulk material transfer points and comprehensive pollution control measures must be implemented;
- From the analysis of the road traffic impacts above, as many as 100 and 70 buses may be on the B2 and C28 respectively at peak hours under Scenario 3. This will have a major impact on road traffic at those hours and consideration must be given to the use of the railways for commuter transport. A new transport hub could be built at Arandis from where mine commuters will take buses to their respective mines – Rössing, Rössing South, Valencia and Trekkopje. Given the restrictions on the current Trans Namib line (unsuitable gauge and

restricted speeds), it may be viable to construct a new light rail link between Swakopmund and Arandis, or even up to Trekkopje. As with the freight lines, such a venture would have to be a private or private-public partnership.

7.3.4.3 Port of Walvis Bay

Apart from the envisaged expansions, it is recommended that NamPort should consider involvement in the development of the bulk commodity jetty being planned by Gecko north of Swakopmund.

7.3.4.4 Airports and air travel

- The passenger terminal at the Walvis Bay airport may need to be expanded and upgraded to cope with increased numbers of passengers;
- Scenic flight tourism operators should alter their flight paths to avoid high levels of visual impact from the mines or, possibly offer aerial mine tours.

7.4 Cumulative Effects Analysis – Water

7.4.1 Introduction

7.4.1.1 Water supply and demand

The sources of water in the central Namib are fog, direct summer rainfall, surface water runoff during the rainy season in the rivers running from the interior of the country through the central Namib, groundwater and seawater. However, the origin of all water in the desert is due to some form of precipitation and the occurrence of this vital resource is determined by important factors such as climate, hydrology, topography and geology. Unfortunately the hydro-climate does not lend itself to produce an abundance of water, and the scarce water resources require innovative management to ensure that the development potential of the central Namib can be realised.

There are four main ephemeral rivers flowing through the central Namib: the Omaruru, Khan, Swakop and Kuiseb Rivers. All of these contain intermittent surface flows following rain, but most of the time, water 'flows' below the surface in the sediments of the river bed. The groundwater resources in the lower reaches of both the Omaruru and the Kuiseb Rivers provide most of the domestic and industrial water supplies at the coast. Groundwater resources in the alluvial aquifer of the Swakop River currently supplies a small proportion of the total mining demand at Langer Heinrich mine[1], as well as irrigation water for farmers in the lower Swakop. All of the rivers represent linear oases through the desert and support a multitude of life forms.

All the coastal aquifers are recharged by runoff originating in the central highlands of Namibia where rainfall is higher and more reliable. The sustainable yield from the Kuiseb and Omdel schemes combined is 12Mm^3/a, but abstraction has been *temporarily* increased over the last 2 years to supply the increasing demand from the new uranium mines (Langer Heinrich and Trekkopje's construction demand). The current (2009) water demand at the coast from all users is 14.4 Mm^3/a, of which 4.6 Mm^3/a is from mining and 9.8 Mm^3/a is from domestic and non-mining industrial demand. This level of abstraction is patently not sustainable.

Unfortunately, the groundwater resources in the other two rivers (Khan and Swakop) are limited – exacerbated by the construction of the Swakopport and Von Bach dams in the upper reaches of the Swakop River in the 1970s. Studies have shown that the total groundwater recharge to the Swakop alluvial aquifer has dropped by 32% as a result of these dams (BIWAC, 2010).

Compounding this problem is the fact that the alluvial aquifers of both the Khan and Swakop Rivers are not homogenous, but separated into sections called compartments created by outcropping bedrock or narrowing of the river gorge. These compartments are mostly dominated by vertical flow (evapo-transpiration and recharge), rather than lateral flow. The stored water volumes in each compartment are therefore not replenished on a continual basis from upstream, but rather from occasional flood events.

The BIWAC (2010) study found that water levels in the Khan River tend to react more strongly to abstraction than in the Swakop River. The results of modelling[2] the Valencia compartment in the Khan suggested that this compartment cannot support long-term bulk abstraction by Valencia mine and that abstraction should, therefore, be limited to the construction phase. On the other hand, the

[1] Note that Rössing Uranium Mine stopped abstracting water from the Khan River aquifer from 1st January 2010.
[2] See the BIWAC, 2010 report for full details of the models used.

groundwater model suggested that the compartment from which Langer Heinrich abstracts water in the Swakop River, could provide the permitted amount of 500,000 m^3/a.

While these modest volumes can contribute towards water demand during construction and a limited amount to the operational demand, the available groundwater resources in the Khan and Swakop rivers do not start to meet the full demands of an operating mine, which typically requires >3 million cubic metres per annum.

It has been known for a long time that the only viable source of additional water at the coast to meet predicted future water demand is the sea via desalination. These plants are extremely costly to build and operate and so in order to delay the eventual need for desalination as long as possible, the coastal municipalities and Rössing Uranium Mine initiated a successful water demand management campaign in cooperation with the Department of Water Affairs and Forestry (DWAF). However, all these measures have now reached their limits and it is clear that even with the best conservation practices, desalination is the only viable option to augment the existing water resources and to supply anticipated future water demand from the uranium mines in the central Namib.

Desalination requires both energy and technical capability, and the cost of the water would be prohibitively high for domestic use. Considering the demographics and socio-economic status of the Erongo Region and the central Namib in particular, the most justifiable way to satisfy the domestic water demand would be to supply residents with water from the cheaper groundwater resources of the Omdel and Kuiseb schemes and the more expensive desalinated seawater would be used to supply the mines. Once the mining water demand is satisfied from desalinated water, domestic demand under Scenario 1 (low growth scenario)[3] can be fully met from the groundwater resources at the sustainable abstraction rate i.e. less than 12 Mm^3/a (Figure 7.4.1).

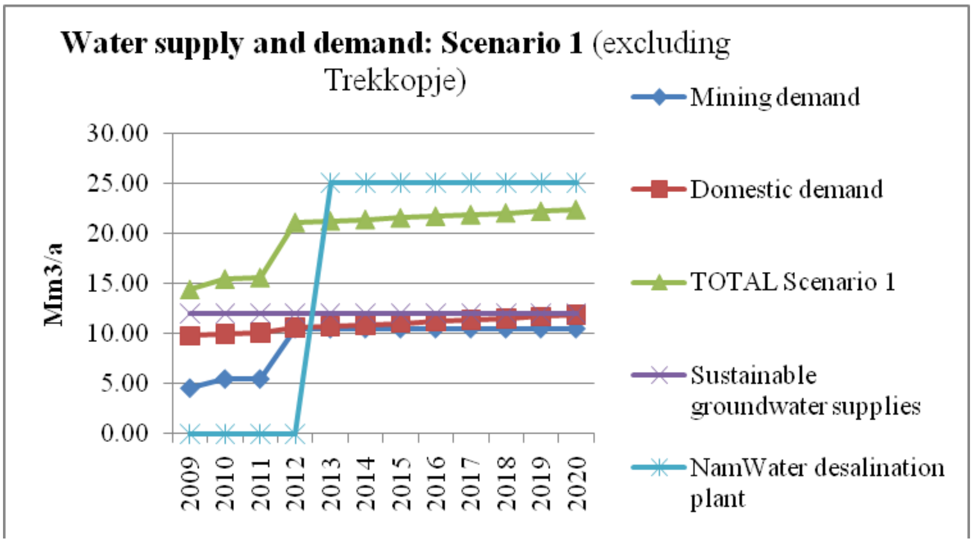


Figure 7.4.1: Domestic, mining and total water supply and demand for Scenario 1

Without *any further supply sources* being developed, domestic demand[4] under Scenarios 2 and 3 would exceed the sustainable groundwater yields by 2013 and 2011 respectively and is likely to rise

[3] Domestic demand for Scenario 1 has been calculated at a low urban growth rate of 2.5% for Swakopmund and 0.8% for Walvis Bay.
[4] Domestic demand for Scenario 2 has been calculated on a medium urban growth rate of 3% for Swakopmund and 1.15% for Walvis Bay and for Scenario 3 at a growth rate of 3.5% for Swakopmund and 1.5% for Walvis Bay.

to over 14 Mm^3/a and 18 Mm^3/a by 2020. While there may be some surplus from the NamWater and Areva desalination plants in the short-term, this will also not be enough to meet domestic demand from about 2013. The planned Gecko Chemicals plant will, however, produce a maximum of 4 Mm^3/a from its seawater desalination plant, which could be sold to NamWater, thus reducing demand on the aquifers – hence the 'dip' in the domestic demand line in Figures 7.4.2 and 7.4.3[5]. The Gecko plant is expected to be up and running by 2013, and could augment supplies from that date. This extra 4 Mm^3/a will mean that domestic demand under Scenario 2 can be met up to 2020 and beyond, but under the high growth Scenario 3, shortages in water supply may be experienced from 2016, unless other resources are developed (Figure 7.4.3).

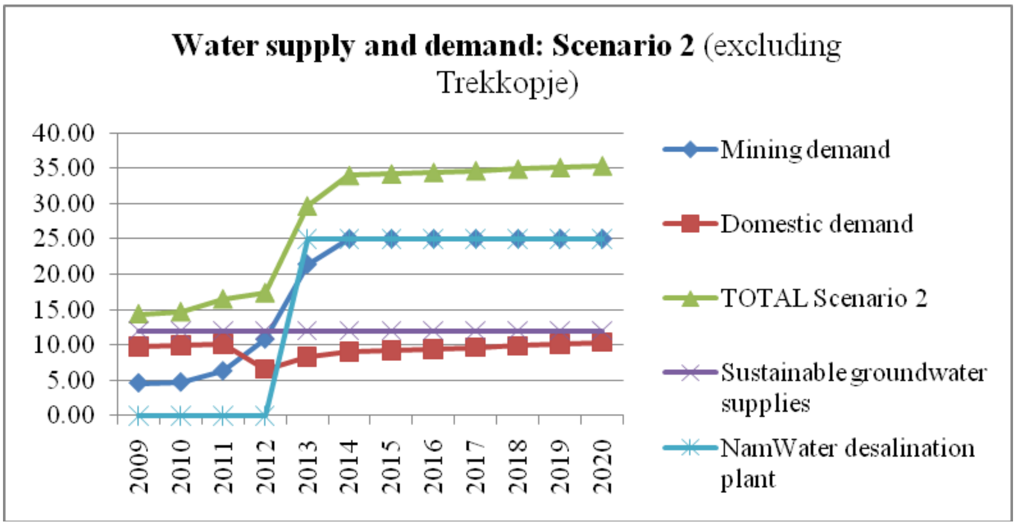


Figure 7.4.2: Domestic, mining and total water supply and demand for Scenario 2

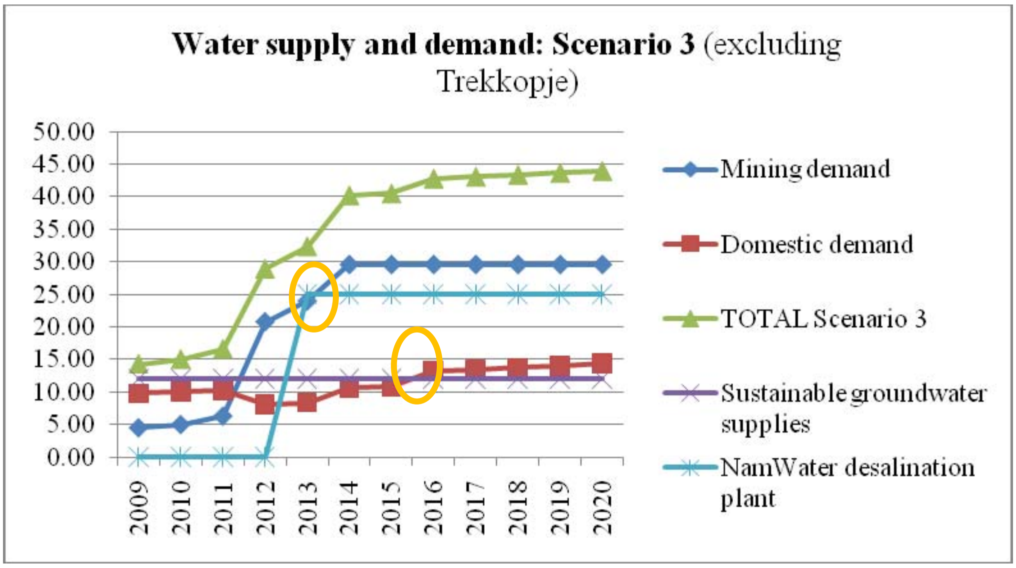


Figure 7.4.3: Domestic, mining and total water supply and demand for Scenario 3

These figures clearly show the urgent need for a second desalination plant. NamWater is currently conducting investigations into the development of a desalination plant at Mile 6, north of Swakopmund. The estimated cost of the project is N$1,800 million and it will have a minimum

5 This amount represents a maximum value and could be less depending on production demand. At a minimum, 2 Mm^3/a could be fed into the supply system.

lifespan of 20 years. It was originally planned to be commissioned by 2010, but the programme is behind schedule and it is unlikely that the plant will be operational until 2013-14. The design capacity of the plant is 25 Mm^3/a of potable water. While such a plant would be able to cater for the estimated demand under Scenario 2, it would be insufficient to meet predicted demands under Scenario 3 (see Figure 7.4.3 above), and additional sources of water would need to be found.

Furthermore, the demand for water from the mines is likely to start increasing from 2011 (see Figures above), but the NamWater plant will not be in operation by that date. Therefore, NamWater will have to enter into negotiations with Areva to purchase surplus water from them (estimated to be about 6 Mm^3/a) until an additional plant is commissioned. Thus water supply is a critical factor in future mine development and a shortage of water could seriously delay or impede such development.

This means that the mines will have to try and minimise their water consumption by implementing a number of measures such as reduced consumption, re-use and recycling (see section 7.4.4 below) in order to stay within the supply capacity.

The limited water resources at the coast necessitated the development of an integrated, long distance, bulk water supply network, known as the Central Namib Water Supply System (CNWSS). Bulk water is supplied to consumers in the central Namib by NamWater from the alluvial aquifers in the lower Kuiseb and Omaruru rivers, via infrastructure that was developed in the 1970s. Some of the pipelines are showing signs of having reached the end of their useful life, but most of the reservoirs are generally in good condition.

Although cross catchment transfers are possible between the Kuiseb River and the Omdel supply scheme, Walvis Bay is at present supplied from the Kuiseb River alone. After the significant floods in 2009 which recharged the Kuiseb River aquifer, supply for Walvis Bay is secure for another 10 years. Rössing mine, Arandis, Swakopmund and Henties Bay are supplied by the Omdel aquifer.

The existing Central Namib Area Bulk Water Supply System is divided into the following schemes, as shown on Figure 7.4.4:

- The Omdel-Swakopmund Water Scheme;
- The Kuiseb Water Scheme;
- The Swakopmund-Rössing Water Scheme; and
- The Swakopmund-Langer Heinrich Water Scheme.

However, the proposed new mines will require additional or larger pipelines to deliver water to them, necessitating new pipelines, pump stations, access tracks, and power lines, which could result in considerable cumulative impacts if not carefully planned (see sections 7.4.2 and 7.4.4 below).

A final issue that needs to be considered in addressing water supply is the vulnerability to climate change. Although the real effect that climate change may have on the occurrence of groundwater in Namibia is not yet fully understood, it can be assumed that there will likely be reduced precipitation and increased evaporation (see section 5.1.4). This will have a negative impact on groundwater resources due to reduced groundwater recharge, which could increase pressure on aquifers in the region.

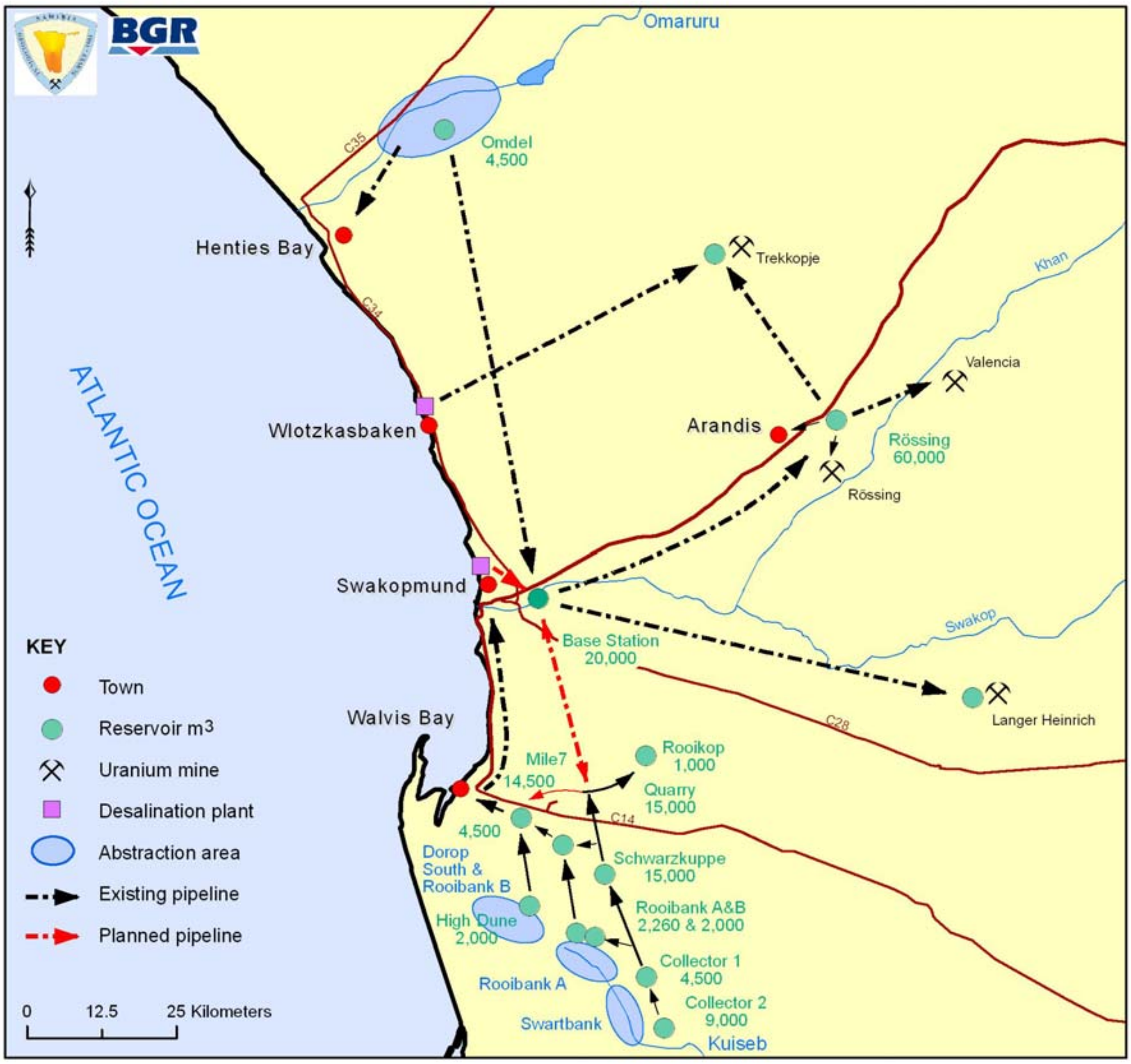


Figure 7.4.4: Layout of the existing Central Namib Area Bulk Water Supply System and proposed new developments. (Source: NamWater)

In summary therefore:

1. There is sufficient water from the existing NamWater groundwater schemes (Omdel and Kuiseb) to supply potable water to current domestic users in the coastal towns until 2020 and beyond under Scenario 1, as well as under Scenario 2, but in this case, only if the Gecko plant can sell its excess water to NamWater. However, under the high growth conditions suggested in Scenario 3, new water supplies will need to be found to meet domestic demand from about 2016;
2. There is not enough water from existing groundwater sources to supply the operational needs of the existing mines, let alone the proposed new mines;
3. There is not enough water in the primary alluvial aquifers of the Khan and Swakop Rivers to satisfy the water requirements of the mines for operations, but there may be enough to supply

water for construction purposes in the short-term (within safe yield limits), without compromising existing water users (farmers in these valleys) and riverine ecosystems;

4. Therefore NamWater needs to build a desalination plant (or, more preferably ‘piggy-back’ on the Areva plant) as soon as possible to be ready to supply the new mines when they start operating from about 2012;
5. A network of new pipelines will be required to supply the new mines with water which must be planned in ‘proposed infrastructure corridors’. A working group under the SEMP office in GSN, including input from NamWater, NamPower and MET should delineate optimal routes, based on the findings of this SEA;
6. Desalinated water is expensive and the cost of this water should not be borne by domestic users while there is still sufficient groundwater to meet domestic demand;
7. The high price of water from the desalination plant should be sufficient incentive for the mines to closely manage their water demand through reduction, re-use and recycling strategies (see section 7.4.4).

7.4.1.2 Water quality

As noted above, most domestic supplies are obtained from the alluvial aquifers of the Omaruru and Kuiseb Rivers. Even without treatment, this water is generally of good quality (see section 7.4.1.3 below). The rest of this section deals with water quality issues in the Khan and Swakop Rivers, neither of which are used for domestic consumption, but could be affected by the Uranium Rush.

In considering groundwater quality in this area, the two types of aquifers which are discussed are:

- The shallow, alluvial aquifers (primary aquifers) of the Khan and Swakop Rivers; and
- The deep, fractured, secondary aquifers.

In 2009, 78 locations on the Khan and Swakop Rivers were sampled by a joint water team of BGR, GSN, BIWAC and DWAF for this SEA and analysed for major cations and anions, dissolved uranium, and trace elements. The main findings of the water quality study can be summarised as follows:

- Alluvial groundwater in the upper Khan and Swakop River catchments is Ca-Mg-HCO_3 dominated **freshwater** of ‘acceptable’ (B) or ‘excellent’ (A) quality for drinking according to the classification of the Water Act (1956);[6]

- Downstream of the 15°35’E line of longitude, the Ca-HCO_3 dominated freshwater of the upper catchment changes into Na-Cl-dominated **saline groundwater** with electrical conductivities of up to 17,000 µS/cm (11,000 mg/l TDS) caused by evapotranspiration and groundwater evaporation, making it unsuitable for domestic use. Locally, freshwater lenses exist on top of saline groundwater;

- The **pH** of the alluvial groundwater is controlled by the natural buffering of the carbonate-bicarbonate environment and has a median of pH 7. Localised occurrences of sulphidic rock

[6] See definitions of water quality classes in s. 7.4.1.3.

can cause high acidity in the fractured aquifers, as noted in one sample taken near Rössing from a known iron sulphide deposit, where the pH was found to be 4.3;

- Nitrate concentrations are largely elevated, but 90% of the *freshwater* samples have **nitrate** concentrations below the Namibian Drinking Water Standard of 10 mg/l N (40 mg/l nitrate);

- Concentrations of potentially harmful or toxic elements such as **fluoride, arsenic, lead or cadmium** are – with the exception of one or two outliers associated with sulphide rocks – below the guideline values of the Namibian Water Act. The presence of sulphate and iron at a low pH at depth near Rössing does not have the mine process water signature and could therefore reflect poor quality fossil water in the fractured aquifers.

- **Uranium** was found in all 78 samples collected along the length of both rivers and is therefore a common trace element, as would be expected in a geological uranium 'province'. The study found that the *natural background* concentrations of uranium range between 2 µg/l and 528 µg/l in the alluvial groundwater, with a mean of 39 µg/l. These values are well above the WHO provisional Guideline Value for Drinking Water of 15 µg/l (WHO, 2004), but well within the Namibian Group A water quality limit of 1000 µg/l.[7] The natural concentrations are generally higher in the upper Khan River catchment compared to the upper Swakop River catchment. Saline water samples from lower Swakop River catchment generally exhibit higher uranium concentrations than the respective samples from in the headwater regions. See section 7.12 for a more in-depth discussion on the presence of uranium in groundwater.

The water team also took samples of mine process water at both the Rössing and Langer Heinrich mines and compared it to the water in the alluvial aquifers up and downstream of the mines. The analytical results of trace elements, radioisotopes and stable isotopes showed that neither Langer Heinrich nor Rössing has had a detectable influence on the groundwater quality in the main streams.

Modelling of the Swakop and Khan Rivers has shown that the alluvial water quality is influenced by lateral inflows of poorer quality water from the basement aquifers (BIWAC, 2010). Groundwater hosted in the *secondary,* fractured aquifers (fractures, faults, etc) is mostly of poor quality owing to little direct recharge. It is therefore naturally highly saline and acidic, with sulphate, sodium and chloride ions dominating and trace metals in solution. Where water comes into contact with uraniferous rocks, it can also have naturally elevated concentrations of radio-nuclides, as described above. Thus although the contribution to alluvial flow from the secondary aquifers is only 5-15%, the influence on quality is much more significant (BIWAC, 2010).

7.4.1.3 Potable water standards and users

The quality of potable water is governed by the 'Guidelines for the Evaluation of Drinking Water for Human Consumption with Regard to Chemical, Physical and Bacteriological Quality' (DWA, 1988). For practical reasons the guidelines have been divided into three basic groups of determinants, namely: aesthetic/physical, inorganic and bacteriological. The concentration of and limits for each of these determinants define the group into which water will be classified. These groups are:

Group A: water with an excellent quality and bacteriologically safe to drink;

[7] Note: as previously mentioned, neither the Khan nor Swakop Rivers is used for domestic water consumption.

Group B: water with good quality which is suitable for human consumption;

Group C: water with a low health risk on account of inorganic or bacteriological pollution, which requires immediate remedial action before it is safe to drink;

Group D: water which has a high health risk and is unsuitable for human consumption.

The water in the Omdel scheme is classed as Group B and the water from the boreholes in the Kuiseb aquifers varies from excellent to good quality (Groups A and B). This water is further treated for domestic consumption by NamWater prior to distribution to the Municipalities. Samples taken by Kringel and Wagner from tap water in the coastal towns demonstrated that the quality is good and contains no uranium or other toxic elements.

However, as noted above, the water quality in the primary aquifers of the Swakop and Khan Rivers is compromised by salinity and locally, by naturally occurring uranium and other elements. It is variable in both a vertical and horizontal direction, and quality can range from Group A to D. The water in the secondary, fractured aquifers is usually classed as Group D on account of the high salinity.

There is a range of different users in the region who may be categorised as follows:

- Urban users (domestic and light industrial sectors) in the towns of Walvis Bay, Swakopmund, Henties Bay and Arandis who are supplied with potable (Group A or B water) by NamWater from the Omdel or Kuiseb aquifers;
- Domestic rural users i.e. the Topnaar communities along the Kuiseb, who are supplied with potable water by NamWater;
- Livestock farmers living on the commercial farms east of the Namib-Naukluft Park. The water obtained from the fractured aquifers is used for stock watering only, because it is unfit for human consumption (Group D). Water for domestic consumption on these farms has to be obtained from the alluvial aquifers of active and palaeo river channels;
- Commercial irrigation farmers living along the lower Swakop River. As indicated above the water in the alluvial aquifer of the lower Swakop River is highly variable, ranging from potable (Group A) to non-potable (Group D) depending on the location and depth of the boreholes;

Plate 7.4.1: Downstream users of groundwater include small-scale irrigation projects. Even though these enterprises may be modest in terms of economic output, they are important for livelihoods and they supply high value products for the local market.

- The natural ecosystems along the river beds and ephemeral washes which are sustained by groundwater – particularly the large trees; and
- The mines (Rössing and Langer Heinrich), which use poor quality groundwater (Group D) for non-potable water uses e.g. dust suppression.

It is clear from the above that most of the groundwater in the region is used for many purposes and many livelihoods and entire ecosystems are directly sustained by such use.

7.4.2 Analysis of cumulative impacts

From the above discussion, it is clear that the two issues relating to water revolve around the quantity and quality of available water resources. If we assume that all the mines and related large industrial developments will be supplied with desalinated water, what are the remaining cumulative impacts?

Many of the known impacts on water resources caused by mining operations are extremely localised and it will be the responsibility of each mine to control these impacts through their own mine-specific EMPs. These issues usually include:

- Mine infrastructure such as roads, embankments, tailings dams etc can cause local flooding and interrupt natural flow paths;
- Local drawdown of the water table due to pit dewatering;
- Localised contamination of the ground from uncontrolled stormwater runoff;
- Spills and leaks in the plant and workshops.

However, there are four major potential cumulative effects that may result from the Uranium Rush:

- Pollution of the primary aquifers by seepage and spills;
- Over-abstraction of water from the primary aquifers;
- A proliferation of pipelines across the region; and
- Impacts on the marine environment from numerous desalination plants at the coast.

7.4.2.1 Pollution of the primary aquifers

From Figure 7.4.5 and Table 7.4.2 below, it can be seen that many of the mining and exploration companies abut onto or straddle one of the large west-flowing ephemeral rivers.

Table 7.4.2: Mines, EPLs and potentially affected primary river aquifers

River	Mine or EPL	Responsible company
Ugab	EPL 3328: Uis/Namib	Extract/Swakop Uranium
Omaruru (Omdel scheme)	EPL 3454: Erongo Granites EPL 3851 and 3850: Klein Spitzkoppe EPL 3569 and 3570: Cape Cross	Erongo Energy Ltd SWA Uranium Mines Xemplar Energy Corp.
Khan	EPL 3637: Ancash EPL 3638: Namibplaas EPL 3602 **EPL 3138: Rössing South** **(EPL 3345: Etango)** **ML 149: Valencia** **ML 28: Rössing**	Forsys Metals Forsys Metals Zhonghe Resources Namibia Extract Resources Bannerman Forsys Metals Rössing Uranium Ltd
Swakop	EPL 3346: Swakop River **EPL 3500: Langer Heinrich extension** EPL 3668: Gawib West EPL 3439: Ida Dome **(EPL 3138: Rössing South)** **EPL 3345: Etango** **ML 140: Langer Heinrich Mine**	Bannerman Paladin Energy Reptile (Toro Energy) Swakop Uranium Extract Resources Bannerman Paladin Energy
Kuiseb	EPL 3498: Aussinanis EPL 3670: Chungochoab EPL 3516 and 3518: Dome Project	Reptile Reptile (Toro Energy) Cheetah Minerals

Note: the mines which are most likely under Scenario 3 are highlighted in bold.

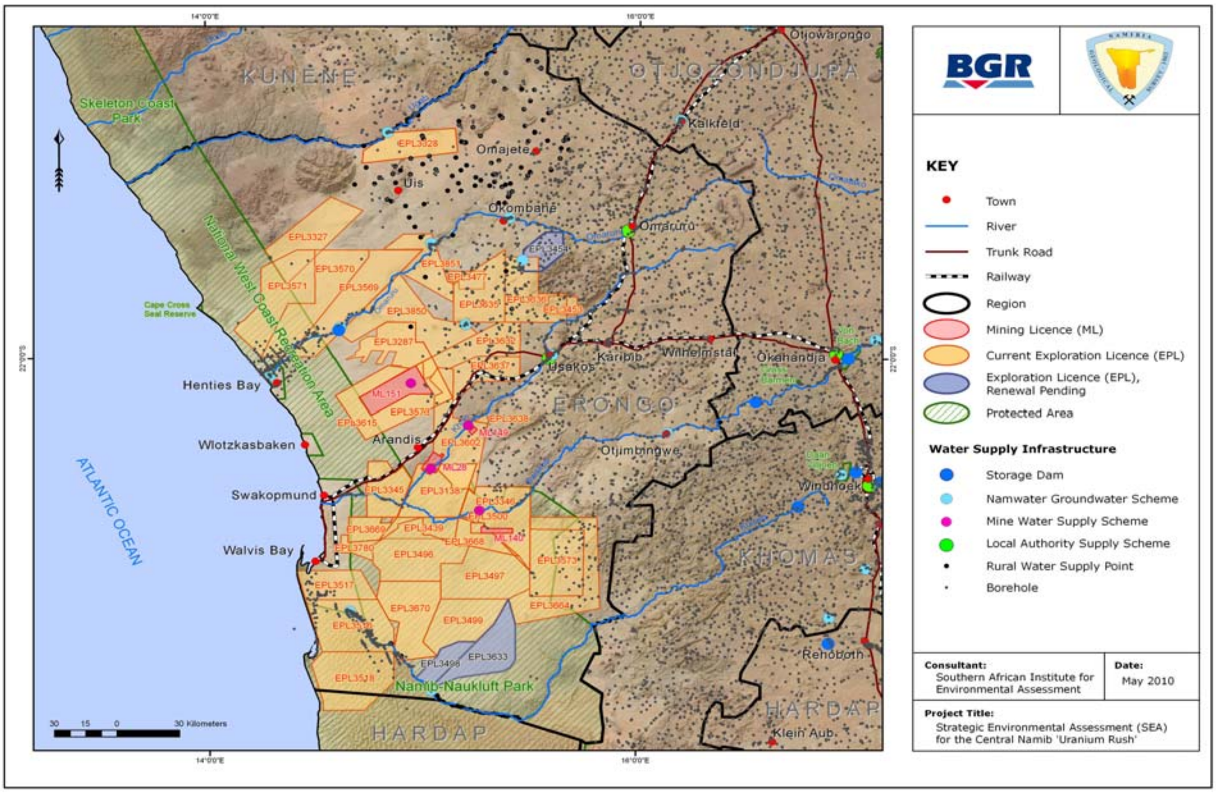


Figure 7.4.5: Uranium EPLs and Mining Licences in relation to dams, rivers, boreholes and water supply schemes

All of the current and possible future mines (highlighted in bold in the table) will have large-scale potential sources of pollution, namely: waste rock dumps, low-grade ore stockpiles, tailings dams, heap leach pads and heap leach residue disposal dumps, as well as process plant areas, effluent dams and ponds etc. With the exception of the waste rock dumps, best practice dictates that all these facilities should be lined. Indeed, Section 23(1) of the Water Act, 54 of 1956 states that it is "*…an offence to commit an act which could pollute any public or private water, including underground water, or sea water in such a way as to render it less fit for the purposes for which it is or could be ordinarily used by other persons …for legitimate purposes.*" Thus all new mines should be designed as 'zero effluent discharge' mines and those with existing water permits must ensure that the permit conditions are being rigorously monitored and enforced, both by themselves, the Department of Water Affairs and Forestry and MET.

The consequences of non-compliance of Scenario 3 mines would particularly affect the Khan and Swakop Rivers, with the main pollutants being sulphate, sodium, chloride, nitrate, uranium and other radio-nuclides and trace metals. The mines using the sulphuric acid leach process could cause the pH of the groundwater to drop since the effluent and tailings water can have a very low pH, whereas, the mines using an alkaline leach process would cause an increase in the pH.

Plate 7.4.2: Tailings dams need to be carefully located, well designed and constructed, properly maintained and closed according to international best practice to avoid contamination of groundwater resources. The Langer Heinrich tailings dam is situated in a dry river channel, which could be hazardous in the event of a large flood (photo P.Tarr).

Should any of the EPLs along the Omaruru or Kuiseb be developed into mines, extra care will have to be taken to ensure that no pollution whatsoever reaches the primary aquifers, as these supply all domestic users in the coastal region.

7.4.2.2 Over-abstraction

The second major cumulative impact relates to the incremental lowering of the water table in the groundwater compartments in the river beds. If each mine is allowed to extract its permitted maximum from the alluvium, this may result in a general decline in water levels throughout the compartment. This will affect the vegetation and all the dependent ecosystems along the affected river reaches, as well as the borehole yields of the farmers who abstract water from the river beds for irrigation and domestic consumption. This impact would last for as long as over-abstraction is allowed to continue and for some years afterwards until water table levels are naturally restored.

It is imperative therefore that the abstraction permits granted to the mines take into account the cumulative rates of abstraction to ensure that the permitted amount is within sustainable limits (see section 7.4.4).

7.4.2.3 Proliferation of pipelines

If the bulk water supply infrastructure is not carefully planned to allow for existing and potential new customers and demand volumes, there could be numerous pipelines across the desert, either in parallel ranks or taking the shortest route from the supply point to the customer. Furthermore, the presence of corrosive soils and shallow bedrock throughout the area means that pipelines have to be laid on the surface, rather than being buried. This has a major visual impact and also fragments wildlife habitat by impeding the movement of some species of animals, particularly ostrich, springbok, oryx and mountain zebra. Restricting the movement of wildlife in hyper-arid areas by isolating them from seasonal water and grazing will undermine their chances of survival. In order to reduce this cumulative impact, recommendations are made in section 7.4.4 below to optimise the sizing of the pipelines to restrict the number of parallel pipes and to restrict pipeline routes to designated corridors.

Plate 7.4.3: Pipelines are both a visual impact and a barrier to many forms of wildlife (photo J.Pallett).

Secondly, if it assumed that each pipeline construction corridor leads to a 10m wide zone of disturbance, some land will inevitably be disturbed. If the number of pipelines is restricted, as recommended, the lengths of pipeline and the associated areas of disturbance per scenario are shown in Table 7.4.3 below i.e. the best case scenario.

Table 7.4.3: Length and affected areas caused by new water pipelines

Scenario	Minimum length of new water pipelines (km)[8]	Minimum area of disturbance caused (km^2)[9]
Scenario 1	223	2.23
Scenario 2	250	2.50
Scenario 3	287	2.87

It should be noted that the area of disturbance includes the service road, but excludes the areas required for pump stations and powerlines. The figures shown therefore are minimum figures and if optimisation measures cannot be implemented, the cumulative impact could be far greater.

7.4.2.3 Impacts of desalination plants

It was beyond the scope of this study to evaluate the cumulative impacts of several desalination plants operating along the coast of the central Namib. However, possible impacts of these plants, together with other marine structures such as jetties, could affect normal sediment movement and scour and accretion processes by interfering with the long-shore currents. In addition, the brine discharge could locally affect marine life if the outlet structure is not carefully designed to ensure maximum mixing and dilution. As with all cumulative impacts, the effects of one plant may be deemed in the EIA to be insignificant, but if there are two or even three plants in the future, or if the capacity of the existing plants is increased, then the cumulative impacts could become significant with time.

7.4.3 <u>Desired state</u>

The desired state for water supply in the central Namib under any of the mining scenarios is that there should be a sufficient, reliable supply of good quality water at an affordable price for all customers.

[8] Assuming optimisation of water pipelines and not including possible reagent pipelines.
[9] Assuming a 10 m wide zone of disturbance, which allows space for an access road (single track) and an above-ground pipe to be constructed.

However, the bulk water supply network must be optimised as far as practically possible to minimise the number of pipelines and associated infrastructure (pump stations, power lines etc).

Secondly, the quality of water used by existing water users must not be polluted in any way that renders the quality of water unfit for its current use.

7.4.4 Recommendations

In order to fulfil the desired outcomes, it is clear that:

- All mines must use desalinated water for mine operations, but an SEA needs to be conducted on various future scenarios for desalination as soon as possible, to ensure that the cumulative negative effects are not significant;
- Groundwater can be used in exploration and mine construction phases so long as that abstraction is based on a comprehensive hydrogeological investigation, including groundwater modelling of the affected compartment and all downstream compartments;
- Standards and protocols for pollution monitoring should be developed by the SEMP office in conjunction with DWAF, using the findings of the SEA water team. Future monitoring should take into consideration the vertical variation in groundwater quality, particularly in the saline downstream areas. Future monitoring should also take into account the likely mine process chemicals and ore body characteristics in determining the list of parameters to be monitored so that the signature of mine-related pollution can be readily detected. All future monitoring should also include annual sampling and analysis of important uranium daughter elements at selected stations;
- The monitoring data collected should be evaluated and used for regular reporting by the SEMP office;
- The monitoring data should also be maintained in a central database at the SEMP office and a hydrogeological information system should be developed to facilitate reporting, public information response to requests and the implementation of groundwater policies and management.

In order to prevent pollution, it is recommended that the following management controls should be built into every mine's EMP and closure plan, and compliance needs to be closely monitored:

- Appropriate siting of tailings dams away from surface water courses and preferential groundwater flow paths;
- Application of best practice design and construction methods for seepage control and detection around tailings dams, heap leach pads, heap leach residue facilities and effluent ponds;
- Construct suitably sized and separate stormwater collection drains for 'clean' and 'dirty' stormwater;
- Conduct regular monitoring and reporting;
- Rehabilitate all disturbed areas as soon as they are decommissioned;

- Each mine (in conjunction with all suppliers) should develop a Code of Conduct to prevent spillage from vehicles transporting products and wastes along all roads (both public and mine site), including an emergency plan to deal with any such spillages.

- Funds for post closure pumping and maintenance.

In order to reduce the freshwater demand on each mine, it is recommended that each mine should develop a water demand management plan which aims to minimise the use of raw water, minimises water losses and maximises recycling and reuse of water wherever possible. Some suggested water saving measures include the following:

- Tar all access roads and in-plant service roads where possible to reduce the need for water for dust suppression;
- Use chemical binding agents on all haul roads and other un-surfaced roads to prevent dust rather than using water;
- Collect all ‘dirty’ plant runoff water and re-use it in the plant;
- Dewater tailings at source with appropriate technology. This will reduce water losses from the tailings dam through evaporation, seepage and entrainment, and the recovered water can be recycled through the plant. It will also reduce the hydrostatic head driving any pollution plume;
- Use groundwater collected in the pit to suppress dust during drilling operations and ore loading;
- Use water saving devices in all ablution facilities e.g. dual flush toilets, tap diffusers, automatic turn-off taps etc;
- Embark on a programme of raising awareness amongst the entire workforce regarding water conservation;
- Put automatic turn-off nozzles on all hoses;
- Recycle grey water (from the canteen and ablution blocks) and use for other purposes;
- Plant water-wise desert gardens (with indigenous species only);
- Install fog and rainwater harvesting systems where practical to augment supplies.

In order to minimise the cumulative footprint of the bulk water supply infrastructure, it is strongly recommended that where possible, supply schemes should comprise only one pipeline along a demarcated corridor – following other infrastructure e.g. roads, with a capacity to supply existing **and** future demands (Figures 7.3.1, 7.3.2 and 7.3.3). This will perhaps cost more in the short-term, but will have significant long-term cost savings due to economies of scale and the synergies that can be achieved, such as a reduced number of pump stations, fewer powerlines, less need for service roads, less maintenance etc.

7.5 Cumulative Effects Analysis – Energy

7.5.1 Introduction

7.5.1.1 Power supply – generation capacity

Namibia currently has only three power generation stations linked to the national grid:

1. The Ruacana hydro-power station on the Kunene River in the far north of the country. This station has an installed capacity of 240 MW, but it only has an average availability of 50%. This is due to the fact that the upstream dams which should control the releases to the power station are badly damaged. It is not known when or if this situation can be rectified.

2. The Van Eck coal-fired power station in Windhoek, which has an installed capacity of 120 MW. This power station operates on a stand-by basis due to the high costs of importing the coal to Windhoek and running the station.

3. The Paratus diesel generator in Walvis Bay. This can generate 24 MW, but also runs on a stand-by basis.

Thus Namibia has a maximum generating capacity of 384 MW.

The current national demand for electricity is ~550 MW, which leaves a deficit at peak demand of 166 MW. Furthermore, the predicted growth in demand is expected to average 3.5% per year, excluding the uranium rush. The balance is supplied from various sources within the Southern African Power Pool (SAPP) with the largest share traditionally coming from Eskom, South Africa. However, South Africa has had trouble meeting its own demand requirements since 2005 and its ability to assure a cheap, uninterrupted power supply to Namibia in future is doubtful. Furthermore a tariff increase of 25-26% per year for the next three years has recently been approved by the National Energy Regulator of South Africa, which is likely to be passed on to Namibian users in future.

The predicted demand from the uranium mines alone ranges from 120 MW under Scenario 1 (see section 4.5 for definition of scenarios), to 231 MW under Scenario 2, to a possible 278 MW under Scenario 3. If the industries i.e. one or two desalination plants and urban growth related to mine development are factored in, the total demand increases to at least 175 MW under Scenario 1, 333 MW under Scenario 2 and at least 380 MW under Scenario 3 (see Table 7.5.1). The predicted Uranium Rush step loads are shown in Figure 7.5.1.

It should be noted that the Gecko chemicals plant near Swakopmund will be designed to be energy neutral, since it will convert the waste heat from the acid plant to electricity on site.

Table 7.5.1: Predicted future power demand from the uranium mines and associated industries per scenario

Scenario	Power demand – mines (MW)	Power demand – related industries and urban growth (MW)	Total demand (MW)
Scenario 1	120	55	175
Scenario 2	231	102	333
Scenario 3	278	102	380

It is clear therefore, that NamPower is currently not in a position to meet the requirements of the new mines and associated infrastructure from *existing* sources and power purchase agreements. Thus NamPower is investigating a number of *additional* generation and power purchase agreements within the SAPP to meet power demand in the short-, medium- and long-term.

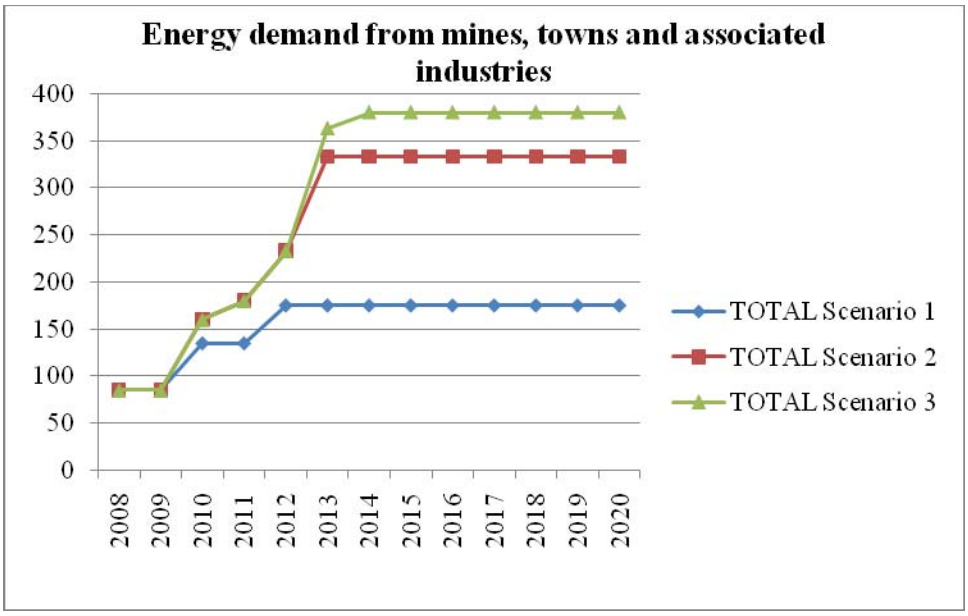


Figure 7.5.1: Cumulative energy requirements for the mines and associated industries by scenario

The various supply options are set out in Table 7.5.2 below.

Table 7.5.2: Possible future power supply options for the West Coast

Generation/ Contract	Size (MW)	Dispatch	Commissioning date
ZESA and ZESCO power purchase agreements	150-300	Via Caprivi Link	2010
Anixas Emergency Diesel	21-45	Emergency	Q4 2010
Ruacana 4th Turbine-Generator	80	Run of River	Q2 2012
Walvisbay 'Slop'	70-270	Mid Merit	2013-2014
Kudu Gas CNG or Walvis Bay Coal	450 – (800) 200 - 800	Base Base	Q2 2013 Q1 2014
Baynes Hydro	360	Base or Mid Merit Small dam (1 year drought)	?
Wind	35	CF 35%	Q4 2011
Orange River Small Hydro	110	Run of River	2013 earliest

There are two possible alternatives to supply base load power on a long-term basis in the Erongo Region: generation of power by an Independent Power Producer from Compressed Natural Gas (CNG) imported to Walvis Bay from the Kudu Gas Field; or a coal-fired power station at Walvis Bay. NamPower has conducted several investigations into the coal-fired power station option, looking at several different locations and sizes.

For the purposes of scenario planning for this SEA, we have assumed that a 200 MW station would be sufficient to meet the demands of Scenario 1 mines; a 400 MW station would be needed for Scenario 2 and an 800 MW station would be required for Scenario 3.

A power station near Walvis Bay would have several advantages: it would be in close proximity to the port for the importation of coal or CNG; cooling water would be obtained from the ocean; and the power would be generated close to its major customers - the uranium mines, the desalination plants and other mine-related industries. It could also provide an opportunity for thermal desalination of seawater by using waste heat from the power plant, if it was situated near enough to a desalination plant. Thus long-term base load will be generated from a gas plant **or** coal thermal plant at Walvis Bay plus hydropower from Baynes (on the Kunene). In the interim, power to the coast will be available from imports through the Caprivi link from SAPP, the 4th turbine at Ruacana and in emergencies, expensive electricity could be sourced from the Anixas diesel plant.

If these additional sources of power materialise, NamPower will be able to supply the mines and related industries with sufficient power for any of the proposed mine development scenarios in the short-, medium- and long-term.

7.5.1.2 Power transmission

The supply of electricity is not just determined by the availability of generating capacity, but also by the electrical grid. The high voltage grid system needs to be able to transmit the voltages required and also needs to be configured to a) minimise transmission losses; b) maximise stability; and c) provide emergency power.

The existing transmission network supplying power to the coast consists of a 220 kV transmission line connecting the Omburo (at Omaruru) Substation via the Khan and Rössing Substations to Walmund Substation near Swakopmund. A ring system was created after the construction of the Van Eck – Kuiseb – Walmund 220 kV line in 2003. However, with the envisaged power demands from the uranium mines, NamPower is considering the necessity to reinforce this ring to be able to provide a stable and assured power supply to the mines. NamPower is thus considering a new line from the Khan Substation near Usakos via Valencia and Rössing South, to the Kuiseb Substation (see Figure 7.5.2).

The project currently being rolled out by NamPower is the construction of the transmission network from the Khan Substation to the desalination plant at Wlotzkasbaken, via the Trekkopje mine (Dolerite Substation). NamPower has also issued a tender for the construction of a transmission line from the Khan Substation to the proposed Rössing South Substation. While these projects are being implemented, both Rössing and Langer Heinrich Uranium Mines indicated that they also need higher power supply capacity in the near future.

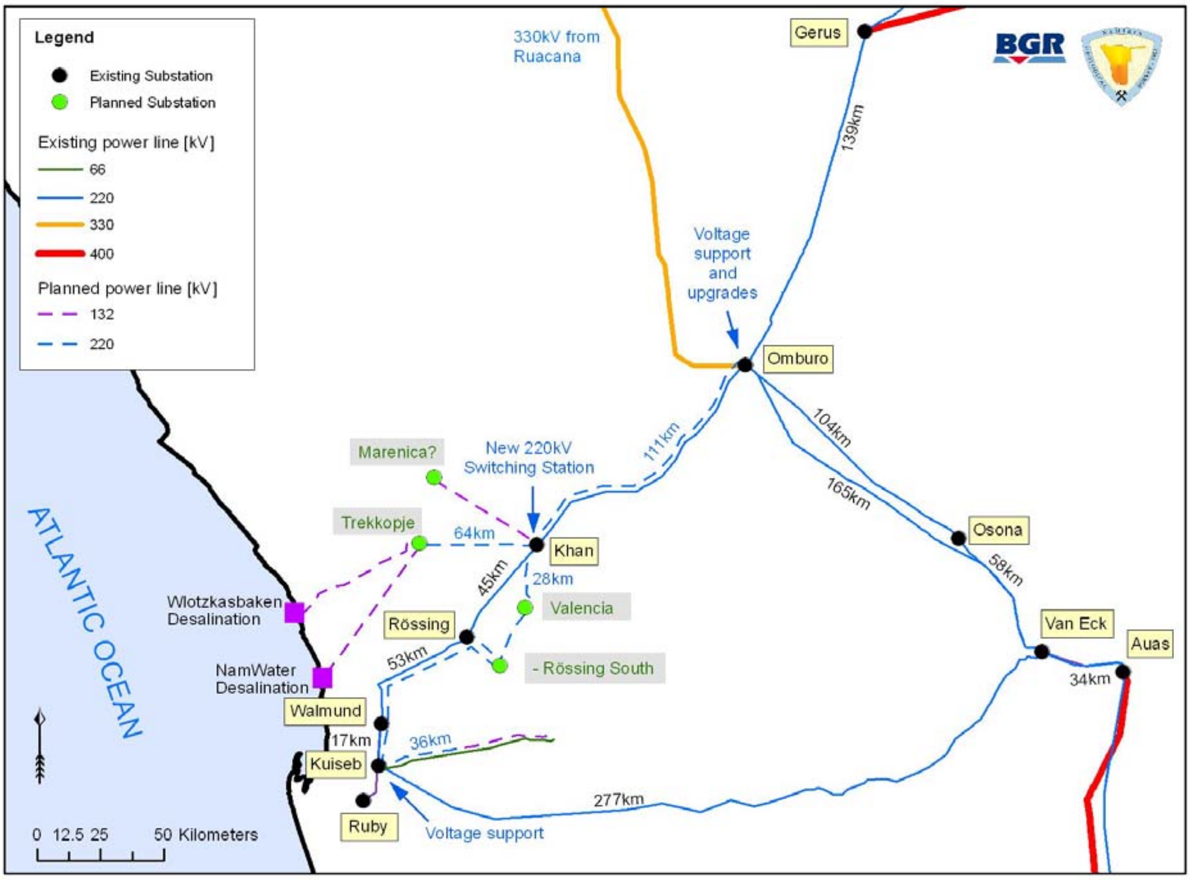


Figure 7.5.2: Proposed Transmission Network in the Erongo Region

The condition of the existing 220 kV line between Rössing and Walmund (constructed in the early 1980s) is poor as it transverses a highly corrosive area. NamPower is therefore considering dismantling this line and building a new line in its place.

Future projects, dependent on the timing and power supply requirements of the proposed Etango and Tubas Mines as well as the upgrade of the power requirements of Langer Heinrich Uranium Mine, are as follows:

- 220 kV transmission line to connect the future Khan Substation to Kuiseb via the future Valencia and Rössing South Substations;
- Voltage support at Kuiseb Substation, to be operational on a permanent basis, through for example, the installation of an SVC (Static VAr Compensator) or similar dynamic voltage support technology;
- Replacement line from Kuiseb Substation to Langer Heinrich;
- New line from Kuiseb Substation to Etango, with a possible future extension to Tumas.

In addition to this, NamPower will also have to supply electricity to the proposed NamWater desalination plant north of Swakopmund (Figure 7.5.2). This will be a 132 kV transmission line of approximately 44 km from the proposed Dolerite Substation on the Trekkopje – Wlotzkasbaken scheme.

7.5.2 Analysis of cumulative impacts

Cumulative effects in the coastal region will arise from the presence of a diesel, and coal-fired or gas power station at Walvis Bay and the proposed network of transmission lines. These are discussed below.

7.5.2.1 New power station

From the above analysis, it is clear that there is an urgent need for a new source of base load power in the coastal zone of the Erongo Region. The *quickest* supply source to commission would be a diesel power station (as contemplated at Anixas), but these stations are very expensive to run and therefore it would only be operated during emergencies. The best option in terms of national power security and *cleanest* source of power would be a combined cycle gas turbine using CNG (transported from the Kudu gas field), but feasibility studies have only just commenced on this option.

A coal-fired power station would be the *cheapest* to operate, using a known technology, but it would have the greatest number of cumulative environmental and economic effects:

- One of the main pollutants emitted from a coal-fired power station is sulphur dioxide. Background sulphur levels in the Walvis Bay area are naturally quite high. The addition of SO_2 from the power station combined with expected SO_2 emissions from the proposed Gecko Chemical Plant need to be carefully monitored to ensure that they do not combine to cause negative effects on health and biodiversity.

- Another cumulative effect could be on aesthetics and sense of place, depending on the location of the power station. If it is located near the port, then the impact will be low, but if it is located in the designated Export Processing Zone (EPZ) east of the dune belt, it will have yet another impact on a favourite tourism destination – namely Dune 7. However, if the EPZ is developed for other industries – as is contemplated, the views from Dune 7 will be compromised anyway.

- A coal-fired power station will contribute to global warming at a time when steps are being taken around the world (including ironically, nuclear power - one of the drivers for this Uranium Rush) to reduce carbon emissions. The exact amounts that would be contributed from the power station will depend on a) the size of the station; and b) the measures and technologies put in place to minimise emissions of GHGs.

- In comparison to the mines, the power station, when in operation will employ fewer people: 60 will be required to run the 200 MW station, 116 for the 400 MW station and up to 204 for the 800 MW station – this compares to an average of about 800 for each mine. However, during construction, a large number of workers will be required at the same time as construction starts on 2-3 mines and the Mile 6 desalination plant, which will mean that the power station (coal or gas) will have to compete for labour and skills.

- A coal-fired power station is fully dependent on the availability of suitable coal and prone to price fluctuations on the world market.
- Dust emissions at the harbour.
- The construction stage (for any power station) is also likely to add to the congestion on the roads and the importation of coal through the port could stretch port facilities (see section 7.3).

7.5.2.2 Transmission lines

It is estimated that under Scenario 1, approximately 204 km of new lines will be added (including the line recently built to Langer Heinrich and the new ring feed line from Khan to Kuiseb). For Scenario 2, the total length of new powerlines will be roughly 228 km and for Scenario 3 this will increase to some 278 km.

The cumulative effects of the proposed new transmission network include:

- Visual impact. Even with the best route planning, the new power lines – in addition to the existing lines, will have a major cumulative impact on the wide open spaces and landscapes of the Namib-Naukluft Park in particular. As mentioned in section 7.6 on Recreation and Tourism, the sense of space and place is a key drawcard for tourists to the coast and desert. The wilderness qualities so valued by the tourists will be compromised by the presence of numerous power lines and substations. For example, NamPower have carefully routed the proposed Khan-Valencia-Rössing South-Kuiseb line to avoid the tourist views from Welwitschia Flats and the Moon Landscape by taking the line north from Rössing South to run parallel with the existing lines along the main B2 road.
- Several new substations are planned to supply the mines: at Valencia, Rössing South and Dolerite, as well as on the coast at the desalination plants. These structures have the potential to cause a major visual impact and need to be carefully located and designed.
- Another potential impact which is common to power lines is that construction causes tracks across the desert. While these are necessary for construction, they also ‘invite’ unauthorised access to remote parts of the Park. There are already several power lines through the park and additional lines will just add to this potential threat. The cumulative impact of disturbance caused by powerline construction is estimated to be between 4.0-5.5 km^2, depending on the scenario.[1]
- There will be an increased potential for bird collisions due to the number of new lines. The new ring feed line will cross both the Khan and Swakop Rivers and so it will need to be clearly marked with bird flappers in these locations (see Figures 7.5.2 and 7.3.2). In addition, new lines at the coast pose a hazard to migrating birds, particularly flamingos and several bird collision incidents have been recorded along the trekkopje to Wlotzkasbaken line in recent months (Figure 7.5.2). The main bird groups that are susceptible to colliding with powerlines are bustards, korhaans, flamingos and vultures, all of which occur sporadically throughout

[1] This has been calculated on the assumption that the total width of disturbance during construction will be 20 m (pers. comm.. NamPower)

this area and most of which are Red Data species. Individual EIAs will need to ensure that the lines are routed to avoid major bird flight paths and that the lines are adequately marked.

Plate 7.5.1: Powerlines degrade the sense of place of the desert and impact negatively on various bird species (photo J.Pallett).

7.5.3 Desired state

Acknowledging the need for additional power and the unavoidable impacts that this will cause, the desired outcome is that electricity will be available, reliable and affordable for all users in the Erongo Region, when it is required and with as small impact on the environment (primarily visual impact, birds and air quality) as possible.

However, it is also desirable that the demand for grid electricity should be managed so as to reduce the total demand and that the use of alternative sources of energy should be actively encouraged in all sectors.

7.5.4 Recommendations

In order to minimise the cumulative impacts described above, the following recommendations can be made:

- Power demand management should be actively encouraged in all sectors, including the mines, through incentives and subsidies. Measures that need to be considered include: use of solar water heaters; the introduction of passive heating and cooling in all building designs to create energy efficient buildings; use of 'waste' heat from boilers and other industrial plants to generate electricity on site; use of solar panels for borehole pumps and other installations that can be operated using this source of power; etc.;

- The proposed new power station must be fitted with the latest technology to reduce CO_2, SO_2 and NOx emissions to the atmosphere;

- The proposed new power station must be strategically located to minimise negative impacts and to maximise opportunities for synergies with other developments in the area;

- The new power station should be located such that it does not negatively affect tourism and view points;

- The port expansion, or new bulk goods jetty (see section 7.3) needs to be completed before the power station is commissioned to ensure the efficient and safe handling of bulk coal (or gas) imports;
- The proposed new power lines should preferably follow existing infrastructure routes such as roads, railways, pipelines and other power lines. Where this is not possible, the lines need to be carefully routed to avoid tourist routes, view points and bird flight paths;
- Where additional powerlines are contemplated to augment existing supplies e.g. to Langer Heinrich, the old lines should be removed and a new higher voltage line constructed so as to avoid ranks of parallel lines;
- Bird flappers and other flight diverters need to be placed on all power lines that cross river crossings and bird flyways, especially near the coast. Lines also need to be routed away from the lappet-faced vulture breeding areas at Ganab. These issues should all be addressed in detail in the EIAs for future transmission lines.
- Substations need to be located and designed so that they have a minimal impact on views and biodiversity, while maintaining minimum technical requirements.

7.6 Cumulative Effects Analysis - Recreation and Tourism

7.6.1. Introduction

Residents and tourists to the central Namibian coast define their quality of life as being enhanced by opportunities for sport, exploring the desert by vehicle, relaxing on the beach and living in tranquil towns, angling or adventure activities. Tourism products in the central Namib include adventure tourism (e.g. parachuting and quad biking), business tourism (e.g. workshops and conferences), consumptive tourism (e.g. hunting and fishing) and ecotourism (excursions into the desert). There is also the use of the desert landscapes for filming of documentaries, adverts and feature films[1].

Plate 7.6.1: The central Namib is used for a range of tourism activities, including conference and special events, camping and enjoying the tranquil surroundings, adventure and sport activities (photos P.Tarr and NACOMA).

[1] Filming is not strictly tourism, but is included as tourism in this SEA

The tourism sector is of considerable importance to the Namibian economy. It provides over 18,000 direct jobs (5% of total employment), and N$ 1,600 million pa in revenue (3.7% of GDP). The sector has seen significant growth over the past fifteen years, with tourist arrivals increasing more than threefold from 254,978 in 1993 to 833,345 in 2006 (NTB, 2007). The coastal region provides 16% of national bed occupancy (an indicator of tourism popularity). National bed occupancy was 53% in 2008 compared to 63% in Swakopmund and surrounds (HAN, 2008). In a survey conducted by NTB (2006-2007) the most popular destinations in Namibia were Swakopmund (30%), Etosha (27%) and Sossusvlei (16%).

The output for the coastal tourism accommodation sector was estimated at N$833.2 million in 2007 (Alberts and Barnes 2008). They report that the number of international tourists visiting the coast for leisure and business (54% of the total) was estimated at 422,390. Among nature-based tourists, 22% were from overseas, 48% were from southern Africa, and 30% were domestic (Barnes et al. 1999). Areas used by the above activities are shown in Figure 7.6.1.

The Goanikontes – Moon Landscape and Welwitschia Flats are common routes for self-drive tourists, environmental tours, bus tours and even scenic flights. Ten of the 13 Swakopmund-based operators interviewed during this SEA offer this area in their tours, but there are no statistics on exactly how many visitors enter the area. One tourist operator specialises in high volume tours to the area from the Walvis Bay harbour (4,000 – 5,000 visitors annually), catering specifically for luxury cruise ships, which occasionally dock at Walvis Bay.

Plate 7.6.2: The Moon Landscape and Welwitschia Drive are routes frequented by almost all tourists who visit Swakopmund, showing off aspects of the Namib's superior tourism features within a short distance from the coastal town (photos P.Tarr and J.pallett).

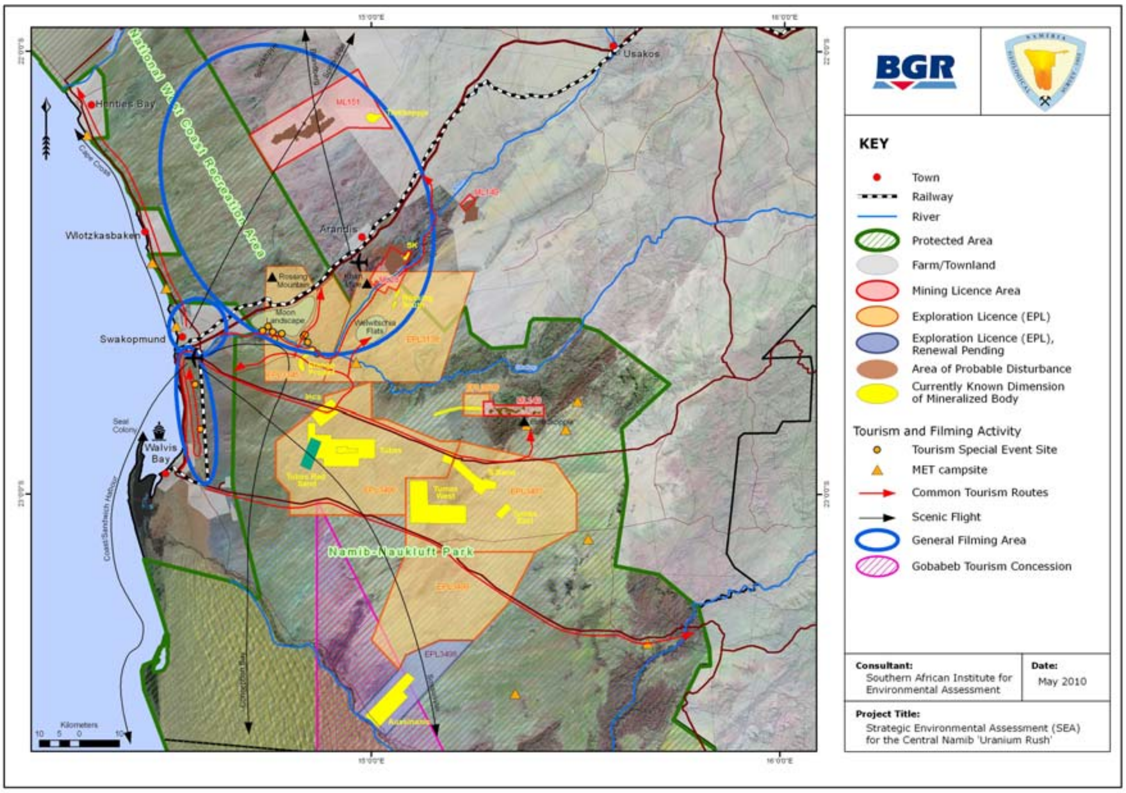


Figure 7.6.1: Map showing areas and routes used for recreation and tourism

7.6.2 Key issues

The most important tourism related concerns can be summarised as:

1. Concerns or perceptions over public health due to radiation exposure (this is addressed in section 7.13);
2. Diminished sense of place due to visual impacts and noise;
3. Actual or perceived loss of unique biodiversity; and
4. Reduced accessibility to sites of tourism importance.

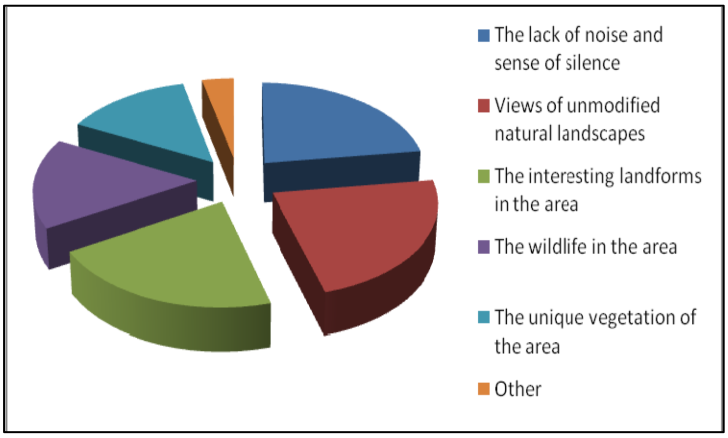


Figure 7.6.2: Tourism operators' perceptions of what makes the central Namib attractive to tourists[2]

Stakeholders interviewed within the tourism industry provided a useful assessment of what attributes are required to 'sell' the Namib to tourists (Figure 7.6.2).

Nine of the 13 tour operators interviewed as part of this SEA stated that landscape modifications from mining structures and related infrastructure would cause the most change to the desert landscape, and therefore impact negatively on its attractiveness to tourists. Also, increased mining is expected to reduce the accessibility of sites in the area for tourism and recreation activities. However, there will be opportunities for significantly increased business and workshop based tourism as well as the direct use of mines as an attraction, building on the popular Rössing tours that have been operating successfully for many years.

Stakeholders also expressed concern about the cumulative impacts of increased mining on the town of Swakopmund, which is marketed as a leisure and tourism destination. They stressed the need to maintain the aesthetically interesting architecture, holiday ambience and peaceful nature of the town. There was a concern over the influx of mining personnel, and the need for ancillary industries to be established in Swakopmund to support the Uranium Rush. It is expected to change the ambience to a more industrialised, busy centre.

[2] Sample size: 13 operators

A number of stakeholders were concerned about mining and exploration employees and contractors poaching wildlife. Sixty percent of tour operators rely on wildlife as a key component of a unique desert experience for tourists. They report a recent reduction in wildlife numbers in certain areas, and an increase in avoidance behaviour by wildlife species.

Plate 7.6.3: Swakopmund (left) is renowned as a quaint coastal resort town with a strong tourism appeal. Walvis Bay has more of an industrial character yet has also experienced growth in its tourism attractions which are largely focussed on the lagoon and nearby sand dunes (photos NACOMA).

7.6.2. Assessment of direct, indirect and cumulative impacts

In the context of public recreation and tourism, the main impacts likely to result from the Uranium Rush are listed as follows, and then discussed in more detail below:

- Visual impacts and noise, leading to compromised natural beauty and deteriorating sense of place;
- Loss of access to recreation and tourism destinations;
- Deterioration of roads; and
- Pressure on social and physical infrastructure as a result of escalating population influx.

The **natural beauty and ambience** of the desert will be compromised by the Uranium Rush, because prospecting and mining results in visually intrusive infrastructure, creates dust and noise, and will scar the Namib for decades or longer.

For this reason, the SEA commissioned a specialist study to assess the potential visual impacts of the Uranium Rush. The cumulative visual impacts (without and with mitigation) of multiple mines in the area were assessed using a Digital Elevation Model, and mapped. The following figures illustrate the possible visual impacts of the three Uranium Rush scenarios, assuming mitigation is applied (Figures 7.6.3 – 7.6.5).

The visual impacts of current mining are relatively low because Rössing Mine is situated in an area with high visual absorption capacity (Khan Valley) and as a result, the exposure of the more industrial structures, such as the processing plant, waste rock dumps and pit, have been concealed. Rössing is far from popular tourist destinations but nevertheless, there have been reports that mining activities can be heard at night from camping areas in the NNP.

Langer Heinrich Mine is located in a valley with the Langer Heinrich Mountain as a backdrop, and is thus barely visible from the C28. However, it is audible from the Bloedkoppie camp site and visible from the Bloedkoppie view point during both the day and night, thus diminishing the sense of place at this tourist spot.

The proposed Valencia mine is also located in the rugged topography of the Khan Valley, which will partially conceal features such as the open pit. The tailings dam, however, will be located on an open plain and will be visible at a distance from the B2. The Trekkopie mine does not have the advantage of topographic screening, since it is situated on open gravel plains. However, this area is not used for desert tour drives and the mine is located approximately 30 km from the B2. The mine will be visible to tourists on pleasure flights from Swakopmund to Spitzkoppe. It is likely that the waste rock will be dumped in the shallow pits as mining progresses laterally at both Trekkopie and Langer Heinrich, thus reducing visual impacts. Noise will be less of a problem at Trekkopje and Valencia mines because they are both remote from popular tourist destinations.

Other than from drilling activities, the Moon Landscape and Welwitschia Drive areas would not be visually impacted under Scenario 1.

For Scenario 2 there are significant impact differences between 'with' and 'without' mitigation. This is because Rössing South and Etango will both be deep pit mines with large waste rock dumps. These mines will visually influence the Welwitschia Flats from which three mines could be visible from a single location, significantly changing the area's sense of place. Given the Moon Landscape's very close proximity to the proposed Etango mine, there will also be a major deterioration to this area's sense of place. However, it may be possible to re-route tourist roads so that the mines are less visible from public access areas.

Plate 7.6.3: The visual, noise and sense of place impacts of a mine the size of Rössing are major. Rössing benefits from the fact that it is largely hidden from view along major tourism routes in the Namib (photos J.Pallett).

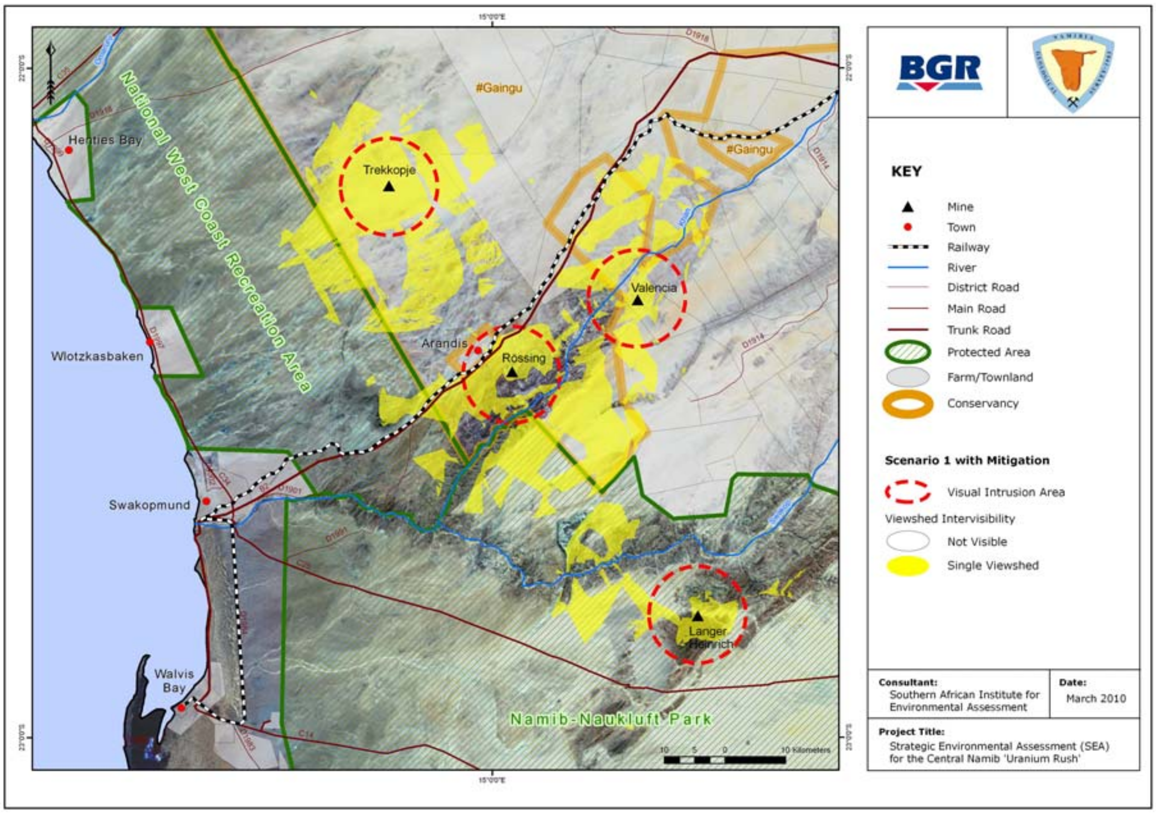


Figure 7.6.3 Predicted Viewshed and Visual Influence of Scenario 1 Mines with Mitigation

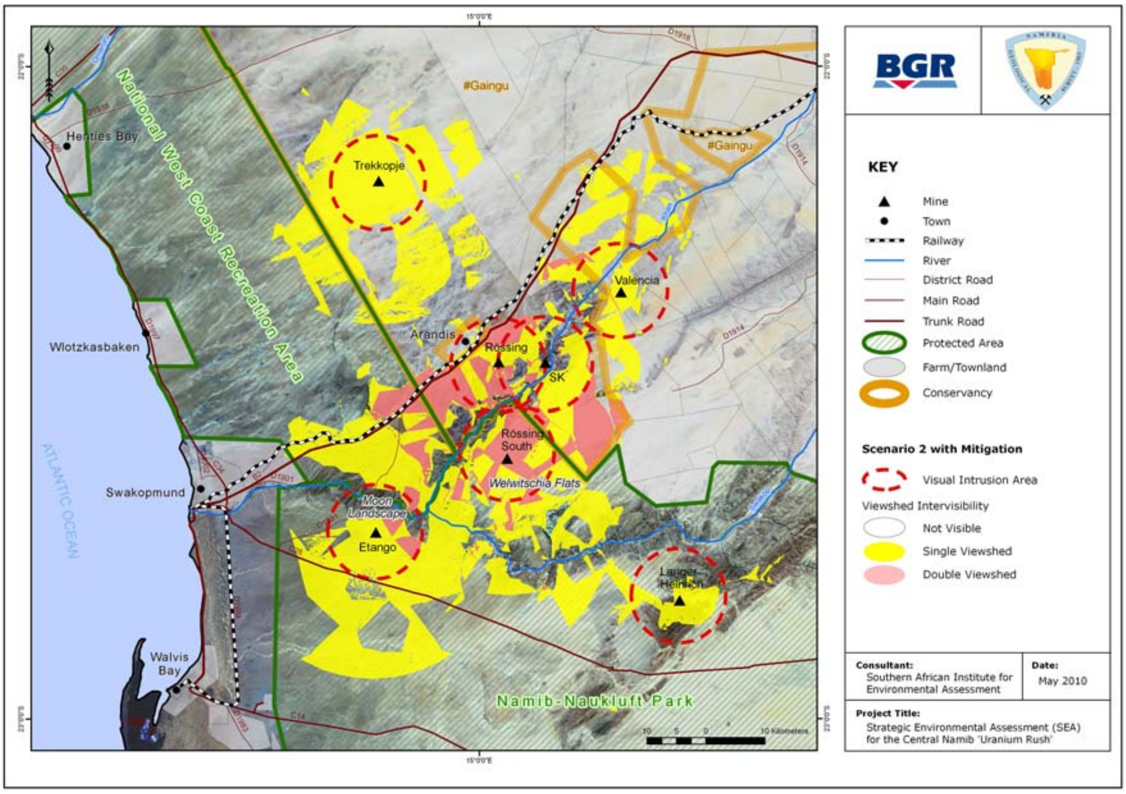


Figure 7.6.4 Predicted Viewshed and Visual Influence of Scenario 2 Mines with Mitigation

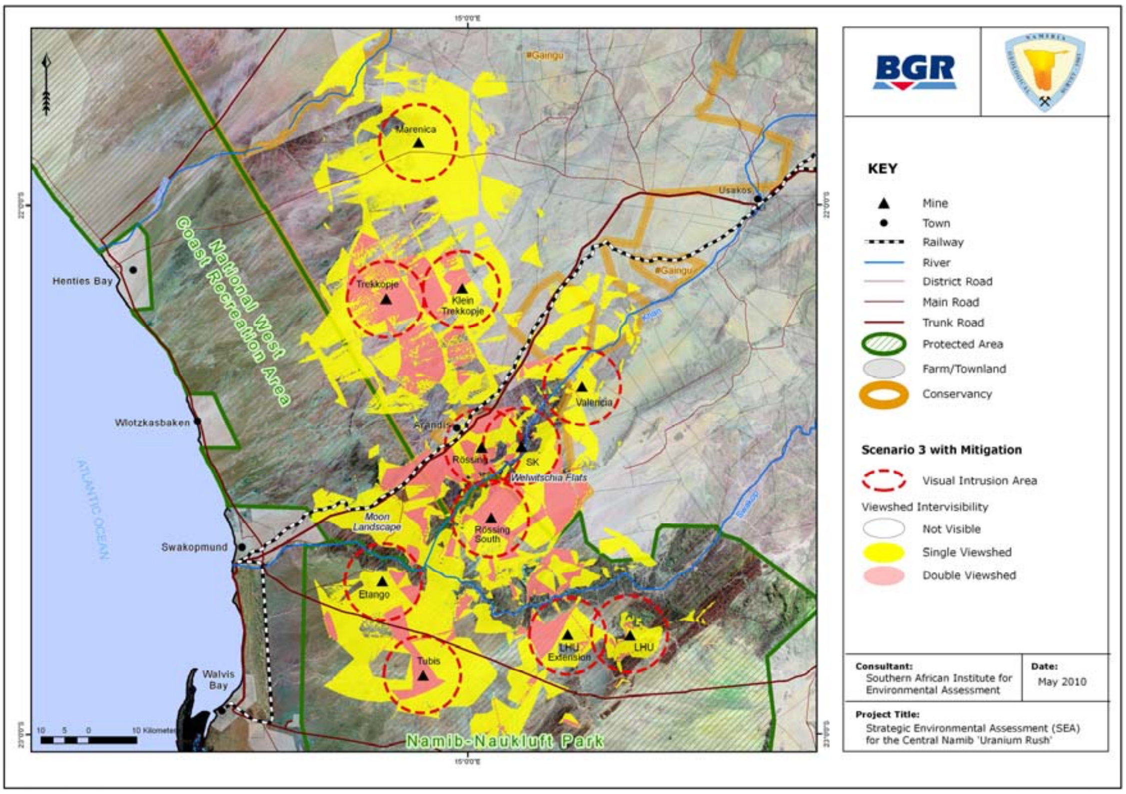


Figure 7.6.5 Predicted Viewshed and Visual Influence of Scenario 3 Mines with Mitigation

Mitigation requires back filling where possible, and landscape shaping of the remaining waste rock dumps as well as a reduction of height from 80 m to 40 m. This would significantly reduce the inter-visibility in the Welwitschia Flats access areas. Areas previously associated with the visibility of two mines would be restricted to partial visibility of one mine at a time. With careful positioning and height restriction of the Etango waste rock dumps, mining activities (other than blasting plumes) would not be visible from the Moon Landscape, however, the mine would still be audible to visitors. However the close proximity of the proposed Rössing South mine to the Welwitschia Flats would result in the potential impact of those areas within the visual intrusion buffer. The possibility should be investigated of creating a new tourist route to the Welwitschia Flats to the south of the proposed Rössing South mine, taking advantage of the topography to afford both visual and acoustic screening.

The existence of EPLs and mines, and their right to **exclude locals and visitors** from their areas, limits the places available for tourism and recreation, though some new tourism products could be developed (e.g. mine tours). Also, it may be possible to create new tourist and public roads, alternative viewpoints and campsites, so that there would be no net loss in terms of tourism and recreation opportunities.

Vehicles linked to prospecting and mining might **degrade gravel roads** in parks and other areas, making travel unpleasant and uncomfortable for locals and tourists, while **human influx** in coastal towns will place greater pressure on social and physical infrastructure, though the economic boost resulting from the Uranium Rush will also result in benefits, such as:

- Investments in new infrastructure (roads, seawater desalination plants, shops, hotels) that will be positive for locals and tourists;
- Increased business for local service providers (retailers, restaurants, adventure sports, etc.);
- Increased business and workshop tourism;
- Improvements to schools, clinics and other facilities which are needed to maintain investor interest; and
- Increased tax base and spending, which will contribute to the municipal budgets and thus increase the likelihood of improved service delivery and the provision of amenities.

Given that so many impacts relating to the Uranium Rush are interlinked, there are many cumulative impacts: for example, the proliferation of mining related infrastructure (e.g. powerlines, pipelines, roads and railways), added to the alienation for mining of areas previously used for public recreation and tourism, effectively means that one land use may displace the other (if not properly managed), resulting in opportunity costs for the tourism industry. Add to this:

- Increased crowding and industrialisation in coastal towns such as Swakopmund (which is essentially a tourist town) and subsequent avoidance of Swakopmund as a tourist destination;
- Real or perceived increased health risks because of radiation;
- Social impacts because of in-migration of job seekers (many of whom will not succeed in finding a job, resulting in them seeking other means – possibly crime to make ends meet), and an increased strain on infrastructure (ranging from parking, roads, sewerage, electricity, waste).

In addition to the direct impacts of the Uranium Rush discussed thus far, there will also be a host of impacts from other industries emerging to take advantage of the opportunities offered by the Uranium Rush. Examples are:

- New power station at Walvis Bay (either coal or gas, and diesel);
- New desalination plants (Wlotzkasbaken and Mile 6);
- Proposed acid and alkaline chemical plants at Arandis and north of Swakopmund, with associated salt and marble mining (Gecko Minerals and Gecko Chemicals) and emission of odour and fumes;
- Port expansion at Walvis Bay;
- Possible bulk materials jetty north of Swakopmund;
- Probable revitalization of the Export Processing Zone (EPZ) at Walvis Bay;
- Rapid urban development (Walvis Bay, Langstrand, Swakopmund); and
- Rapid growth in the light industrial and service sectors.

When one considers the combined impacts of the Uranium Rush and the other likely projects which are, to a large extent, linked to uranium prospecting and mining, one concludes that the cumulative impacts will likely result in a deterioration of most forms of tourism (notably desert tours and pleasure flights) and some forms of public recreation (notably desert excursions) if not addressed and mitigated during the planning and feasibility stages of all mining and related projects.

7.6.3. Desired state

MET's vision is "*a mature, sustainable and responsible tourism industry contributing significantly to the economic development of Namibia and the quality of life of all her people, primarily through job creation and economic growth*" (MET, 2008).

To achieve this vision, conducive conditions must be created for recreation and tourism. These are linked to a great number of the EQOs that have been developed as part of the Uranium Rush SEA, and include access to safe water, suitable infrastructure, a broad range of goods and services, accommodation and housing, access to the desert, low crime, good air quality, road safety, low noise levels, good governance, intact ecosystems and biodiversity, natural beauty and a conducive 'sense of place' (see Chapter 8). In many ways, sense of place encapsulates nearly all of the EQOs and is therefore at the heart of the Uranium Rush SEA.

7.6.4. Recommended avoidance, enhancement and mitigation measures

From a strategic point of view, avoiding and/or reducing negative impacts of the Uranium Rush on public recreation and tourism is required. In order to avoid or mitigate conflicts between these two key sectors, important tourism and recreation areas have been categorised as 'red' or 'yellow flag' areas (Figure 7.6.6). Application for mineral licences in both these categories of areas requires very careful consideration by the relevant government agencies (see Chapter 8).

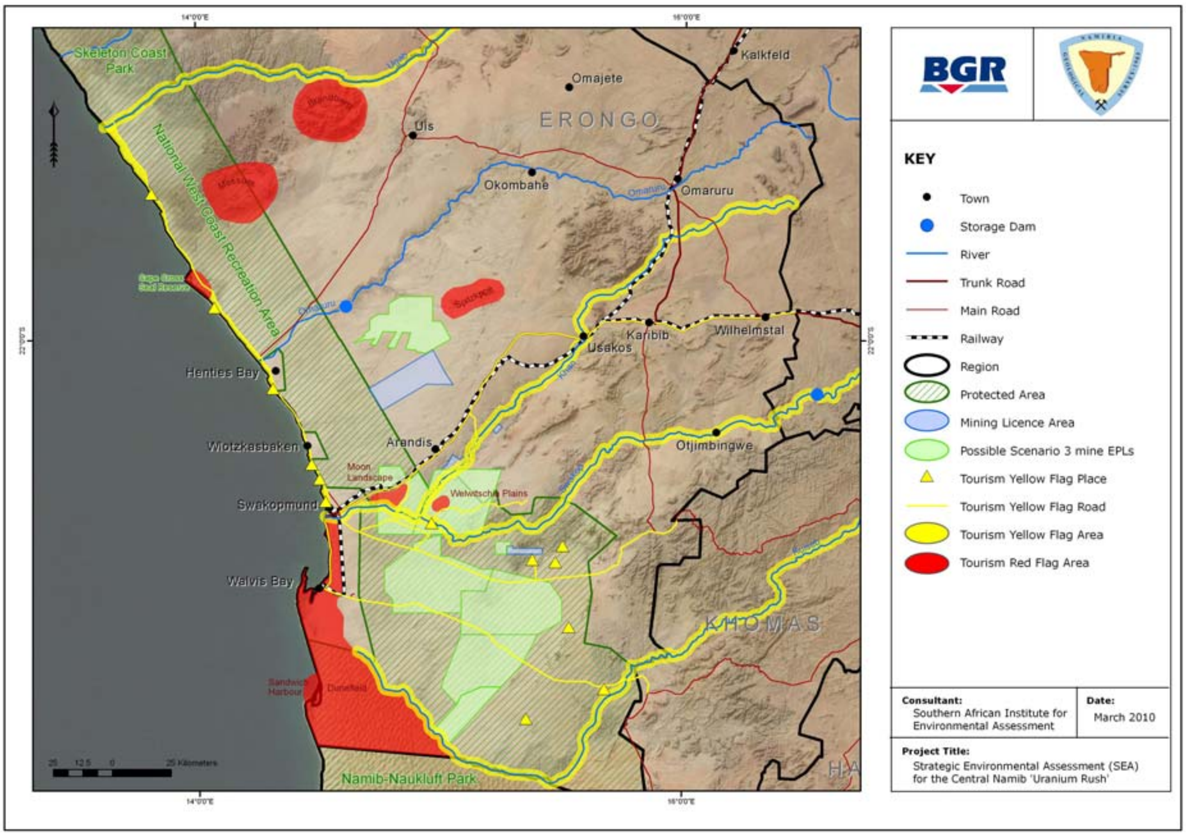


Figure 7.6.6: Red and Yellow Flag tourism areas

The proposed ‘red’ and ‘yellow’ flag areas are as follows:

Tourism Red Flag Areas: Unique areas of high importance for recreation[3] should be declared as ‘red flag’ areas for future prospecting or mining. In some areas such as Messum Crater, Spitzkoppe and Brandberg small scale mining has been present for years and is still being carried out today. Salt has been mined at Cape Cross for decades and there are plans to reactivate this mine (Chapter 4). The fact that mining has occurred, and continues in some of these areas should not negate the designation as a red/yellow flag area from a tourism perspective. The red flag areas include (see Figure 7.6.6):

1. Messum Crater;
2. Spitzkoppe;
3. Brandberg;
4. The dunefields;
5. Sandwich Harbour;
6. Moon Landscape;
7. Cape Cross, and
8. The Welwitschia Plains.

Tourism Yellow Flag Areas: These areas are popular amongst local and regional tourists. In some cases, it may be possible to provide a like-for-like alternative when a recreation or tourism area is ‘alienated’, so there is no net loss. These are ‘yellow flag’ areas:

1. The Swakop, Khan, Ugab and Kuiseb rivers;
2. The Erongo coastline from the low water mark to the main north-south coastal road;
3. All campsites within the Namib-Skeleton Coast National Park (NSCNP); and
4. Major tourist roads in the NSCNP.

To achieve relative harmony between recreation/tourism and mining and to minimise opportunity costs, there also needs to be institutional reform and the creation of partnerships. For example:

- All prospecting and mining to conform to Best Practice;
- Wherever possible, establish support infrastructure in defined ‘corridors’;
- Closer cooperation between MET and MME, so that new licences are carefully scrutinised before they are granted (see Chapter 8);
- In the management and development plans for the coastal parks, it is specified that each park will have a multi-stakeholder Consultative Forum, which is designed to support GRN in running the parks. Perhaps this forum could advise on future prospecting and mining licences, as well as assist with monitoring of prospecting and mining;

[3] These are places which have national importance and significance from a tourism and landscape perspective.

- Create a functioning SEMP office to provide input into the decision making process, opportunities for stakeholder dialogue and monitoring (see Chapter 8).

Capacity building is required, especially to enable MME and MET staff to interact confidently with prospecting and mining companies and personnel – current skills in this regard are inadequate. However, GRN might consider/could be encouraged to outsource EIA guide and review, as well as post implementation monitoring, to professional service providers. The costs of this outsourcing must be borne by the proponent (e.g. mining company). This is in line with the Polluter Pays Principle and the Environmental Management Act of 2007.

In spite of the many threats posed by mining to public recreation and tourism, there are opportunities for synergy between the companies that are part of the Uranium Rush, and between mining and other industries in the Erongo Region. In the context of public recreation and tourism these include:

- Supporting coastal conservation efforts (see section 7.7);
- Supporting public awareness campaigns about the desert and the importance of conservation (as above);
- Establishing new roads to various tourist attractions (e.g. Welwitschia Flats);
- Establishing new, replacement tourist attractions (e.g. an alternative 'Moon Landscape');
- Assisting local and national authorities with maintaining key infrastructure, including maintaining gravel roads in the NSCNP;
- Assisting local authorities to maintain public open spaces;
- Assisting local authorities and the police in combating crime (see section 7.2);
- Boosting local economies, with the resultant socio-economic spin-offs;
- EPL and Mining Licence holders may have to make compromises and develop offsets as part of their social 'licence' to mine, especially in a national park and important tourism area.

7.7 Cumulative effects analysis – Biodiversity

7.7.1 Introduction

Biodiversity is the diversity amongst living organisms (i.e. all animals, plants and other organisms such as lichens and fungi) as well as the ecosystems they inhabit (terrestrial, aquatic and marine ecosystems) and the ecological processes that they are part of and contribute to.

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.

In this report we consider biodiversity under four main headings, to assess how it will be affected by the Uranium Rush:

- The habitats in which plants and animals occur;
- The species which are most vulnerable due to endemicity or threatened status;
- The ecological processes which support life in the central Namib; and
- The areas of high biodiversity value.

7.7.1.1 Habitats

The main terrestrial habitats found in the central Namib can be classified into six main types, illustrated and described in Plate 7.7.1a-f and Figure 7.7.1.

Plate 7.7.1 (a) Gravel plains – flat to gently undulating plains, which support scattered low bushes and shrubs. Lichens grow on plains near the coast, and these 'plants' as well as the biological soil crust are important in maintaining the structural integrity of the surface (photo J.Pallett).

(b) Savanna transition – rainfall increases eastwards and this area supports more permanent grasses, scattered trees and other perennial vegetation. (Photo taken after rains, hence much more green grass than usual.) (photo J.Pallett).

Plate 7.7.1 (c) Rocky ridges and inselbergs break the plains, varying in size from low outcrops to mountains such as Spitzkoppe and Rössing Mountain. These support more diverse and more abundant vegetation than their surroundings (photo J.Pallett).

(d) Large ephemeral rivers support fairly dense woodland that creates linear oases through the arid surroundings. Flows last for a few days to weeks per year, sometimes with no flow for a few consecutive years (photo J.Pallett).

(e) Sand dunes occur south of the Kuiseb River and in a thin belt along the coast between Walvis Bay and Swakopmund. Sandy hummocks occur sporadically north of Swakopmund close to the coast (photo J.Pallett).

(f) Coastal wetlands are important sites for seabird and wader concentrations, and Walvis Bay lagoon and Sandwich Harbour are recognised as Ramsar sites of International Importance (photo J.Pallett).

Within these broad-scale habitat descriptions, there are small-scale features such as caves, springs, ephemeral pans and isolated patches of wind-blown sand, which are very important for the biodiversity they support.

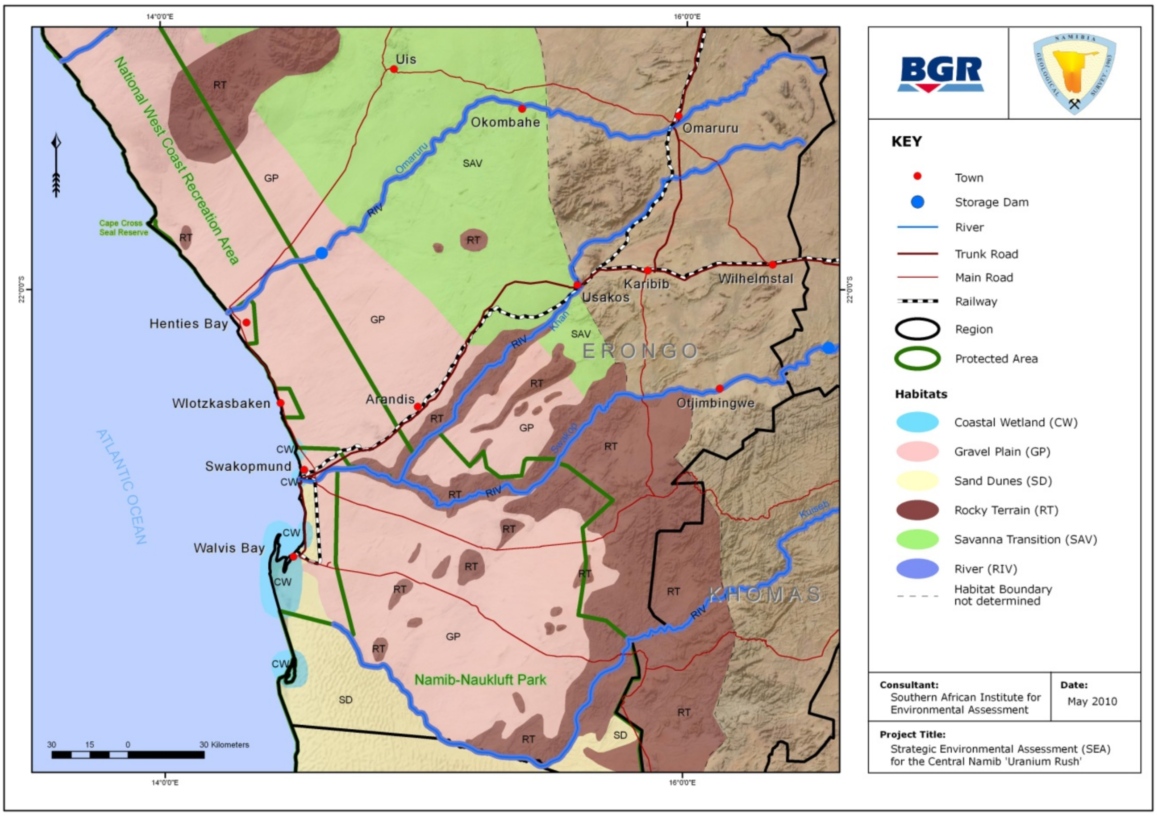


Figure 7.7.1: Main habitats in the central Namib

7.7.1.2 Species of conservation priority

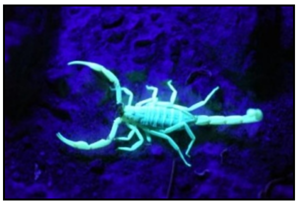
Animals and plants which are recognized conservation priorities (according to Red Data Book criteria) are shown in Table 7.7.1.

Table 7.7.1: Central Namib animals and plants which are classified as conservation priorities

Conservation category	Species
Critically Endangered (CR)	57 central Namib endemic invertebrate species, e.g. the spider *Moggridgea eremicola* (possibly extinct), the solifuge *Blossia planicursor*, the fishmoth *Ctenolepisma occidentalis*.
Endangered (EN)	30 central Namib invertebrate endemic species e.g. the beetle *Cauricara eburnea*, a new scorpion species *Hadogenes* sp. nov., the ant *Monomorium drapenum*. Damara Tern, Bank Cormorant, Martial Eagle
Vulnerable (VU)	7 central Namib endemic invertebrate species e.g. the solifuge *Blossia purpurea*, the beetle *Zophosis dorsata*. Veld Leguaan, Leopard Tortoise (both marginal in the central Namib) Lappet-faced Vulture Lesser and Greater Flamingos Cape Fox, Bat-eared Fox, African Wild Cat, Cheetah, Giraffe (latter 3 marginal in the central Namib)
Threatened (precise category CR/EN/VU not known due to data deficiency)	10 plant species Husab Sand Lizard, Damara Tiger Snake
Near-Threatened	Elephant's Foot (*Adenia pechuellii*) Rüppell's Parrot, Verreaux's Eagle, Peregrine Falcon, Cape Eagle-Owl, plus 7 coastal wetland bird species: African Black Oystercatcher, Chestnut-banded Plover, Caspian Tern, Crowned Cormorant, Greater and Lesser Flamingos, Great White Pelican Southern African Hedgehog (data deficient, but probably marginal in the central Namib)
Not categorised, but of concern	3 species of reptiles (Bradfield's Namib Day Gecko, Namib Ghost Gecko and Banded Barking Gecko) endemic to the central Namib. Many more species of all animal and plant groups which are endemic to the Namib Desert or to Namibia as a whole, for which Namibia carries the sole responsibility for their conservation. Ludwig's Bustard (newly recognized as being impacted heavily by powerline mortalities).

Lappet faced Vulture (Vulnerable)

Elephant's foot plant (*Adenia pechuelli*) (Near-Threatened)



Scorpion species (four species Threatened)

***Adenolobus pechuellii* (near-Endemic to Namibia)**

Tenebrionid beetle species (26 endemic to the central Namib, all Threatened)

Damara Tern (Endangered)

***Hoodia pedicellata* (endemic to Namibia)**

***Pedioplanis husabensis* (Threatened, endemic to central Namib)**

Namib Long-eared Bat (endemic to central Namib)

Rhoptropus gecko (endemic to central Namib)

Ludwig's Bustard (species of concern)

Leopard Tortoise (Vulnerable but marginal in the central Namib)

Plate 7.7.2: Examples of various conservation priority species in the central Namib (photos J.Pallett and P.Tarr).

Some of the implications for conservation, mining and environmental impact assessment are:

- Every part of the central Namib is unique and can potentially harbour extremely range-restricted endemic invertebrates. The possibility of mining causing the extinction of certain species is real, but information on precisely where these species occur or how many other undescribed species are also threatened, is not available;
- Each potential new exploration project and mine will have to carry out detailed surveys and research to determine the presence and biogeography of these conservation priority species;
- Careful and well implemented management and prevention of illegal activities will be required to prevent the Uranium Rush and associated human encroachment into the Namib

from increasing the level of threat against various Threatened and Near-Threatened animals and plants.

7.7.1.3 Ecological processes

The integrity and functioning of food webs, cycling of nutrients between organisms and their physical environment, and other ecological processes are essential to enable plants and animals (including people) to inhabit and survive in the Namib. The most important ecological processes include:

- Water provision by rivers and springs, rain and fog. Continuity of flows (surface and below ground) down the small washes and the larger ephemeral rivers is essential for maintaining the perennial vegetation that is so important to life on the plains, and the larger river flows which recharge aquifers and provide water for riverine fauna and flora.
- Food provision is a vital requirement, and all plant material (even dead wood) is used and recycled through the food web. Plant detritus is dispersed by wind and water agents.
- Freedom of movement. Relatively large mammals and birds move around in relation to available food and water sources, and freedom of movement is important for their survival. Fences and pipelines potentially restrict mammal movements, and powerlines interfere with movements of large birds through the effect of collisions with high voltage cables.
- Integrity of the biological soil crust. This is important to minimise dust levels, and aesthetically, the surface should be kept free of vehicle tracks as much as possible.
- Episodic events. Recolonisation and restoration processes are inherently slow, but are sporadically accelerated by high-rainfall events. Episodic events such as these have a long-lasting effect in the desert.
- Ecological integrity of the area relies on ecological processes being allowed to continue freely and plants and animals being allowed to fulfil their ecological roles. These make an important contribution to the wilderness sense of place of the desert.

7.7.1.4 Areas of biodiversity value

Areas of relatively high biodiversity value and that are sensitive to mining and prospecting activities have been identified and mapped (Figure 7.7.2). Some must be considered ‘Red Flag’ areas where mineral licence applications should preferably not be allowed, and some have been categorised as ‘Yellow Flag’ areas where mineral licence applications will be considered only after careful consideration (see Chapter 8).

The ‘red’ and ‘yellow’ flag areas have been proposed on the basis of the following guiding principles:

- Areas with high levels of endemicity and diversity;
- Conservation status of species;
- The extent to which habitats are threatened or vulnerable to disturbance; and
- Habitats or migration routes which are critical for species’ survival.

These areas were designated during an expert stakeholder workshop. The boundaries are not based on scientific data, but on informed opinion; they must therefore be considered as indicative. In addition, the areas between red and yellow flag areas are not devoid of biodiversity; activities taking place outside the flagged areas will still need to be assessed (in an EIA) and carefully managed (according to an approved EMP).

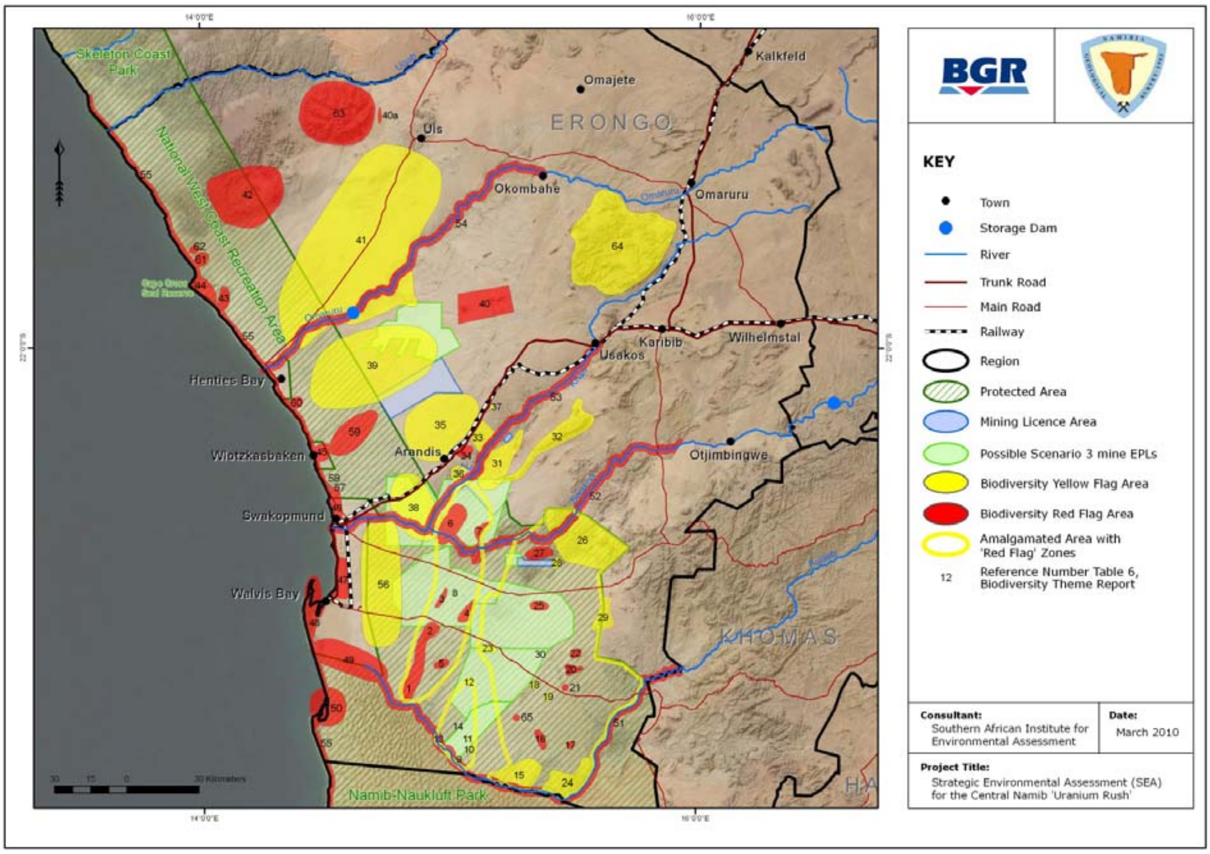


Figure 7.7.2: Areas of high biodiversity value in the central Namib in the context of the Uranium Rush. (Reference numbers appear in Table 7.7.2 which names the areas and justifies their consideration as areas with conservation priority)

Table 7.7.2: Areas of high biodiversity value in the central Namib.

Number in Fig 7.7.2	Name	Area (km^2)	Justification
1	Swartbank	175	Marble and dolerite inselberg with high plant diversity, especially prolific lichens, Lithops.
2	Hamilton Range S of C14		Marble inselberg and dolerite dykes, with high plant diversity, especially lichens, Lithops, aloes.
3	Hamilton Range N of C14	18	Marble inselberg with high plant diversity.
4	Leeukop	36	Inselberg with very high concentration of Adenia pechuelli.
5	Chungochoab	20	Granite inselberg with high plant diversity and large washes coming off the northern slopes, including one small perennial stream. Lichens and large Acacia trees require protection. Abundant aloes, especially A. Asperifolia.
6	Welwitschia Flats	138	Iconic plants including Giant Welwitschia and many other large individuals of this plant. Area of ridges and plains that supports very high plant abundance and diversity compared to surrounding areas, high productivity probably due to 'fog trap' between the Khan and Swakop R valleys.
7	Husab and Witpoortberg	60	Inselberg with high biodiversity, part of restricted range of lizard Pedioplanis husabensis. Similar to Hamilton Range. Many Lithops, also Adenia.
8	Central Namib Plains	1632	Amalgamated area that includes Swartbank, Hamilton Range, Leeukop, Chungochoab, Witpoortberg, Husab Mountain and Welwitschia Flats as an area with exceptional value. Possibly important for lizards which seek contrasting substrates. Includes Inca area as part of Reptile.
9	Gobabeb	2	Combines dune, river and plains habitats, has high invertebrate and reptile biodiversity. Highest tenebrionid beetle diversity in the world recorded from this 'middle zone' of the central Namib where total precipitation from fog and rain is the lowest and aridity is most extreme (refer to Fig 5.3).
10	Sout Rivier spring	2	Hyper-saline spring with specialised fauna e.g. forams, rotifers, certain spiders (wolf, widow) that only exist at such springs. All springs important as magnets for ungulates, bats and birds.
11	Spring	2	Spring, same as 10.
12	Spring	6	Spring, same as 10.
13	Aussinanis	6	Large grove of gnarled, very ancient Acacia erioloba trees, high flood debris hundreds of metres from river, scenic (linear and star dune), confluence of large ephemeral catchment with the Kuiseb with comparatively high plant diversity and abundance.
14	Aussinanis-Gobabeb plains	409	Amalgamated area that includes permanent springs, ephemeral springs in wet years, lower Aussinanis wash and plain with scenic granite boulders, and Gobabeb. Invertebrate and reptile diversity exceedingly high.
15	Hope Mine area	179	Outlier occurrence of a dense Welwitschia patch, southernmost distribution of the species, in the scenic Hope Wash. Snake diversity high.
16	Mirabeb hills	25	Granite inselberg with springs, with resulting high concentrations of wildlife. Notably high plant diversity.
17	Zebra Pan	8	Ephemeral pan with high game concentration, especially Mountain Zebra and Lappet-Faced Vultures. Not permanent water but as important as any other water source when it has it.
18, 19	Springs in upper Aussinanis wash	18	Springs with specialised fauna e.g. forams, rotifers, certain spiders (wolf, widow). All springs important as magnets for ungulates, bats and birds.

Number in Fig 7.7.2	Name	Area (km^2)	Justification
20	Heinrichsberg and Amichab	24	Inselbergs with many Namib plant endemics.
21	Kriess se Rus	6	Open Acacia erioloba woodland, many very old trees, many contain Lappet-Faced Vulture nests.
22	Tumas Mtn - Ganab	15	Granite inselberg, high richness of rodents, high populations of Aloe asperifolia and A.dichotoma.
23	Ubib Spring + wash (also called Foram Spring)	21	Spring, see 18.
24	Barrowberg	195	Marble inselberg with high concentration of Adenia pechuelli.
25	Hotsas	26	Waterhole, open camelthorn woodland, plentiful wildlife, also Lappet-Faced Vultures.
26	Broken hills linked to Swakop R valley	520	Wilderness area, scenic beauty, Lappet-Faced Vulture breeding area. Large cave with abundant bats.
27	Langer Heinrichberg	51	Inselberg with particularly high biodiversity, important area for Mountain Zebra.
28	Tinkas Dam	15	Waterhole, abundant birdlife and wildlife, open Acacia erioloba woodland with Lappet-Faced Vulture nests.
29	Arechaoamab	59	Quartzite inselberg with spring. Fox, Suricate, Ground Squirrels concentrated in this area.
30	Eastern Namib plains	5167	Amalgamated area that includes sensitive areas 15-29 and is important as an open area for vulture conservation, and wilderness area NE of Langer Heinrich.
31	Broken plains	220	Dense populations of Adenia pechuelli and Aloe dichotoma on granite broken plains.
32	Chuos Mtns	274	Expected high biodiversity but this is private land.
33	Broken plains between Vergenoeg and Valencia	88	Broken granite landscape, rich plant diversity. Many Aloe asperifolia and A. namibensis, Sterculia trees, Adenia pechuelli.
34	Marble ridges NE of Arandis	35	High plant diversity including Avonia ruschii and a cave (concentrated bat population).
35	Plains S of Trekkopje	631	Relatively undisturbed gravel plains, wildlife concentrations (springbok, ostrich). Very large, dense field of Sarcocaulon marlothii.
36	Mountains surrounding Rössing, including Rössing Dome	42	High density of Lithops rushciorum and Adenia pechuelli, lizard Pedioplanis husabensis, only known distribution of possibly extinct spider Moggridgea eremicola.
37	Marble koppie on farm Vergenoeg	4	Dense population of Aloe namibensis, hedgehog occurrence.
38	Swakop-Khan confluence (Haigamchab), Goanikontes, Rössing Mountain	439	Amalgamated area including Haimgamchab, Goanikontes, Rössing cave. Haimgamchab – huge, very old Acacia erioloba, permanent spring (supports furthest west occurrence of baboons), reedbeds. Swakop R canyon upstream of Goanikontes with marble ridges, rich patches of special plants (Aloe dichotoma, Anacampseros and Lithops ruschiorum), Rössing cave – concentrated bat population.
39	Plains N of Trekkopje	1346	Relatively undisturbed gravel plains, wildlife concentrations (springbok, ostrich).
40	Spitzkoppe and Klein Spitzkoppe	267	Granite inselbergs with great natural beauty and recreational use, also high plant diversity. Surroundings (washes coming off the mountains) have especially high plant abundance.
40a	Inselberg E of Brandberg	8	Plant diversity, runoff from granites.
41	Lower Omaruru River and gravel plains	3403	Amalgamated area with patches rich in Adenia pechuellii, relatively undisturbed plains, dissected by dolerite and marble ridges with high plant diversity. Transition area between desert zones, mosaic of

Number in Fig 7.7.2	**Name**	**Area (km^2)**	**Justification**
			patches with varying diversity and abundance.
42	Messum Crater and rivers to W of it	642	Very rich in lichens, dense welwitschia population, Aloe namibensis and A. asperifolia, plus other plant diversity.
43	Lagunenberg	36	Prolific lichen abundance and diversity.
44	Cape Cross Seal Reserve	74	Important seal breeding area and particularly high density of jackals.
45	Black Ridge area inland of Wlotzkasbaken	51	Many dolerite ridges, rich in lichens and other plant diversity – e.g. Aloe namibensis, Euphobia lignose.
46	Swakopmund surrounds	84	Important Bird Areas at Panther Baken (salt works) and Swakop River Mouth.
47	Coast immediately N of Walvis Bay	90	Important Bird Areas, high density of waders along beach, Damara Tern breeding area.
48	Walvis Bay Lagoon	152	Internationally recognised Ramsar Wetland and Important Bird Area.
49	Kuiseb Delta	344	Very high density of !nara plants, important for Topnaar livelihoods.
50	Sandwich Harbour	203	Internationally recognised Ramsar Wetland and Important Bird Area.
51	Kuiseb River	754	Linear oasis, riparian woodland, aquifer recharge, rich wildlife.
52	Swakop River	706	Linear oasis, riparian woodland, aquifer recharge, rich wildlife, bird flight paths.
53	Khan River	420	Linear oasis, riparian woodland, aquifer recharge, rich wildlife, bird flight paths.
54	Omaruru River	622	Linear oasis, riparian woodland, aquifer recharge, rich wildlife.
55	Coastal strip between the beach and coastal road	708	Coastal birds (some Near-Threatened and Threatened species, including Damara Tern breeding areas), dune hummocks with endemic coastal invertebrates and reptiles, brown hyena, lichens and marine life, surf zone species.
56	Inland gravel plains	813	Lichens, invertebrates and biodiversity associated with Tumas drainage area. Tumas 'mouth' (reedbed and ephemeral spring on eastern edge of dunes) – hummocks and ephemeral wetland.
57	Mile 4 wetland	1	Important Bird Area at saltworks.
58	Area N of Swakopmund, up to 5 km inland from coast	2	Important Damara Tern breeding and feeding area.
59	Wlotzkasbaken lichens	217	One of the most important lichen areas in Namibia – under threat from off road driving. Damara Tern nesting area, flamingo flightpaths.
60	Henties Bay hummocks	24	Endemic invertebrates and lizards – this is a fast disappearing habitat, mostly because of recreation impacts.
61	Cape Cross Lichens	31	Substantial lichen areas with associated biodiversity.
62	Cape Cross ridges	12	Various desert plants and lichens, similar to Laguneberg (Area 43).
63	Brandberg	688	High endemicity of plants, reptiles and insects.
64	Erongo Mountains	1285	Inselberg with high biodiversity, several special areas (high runoff from outcrops) within the horseshoe, ephemeral pools, intended area for rhino relocation.
65	Sewefontein	7	Confluence of a few ephemeral streams with concentration of seven springs.

Examination of Figure 7.7.2 shows that the prospecting and potential mining areas under Scenario 3 will affect quite a number of areas with high biodiversity value. Table 7.7.3 shows which EPLs and mining licence areas affect which sensitive areas. While this does not mean that mining may not happen in these areas, it does highlight the need for individual companies to take responsibility for protecting and managing these sensitive environments. Each company's exploration EMP and EIA (if the project advances to the feasibility stage), should pay specific attention to avoiding these areas, minimising indirect impacts and ensuring that the areas and/or sensitive components are adequately protected. The Scenario 3 mines are highlighted in bold and yellow shading in Table 7.7.3.

Table 7.7.3: Areas of high biodiversity value in EPL and ML areas. Area numbers in column 2 refer to the numbering in Table 7.7.2 and on Figure 7.7.2

ML/EPL number and name	Known main biodiversity concerns
ML28: Rössing (existing operation and expansion project), Rössing Uranium Mine	High density of Lithops rushciorum and Adenia pechuelli, lizard Pedioplanis husabensis, only known distribution of possibly extinct spider Moggridgea eremicola. Area 36. Khan R – linear oasis, riparian woodland, aquifer recharge, supports wildlife. Area 53.
ML140: Langer Heinrich, Paladin Resources	The Schiefferberg to the south of the mine is important for Mountain Zebra. The Langer Heinrich mountain also has high biodiversity. Area 27. The Tinkas Dam and German war graves and battlefields provide an interesting historical context and this area also supports open Acacia erioloba woodland. Area 28.
ML151: Trekkopje, Areva	The Trekkopje deposit is located in a relatively undisturbed part of the gravel plains with relatively high wildlife concentrations. Areas 35, 39.
ML 149: Valencia, Forsys	The broken granite hills at Valencia support a dense population of Elephant's Foot (Adenia pechuelli) and Aloe dichotoma. Area 31. Close to Khan R – linear oasis, riparian woodland, aquifer recharge, supports wildlife. Area 53.
EPL3345: Etango Project, Bannerman Resources Ltd	Swakop R canyon upstream of Goanikontes with marble ridges with rich patches of special plants (Aloe dichotoma, Anacampseros and Lithops ruschiorum), Area 38. Swakop R – linear oasis, riparian woodland, aquifer recharge, supports wildlife. Area 52.
EPL3138: Husab Project (Rössing South), Extract Resources	Iconic plants including Giant Welwitschia and many other large individuals of this species. Area of ridges and plains that supports very high plant abundance and diversity compared to surrounding areas, high productivity probably due to 'fog trap' between the Khan and Swakop R valleys. Area 6. Inselbergs with high biodiversity, part of restricted range of lizard Pedioplanis husabensis. Area 7. Broken granite hills in NE part of EPL support high numbers of Elephant's Foot (Adenia pechuelli) and Aloe dichotoma. Area 31. Swakop and Khan R – linear oases, riparian woodland, aquifer recharge, support wildlife. Areas 52 and 53.
EPLs3327, 3328: Uis/Namib Rock, Extract Resources	No hotspots known yet – research may change status. Close to Brandberg which is biodiversity and endemism hotspot – Area 63. Also close to Messum Crater with dense welwitschia population – Area 42.
EPL3439 Ida Dome, Swakop Uranium	Part of Area 8 that has overall relatively high biodiversity value. Swakop R linear oasis, riparian woodland, aquifer recharge, supports wildlife. Area 52.
EPLs 3635, 3636, 3632, 3637, Dunefield Mining	No hotspots known yet, though borders on Erongo Mountains and Spitzkoppe, which are biodiversity hotspots (Areas 64 and 40).
EPL3638: Namibplaas, Dunefield Mining	Dense population of Adenia pechuelli. Close to Khan River - Linear oasis, riparian woodland, aquifer recharge, supports wildlife. Area 31.
EPL3346: Swakop River (Bloedkoppie Prospect), Bannerman Resources Ltd	Langer Heinrich inselberg, important for mountain zebras. Area 27 with high biodiversity. Tinkas Dam - open woodland, vulture breeding area. Area 28. Wilderness area, scenic beauty, vulture breeding area. Area 26. Swakop R - Linear oasis, riparian woodland, aquifer recharge, supports

ML/EPL number and name	Known main biodiversity concerns
	wildlife. Area 52.
EPL3496: Tubas Project (including Inca, Red Sands and Oryx), Reptile Uranium Pty Ltd	Lichens, invertebrates and biodiversity associated with Tumas drainage area. Area 56. Hamilton Range northern section – marble inselberg with high biodiversity. Area 3. Covers large part of Area 8 – generally high biodiversity value on central Namib plains.
EPL3497: Tumas and Namib Park (including Oryx extension), Reptile Uranium Pty Ltd	Leeukop inselberg with very high concentration of Adenia. Area 4. Part of Area 30 – eastern Namib plains, important as open area for vulture conservation. Includes Hotsas waterhole with concentrated wildlife, vulture breeding area in open Acacia erioloba woodland - Area 25.
EPL3498: Aussinanis, Reptile Uranium Pty Ltd	Combines dune, river and plains habitats with exceedingly high invertebrate and reptile biodiversity, large ancient Acacia erioloba specimens, confluence of large Aussinanis ephemeral catchment with Kuiseb, high plant diversity and abundance. Area 13. Part of Amalgamated Area 14 that includes permanent springs, ephemeral springs in wet years, lower Aussinanis wash and plain with scenic granite boulders, and Gobabeb. Area 9.
EPL3499: Ripnes, Reptile Uranium Pty Ltd	Ubib Spring, with associated biodiversity. Area 23. Part of amalgamated Areas 30 and 14 that includes permanent springs, ephemeral springs in wet years, lower Aussinanis wash and plain with scenic granite boulders, and areas important for vulture conservation.
EPLs3516, 3517, 3518: Dome Project, Cheetah Minerals	Abuts Walvis Bay Ramsar Wetland and Important Bird Area. Area 48. High density of !nara plants in Kuiseb delta, important for Topnaars. Area 49. Includes Sandwich Harbour Ramsar Wetland. Area 50.
EPLs3453, 3454: Erongo Granites Project, Erongo Energy Ltd	Borders on Erongo Mountains, which support high biodiversity. Area 64.
EPL3477: Spitzkoppe Project, Erongo Energy Ltd	No hotspots known yet – research may change status.
EPLs3569, 3570, 3571: Cape Cross, Xemplar Energy Corp	Large area of open relatively undisturbed plains with outcrop patches rich in Adenia pechuellii, and other plant diversity. Area 41. Omaruru River Linear oasis, riparian woodland, aquifer recharge, supports wildlife. Area 54.
EPL3287: Marenica, West Australian Metals	Relatively undisturbed gravel plains with wildlife concentrations. Area 39.
EPLs3850, 3851: Klein Spitzkoppe, SWA Uranium Mines	Klein Spitzkoppe inselberg with great natural beauty and recreational demand, also high plant diversity. Area 40. Part of amalgamated Area 41 with outcrop patches rich in Adenia pechuellii, relatively undisturbed plains. Omaruru River linear oasis, riparian woodland, aquifer recharge, rich wildlife. Area 54.
EPL3668: Gawib West, Toro Energy Ltd	Part of amalgamated Area 30 that is important as an open area for vulture conservation.
EPL3669: Tumas North, Toro Energy Ltd	Lichens, invertebrates and biodiversity associated with Tumas drainage area. Area 56.
EPL3670: Chungochoab, Toro Energy Ltd	Hamilton Range marble and dolerite ridge with high plant diversity, especially lichens, Lithops, aloes. Area 2. Chungochoab granite inselberg with high plant diversity, especially lichens, abundant aloes, large Acacia erioloba specimens. Area 5. Part of amalgamated Area 8 that includes plains and inselbergs with high biodiversity value. Kuiseb River linear oasis, riparian woodland, aquifer recharge, supports wildlife. Area 51.
EPL3500: Langer Heinrich extension	Close to Langer Heinrichberg with high biodiversity and an important area for mountain zebra. Area 27. Part of amalgamated Area 30 that is important as an open area for

ML/EPL number and name	Known main biodiversity concerns
	vulture conservation.
EPLs3600, 3602, Zhonghe Resources Namibia	Dense populations of Adenia pechuelli and Aloe dichotoma on granite broken plains. Area 31. Broken granite landscape, rich plant diversity. Many Aloe asperifolia, A. namibensis, Sterculia trees, Adenias. Area 33. Khan River linear oasis, riparian woodland, aquifer recharge, supports wildlife. Area 53.
EPL3664, Green Mineral Resources	Amichab and Heinrichsberg inselbergs with many plant endemics. Area 20. Tumas Mountain – high population of Aloe dichotoma and A. asperifolia. Area 22. Part of amalgamated Area 30 that includes areas important for vulture conservation, and wilderness areas.
EPL3780, Petunia Investments 3	Lichens, invertebrates and biodiversity associated with Tumas drainage area. Area 56.
EPL3615, Namibia China Mineral Investment and Development cc	Wlotzkasbaken lichen - one of the most important lichen areas in Namibia. Area 59.
EPL3573, Uramin (Areva)	Part of Areas 35 and 39 with open undisturbed gravel plains, large field of Sarcocaulon marlothii, wildlife concentrations. Western part extends into Wlotzkasbaken lichen field - one of the most important lichen areas in Namibia. Area 59.

7.7.2 Cumulative impacts

The cumulative impacts of the Uranium Rush on biodiversity may be categorised as follows:

- Deterioration of water quantity and quality for biodiversity and ecosystem functioning (see also Chapter 7.4);
- Habitat loss, degradation and fragmentation caused by mines and infrastructure;
- Threats to specific (Endemic and Threatened) plants and animals.

7.7.2.1 Deterioration of water quantity and quality for biodiversity and ecosystem functioning

The cumulative impacts assessed in this section are similar to the cumulative impacts on water (section 7.4.2) but focus on the effects on biodiversity. The impacts are:

- Pollution of surface and groundwater from seepages, spills and accidents is a possible threat, and includes the possibility of contamination from radioactive substances (uranium and other radio-nuclides), hazardous chemicals (acids, alkalines, sulphate, sodium, chloride, nitrate), and fuels, oils and greases (see section 7.4.2.1);
- Over-abstraction from the alluvial aquifers could threaten the ecosystems along the river beds of the main ephemeral rivers because they are dependent on groundwater for survival (see section 7.4.2.2);
- Water flows in the washes and ephemeral rivers may be blocked or diminished;
- Point water sources such as ephemeral springs and pans may be degraded or may dry up as a result of prospecting and mining activities.

Scenario 1 mines have not shown any significant impacts beyond their Mining Licence areas in this regard, although the impacts stated above might still occur, particularly over-abstraction and pollution of water. Desalinated water from Wlotzkasbaken will come on line in the near future, but abstraction of water from the Khan and Swakop will continue for the purposes of construction and dust suppression.

In Scenario 2 the NamWater desalination plant is likely to be operational, so there will be a greater network of pipelines and roads to the mines at Etango and Rössing South (possibly interrupting wash flows), and the higher number of operating mines means a greater risk of pollution. Ongoing abstraction from the alluvial aquifers for exploration and construction will continue to put pressure on these aquifers although abstraction is supposed to be within permitted limits (see section 7.4.4).

In Scenario 3 the pipeline network could extend further north and south, to supply the Marenica and Reptile mines. The higher number of mines will increase the risks of pollution and over-abstraction, if not properly controlled.

Rapid abandonment of uranium mines in Scenario 4 greatly increases the vulnerability of surface and groundwater sources to contamination by radioactive and hazardous substances.

The level of impact on water quality and quantity for ecosystem processes therefore increases gradually from Scenarios 1 to 4. The most significant impact on future water sustainability for ecosystem processes comes from the long-lasting danger of seepage from tailings dams and heap leach pads that are not properly monitored and actively prevented from causing groundwater contamination.

7.7.2.2 Habitat loss, degradation and fragmentation caused by mines and infrastructures

Activities that are responsible for loss, degradation and fragmentation of habitats include land clearing, earth-moving and excavations; construction of mine plants, heap leach pads and residue dumps, waste rock dumps and tailings dams; smothering by dust; clearing for roads, tracks, pipelines, powerlines and railways; and the degradation of vegetation in cones of depression around water abstraction points. Included in the impact is the secondary effect of illegal off-road driving which already occurs, but which may be exacerbated by the increased number of people in the area.

The impacts on biodiversity include:

- Population depletion of range-restricted species, possibly causing extinction of many invertebrates which are endemic to very small areas (median 25 km²) within the central Namib, and threatening other vertebrate animals which are central Namib endemics (such as Husab Sand Lizard) or have population strongholds in the central Namib (e.g. Lappet-faced Vulture). According to the Constitution of Namibia and internationally recognized guidelines (e.g. Equator Principles, UN Convention on Biological Diversity), the possibility of extinction is a fatal flaw to a project;
- The impact of vehicles on the soil surface is more than just aesthetic. Compaction can crush animal burrows, break down the fragile biological soil crust (BSC) and disturb the protective desert pavement. Alteration of the micro-topography of the desert surface can lower its ability to accommodate and shelter wind-blown seeds, thus reducing the potential for plant recruitment. It also means that more dust will be generated during high wind conditions;
- Dust generation from mining activities could expand the footprint of disturbance, if not correctly managed. Dust, depending on how thickly it settles out onto plants, can kill plants or lower their productivity, and reduce seed generation and young plant recruitment. Dust fallout combined with fog precipitation is thought to clog up crevices and cracks which are important shelter and refuge sites for invertebrates. These impacts will be most pronounced along the gravel roads and locally adjacent to dusty activities on the mines;

- Habitat loss on a small scale can have far-reaching effects. For example, destruction of a single cave used by bats may be deleterious to many thousands of bats of a species that normally roams quite widely, and that fill an important niche as predators of flying insects.

The total footprint of the individual mines and of the associated infrastructure is shown in Table 7.7.4.

Table 7.7.4: Cumulative habitat loss by mines and new infrastructure, in km²

	Mines	Roads	Pipelines	Powerlines	Railways	Rounded total
Scenario 1	443.8	2.34	2.23	4.08	0	452
Scenario 2	496.8	3.18	2.86	4.56	1.20	509
Scenario 3	576.8	3.39	3.23	5.56	1.64	591

These areas have been calculated on the assumption that the construction and final footprints in all cases will be minimised and that as far as possible, most infrastructure will be confined to a designated corridor (see section 7.3). It also assumes that where possible, optimum use will be made of the infrastructure e.g. one pipeline will supply water to more than one mine.

The bulk of the footprint from mines and infrastructure (more than 76% in all cases) is made in Scenario 1, and increases thereafter. The size of the footprint of mines in Scenario 1 is due to the large areal extent of the Trekkopje mine. The bulk of the impact on habitats will be felt in the early stages of the Uranium Rush, probably in the next five years.

The significance of the impact is not worsened by Scenario 4 in which mines are rapidly abandoned. By that stage, the damage has been done. The impact can be considered to be long-term and in some cases (such as from mine pits and waste rock dumps), permanent.

7.7.2.3 Threats to specific plants and animals

Various species of plants and animals will be impacted by the Uranium Rush through increased disturbance, which will take a variety of forms:

- Noise and movement from mining activities will deter many species of wildlife from foraging in or moving through an area. This may affect a certain critical component of their life, such as changing their ability to access a certain resource in the area. If particular routes are blocked or disturbance along the route becomes frequent, a significant proportion of the population may move away or be killed by becoming stressed and more prone to predation;
- Poaching e.g. of plains wildlife (already witnessed in the vicinity of Langer Heinrich);
- Disturbance of birds at their nests (e.g. Lappet-faced Vulture, Martial Eagle, Rüppell's Parrot), even if unintentional;
- Illegal collecting of plants (e.g. Lithops, Hoodias);
- Power line mortalities (e.g. Ludwig's Bustards, flamingos);
- Loss of wildlife lowers the wilderness appeal of the area, and will have a negative impact on tourism (see section 7.6);

- Accelerated growth and development at the coast has secondary impacts on species such as Damara Terns, which have lost breeding areas and suffer increased mortalities at nests as a result of the northward expansion of Walvis Bay.

The spatial extent of disturbance is mostly limited to quite close to mining and infrastructure developments. But because the extent of infrastructure is as widely distributed as uranium prospects and mines, the impact is felt widely. The impact will last for as long as the mines, and in most cases will continue long after the mines have closed.

7.7.3 Desired outcome

The objective of the SEA with respect to biodiversity is that 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 key habitats are protected, rare, endangered and endemic species are not threatened, ecological processes are maintained, and areas of high biodiversity value are conserved. All efforts are taken to avoid impacts on the biodiversity, and where this is not possible, measures are put in place to minimise negative impacts, and disturbed areas are rehabilitated and restored to function after mining/development. Because certain impacts are unavoidable, offset areas will be set up and supported by the mining industry.

7.7.4 Recommendations to manage the cumulative impacts

Most of the recommendations highlighted in this section need to be addressed when individual mines conduct their EIAs and develop their EMPs, however, it is essential that the Government has an understanding of what is happening at a landscape level so that cumulative impacts can be minimised as uranium mining develops in the region. Firstly, additional studies must be commissioned and long term monitoring programmes established to improve the knowledge base on which biodiversity decisions are founded. Secondly, the mitigation hierarchy must be applied for all developments that are proposed in the central Namib and have the potential to cause negative environmental impacts. Essentially the mitigation hierarchy outlines how developers should approach biodiversity impacts:

- Most importantly, wherever possible, **avoid** negative impacts;
- Where impacts are unavoidable, adopt suitable design and technologies that **minimise** the negative impacts;
- **Mitigate** the remaining impacts throughout the life of the operation;
- Where environmental damage is incurred, **rehabilitate** and **restore**;
- Establish **biodiversity offsets** for the residual negative impacts in order to achieve a zero net loss to biodiversity and if possible make a net positive impact through other beneficial actions e.g. supporting additional conservation activities.

7.7.4.1 Improving the knowledge base

Findings from the literature survey and workshop held with local biodiversity specialists revealed that there is a great paucity of data on the biodiversity of the central Namib, however, due to inadequate funding and insufficient time additional studies were not commissioned for this SEA, therefore the findings of this assessment are based on what information was available at the time. At a high level the SEA was able to identify the most important issues related to biodiversity, but if decision makers are to have information that will give them the confidence to make decisions in favour of biodiversity then it is critical that additional studies are commissioned and long term monitoring programmes initiated. The aim is not to propose an infinite number of studies that will carry on for years but to undertake an assessment of a few critical components of the landscape that will better inform the biodiversity Flag map, which at this stage, is purely indicative.

7.7.4.2 Avoid causing negative impacts

Respect the protected area status of the central Namib parks and the conservation priorities of communal conservancies. Wherever possible, mine plants and associated infrastructure should be situated outside of Parks (i.e. where infrastructure can feasibly be routed outside of the NNP, do not erect it within the Park). Possible extinction of any animal or plant is a fatal flaw to a development. Recent work on central Namib endemic invertebrates has shown that most of them have very small ranges and many species are critically endangered by mine developments. Before mine or infrastructure development proceeds, funds and time should be allocated for reasonable investigation to ensure that very range-restricted species are not endangered.

Areas with high biodiversity value, as set out in section 7.7.1.4, should be avoided wherever possible. The red flag areas should be endorsed by MME and MET so that those that are not yet compromised by mining are eventually retained as ‘no-go’ areas. Mines that have already impacted on red flag areas should be encouragedto establish a biodiversity offset to ameliorate their impact,

A wilderness and desert sense of place requires ecological integrity to be maintained. Any processes that jeopardize ecological functioning or particular species should be avoided. With respect to water provisioning, mine and infrastructure footprints must be carefully positioned and implemented so that interference with surface and groundwater flows are not interrupted or interfered with. Also, obstacles such as long fences and above-surface pipelines should not restrict animal movements, nor should wind dispersal of seeds and plant detritus be obstructed.

7.7.4.3 Minimise the harm caused by unavoidable impacts

The overriding message about habitat loss is that the footprint of mining activities must be kept to a minimum. This covers all prospecting and mining activities, installation and maintenance of associated infrastructure, and all activities which might degrade habitats indirectly, such as vegetation degradation within a dust plume or cone of depression.

Infrastructure corridors should be created so that lines for road, power and water are clustered together, to reduce the total area of disturbance. This is difficult to achieve when mines are in different stages of development and details of where and when water will be needed in future must be considered. To cause the least environmental harm, government, parastatals and mining companies must show commitment to use ‘green routes’. See Figures 7.3.1, 7.3.2 and 7.3.3 in section 7.3 for indicative corridors.

Active and dedicated commitment to preventing contamination of groundwater sources is necessary. It can be taken for granted that seepage out of the bottom of tailings dams happens; it must be prevented from getting into places where it puts people and ecosystems at risk. Preventative measures that continue long-term after mine closure should be put in place (see section 7.4.4). With respect to groundwater abstraction, there must be regular monitoring with feedback to decision-making so that negative impacts on riverine vegetation, springs and pans are detected and responded to appropriately. Collaboration between mines using different portions of the river beds is important, so that upstream-downstream results are combined and feed into a unified monitoring data set (see Chapter 8). Mining and prospecting activities should under no circumstances be allowed to interfere with springs and pans.

For the purpose of reducing dust generation, damage to the desert pavement and living biological soil crust layer (from off-road driving, earth-moving operations, land clearing) should be kept to the absolute minimum. Any activities originating from mines that contravene local or protected area regulations should be severely dealt with. While mines cannot be held responsible for activities of the public, they must recognize that their presence and activities exacerbate the problem of illegal activities by the public. For example, mining and prospecting tracks have already become access routes and points of departure for illegal off-road driving and poaching. Mines and infrastructure parastatals should therefore contribute to improving vigilance and law enforcement against illegal activities.

Other illegal activities that increase levels of disturbance of Namib fauna and flora include camping close to springs or in pans, firewood collection in riverbeds, and disturbing nesting birds. Law enforcement options that mainly depend on legislation, regulations, patrolling, permits and fines, controlled and implemented by MET, have not succeeded overall in the past. The system of strengthening law enforcement by involving civil society through an Honorary Warden system, proposed by MET through Nacoma, should be supported by the mines.

7.7.4.4 Restore environmental damage

Restoration of mined areas must be considered wherever it is possible, within the constraints of what is technically possible and the requirements for long term radiation safety. Restoration should be informed by robust research so that the practices are effective and economical. For instance, while raking of vehicle tracks shows a positive commitment to rehabilitate, its effectiveness varies depending on the substrate, amount of biological soil crust present and other factors. Under certain conditions, raking may actually increase the damage. Thus research is required to measure, monitor and evaluate the impact on biodiversity. Novel approaches to rehabilitation need to be identified and investigated.

Funding should be provided for long-term scientific research on specific threatened or iconic species, such as on the distribution and habitat requirements of Welwitschias in the central Namib, and source-sink relationships which can inform future rehabilitation strategies. Restoration in arid climates is complex and it needs to suit the local conditions, such as winds, fog, and introduction of appropriate local plants and animals to assist the process. There is an opportunity to collaborate with local organisations, such as surrounding conservancies, to establish plant nurseries and propagate the kinds of plants that will assist rehabilitation, such as Commiphora, Adenolobus and Zygophyllum which populate the plains. The local research institution, Gobabeb Research and Training Centre, as well as other Namibian institutions such as UNAM, should be actively involved in researching and trialling restoration practices.

Restoration work should be started as early as possible, since vegetation growth and ecological processes take place very slowly in the arid climate. This also makes it possible to capitalise on episodic high-rainfall events which are important drivers in plant germination and recruitment.

7.7.4.5 Set up and support offsets and other conservation measures

Measures to manage the loss or degradation of valuable biodiversity areas must be designed for all proposed developments and should follow the mitigation hierarchy. It is clear that the developments considered in the three scenarios will be unable to avoid priority biodiversity areas and as there are limited mitigation measures that can be implemented in the desert and because restoration of arid ecosystems is essentially untested, a large residual impact on biodiversity is expected. For this reason it will be essential to include the establishment of sustainable offsets (developed in accordance with the ten principles of offsets)1 for many of the proposed developments. For example where highly sensitive habitats will be destroyed or seriously damaged, e.g. the Gawib Valley, it would be important to flag another similar habitat (preferably close by) and ensure that it is conserved in perpetuity.

As far as the mining of uranium in the central Namib is concerned, it might be beneficial to consider an aggregated offset as the potential for fragmentation of the landscape exists if the various mines and other industries developing in the area adopt their own initiatives. Potential areas for aggregated offsets suggested by local biodiversity stakeholders and specialists include:

- Messum Crater;
- Spitzkoppe and its surrounding inselbergs (Pontok Mountains and Klein Spitzkoppe);
- The Brandberg
- Other Namib Desert areas in north-western Kunene.

It is important to realise that as not all biodiversity impacts can be offset – for example, species extinction is ‘un-offset-able’, and that the ‘no-go’ option must be considered as one of the alternatives during all EIAs conducted in this region.

Because of the overall sensitivity of the area with respect to biodiversity, companies would be well placed to seek additional ways to enhance biodiversity conservation in the region as part of their corporate responsibility programmes. If this is done in addition to the actions implemented as part of the mitigation hierarchy, companies stand to have a net positive impact on the ecosystems.

The mines provide great opportunities to teach people about man’s impact on the environment. If mine tours are offered (such as at Rössing), they can showcase their environmental commitment by demonstrating water conservation techniques, the importance of maintaining the integrity of linear oases, species that are endemic to their area and the measures they take to minimize impacts on them, and the ecological role of little-known animals such as spiders, insects, etc. Such education programmes have great credibility from organizations which demonstrate environmental responsibility, and are a powerful method of influencing behaviour by school children and members of the public.

Mining companies can and should make a positive contribution to conservation practices since many of the mines are located in protected areas or conservancies, and have an impact on the sense of place of the central Namib. Wetland bird counts, wildlife surveys, establishment of a Namib Birding Route, coastal management and public awareness are suggested beneficiaries of mining support.

Additionally, mining companies can and should contribute to expanding the information base on which biodiversity management decisions are based. The Uranium Rush presents an opportunity to remedy the information gap with funded, well conceived and long-lasting environmental research.

7.7.4.6 Monitoring

[1] See BBOP website www.forest-trends.org/biodiversityoffsetprogram

Mines and/or regulators should contribute to independent monitoring of environmental quality indicators (as set out in the EQOs in Chapter 8) and there should be response mechanisms and commitments to react to deteriorating situations if they occur.

7.8 Cumulative effects analysis - archaeological heritage

7.8.1 Introduction

The Erongo Region has an archaeological record spanning more than one million years, including evidence of significant human evolutionary and technological advances, as well as specific adaptations to extreme aridity and environmental uncertainty. While the late Pleistocene component of the archaeological record is much reduced as a result of natural processes of deterioration, the Holocene evidence (post-dating the Last Glacial Maximum) presents an extremely comprehensive and well preserved record. The archaeology of Namib hunter-gatherers and nomadic pastoralists, and their interaction with early European trading missions has been the subject of intensive study for more than fifty years. This cumulative research effort has resulted in a very extensive literature, with numerous well documented excavations and other investigations (Figure 7.8.1), and several long-running research programmes involving local and international institutions.

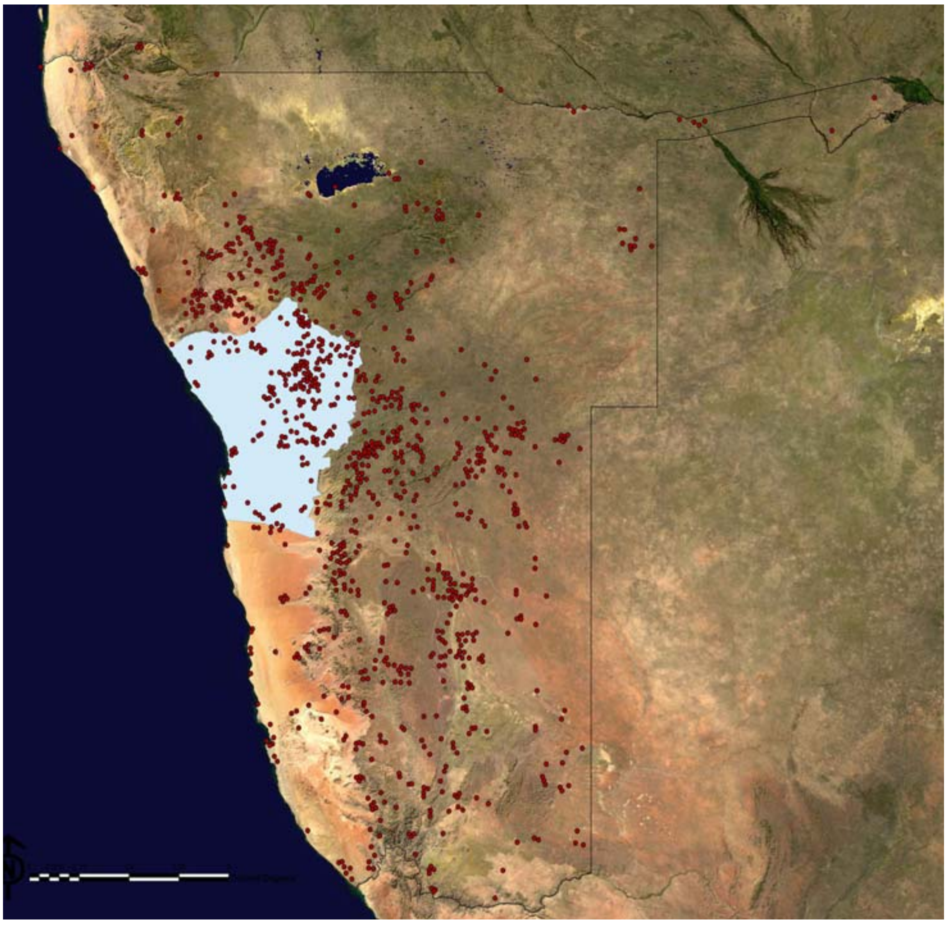


Figure 7.8.1: The Erongo Region in relation to the general distribution of known archaeological sites in Namibia

The primary importance of archaeological heritage in this context is that it forms the material basis of knowledge about the occupation of the Namib during the Pleistocene and Holocene periods. There is securely dated evidence of human presence in this region throughout most of the last 500,000 years, with somewhat less certain dating to at least 700,000 years. Undated material from some parts of the Namib is comparable with evidence from elsewhere in southern Africa that may date to the Plio-Pleistocene boundary, up to two million years ago. This long sequence, discontinuous though it is, covers much of the evolutionary career not only of humanity, but also of some of the other important mammalian components of the Namib environment. The human record is therefore intrinsic to the overall environmental history of the region. Its unique value, however, is that the human record – as represented by the archaeological heritage – provides a diachronic perspective that is not available from other bodies of evidence.

There are four archaeological heritage sites in the Erongo Region that are proclaimed National Monuments: Philips Cave (Ameib), Paula Cave (Omandumba West), Brandberg National Monument Area[1], and Bushman Paradise at the Spitzkoppe. Monument status does not necessarily preclude mineral exploration, and even if it did, proximity to mining areas would increase the risk of impact. All are rock art sites: the first two are located on private farmland, while the second two are on State Land. The two farmland sites are unsupervised and the rock art has suffered from vandalism, but to a limited extent. None of them are directly or indirectly affected by current Uranium Rush scenarios (as described in section 4.5), but could be affected if other companies develop mines on their EPLs in future (see Table 7.8.1 and Figure 7.8.2).

The types of archaeological sites that are considered vulnerable to impacts caused by prospecting and mining include surface scatters of stone artefacts, rock shelters with evidence of occupation, including rock art, graves, stone features such as hunting blinds and huts, and more recent sites such as colonial battlefields, old road-works and historical mines. Certain sites, such as graves, are specific and localised features that are easily defined and demarcated; others, such as battlefield sites, are very extensive and difficult to demarcate. Such distinctions differentiate the archaeological *site* from the archaeological *landscape*, the latter being a dispersed but coherent group of sites similar in age or cultural affinity. Some of these site types are obvious to any observer, such as rock art or historical mines; others are quite ambiguous and might appear less significant than they are, such as pre-colonial stone features; others, such as surface scatters of stone artefacts are virtually invisible to the untrained eye. This means that it is very difficult for mining projects to avoid damage to archaeological heritage sites if they have not been located, identified and made known to company personnel. Consequently, it has become an increasingly regular practice to carry out archaeological surveys and assessments of mining areas at the earliest possible stage of exploration.

Plate 7.8.1: A harvester ant seed cache fenced off to protect it from road construction activities associated with the Valencia access road. The site provides evidence of hunter-gatherer existence 500 years ago

[1] The Brandberg National Monument Area is also a proclaimed UNESCO World Heritage Site.

A considerable part of the Erongo Region is either under current uranium exploration and mining licences, or has licence renewals pending (Figure 7.8.2). Detailed archaeological surveys have been carried out over a core group of licence areas, and this information, together with other available data provides a basis for identifying specific archaeological landscapes - relatively large land units, that are vulnerable to impacts from prospecting and mining. Figure 7.8.2 delineates the twelve most important of these areas, classified into areas of high and medium significance. These may be designated as 'red' and 'yellow' flag areas in the same manner as for tourism and biodiversity (see sections 7.6 and 7.7.)

Highly significant landscapes (Red Flag) should be conserved because the archaeological sites they contain represent irreplaceable evidence of global importance. Red Flag landscape types include granite outcrops and inselbergs associated with rock art and other evidence of hunter-gatherer occupation during the last 5,000 years. Important examples are Spitzkoppe, Klein Spizkoppe, Bloedkoppie, Erongo and Brandberg (Figure 7.8.2). While it is possible that these areas will not be directly impacted, field surveys have shown that such features are surrounded by a wide zone of archaeological sensitivity, with significant site concentrations within 5km of the outcrop. These areas are highly sensitive, containing such concentrations of archaeological sites that it would be very difficult to avoid damage in the course of mineral exploration.

Another vulnerable zone requiring Red Flag status is the lower Kuiseb River which contains a uniquely well preserved array of late pre-colonial sites with evidence of trade between indigenous communities and European merchants. The Kuiseb is the only river mouth on the Namib coast with significantly high concentrations of archaeological sites.

Areas of medium significance (Yellow Flag) have well preserved (i.e. relatively undisturbed) archaeological evidence which has a high research value and could make large material contributions to our understanding of the archaeological sequence. One of these vulnerable landscape areas is the steppe zone stretching from Ebony in the east to Goanikontes in the west, and between Trekkopje in the north and Husab in the south, extending south of the Swakop River to the area surrounding the Tumas Mountains (Figure 7.8.2). The steppe zone is significant in that it contains unique evidence for the re-colonization of the Namib during the late Holocene.

Applications for EPLs and mineral licences in these Red and Yellow Flag areas would have to follow the procedures as set out in Chapter 8. This would require consultation with archaeological experts, archaeological surveys and if necessary, intensive mitigation work to rescue as much archaeological evidence as possible.

Table 7.8.1 identifies which Mining Licences and Exclusive Prospecting Licences could impact on these sensitive archaeological landscapes.

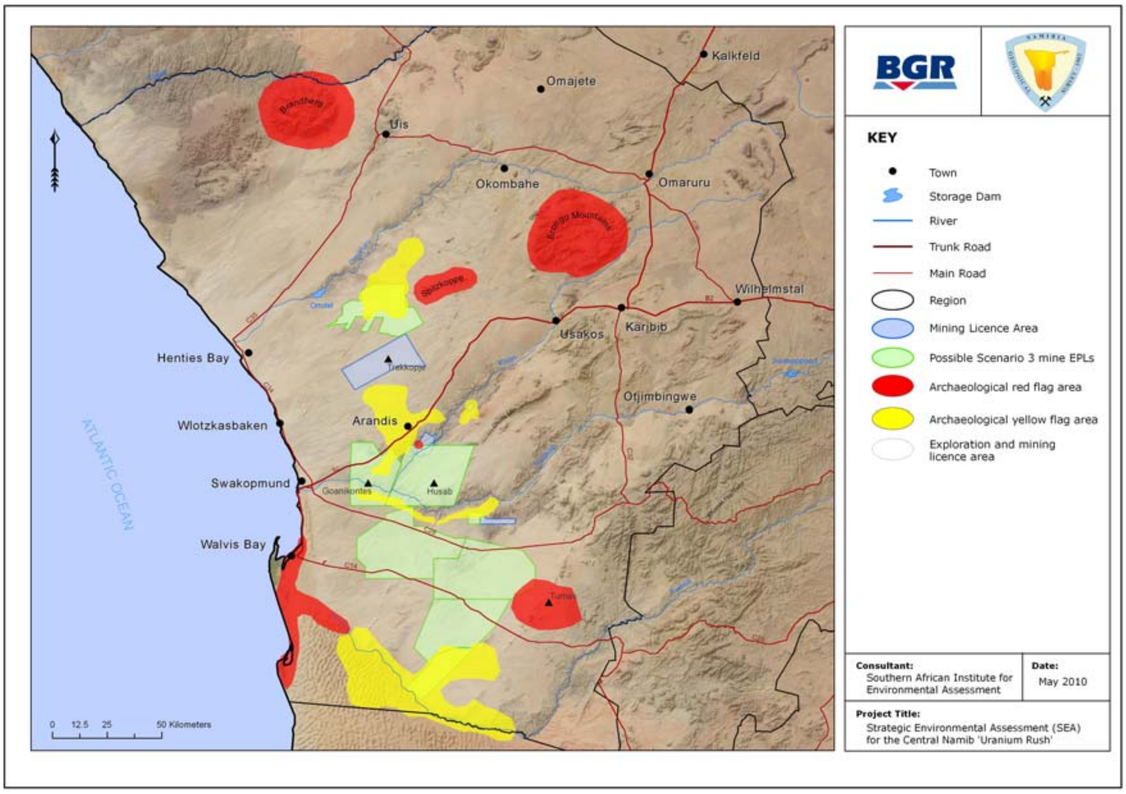


Figure 7.8.2: The distribution of Red and Yellow Flag archaeological areas in the Erongo Region, showing the areal extent of current and pending uranium exploration and mining licences

Table 7.8.1: Sensitive archaeological landscapes in relation to EPLs and MLs in the central Namib

Archaeological landscape	Signif-icance	Description	ML or EPL which may affect this landscape
1. Brandberg, or Dâures massif	High	The area has several thousand archaeological sites, including one of the highest concentrations of rock art in the world	None
2. Erongo	High	The area has a very high number of archaeological sites mainly dating to within the last 5,000 years.	EPL3453: Erongo Energy EPL3454: Erongo Energy EPL3636: Dunefield Mining
3. Spitzkoppe inselberg complex	High	A high number of archaeological sites but extensively damaged by vandalism.	EPL3632: Dunefield Mining EPL3287: West Australian Mining EPL3850: SWA Uranium Mines EPL3851: SWA Uranium Mines
4. Lower Omaruru drainage	Medium	Well preserved but incompletely investigated sites mainly dating to within the last 5,000 years.	EPL3569: Xemplar Energy EPL3570: Xemplar Energy EPL3850:SWA Uranium Mines
5. Lower Khan drainage	Medium	Dispersed archaeological sites with well preserved evidence of the mid-Holocene re-colonisation of the Namib.	EPL3638: Dunefield Mining EPL3602: Zhonghe Resources **EPL3138: Extract Resources** **EPL3345: Bannerman** **ML149: Valencia Mine** **ML28: Rössing Uranium Mine**
6. Panner Gorge	High	Unique late Pleistocene quarry and workshop site forming part of the Namib chert group.	**ML28: Rössing Uranium Mine**
7. Northern Geiseb mountain area	Medium	Dense local concentration of sites dating to within the last 2,000 years.	EPL3602: Zhonghe Resources
8. Southern Swakop plains	Medium	Dispersed mid- to late Pleistocene sites belonging to the Namib chert group.	**EPL3345: Bannerman** EPL3669: Reptile Uranium EPL3780: Petunia Investments EPL3439: Extract Resources **EPL3496: Reptile Uranium**
9. Husab plains	Medium	Historical remains of World War I conflict at Reit, prior to the capture of Jakkalswater in 1915.	**EPL3138: Extract Resources**
10. Kuiseb delta	High	High local density of sites with well preserved evidence of late pre-colonial contact between Namib pastoralist communities and European traders.	EPL3516: Cheetah Minerals EPL3517: Cheetah Minerals
11. Lower Kuiseb drainage	Medium	Dispersed archaeological sites with incompletely investigated evidence dating to the last 500,000 years.	EPL3516: Cheetah Minerals EPL3670: Toro Energy (now Reptile) EPL3498: Reptile Uranium
12. Upper Tumas drainage	High	High local density of well preserved evidence relating to opportunistic hunter-gatherer occupation during the last 500 years.	**ML140: Langer Heinrich Uranium** EPL3500: Langer Heinrich Uranium EPL3668: Toro Energy (now Reptile) **EPL3496: Reptile Uranium**

This table highlights the need for individual companies who already have a mineral licence (EPL or ML) to take responsibility for protecting and managing these sensitive archaeological landscapes. Each company's exploration EMP and EIA (if the project advances to the feasibility stage), should pay specific attention to avoiding these areas, minimising indirect impacts and ensuring that the areas are adequately protected. The Scenario 3 mines are highlighted in bold in Table 7.8.1.

Plate 7.8.2: General view of a late Pleistocene chert quarry and workshop Site QRS 72/48, situated close to the Rössing open pit. The site extends over an area of approximately 22,000 m^2, and represents successive occupation between 120,000 and 70,000 years ago.

7.8.2 Analysis of cumulative impacts

Despite the acknowledged global importance of the Namibian archaeological record (most particularly that of the Erongo Region), the sites and their remains have a long history of inadequate protection, many having been degraded or destroyed as a result of uncontrolled human activity, a process exacerbated by an institutional incapacity to provide proper site management (Plates 7.8.3 and 7.8.4). There is also a legacy of destruction from past mining activity in this region, when no environmental controls were in place. Exploration and mining activities damaged many archaeological sites, usually by unwitting disturbance of archaeologically sensitive terrain. Whole-scale destruction of archaeological sites is associated with dimension stone mining, as well as road construction and the excavation of borrow-pits. Indeed, the combined area of road and borrow-pit sites in this region exceeds the footprint of all existing mines combined. Mining activity is identified as an important threat to the archaeological heritage, but the cumulative impact of the construction of roads, as well as pipelines, power-lines and other utilities which develop in support of mining will also pose a threat.

Plate 7.8.3: Dilapidated National Monument signage at Spitzkoppe (note that this sign has been recently replaced)

The most critical impact for archaeological heritage is the cumulative loss of archaeological sites and landscape as exploration and mining advances. With this cumulative loss, the value of remaining archaeological resources increases. This is also a matter for concern because archaeological surveys of mining leases are carried out under pressure of time and do not extract the maximum information from the sites. Furthermore, archaeological methods are constantly improving and it is likely that the potential of some sites will be higher in the future. This may result in higher cumulative impacts than currently estimated.

Plate 7.8.4: Damage due to application of artificial compounds to improve visibility of rock art image

More specifically, cumulative impacts of the Uranium Rush on archaeological resources of the central Namib can be categorised as:

7.8.2.1 Direct negative impact of mining activity, involving outright destruction of archaeological sites or attrition of the archaeological record over the duration of mining and related activity.

The extent of the impact is variable, dependent on the contextual importance of specific archaeological sites (e.g. sites dating to within the last 5,000 years represent unique human adaptations and consequently the loss of these sites may represent a regional or even global impact). Without mitigation this impact is likely to occur and will lead to permanent damage as disturbances to archaeological sites destroys their context within the historical record of the region.

7.8.2.2 Negative impacts resulting in the disruption of the landscape setting of archaeological heritage sites.

The three main considerations here are the importance of the archaeological sites in the landscape setting concerned, their possible uniqueness as an example of a particular archaeological landscape, and the degree of existing disruption caused by other developments such as roads or power-lines. The probability of this impact occurring is medium to high, given that archaeological landscape areas are very extensive and so are exploration and mining areas.

7.8.2.3 Impacts resulting from increased and uncontrolled access to archaeological sites

Without adequate controls, access by mine personnel and tourists to archaeological sites can result in negative impacts. Most archaeological sites are highly sensitive to human traffic, and often suffer from the effects of trampling and soil erosion. Rock art sites are particularly sensitive to the effects of dust. Vandalism and looting are serious concerns, even where access is supervised.

7.8.2.4 Benefit of increased archaeological knowledge

A positive cumulative impact of the Uranium Rush is the improvement in knowledge of archaeology in the central Namib as a result of the EIAs conducted for exploration and mining activities. During the last five years, detailed archaeological surveys and impact assessments have been carried out on many of the major uranium EPLs in the western part of the Erongo Region. Furthermore, archaeological surveys and assessments have been carried out for a wide range of mining-related infrastructure developments, such as roads, power- and water-supply. These surveys and assessments have been carried out by professional archaeologists either under direct contract to the project proponent, or as part of multi-disciplinary environmental assessments. In total, the archaeological surveys have added more than 1,000 sites, or a 25% increment, to the known record for Namibia. Detailed investigations, including surface mapping, excavation, radiometric dating and finds analysis have been carried out on a number of these sites, usually as mitigation measures.

Plate 7.8.5: Typical Namib rock shelter site with test excavation in progress

Taken together, the surveys and investigations carried out for uranium projects represent the largest archaeological research effort yet undertaken in Namibia. It is significant that in contrast to all previous archaeological investigations, these are entirely funded by industry, on a strict contract basis; they do not involve staff, facilities or other components of national institutions in Namibia, nor funding of any kind via international research grants.

There is limited awareness of archaeological heritage issues in Namibia, but this is changing quite rapidly as archaeological heritage becomes a routine component of environmental assessment.

7.8.3 Desired state

The desired state for heritage resources of the central Namib would be that uranium exploration and mining - and all related infrastructure developments – have the least possible negative impact on archaeological heritage resources. The degree of impact will be determined on the basis of empirical data gathered by direct assessment of specific projects, using established criteria of significance and vulnerability, and by means of explicit methods of survey and description. In applying these principles, the negative impacts of mining activity in the Erongo Region will be mitigated, and partly offset. Thus, survey, assessment and mitigation will result in significant advances in knowledge of archaeological heritage resources, so that their conservation status is improved and their use in research, education and tourism is placed on a secure and sustainable footing.

In the absence of formal regulations to the National Heritage Act, it is necessary for archaeologists and mining companies to operate in terms of their permit conditions, if applicable, or otherwise as they think best. For archaeologists this is a matter of balancing the need for a credible impact assessment against the economics of mineral exploration. The archaeological assessment has to be robust and well based on field evidence, sufficient to withstand critical scrutiny in the archaeology profession.

7.8.4 Recommended avoidance / mitigation or enhancement measures

Mining companies have in some respects behaved as model stakeholders in the field of archaeological heritage. This relatively recent development has much to do with the need felt by uranium companies to avoid controversy. This is turn, relates to the fact that uranium companies currently operating in Namibia are linked to countries where the negative consequences of damage to the archaeological heritage have affected the public image of all uranium mining companies. The establishment of the Uranium Stewardship Council should help to maintain some cohesion in the industry when it comes to issues such as archaeological heritage. If Scenarios 2 or 3 of the Uranium Rush becomes a reality there will be greater pressure on the industry to implement conservation strategies. The Uranium Stewardship Council should set a common standard for members.

Awareness of archaeological heritage issues is generally very low in Namibia, perhaps lower than anywhere in the southern African region. Reasons for this may include a lack of education regarding long-term history in general, and a shallow perception of Namibian history in particular, with the period of the liberation struggle looming larger than any other. If this is so, the most important reason for the disinterest in archaeological heritage is probably that there is no historical continuity between archaeologically defined cultural entities in Namibia, and the identity of the country's political elite. The increase in archaeological knowledge in the central Namib is therefore an opportunity to raise the general awareness about Namibia's heritage.

If current and future mineral licence holders occur in areas identified as red or yellow flag areas, the industry could be persuaded to invest resources in offset benefits for archaeological heritage in the region. For example, it should be possible to identify a series of representative archaeological 'reserves' where the mining industry could support conservation and research in compensation for the loss of archaeological heritage resources within the mining lease areas. A common optimising synergy for archaeological conservation is tourism, but this requires careful management and control.

Archaeological surveys have been carried out over many of the core uranium exploration and mining leases in the Namib and proposals to minimise impacts have been implemented in a number of cases. Now, the results of these surveys are being combined under the umbrella of the Namib Desert Archaeological Survey Project which will allow a general assessment of archaeological resources, research opportunities and identification of potential offset reserves. The value of the Survey Project is that it creates a 'knowledge offset' instead of, or in addition to physical offsets in the form of reserve areas. One of the functions of the Survey Project is to identify the regional archaeological value of heritage resources, so that mitigation or any other attempt to minimize cumulative impacts is carried out in a broader framework than the individual mining project.

7.9 Cumulative Effects Analysis – Macro-Economics

7.9.1. Introduction

This chapter of the SEA estimates the potential economic benefits Namibia could derive from the Uranium Rush. It focuses mainly on the impact on Gross Domestic Product (GDP), potential income to government, national employment effects, salaries and wages, and income distribution. It also covers issues pertinent to mining investments such as rehabilitation funds and the management of the revenue stream from the industry that could be channelled into a Sovereign Wealth Fund.

The analysis is based on a baseline scenario for 2008 with two mines operating but with Langer Heinrich not at full capacity. Assumptions made for the calculations are summarised in Table 7.9.1. Since detailed information about the uranium-mining sector is missing for Namibia, certain ratios used are taken from the mining sector in general and not uranium mining in particular.

The analysis provided has kept certain variables of the baseline case constant over time, hence there is no attempt to forecast the exchange rate of the Namibia dollar vis-à-vis the US dollar, nor the contract price for uranium. Furthermore, we analyse the impact on real GDP (excluding inflationary impacts) and not on nominal GDP.

The static linear expansion of the sector as modelled here also does not comprehensively treat labour market dynamics optimally. Given that the mines will need skilled technicians to operate machinery, part of the effects of the mines could be to push wages of skilled Namibian labour up (or rather attract more foreign labour) rather than increase overall employment in the short run.

Finally, the potential forward linkages of the uranium mining industry, such as uranium conversion is not part of the scope of work and hence not covered in this report.

7.9.2. Assumptions and limitations

At the macro-level, the investigation of the impact of a mining project would apply advanced economic tools such as Input-Output (IO) Modelling to analyse economy-wide effects. However, a full scale IO table with a separate uranium sector is not developed and the Namibian Social Accounting Matrix (SAM) of 2004 that is used for the analysis combines all mining activities into one sector. The table below provides a summary of the baseline data and assumptions used in the study.

Table 7.9.1: Baseline data and assumptions

Variable	Value	Source
GDP in NAD m	72,904	Central Bureau of Statistics, Preliminary National Accounts 2000-2008
Real GDP growth 2009 to 2020	5.1%	Based on average GDP growth between 2000 and 2008
Exports in NAD m	42,066	Central Bureau of Statistics, Preliminary National Accounts 2000
Imports in NAD m	44,770	Central Bureau of Statistics, Preliminary National Accounts 2000
Foreign reserves in NAD m	12,858	Bank of Namibia, Annual Report 2008

Variable	Value	Source
Exchange rate - NAD per USD	8	own assumption
Contract price - USD/lb	70	own assumption based on consultations and industry reports
Actual output as percentage of full capacity	90%	Own assumption
Value added as share of output	45%	own calculation based on National Accounts 1993-2005 for mining sector
Import requirement of uranium mines -share of intermediate consumption	33%	Own calculation based on the Namibian Social Accounting Matrix intermediate consumption for mining sector
Overall Government. revenue from own sources (NAD m)	21,646	Bank of Namibia, Annual Report 2008 - annualised
Increase in Government revenue	8.3%	Ministry of Finance, Medium-Term Expenditure Framework
Compensation of employees as share of turnover	12%	based on company information
PAYE rate as share of compensation of employees	19%	own calculation based on employment data
Govt. revenue from PAYE (NAD m)	4,097	Ministry of Finance, Fiscal Policy Framework for 2009/10 - 2011/12 MTEF – annualised
Economy-wide multiplier	6.5	own calculation based on the Namibian SAM
Employment multiplier	1.32	own calculation based on the Namibian SAM
GDP multiplier	1.98	own calculation based on the Namibian SAM

The Namibian economy grew by 5.1% per annum over the past nine years, thus justifying the assumption of an average annual growth rate of 5.1% over the next 12 years despite the current economic downturn. However, we have also run the calibrations for GDP growth rates of 3% and 7% in order to cover a worst and best case economic scenario.

Based on current longer-term contract prices – as opposed to the spot market prices - we have used USD70 per lb U_3O_8 for all calculations. In addition, we ran simulations on USD50 and USD90 per lb to estimate the effect of possible price fluctuations on GDP growth rates and on Government revenue.

Thus, this report is not a firm and precise prediction of the economic impacts of the Uranium Rush, but rather an indication of the possible magnitude of the impacts.

7.9.3. Contribution to GDP

Uranium mining contributed about 4% to total GDP, based on the National Accounts for 2008. Assuming mining companies operate on average at 90% of full capacity, the contribution of uranium mining companies to GDP could almost double in Scenario 1 from about N$ 3,000 m to some N$ 5,126 m in 2020, and increase almost fourfold in Scenario 3, to over N$ 11,476 m. In the most optimistic Scenario 3, GDP growth would increase from 5.1% in the baseline scenario to 8.2% in 2012. This would be the second highest GDP growth rate recorded in Namibia in recent years, only exceeded in 2004 (12.3%), when the textile company 'Ramatex' and the Skorpion zinc mine and smelter started operations.

The direct share of uranium mines to GDP could increase from 4% in 2008 to some 6.2% in 2012 for Scenario 1 and 11.5% in 2015 for Scenario 3 but decline slowly thereafter. In comparison, the diamond-mining sector contributed 10.1% to GDP in 2002 and 7.6% in 2008. Based on the three Scenarios it is likely that the uranium industry becomes the strongest contributor to GDP. If mines are running at full capacity, their contribution to GDP could reach 7% and 13% in Scenario 1 and 3 respectively and result in GDP growth rates of up to 8.6%

Table 7.9.2: Contribution of uranium mining companies to GDP at 90% of their production capacity, contract price 70USD per lb

Scenario 1	2008 baseline	2009	2010	2011	2012	2013	2015	2020
Value added in NAD m	2,426	2,631	3,606	3,856	5,534	5,466	5,511	5,126
Contribution of uranium mining to GDP	3.3%	3.4%	4.5%	4.6%	6.2%	5.8%	5.3%	3.9%
GDP growth	**5.1%**	**5.4%**	**6.4%**	**5.4%**	**7.1%**	**5.0%**	**5.2%**	**4.9%**
Scenario 2								
Value added in NAD m	2,426	2,631	3,606	3,856	6,441	8,074	10,206	9,820
Contribution of uranium mining to GDP	3.3%	3.4%	4.5%	4.6%	7.2%	8.6%	9.9%	7.4%
GDP growth	**5.1%**	**5.4%**	**6.4%**	**5.4%**	**8.2%**	**6.9%**	**5.2%**	**4.9%**
Scenario 3								
Value added in NAD m	2,426	2,631	3,606	3,856	6,441	8,573	11,862	11,476
Contribution of uranium mining to GDP	3.3%	3.4%	4.5%	4.6%	7.2%	9.2%	11.5%	8.7%
GDP growth	**5.1%**	**5.4%**	**6.4%**	**5.4%**	**8.2%**	**7.5%**	**5.4%**	**4.9%**

Source: Authors' calculation.

While long-term contract prices may remain in the range of USD70 per lb, this assessment has also calibrated for minimum and maximum average prices of USD50 per lb and USD90 per lb. Subsequently, the uranium industry could contribute as much as 14.8% to GDP (Scenario 3, year 2015 – see Table 7.9.3) and GDP growth could peak at 9.0% in 2012 (Scenario 3) at prices of USD90 per lb. On the other hand, if contract prices drop to USD50 the sector's contribution to GDP will decline and GDP will grow less strongly. Table 7.9.3 illustrates possible ranges of the sector's contribution to GDP and GDP growth for contract price ranges of USD50 to USD90 per lb.

Table 7.9.3: Range of possible contribution to GDP at assumed contract price ranges of 50USD per lb to 90USD per lb, 90% production capacity

Scenario 1	2010	2011	2012	2013	2015	2020
Value added in NAD m	2,576 – 4,676	2,754 – 4,957	3,953 – 7,115	3,904 – 7,028	3,937 – 7,086	3,661 – 6,590
Contribution of uranium mining to GDP	3.2 – 5.8%	3.3 – 5.9%	4.4 – 8.0%	4.2 – 7.5%	3.8 – 6.9%	3.2 – 5.7%
GDP growth	**6.0 -6.7%**	**5.3 – 5.5%**	**6.5 – 7.6%**	**5.0%**	**5.2%**	**5.0%**
Scenario 2						
Value added in NAD m	2,576 – 4,676	2,754 – 4,957	4,601 – 8,281	5,767 – 10,381	7,290 – 13,122	7,015 – 12,626
Contribution of uranium mining to GDP	3.2 – 5.8%	3.3 – 5.9%	5.2 – 9.3%	6.20 – 11.1%	7.1 – 12.7%	5.3 – 9.5%
GDP growth	**6.0 – 6.7%**	**5.3 – 5.5%**	**7.3 – 9.0%**	**6.4 – 7.5%**	**5.2%**	**5.0%**
Scenario 3						

Value added in NAD m	2,576 – 4,676	2,754 – 4,957	4,601 – 8,281	6,124 - 11,022	8,473 - 15,251	8,197 - 14,755
Contribution of uranium mining to GDP	3.2 – 5.8%	3.3 – 5.9%	5.2 – 9.3%	6.6 – 11.8%	8.2 - 14.8%	6.2 – 11.1%
GDP growth	**6.0 – 6.7%**	**5.3 – 5.5%**	**7.3 – 9.0%**	**6.8 - 8.2%**	**5.3 - 5.5%**	**5.0%**

Source: Authors' calculation.

Likewise, the performance of the whole economy influences the relative significance of a particular economic sector. So far an average annual GDP growth rate of 5.1% is assumed, based on past years. Should the economy perform better or worse over the next years (GDP growth rates of 7% and 3% respectively) the uranium mining sector's relative contribution will be lower or higher respectively. Thus, the uranium mining's contribution could vary between 3.1% and 6.7% in Scenario 1 or 4.3% and 13.2% in Scenario 3. Overall GDP growth rates would range between 5.1% to 8.9% (Scenario 1) and 6.3% to 9.9% (Scenarios 2 and 3) in 2012. Table 7.9.4 presents all results.

Table 7.9.4: Range of possible contribution to GDP for GDP growth rates varying between 3% and 7%, assumed contract price of 70USD per lb, 90% production capacity

Scenario 1	**2010**	**2011**	**2012**	**2013**	**2015**	**2020**
Contribution of uranium mining to GDP	4.3 – 4.7%	4.3 – 4.8%	5.8 – 6.7%	5.4 – 6.5%	4.7 – 6.2%	3.1 – 4.9%
GDP growth	**4.3 – 8.3%**	**3.3 – 7.3%**	**5.1 – 8.9%**	**2.9 – 6.9%**	**3.1 – 7.1%**	**2.8 – 6.9%**
Scenario 2						
Contribution of uranium mining to GDP	4.3 – 4.7%	4.3 – 4.8%	6.7 – 7.9%	7.9 – 9.6%	8.7 – 11.4%	6.0 – 9.5%
GDP growth	**4.3 – 8.3%**	**3.3 – 7.3%**	**6.3 – 9.9%**	**5.0 – 8.7%**	**3.1 - 7.1%**	**2.8 – 6.9%**
Scenario 3						
Contribution of uranium mining to GDP	4.3 – 4.7%	4.3 – 4.8%	6.7 – 7.9%	8.4 – 10.1%	10.1 – 13.2%	7.0 – 11.0%
GDP growth	**4.3 – 8.3%**	**3.3 – 7.3%**	**6.3 – 9.9%**	**5.6 – 9.2%**	**3.4 – 7.3%**	**2.8 – 6.9%**

Source: Authors' calculation.

However, all additional economic activities in a specific sector increase the demand for output in other economic sectors, such as transport, business and financial services, and have therefore ripple through effects through the whole economy. This effect is captured by the economic multiplier that includes direct and indirect impacts on the economy. Based on the Social Accounting Matrix the multiplier for the mining industry overall is 3.0, meaning that for every additional dollar of output in the mining sector N$3.00 are generated economy-wide. The GDP multiplier of 1.98, referring to value added alone, implies that for every dollar value added in the uranium mining sector almost an additional dollar of value is added across the whole economy.

7.9.4. Estimated Trade Impacts[1]

The value of exports in the scenarios is expected to increase from N$5.4 bn in 2008 to at least N$12 bn (Scenario 1) or up to N$26 bn (Scenario 3) by 2020 assuming a contract price of US$70 and that the mines run at 90% of their production capacity.

Even with the most modest scenario (Scenario 1), export earnings are expected to double. The contribution of uranium exports to total exports[2] is to increase from 13% to 28% in Scenario 1 or to about 62% in the most optimistic scenario. Total uranium exports are expected to increase by 123% (Scenario 1) or 370% (Scenario 3) between 2008 and 2020. If the mines operate at full capacity until 2020 their contribution to export earnings will reach N$30.5bn (Scenario 3) and account for 73% of total exports (see Table 7.9.5).

Table 7.9.5: Contribution of uranium mining to exports – assuming 90% production capacity

Scenario 1	2008 baseline	2009	2010	2011	2012	2013	2015	2020
Export value in NAD m	5,393	5,846	8,014	8,568	12,298	12,146	12,247	11,894
Uranium contribution	13%	14%	19%	20%	29%	29%	29%	28%
Scenario 2								
Export value in NAD m	5,393	5,846	8,014	8,568	14,314	17,942	22,680	22,327
Uranium contribution	13%	14%	19%	20%	34%	43%	54%	53%
Scenario 3								
Export value in NAD m	5,393	5,846	8,014	8,568	14,314	19,051	26,359	26,006
Uranium contribution	13%	14%	19%	20%	34%	45%	63%	62%

Source: Authors' calculation.

On the other hand, imports will increase due to the demand by additional uranium mining operations. About 33% of intermediate consumption of mining activities is imported, which accounted for roughly 2.2% of total imports in 2008. This share is expected to increase to between 5.0% (Scenario 1) and almost 11% (Scenario 3) in 2020 unless it becomes profitable to produce more inputs locally, such as chemicals. Table 7.9.6 illustrates the impacts on imports if mines are operating at 90% of their production capacity. Import requirements would peak at N$5.5 bn or 12.4% of total imports by 2020 (Scenario 3) if mines are operating at full capacity.

Table 7.9.6: Import requirement by uranium mines – 90% production capacity

Scenario 1	**2008 baseline**	**2009**	**2010**	**2011**	**2012**	**2013**	**2015**	**2020**
Import requirement in NAD m	979	1,061	1,454	1,555	2,232	2,205	2,223	2,067
Share of total imports	2.2%	2.4%	3.2%	3.5%	5.0%	4.9%	5.0%	4.6%
Scenario 2								

[1] The analysis refers to the operation of the mines and not to the development of the mining sites.

[2] Total export figures for 2008 were obtained from the National Planning Commission

Import requirement in NAD m	979	1,061	1,454	1,555	2,598	3,257	4,116	3,961
Share of total imports	2.2%	2.4%	3.2%	3.5%	5.8%	7.3%	9.2%	8.8%

Scenario 3								
Import requirement in NAD m	979	1,061	1,454	1,555	2,598	3,458	4,784	4,629
Share of total imports	2.2%	2.4%	3.2%	3.5%	5.8%	7.7%	10.7%	10.3%

Source: Authors' calculation.

The increase in exports will boost Namibia's foreign reserves and hence help maintaining the currency peg of the Namibia dollar to the South African Rand and improve the import cover.[3] Import cover is an important economic variable that illustrates the country's ability to pay for her import requirements. The import cover could increase from 15 to 22 weeks (Scenario 1) or up to 34 weeks (Scenario 3) (Table 7.9.7). Should the mines operate at full production, the import cover in 2020 could range between 23 and 39 weeks. Namibia will receive substantial Foreign Direct Investment as new mines develop, but cash outflows will result from repatriation of profits and leakages through the employment of foreign nationals and imports (as mentioned above). According to the existing uranium mines, there are currently only 24 expatriates out of a total workforce of about 2,300 employees. Payouts of dividends to mostly foreign shareholders are not expected to have a strong negative impact on the import cover.

Table 7.9.7: Foreign reserves, value of imports and import cover – 90% production capacity

Scenario 1	**2008 baseline**	**2009**	**2010**	**2011**	**2012**	**2013**	**2015**	**2020**
Foreign reserves (NAD m)	12,858	13,266	15,478	16,033	19,762	19,611	19,712	18,855
Imports per week (NAD m)	861	863	870	872	885	885	885	882
Import cover (weeks)	15	15	18	18	22	22	22	21
Scenario 2								
Foreign reserves (NAD m)	12,858	13,266	15,478	16,033	21,778	25,407	30,145	29,288
Imports per week (NAD m)	861	863	870	872	918	941	971	965
Import cover (weeks)	15	15	18	18	24	27	31	30
Scenario 3								
Foreign reserves (NAD m)	12,858	13,266	15,478	16,033	21,778	26,516	33,824	32,967
Imports per week (NAD m)	861	863	870	872	918	948	994	989
Import cover (weeks)	15	15	18	18	24	28	34	33

Source: Authors' calculation.

7.9.5. Contribution to Government Revenue

7.9.5.1. Corporate taxes

A corporate tax rate of 37.5% applies to profits of mining companies, but losses in previous years, investment, depreciation and creative accounting could lower GRN's income from taxes. It is assumed that mines will not pay corporate taxes in the first three years of production, due to losses made in the

[3] The Bank of Namibia is required to back-up every Namibian coin and banknote that it issues by foreign currency, be it South African Rand or any other convertible currency. The favourable foreign reserves allowed the Bank of Namibia to maintain a lower repo rate during 2008 and the first half of 2009 than the South African Reserve Bank.

development phase and depreciation of capital investment. Based on these assumptions uranium mining companies could contribute between N$1.3 bn and 2.8 bn in 2020 to government revenue in the form of corporate taxes translating into 2.2% and 5.0% of total government revenue in Scenarios 1 and 3 respectively (Table 7.9.8). This could increase to N$1.6bn and N$3.3bn respectively if the mines run at full capacity, which would be equivalent to 4.6% and 6.0% of total government revenue for these scenarios respectively (Table 7.9.8). A 10% tax is levied on dividends paid to non-Namibia resident shareholders. This tax could contribute a further 0.2% to 0.4% to overall government revenue.

Table 7.9.8: Contribution of corporate taxes to government revenue – 90% production capacity

Scenario 1	2008 baseline	2009	2010	2011	2012	2013	2015	2020
Corporate tax (NAD	573	573	699	699	699	1,170	1,347	1,253
Contribution to overall Government revenue	2.6%	2.4%	2.8%	2.5%	2.3%	3.6%	3.6%	2.2%
Scenario 2								
Corporate tax (NAD	573	573	699	699	699	1,170	1,663	2,401
Contribution to overall Government revenue	2.6%	2.4%	2.8%	2.5%	2.3%	3.6%	4.4%	4.3%
Scenario 3								
Corporate tax (NAD	573	573	699	699	699	1,170	1,663	2,805
Contribution to overall Government revenue	2.6%	2.4%	2.8%	2.5%	2.3%	3.6%	4.4%	5.0%

Source: Authors' calculation.

7.9.5.2. Royalty

The royalty for uranium is currently set at 3% of output value, except for Rössing Uranium which is levied at 6%. However, mining companies can apply to the Ministry of Mines and Energy for deferment or reduction of royalty payment in specific economic situations. This explains why royalties from uranium mining companies accounted for only 0.08% of total government revenue in 2008, since only N$17 m as opposed to the expected N$294 m were paid. Assuming that payment is not deferred, the contribution of royalties from uranium mining companies to total government revenue is expected to increase to 1.6% in Scenario 1 (2012) or 2.2% in Scenario 3 (2015). The calculation is based on the assumption that government revenue increases by 8.3% per annum. In absolute values royalties are expected to grow from N$294 m to N$848 m in 2015 (Scenario 3) (see Table 7.9.9). The corresponding values for the case of full production are N$350 m to N$1,067 m respectively or 1.9% to 2.8%.

Table 7.9.9: Contribution of uranium royalties to government revenue – 90% production capacity

Scenario 1	2008 baseline	2009	2010	2011	2012	2013	2015	2020
Royalty in NAD m	17	294	352	367	468	464	467	444
Contribution to total Government Revenue	0.1%	1.3%	1.4%	1.3%	1.6%	1.4%	1.2%	0.8%
Scenario 2								

Royalty in NAD m	17	294	352	367	523	621	748	725
Contribution to total Government Revenue	0.1%	1.3%	1.4%	1.3%	1.8%	1.9%	2.0%	1.3%
Scenario 3								
Royalty in NAD m	17	294	352	367	523	650	848	825
Contribution to total Government Revenue	0.1%	1.3%	1.4%	1.3%	1.8%	2.0%	2.2%	1.5%

Source: Authors' calculation.

7.9.5.3. Contribution to income tax on individuals (Pay As You Earn)

Uranium mining employees contributed about N$80 m in 2008 in income taxes, or 2% of total PAYE collected. This could increase to 8% or N$331 m in Scenario 1 by 2020 or almost N$700 m, accounting for 17% of total PAYE in Scenario 3.

Uranium mining and associated industries[4] will likely employ between 2,000 (Scenario 1) and over 6,000 workers (Scenario 3) by 2020. In addition, between 920 and 1,500 jobs will be created in other sectors of the economy due to increased demands for goods and services by the uranium mining sector. Although the number of additional jobs in the uranium industry is relatively small compared to total employment of 385,000 (2004), because of the industry's capital-intensive nature, employment in the mining sector at large would almost double in the best case scenario. Furthermore, wages and salaries in the sector are usually above average and contribute therefore to additional consumer demand, government revenue from taxes on income. Since the industry employs mainly skilled and semi-skilled workers the additional demand for labour could drive up wages. Last but not least, employees in the mining sector often support their families in the northern rural areas and hence their transfers contribute to poverty alleviation.

Table 7.9.10: Contribution of individual income tax to total revenue from PAYE

Scenario 1	**2008 baseline**	**2009**	**2010**	**2011**	**2012**	**2013**	**2015**	**2020**
Pay As You Earn in NAD m	80	148	203	217	312	308	310	289
Contribution of uranium mining to total PAYE	2.0%	3.6%	5.0%	5.3%	7.6%	7.5%	7.6%	7.0%
Scenario 2								
Pay As You Earn in NAD m	80	148	203	217	363	455	575	553
Contribution of uranium mining to total PAYE	2.0%	3.6%	5.0%	5.3%	8.9%	11.1%	14.0%	13.5%
Scenario 3								
Pay As You Earn in NAD m	80	148	203	217	363	483	668	646
Contribution of uranium mining to total PAYE	2.0%	3.6%	5.0%	5.3%	8.9%	11.8%	16.3%	15.8%

Source: Authors' calculation.

[4] That is, those new industries that will only be developed on account of the Uranium Rush

7.9.5.4. Summary of government revenue

Uranium mining companies can become a significant source of government income. While the companies contributed about 3.2% to total government revenue in form of royalties, pay-as-you-earn, non-Namibia resident shareholders tax and corporate taxes in the baseline scenario, this share can increase to 6.2% (Scenario 1) or 8.7% (Scenario 3) in 2015. We assume an average growth rate of government revenue of 8.3% according to the Medium-Term Expenditure Framework. This growth rate could accelerate to 9.5% in Scenario 1 (2011) or 9.8% in Scenario 3 (2013) due to income from additional uranium mining activities (see Table 7.9.11). In the case of full production, government could benefit in 2020 from additional revenue from the uranium mining industry ranging between N$2.6 bn and N$5.3 bn in Scenario 1 and 3 respectively.

Taxes and royalties payable to Government are eventually dependent on the commodity price. Using the price range of 50US$ to 90US$ per lb, total Government revenue from the uranium mining industry could amount to between N$1.7 and 2.7 bn (Scenario 1) or N$3.3 to 5.5 bn (Scenario 3) in 2020. This would account for between 4.7% and 7.7% or 6.7% and 10.6% of total Government revenue for Scenario 1 and 3 respectively.

However, before reaping the benefits Government needs to invest in the necessary infrastructure (such as electricity, water, transport, education and health) in order to encourage private investments into the uranium mining sector which eventually could produce the economic and social benefits outlined here.

Table 7.9.11: Total contribution by uranium mining companies to government revenue – 90% production capacity

Scenario 1	2008 baseline	2009	2010	2011	2012	2013	2015	2020
Contribution in NAD m	697	1,042	1,292	1,321	1,516	2,005	2,198	2,053
Contribution in %	3.2%	4.4%	5.1%	4.8%	5.1%	6.2%	5.8%	3.7%
Increase in government revenue in %	**8.3%**	**9.9%**	**9.2%**	**9.5%**	**8.6%**	**8.9%**	**8.3%**	**8.3%**
Scenario 2								
Contribution in NAD m	697	1,042	1,292	1,321	1,622	2,309	3,077	3,810
Contribution in %	3.2%	4.4%	5.1%	4.8%	5.5%	7.2%	8.2%	6.8%
Increase in government revenue in %	**8.3%**	**9.9%**	**9.2%**	**9.5%**	**9.0%**	**9.6%**	**8.4%**	**8.3%**
Scenario 3								
Contribution in NAD m	697	1,042	1,292	1,321	1,622	2,367	3,269	4,429
Contribution in %	3.2%	4.4%	5.1%	4.8%	5.5%	7.3%	8.7%	7.9%
Increase in government revenue in %	**8.3%**	**9.9%**	**9.2%**	**9.5%**	**9.0%**	**9.6%**	**9.1%**	**8.3%**

Source: Authors' calculation.

7.9.5.5. Contribution to the Social Security Commission

Employers are obliged to register their employees with the Social Security Commission that provides benefits in the case of sick leave, maternity leave and death. Employees and employers contribute equal shares, namely 0.9% each of the salary up to a maximum N$54.00 each per month. Based on employment information from the sector it is assumed that all employees earn in excess of N$6,000 per month and hence both employers and employees contribute the maximum contribution. By 2020 uranium mines could contribute between N$3.6 million and N$6.0 million to Social Security. In addition, companies will contribute to other social schemes such as pension funds, medical aid and the to-be-introduced training levy. In particular, contributions to pension funds will lead to further portfolio investment that could benefit the economy further.

7.9.6 Export Processing Zones

However, the potential of an increased revenue flow and all the benefits that this may have for the country's sustainable social and economic development could be undermined by the GRN granting Export Processing Zone (EPZ) status to any more of the new uranium mines. The EPZ initiative was developed by GRN to attract manufacturers and investors to the country. EPZ status provides a tax haven for export-oriented manufacturing enterprises, in exchange for technology transfer, capital inflow, skills development and job creation. This policy decision was translated into law through the passage in Parliament of the Export Processing Zone Act (Act No. 9 of 1995) (www.mti.gov.na). The implementation of this initiative started in 1996 and the most recent addition to the list of EPZs is the Trekkopje Mine. Enterprises with EPZ status do not pay: corporate tax, import tax or sales tax, stamp and transfer duties on goods and services required for EPZ activities. These benefits are of unlimited duration. In addition, a range of other benefits apply:

- EPZ enterprises are allowed to hold foreign currency accounts in local banks;
- Strikes and industrial lock-outs are not allowed in the EPZ regime;
- Non-resident Shareholders' Tax is only 10 percent;
- Dividends accruing to Namibian companies or resident shareholders are tax exempt;
- Plant, machinery and equipment can be fully written off over a period of three years;
- Buildings of non-manufacturing operations can be written off, 20 percent in the first year and the balance at 4 percent over the ensuing 20 years (manufacturer's operations have even more generous allowances);
- Import or purchase of manufacturing machinery and equipment is exempted from value added tax (VAT);
- Preferential market access to the EU, USA and other markets for manufacturers and exporters is provided.

Thus, if other mines follow the precedent set by Trekkopje, the discussion above becomes academic as many of the main expected benefits for the country in the form of tax revenues will be lost.

7.9.7 Income distribution

Growth in sectors that are highly capital and skills intensive as opposed to labour intensive will benefit the production factor 'capital' and 'skilled labour' with positive impacts on households that derive their income from capital and skilled labour and are already better off. On the other hand, growth in labour intensive industries using unskilled or semi-skilled labour will benefit households relying on income from these factors. These are generally households that are worse off, because of low wages. Wages and salaries in the mining industry are higher than in other industries and the sector employs more skilled and semi-skilled workers than unskilled workers. Many of these workers support families in the rural areas. The impact of the three scenarios on income distribution was analysed using the Social Accounting Matrix. The production factor 'capital' receives the largest proportion of GDP in the baseline scenario – 54%, while labour receives slightly more than 40%. Mixed income makes up for the remaining share. Since mining activities are highly capital intensive and employ mainly skilled and semi-skilled workers, these two factors of production tend to benefit most from increased uranium mining. Table 7.9.12 below summarises the impact on income distribution.

The factor of production 'capital' benefits most and increases its share of value added (or GDP) by between 0.23% and 0.67%, while skilled labour benefits less. Unskilled labour is to lose the most while the relative importance of the remaining two factors of production declines slightly. Subsequently, urban households whose main source of income is either 'wages and salaries' or income from business activities benefit as do rural households relying on wages and salaries as their main source of income. Their share of national income increases. On the other hand, rural households who derive their income from subsistence farming or business activities receive a lesser share of total national income, losing about 2% of their share in national income in Scenario 3 compared to the baseline. This would cement the current unequal income distribution in the country and government could therefore use some of the additional income to mitigate this effect, for instance through increased social spending. But, as part of their social responsibility uranium mining companies could get involved in projects assisting the less fortunate groups of society in various ways, ranging from investment in education, health and housing to investment in infrastructure or productive activities such as agriculture.

Table 7.9.12 Change in income distribution compared to baseline scenario (Author's calculation)

	Income distribution				Change in %		
	Baseline scenario	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 1**	**Scenario 2**	**Scenario 3**
Primary distribution (Factors of production)							
Labour, skilled	17.75%	17.80%	17.89%	17.92%	0.30%	0.79%	0.95%
Labour, unskilled	22.57%	22.37%	22.05%	21.94%	-0.87%	-2.31%	-2.83%
Mixed Income, Commercial Agriculture	3.24%	3.19%	3.11%	3.08%	-1.55%	-4.17%	-5.17%
Mixed Income, Traditional Agriculture	2.42%	2.40%	2.37%	2.36%	-0.84%	-2.24%	-2.74%
Gross Operating Surplus	54.02%	54.24%	54.59%	54.70%	0.39%	1.04%	1.24%
Secondary distribution of income (Households)							
Urban households – Wages & Salaries	53.77%	53.81%	53.87%	53.89%	0.07%	0.18%	0.22%
Urban households – Income from Business Activities	9.13%	9.18%	9.26%	9.28%	0.51%	1.34%	1.61%
Urban households -other sources of income	4.31%	4.31%	4.29%	4.29%	-0.16%	-0.43%	-0.52%
Rural households - Wages & Salaries	12.88%	12.92%	12.97%	12.99%	0.26%	0.68%	0.82%
Rural households - Income from Business & Farming	7.16%	7.13%	7.08%	7.06%	-0.42%	-1.11%	-1.35%
Rural households - Income from Subsistence Farming and other sources	12.74%	12.67%	12.54%	12.49%	-0.62%	-1.65%	-2.02%

7.9.8 Corporate Social Responsibility

Corporate social responsibility (CSR), functions as a self-regulating mechanism whereby business commits to contributing to sustainable economic development, through working with employees, their families, the local community and society at large to improve their quality of life, in ways that are both good to business and good for overall development (World Bank Group, 2003). The concept was founded on suggestions that corporate greening results in competitive benefits, and that improvements in a company's social impact will have a positive effect on profit margins, at least in the medium- to long-term. Hence the International Council of Minerals and Metals (ICMM) commits its members to supporting 'sustainable development so as to enhance shareholder value' (www.icmm.com) (Hamann, 2004).

CSR can take a number of forms, depending on the location of the mine, the host community, and in-country laws and policies. These include, *inter alia*, skills development programmes in host communities, preferential employment and contracting of members from the local community, funding of specific projects relating to education, sport, adult literacy and health, provision of housing and basic services, donations for a specific cause, continuous support to an NGO or institution, establishment of trusts and foundations, and provision of bursaries for students. Rössing spent about N$30 million per annum over the past five years and other uranium mining companies intended donating up to N$1 million in 2009 on social projects. The social commitment of companies usually increases over time with stronger links to local communities. A challenge in the context of the Uranium Rush is to ensure that companies do not base their investments on fashion and self interest. Thus, the SEA has identified the sectors most in need of support. It is recommended that the SEMP office, in consultation with key stakeholders, compiles a project 'wish list', that mines could support.

7.9.9 <u>Opportunity costs of the Uranium Rush</u>

As noted elsewhere, the main economic sectors in the Erongo Region are mining, tourism, fisheries, and to a lesser extent, agriculture, around which a number of service industries have arisen (e.g. transport, power, communications, accommodation, etc.).

If the guidance offered through this SEA is implemented correctly, prospecting and mining should not displace any of the other economic sectors in Erongo. Whilst mining and tourism activities will overlap in certain areas (e.g. Moon Landscape and Welwitschia Flats), opportunity costs can largely be avoided or reduced through tourism offsets (see Section 7.6). Moreover, mining offers some opportunities for the tourism sector through mine tours and business tourism. Furthermore, with the expected increase in population in all the coastal towns, as well as the likely increase in the number of expatriates working on the mines, there is a high potential for an increased demand for tourism products.

The increase in the population in the area will also boost the sales of locally grown agricultural products, thus providing a stimulus for greater agricultural production in the region.

Whilst mines will consume substantial amounts of power and water, the Uranium Rush has provided the impetus needed for the development of new sources of electricity and potable water. Thus, the Uranium Rush is contributing to solving problems already in existence in the Erongo Region. However, until physical and social infrastructure improvements have been made, there will likely be negative impacts and short term opportunity costs. For example, traffic congestion at peak times on the B2 between Arandis and Walvis Bay, will inconvenience tourism and other industries.

Thus, this SEA postulates that, contrary to initial fears, the net impact of the Uranium Rush is the generation of multiple opportunities and net benefits for the agricultural and tourism sectors.

7.9.10 Natural Resource Taxation in Namibia

The economic justification for natural resource taxation is the presence of resource rent[5] or a return to the mineral resource. Resource rent is the supernormal or excess profit that would be earned in the exploration, development and extraction of mineral resource deposits. It is the profit after private investors have received a normal rate of return on their exploration and capital expenditures, including an appropriate risk allowance.

Formally, economic rent is the net income (surplus) or receipt over and above the costs. Economic rent or resource rent is the more appropriate term for economic benefits in the natural resource sector, rather than total sales revenues, labour employment or wage incomes. Sales revenue is a gross income value while wage receipt is merely a compensation for labour services.

While the market, through its price and cost signals, confers a monetary value on the natural resource output, the rents from mining activities originate from the yield of naturally (geologically) given stock of non-renewable deposits. Without the natural yield of nature's geological mineral stock, there would be no economic rent payments to natural resource property holders. It is from this rent that both private investor and government draw their income share.

Specifically, government's receipt of resource-based taxes and royalties comes from this surplus.[6] The respective share of government or the investor in the economic rent is defined by national laws, policies, and incentive measures of a mineral-producing country, together with the position of global investors and other competing nation-suppliers vis-à-vis the government. Both the legal policy framework and the investors' relationship to government also determine the respective use of investor's and government's share of rents. The amount of government's share, however, that would go to current budgetary allocation for environmental protection or public community welfare is dependent on the programme it would enunciate.

Essentially there are two types of resource rent approaches:

- **Profit based royalties** are levied on the net cash flow or profit of a resource project. Variations of this are the *Brown tax* (where government collects a constant percentage of a project's net cash flow in years in which profits are earned and provides a cash rebate to projects in years of negative cash flow) and the *resource rent tax* (where government collects a constant percentage of a project's net cash flow where losses (negative net cash flow) are accumulated at a threshold rate and offset against future profit). Under the *resource rent tax*, the government essentially avoids cash rebates in years in which losses are incurred.

- **Output based royalties** are levied on the volume or value of production of a resource project. Basically two variations are the *ad valorem royalty* (an output based royalty whereby the government collects a constant percentage of the value of production) and *specific royalty* (whereby government collects a constant (dollar) amount per physical unit of production.

[5] The terms 'resource rent' and 'economic rent' are used interchangeably throughout this section.

[6] However, there may be cases of no surplus because market prices do not exceed production costs. In this case, no taxes are paid, but royalties since the latter are calculated on the production value and not on the taxable profit. Companies may also follow other than rent-seeking and profit-making interests, namely for instance ensuring the uninterrupted supply of uranium for operating nuclear reactors.

Under profit based royalty regimes, the government aims to collect a constant percentage of the excess profits of each resource project. This responds to changes in project profitability, although the timing and magnitude of the government return will depend on the particular design of the profit based royalty. Under the output based royalty, the aim is to set a royalty rate that is expected to collect sufficient royalty revenue to justify the imposition of the royalty whilst needing to make a subjective judgement about the negative impact on the profitability of low profit or marginal resource projects (over taxation) and the possible shortfall in returns from high profits (under taxation).

7.9.10.1Objective in Natural Resource Taxation Policy

The objective in natural resource taxation policy is to ensure the collection of a reasonable share of the resource rent at least cost, where administration costs and losses incurred through negative distortions to private exploration and development decisions define the costs. Administration costs also include monitoring and compliance of project investors in meeting their obligations under the policy. Economic efficiency would refer to the extent to which the resource taxation policy has a negative impact on private exploration, development and production decisions to the extent that project profitability assessments are changed fundamentally[7].

It is generally assumed that a profit based royalty regime is most likely to lead to an increase in economic efficiency as well as net resource rent collected as opposed to output based royalty. Administration costs, however, for profit-based royalty regimes are likely to be higher as are data and capacity requirements. Hence, countries with capacity constraints are advised to apply the output-based royalty regime since it is a cheaper and more simplified approach to rent collection. However, in a competitive market based resource, the output-based royalty regime also increases a country's sovereign risk as well as affects the investment decisions of private investors (adversely affecting economic efficiency). Therefore, there is need for a proper cost-benefit analysis before choosing one of the regimes.

Resource rent is an important source of development finance. The question for resource endowed economies is whether to consume the rents by providing welfare to current generations or to invest the rents in other assets (thereby for example promote economic diversification). The World Bank (2006) showed that currently, significant proportions of resource rents are being consumed rather than invested in other productive assets[8]. Resource rents from natural resources are also an important input to the creation of Sovereign Wealth Funds. Sovereign Wealth Funds refers to a separate pool of government-owned or government controlled financial assets that include some international assets. By 2008, these funds totalled

[7] The Namibian government should investigate the appropriateness of recent developments by the International Accounting Standards Board to develop International Financial Reporting Standards (IFRS) for the extractive industries (mining, oil and gas) as an effort to provide uniform accounting reporting for the Namibian uranium sector. In addition, the Framework for Responsible Mining (www.:/frameworkforresponsiblemining.org) is a global initiative by various stakeholders (mining companies, financiers, governments, civil society organizations, academics and others) that seeks to develop and evolve standards of corporate mining behavior. The framework outlines human, environmental and social issues associated with mining. Finally, consideration by the Namibian government should also be given in participating in the Extractive Industry Transparency Initiative (EITI) to further strengthen the openness of Namibia's fiscal and regulatory regime for minerals. First, governments that elect to become EITI candidate countries have to get their own accounting in order and report publicly and accessibly on all the revenues they receive from extractive industry companies in each budget year. All mining (and other extractive) companies, in turn, have to volunteer to submit reports to the government for public dissemination. The reports must detail all their financial remittances to the government and related institutions, as well as profits and expenditure in each financial year.

[8] World Bank (2006): Where is the Wealth of Nations: Measuring capital for the 21st Century.

around US$2 trillion, with natural resource rents as the source of funds estimated at more than 70%. Notable countries that have leveraged natural resources this way are Botswana with the Pula Fund, Malaysia with the Khazanah Nasional, Sudan with the Oil Revenue Stabilisation Fund, Norway's Petroleum Fund and Chile with her Economic and Social Stabilization Fund. Angola is currently considering the creation of a Sovereign Wealth Fund in order to manage her income from the oil sector.

7.9.10.2Namibia's Natural Resource Taxation Regime

Namibia's framework for natural resource exploitation is essentially in line with international best practices (IMF, 2008)[9]. Under this framework, the Government must find the right balance between promoting economic growth and social development, environmental protection, current and inter-generational needs. The "Extractive Industry Transparency Initiative" (EITI) sets global standards that encourage Governments to ensure that the benefits from the exploitation of national resources including minerals are properly determined, verifiably paid, duly accounted for and prudently utilised for the benefit of all citizens. Namibia's existing laws and regulations provide assurances to investors in security of tenure and investment. Tax and other payment obligations due are clearly stipulated and made known to investors in a transparent manner.

Of great importance is that the country has a transparent fiscal regime pertaining to the legal and regulatory mining issue. There are different tax rates for mining and non-mining companies, and even among the mining companies corporate tax rates vary. Diamond mining companies pay 55% corporate profit tax, whilst non-diamond mining companies are taxed at 37.5% profit tax. A 10% royalty is imposed on the value of rough diamond exports, whilst the royalty for nuclear fuel minerals is currently in the range of 3 – 6%. Royalties in Namibia are defined as 'compensation for extracting minerals' as the mineral rights are vested in the state. Thus they are essentially a resource rent. Royalties are paid as a percentage of the net export market value of each mineral group/category exported in rough/semi processed form.

Thus, the resource rent regime in Namibia is based on the ***output based royalty*** regime and licensing fees, taxes and royalties go directly to the state revenue fund and are included in the national budget. A central question then is how efficient Namibia's resource rent collection is. In this regard, Lange (2003a) investigated the performance of Namibia and Botswana over the 1980-1997 period[10]. The results indicate that Namibia captures its resource rent less efficiently than Botswana. Botswana captured 76% of her resource rent, while Namibia managed to capture only 42%, using diamonds as a proxy. Lange (2003b) showed that Norway has successfully captured rent from oil and gas, extracting as much as 78% of the resource rent.[11]

Based on the findings above, there is merit in further assessing and refining Namibia's resource rent policy. An important issue in such a review is the sector's influence on fiscal stability. This is to ensure that sudden changes to the current regimes do not adversely affect current economic growth. However, while mineral production comprises a large portion of value added in the economy, it has a limited impact on the level and volatility of growth. This is a result of factors such as fiscal rules as well as the fact that SACU revenues

[9] IMF (2008): Management of non-renewable natural resources.
[10] Lange, G-M. 2003. National wealth, natural capital and sustainable development in Namibia. *DEA Research Discussion Paper* 56. 15 pp.
[11] Lange, G-M. 2003. Policy Applications of environmental accounting. The World Bank.

contribute much more to tax revenues than resource taxation [12]. Mineral revenues have remained relatively stable as a percent of GDP (1-2%) as a macroeconomic impact.[13] This however, might change as a result of the Uranium Rush.

Improving the mineral resource taxation regime could also help offset projected decline in customs union revenues over the medium term.

A brief international comparison of royalty rates shows that Namibia's rates are low. In the Northern Territories of Australia uranium mines are levied a 5.5% *ad valorem* royalty. Canada applies a royalty system consisting of three components: Basic Royalty (5%), Tiered Royalty (6 to 15%, but levied only once the company realised a profit) and the Saskatchewan Resource Credit (1%). The rates are applied on the gross sales value. Botswana, levies a 3% royalty on the gross market value at the mine's gate. Niger, another major producer of uranium, applies a 5.5% royalty on the final selling price. However, the costs are deductable from corporate taxes levied at 45% of the profit. Zambia introduced a royalty rate of 2% on the market value.

7.9.11 Rehabilitation fund

As a result of inadequate legislation and political will in the past, there are over 200 abandoned, un-rehabilitated mines in Namibia. There are no funds or plans to rehabilitate these mines, which are a threat to the environment, public health and safety, and game and livestock.

Clause 8 of the **Income Tax Amendment Act,** 487 of 1992, makes provisions for deductions in respect of contributions to funds established to remedy "any damage caused by such mining operations to the surface of and the environment on, the land in question", with the provision that these deductions may be used by the government in the event that they are not eventually used for remedial action.

In 2008, the Chamber of Mines of Namibia developed a 'Namibian Mine Closure Framework' (NMCF) with the objective of providing guidance to the local mining industry on how to develop relevant, practical and cost effective closure plans. The framework was adopted by the mining industry.

The NMCF identifies five aspects of closure namely, Workforce, Sustainability of associated communities, Decommissioning of the site, Rehabilitation of the site, and Post closure monitoring and maintenance. It states that financial provision should be part of all closure plans. However it does not provide in detail the nature of these financial provisions. Decommissioning and rehabilitation is costly, and therefore requires early planning by both Government and the mining companies. The key problem is the unavailability of funds from either Government or the mining companies. In South Africa, Australia, Canada and the USA, legislation provides for a production levy and a trust fund for managing mine closure. The fund needs transparent management and accountability in order to prevent unauthorised use.

[12] Namibia's good fiscal rules pertains to the goal of limiting public debt to 25% of GDP and also the application of medium-term expenditure framework (MTEF) which allows the budget to be developed in a multi-year setting. As a result expenditures do not excessively reflect short-term revenues. Furthermore, due to trade liberalization revenue from taxes on international trade are expected to decline.

[13] IMF (2008)

Many countries recognise mines as finite resources and mining companies need to consider the post mining phase and ensure that their mining acts do not cause desolation to people living close to the mine. The Governments in Australia and Canada have begun to use the tax system to provide incentives for closure related environmental expenditures. In Canada for example, rehabilitation bonds are included as a tax deductible expense for mines. In Australia, rehabilitation bonds for mining were introduced in the early 70's in most Australian states and Territories to ensure that Governments had some security in the event that mining companies did not meet their rehabilitation obligations. Mine rehabilitation expenditure has become fully deductible company expenses.

7.9.12 Recommendations

The Uranium Rush can hold some economic and social benefits as explained above. The calibrations however, do not include externalities (costs arising from the production that are borne by society at large). Given the speculative nature of the Uranium Rush, it has not been possible to calculate the costs of externalities or the exact investment requirements that need to be made at national or local government level. At the level of this SEA, it has only been possible to identify the likely cumulative impacts and the types of investments needed (e.g. physical and social infrastructure). Depending on the policy decisions taken by government (e.g. Sovereign Wealth Fund, Rehabilitation Fund, use of the Environmental Investment Fund, etc.), these investments will either be facilitated by government or made at corporate level, or a combination through public-private partnerships.

The benefits depend to a large degree on the management of the income stream from non-renewable resources to government. Therefore we recommend that government considers the creation of a Sovereign Wealth Fund (‘Uranium Fund’) for royalties and other revenue from the uranium industry as is best practice in other natural resource-rich countries, such as Canada, Botswana and Norway. The fund could be used for specific development projects that ensure sustainable social and economic development in post-uranium Namibia, thus ensuring that future generations derive long-term benefits from the Uranium Rush. Part of the fund could be saved for future investment when revenue from the uranium mining industry declines.

Mining legislation needs to be amended to include the specific requirements and standards of rehabilitation. The Government could work in consultation with the Chamber of Mines of Namibia towards finding the financial mechanism for rehabilitation as proposed (Environmental Trust Funds or Bonds) in the Mineral Policy 2002. This has been done in other countries. A thorough study needs to be carried out by the industry to weigh the costs and benefits of each strategic option. Setting up a rehabilitation fund would require upfront payment from government, since costs for rehabilitation incur immediately with the development of the mine, while the mining companies receive income only once production has commenced. A mechanism needs to be developed to ensure that government is reimbursed by the mining companies over a specific period of time for this seed fund.

Internalisation of the cost of closure by mining companies, which includes rehabilitation, remains the objective of the Mine Closure Framework’s objectives. Each mining company should provide a closure strategy and plan that elaborates how it plans to undertake this in the event of closing. As it is best practice, the costs for rehabilitation should be internalised and borne by the company that causes the damages to the environment. This responsibility will act as an incentive to prevent damage to the environment in the first place. The provision of the Income Tax Amendment Act will, in addition, provide incentives for contributions to funds aiming to remedy any damage caused. It appears that there is need for coordinating these efforts described above to put in place a consistent framework. A review of the maximum penalty of N$100,000 can also be considered in light of the substantial amounts invested in the development of new mining sites. Since countries are competing for international investment, Namibia's environmental and tax legislation need to consider legislation in countries competing with her for foreign investment. However, this should not lead to a race to the bottom by lowering standards in order to attract investment because the future generations will bear the costs. The Rehabilitation Fund could be placed under the auspices of the Ministry of Mines and Energy as the regulator rather than being managed by the respective mining company. This would ensure that the fund is not used for other than the intended purpose.

Large mining operations can have negative impacts on the environment, society or other economic sectors such as agriculture and tourism. In order to mitigate these externalities, mining companies could contribute to a kind of Social and Environment Investment Fund that will be used to address negative side effects and support the less fortunate groups in society. Since the negative side effects occur at the beginning of the operations, Government would need to front load the fund and recoup the expenses later from the mining companies once they have started production. The Fund could be governed by a board consisting of representatives from the mining companies, the public sector and civil society. Ideally, contributions to this fund should be based on the production value rather than profits. However, before introduction of such a fund a study needs to be undertaken in order to establish the level of contributions and the possible impact on the competitiveness of Namibia as an investment location.

The Ministry of Mines and Energy could publish any agreement with mining companies concerning deferment of royalty payment in the annual Accountability Report in order to increase transparency and accountability and overall good governance.

Namibia's regulatory framework could be reviewed and compared to international best practices as advocated for instance by the Extractive Industry Transparency Initiative in order to reap the full benefits of its natural resources. The review would include a review of contracting and accounting practices of the mining industry.

7.10 Cumulative effects analysis - education and skills

7.10.1 Introduction

The expansion of uranium mining in the Erongo Region is accompanied by high public expectations that many new jobs will be created, directly and indirectly, that the investment will relieve poverty and reduce inequality, and that new skills will be acquired by Namibians. Although not as exposed as other environmental aspects such as biodiversity and landscapes, human resources and capabilities pose a challenge of their own. It is often a double edged sword: the demand for skilled people in the region and the opportunities that this represents; and the probable influx of more people seeking employment into an area where certain public services are already congested. In this instance it is also evident that very little, if any, provision has been made by the public sector and local government institutions to respond to the potential growth in social demands that will accompany economic growth such as that posed by a potential Uranium Rush. The Uranium Rush and associated industries and developments are expected to result in a number of impacts on education and skills in the Erongo Region and nationally. The key issues are:

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

In all three cases, the cumulative impacts could be negative or positive, depending on the response by decision makers and the political will to achieve synergies and to make the required investments.

7.10.1.1 Increased pressure on schooling

In-migration has placed considerable pressure on schools and the education authorities in the Erongo Region, especially at the coast. The number of children in school in this region has doubled in the past fifteen years, from 13,789 in 1993 to 28,592 in 2009 (Figure 7.10.1). No other region of the country has experienced such consistent growth in education demand – above 3% per annum. Although four new schools have been opened in the past five years, bringing the total to 61, the Regional Education Directorate has typically coped with the situation by adding additional classrooms to existing schools. Currently, only one new school is planned (for Walvis Bay). Some schools at the coast now have enrolments in the range of 1,000 – 1,500 learners.

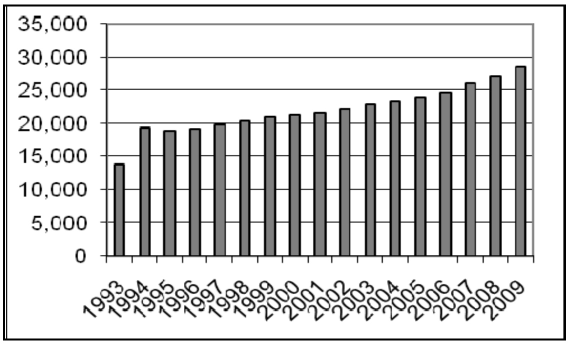


Figure 7.10.1: Number of children in Erongo schools from 1993 to 2009.

Of the 978 teachers in the Erongo Region, 84% have more than two years of tertiary education, much higher than the national average of 77%. Attrition and transfer rates (at 11% and 7% respectively) however are higher than the national rates (9% and 4% respectively).

7.10.1.2 Quality of Education

Particular mention should be made here of the Southern and Eastern African Consortium on the Monitoring of Education Quality (SACMEQ). This regional mechanism for testing primary school learners placed Namibian learners at the bottom of the regional league table even though Namibia has the lowest learner:teacher ratio in the participating countries (Figure 7.10.2). Much debate has followed about what should be done. Besides continuing its participation in SACMEQ, Namibia has decided to set up additional national diagnostic tests at Grade 5 and Grade 7 within the next few years. It seems that while much attention has been given to secondary education not enough effort has been put into primary education, where language is the main complicating factor for both learners and teachers.

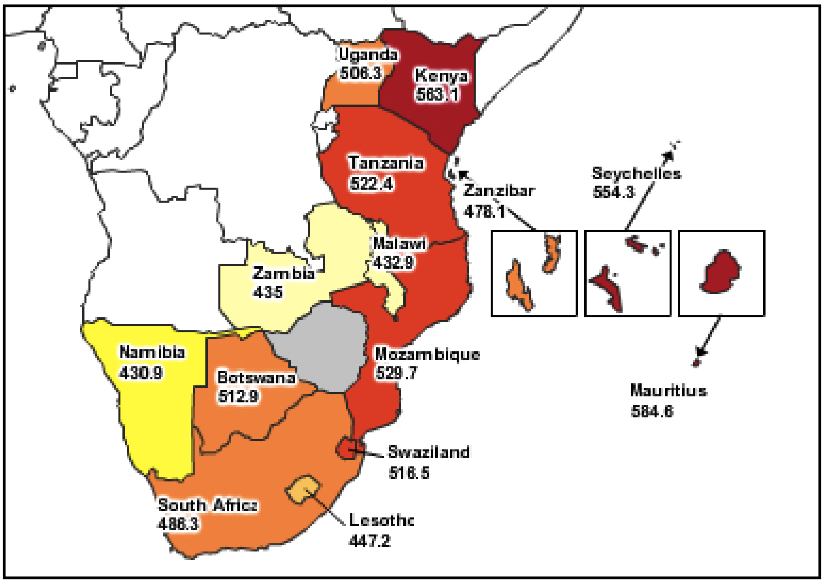


Figure 7.10.2: SACMEC II performance map. Low scores = low performance

At a local level Erongo remains one of the better performing regions of Namibia, but the results of the 2008 National Senior Secondary Certificate results are worrying if mines, exploration companies and industries associated directly or indirectly with the Uranium Rush, wish to employ locally. In 2008, 80% of NSSC candidates in Erongo achieved a D grade or better in English as a second language[1], but only 37% and 35% gained a D or better in Mathematics and Physical Science respectively. However, this situation is compounded when the results of the 2001 Census for the Erongo Region are taken into account: only 21% of people over the age of 15 completed secondary school and less than 6% have a tertiary qualification. While these percentages may have improved over the last 9 years, the low percentage of learners completing their schooling to Grade 12 is of concern. The reasons for this are many, including the lack of sufficient places available in senior secondary schools, the lack of future job prospects, as well as social factors.

[1] Only 4% of the population of the Erongo Region speaks English as a first language at home.

One of the main changes in education since independence has been the attention paid to teacher education. In 1993 (three years after independence) only 13% (14% for females) of teachers were qualified to teach at primary level, and 41% (47% for females) were qualified to teach at secondary level. As a result of the teacher training programmes, the overall percentage of qualified primary teachers has increased to 71% in 2008, while at secondary level it has grown to 90% in 2008.

Plate 7.10.1: Training for employment in the mining industry is offered at the Namibian Institute of Mining and Technology in Arandis (photos M.Hauptfleisch).

7.10.1.3 The need for skills

The biggest constraint on new or expanding industries in Namibia is the availability of skilled human resources, especially at the middle and higher levels, to provide technical and managerial expertise. Even an established mine such as Rössing faces severe problems as its workforce is aging or being ‘poached’ to some extent. While Langer Heinrich and its sub-contractors have managed to source most of the skills they require from within Namibia (Speiser, 2009), the pool of skilled and semi-skilled employees is limited and new mines and associated industries may have to look further afield.

The Namibian Institute for Mining and Technology (NIMT) provides vocational training and thus a supply of qualified artisans. In 2008 NIMT had an enrolment of 1,304 trainees[2], but in 2008, only sixty-three artisans graduated from NIMT after three years of training, and 226 trainees dropped out of training between the end of 2007 and the beginning of 2008, perhaps to take up employment before graduating. This does not bode well for mining companies wishing to source skilled and semi-skilled Namibians.

According to Speiser (2009) of the 35,000 people employed in the Erongo Region, 28% are unskilled labourers, 19% are employed in craft or related trade skills, 13% are professionals or managers, 13% are technicians and clerks, 13% are service and sales workers and only 6% are plant/machine operators and assemblers. At a national level this trend is mirrored, indicating a very low level of skilled or trained workers in relation to unskilled workers.

[2] 18% were female

Plate 7.10.2: Mines require a range of skill levels in the total workforce, and all employees need a level of education that ensures safety in the work place (photo Rössing).

7.10.2 <u>Analysis of cumulative impacts</u>

7.10.2.1 Access to Education and Training

The Uranium Rush under Scenarios 2 and 3 will have a considerable impact on the lives of people in the Erongo Region. If the growth in mining is in accordance with Scenario 2, an additional 6,000 permanent direct jobs will be created in the mining and associated industries which could result in a multiplier effect of 8 new jobs in the Namibian economy (i.e. some 48,000 new jobs). How many of these new jobs can be filled by locals and how many people will migrate to the Erongo Region is not known. Thus by extension, the number of new school children requiring places in the local schools cannot be estimated. What is known however, is that the current schools in the area are overcrowded and many are having to run double sessions (i.e. a morning school and an afternoon school) (Speiser, 2009) and that new schools, classrooms and teachers are urgently required – for example, there is no secondary school in Arandis.

Besides this, it must be noted that the school population has been growing faster than the population of the region as a whole, which means that parents, mostly from the northern regions, have been sending their children to stay with relatives and friends in the region because of the good reputation of the coastal schools and their relatively low fees for school development funds.

Plate 7.10.3 – Learners in a school – classes in Erongo will likely become much more congested in the future. (photo J.Komen)

7.10.2.2 Quality of education

Unless carefully managed, the expansion of the schools could reduce the quality of education that has been achieved in the region thus far, if sufficiently qualified new teachers are not employed and school resources, especially science laboratories and libraries are not augmented. Declining education standards will impact negatively on many aspects of the Erongo Region, including socio-economic development. It will also affect the attractiveness of the area for prospective new employees, who may not want to relocate if the crucial aspect of schooling is not adequately addressed. Specific steps must therefore be taken to maintain high standards and to retain the best teachers in the classroom, through additional incentives if need be.

Erongo already has fifteen private schools, and it is likely that they will grow in size and number. While it is the constitutional right of citizens to invest in private education it is probably not a solution to invest significant public or industry funds in private education due to its high cost and undesirable consequences for equity and social integration. Thus, the biggest investment required is building and resourcing government schools.

7.10.2.3 The demand for skills

As noted earlier, the paucity of middle and high level skills in the Erongo Region may prevent locals being able to take maximum advantage of increased job opportunities associated with the Uranium Rush. Inevitably, companies will ‘poach’ skilled people from each other or from government departments, parastatals and local authorities, or they may have to rely on highly paid non-Namibians. All of the above responses will be negative as they destabilise and distort the job market, severely undermine the ability of the (already stretched) GRN to manage the Uranium Rush and may fuel xenophobic tendencies. Turning these likely negative cumulative impacts into benefits requires pro-active human resources development on a significant scale.

Plate 7.10.4 – Namibia must significantly improve its efforts to develop a skilled workforce, as there are major gaps at both technician and management levels (photo P.Tarr).

7.10.3 Desired state

The Erongo Region is already gaining a reputation as a 'Learning Region', and this brand should be grown by making available relevant skilling and educational facilities to learners in the region. Even with increased population as a result of the Uranium Rush, people should have affordable and improved access to basic, secondary and tertiary education that enables them to develop and improve skills and take advantage of economic opportunities. All children should at a minimum have the opportunity to attend school and be provided with adequate facilities and resources (e.g. books, computers, laboratories). The quality of school education and teachers should improve to enable learners to obtain at least a senior secondary certificate. Namibia, and the Erongo Region specifically should provide adequate training facilities and tertiary learning opportunities for local people to become qualified as artisans, technicians, geologists, accountants and engineers, so that the skills demand of the Uranium Rush and ancillary industries can be met largely by local expertise over time.

7.10.4 Recommended avoidance / mitigation or enhancement measures

7.10.4.1 Access to Education and Training

Since many coastal schools are already large, particularly at the lower primary level, it will be necessary to build new schools, as well as expand existing ones. It is estimated that ten new schools will be needed, primarily in Swakopmund and Walvis Bay, and classroom additions and infrastructure upgrades are required in Arandis and Usakos. Normally, there is a lead time of 3 – 5 years for the planning and building of a new school. However, the existing budgetary mechanisms within government would not give a high enough priority to the Erongo Region for the required new schools to be built, as the region is relatively well-off compared to other regions in the country. There is therefore a need for a high-level political and economic decision to spend disproportionately on school building in the Erongo Region for the next 5 – 10 years, so as to accommodate the expected surge in the school population. The private sector, and uranium mining companies in particular, could help achieve the required investments through public-private partnerships. It should not be a problem to attract the required teachers to the region, provided adequate salaries are paid.

Complementary education initiatives such as those provided by the Rössing Foundation, NIMT, the proposed MCA-funded Community Skills Development Centre in Walvis Bay, private tertiary institutions etc. all contribute towards education outputs in the region. The uranium mining companies should contribute to and strengthen these existing initiatives and institutions rather than establishing new programmes which may not have critical mass to mitigate the expected impacts effectively.

7.10.4.2 Quality of education

The challenge of quality education is not only at primary level but throughout the system, which is not producing the outcomes it should considering the inputs it has been getting since Independence. There is an ongoing public and political demand for greater educational outputs and better educational outcomes. Uranium companies, industry, donors should be given incentives by GRN to provide generously for bursaries and scholarships for Namibians with the aptitude for becoming educators. New mining companies may also wish to add to the efforts of the Rössing Foundation to improve the levels of learner performance, especially in English and the sciences, at the centres it has built at Arandis and Tamariskia, Swakopmund, and the training which is being provided to school principals.

7.10.4.3 The demand for skills

The best way to improve skills in the short term is for mining companies and training specialists to work together to systematically provide the standard and level of training required by the job market[3]. The Industry Skills Committees now being established by the Namibia Training Authority provide a vehicle for such cooperation, and could be particularly significant as a training levy is introduced in the next few years. Whilst the region is fortunate to have NIMT in Arandis, its output cannot satisfy the current demand, let alone the expected future demand. Also, the scope of the training provided at NIMT needs to be expanded into fields such as geology and surveying. Its location away from the coastal towns is a factor adding to the cost of training at NIMT, and it is thus proposed that a satellite campus of NIMT should be established at Walvis Bay. Many industries at the coast, and many young unemployed people, could benefit from an accessible and flexible training institution. Such an institution should be supported by mining companies through funding and provision of skilled trainers (seconded by mining companies to the facility). The appropriate forum for channelling these initiatives is the Industrial Skills Committee.

7.10.4.4 The demand for work

There will be opportunities that arise from the new economic activity associated with the Uranium Rush. Pre-service training could absorb some work-seekers. With good quality support, viable micro, small and medium enterprises could also emerge. The staff members who are directly employed by the new mines represent only a fraction of the possible economic and employment benefits that can accrue to the region as a result of the vast investments that are being made. However, in view of the relative scarcity of Namibian and regional entrepreneurs, some extra support mechanisms seem to be necessary for these new businesses to emerge and be sustained. The new mines and related companies may therefore wish to consider collective support for one or more of the Namibian agencies that currently provide support for Micro and SME development.

[3] Traditionally, the mining industry has supported the training of technical skills such as engineering, geology, etc. However, for the Uranium Rush to contribute best to sustainable development, support is also needed for non-mining skills, such as teaching, health care, management, land use planning, water resources management, etc.

7.11 Cumulative effects analysis – air quality

7.11.1 Introduction

Dust emissions giving rise to ambient pollution concentrations and deposition levels are derived from anthropogenic, natural and biogenic sources (Guest Editorial, 2009). Windblown dust from natural mineral sources is estimated to account for 89% of the global aerosol load (Satheesh and Moorthy, 2005) whilst mining operations and aggregate extraction sites are significant sources of fugitive dust emissions (McKenna Neuman *et.al*., 2009). Evaporation of sea spray can produce particles and pollen grains, mould spores and plant and insect parts all contribute to the particulate load (WHO, 2000).

The Erongo Region falls within the west coast arid zone of Southern Africa and is characterised by low rainfall with extreme temperature ranges and unique climatic factors influencing the natural environment and biodiversity (Goudie, 1972). Episodic dust storms associated with strong easterly winds are a common phenomenon during the winter months and are derived primarily from natural sources. These sources are intermittent sources, giving rise to dust emissions only under conditions of high wind speeds. Anthropogenic sources such as unpaved roads and mining operations continuously contribute to the atmospheric dust load in the Erongo Region.

Airborne particulate matter comprises a mixture of organic and inorganic substances, ranging in size and shape. These can be divided into coarse and fine particulate matter. The former is called Total Suspended Particulates (TSP), whilst thoracic particles or PM10 (particulate matter with an aerodynamic diameter of less than 10 µm) fall in the finer fraction. PM10 is associated with health impacts for it represents particles of a size that would be deposited in, and damaging to, the lower airways and gas-exchanging portions of the lung. TSP, on the other hand, is usually of interest in terms of dust deposition (nuisance).

The main purpose of this section is to examine the baseline air quality conditions in the central Namib with regards to dust and to assess the cumulative impacts of nuisance dust and inhalable dust (PM10) on health and air quality per mining scenario. Gaseous emissions will also occur, caused by stack emissions from roasters, sulphuric acid plants (if used) and vehicles. The point sources are, however, widely spread out and are therefore unlikely to cause regional-scale cumulative impacts. Thus, gaseous emissions have not been addressed in this SEA.

The discussion relating to radiation – baseline conditions in air and water, atmospheric and aqueous pathways and the potential public exposure to radio-nuclides, is presented in the next section (section 7.12).

Various factors influence the dispersion, transformation, and eventual removal of pollutants from the atmosphere. The main influencing factors are local meteorological conditions, topography, land-use, source features (e.g. point, area, volume, line or pit source, and dimensions of source) and source strengths (i.e. amount of emissions deriving from the source). The location of the public relative to the sources of emission is required in assessing the potential particulate impacts.

7.11.1.1 Background situation - total suspended particulates

In order to determine the background dust situation in the central Namib, a monitoring network, comprising 20 single dust fallout buckets, was established by the SEA air quality team (Airshed

Professionals and BGR-GSN) in August 2009. Dust fallout data from existing mining monitoring networks were also made available for inclusion in this study (i.e. Etango, Extract and Trekkopje). Figure 7.11.1 indicates the locations of the 20 dust fallout buckets as part of the Erongo SEA monitoring network as well as the dust fallout locations at the various mining operations. Dust fallout monitoring is a useful and cost effective method of providing trend analysis of dust deposition over a period of time. It also provides an indication of the main areas of dust generation.

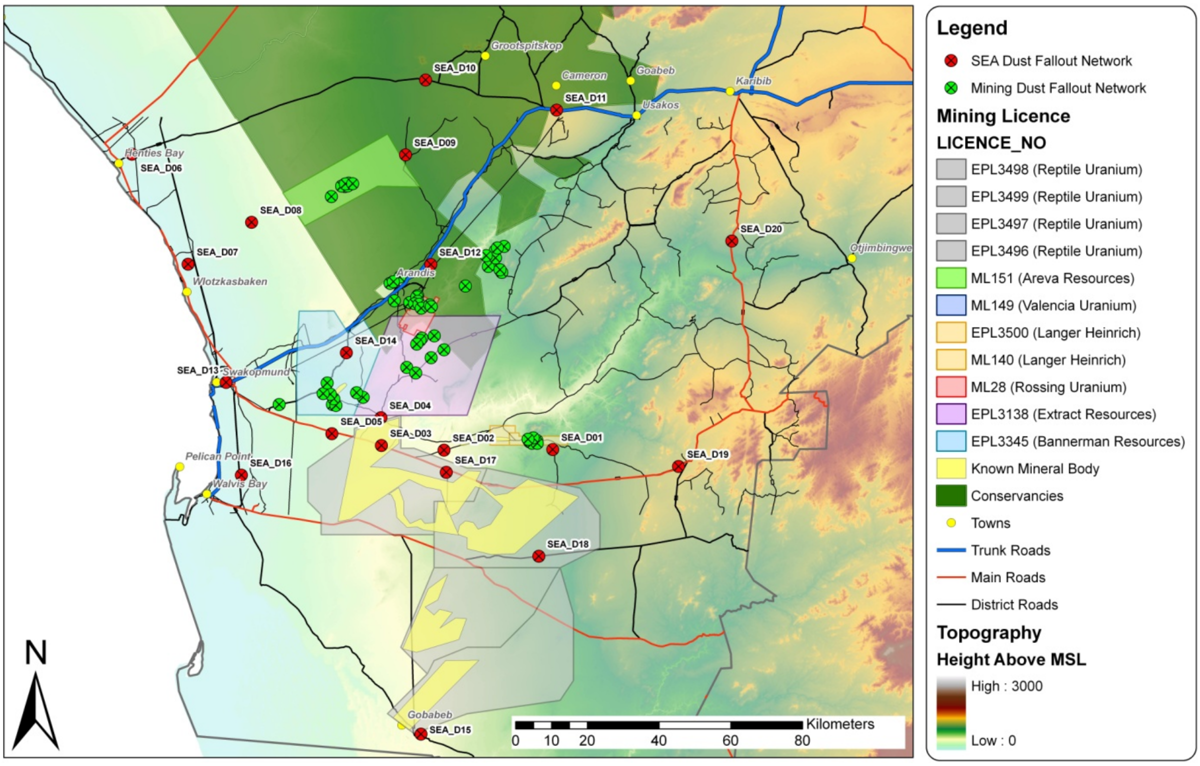
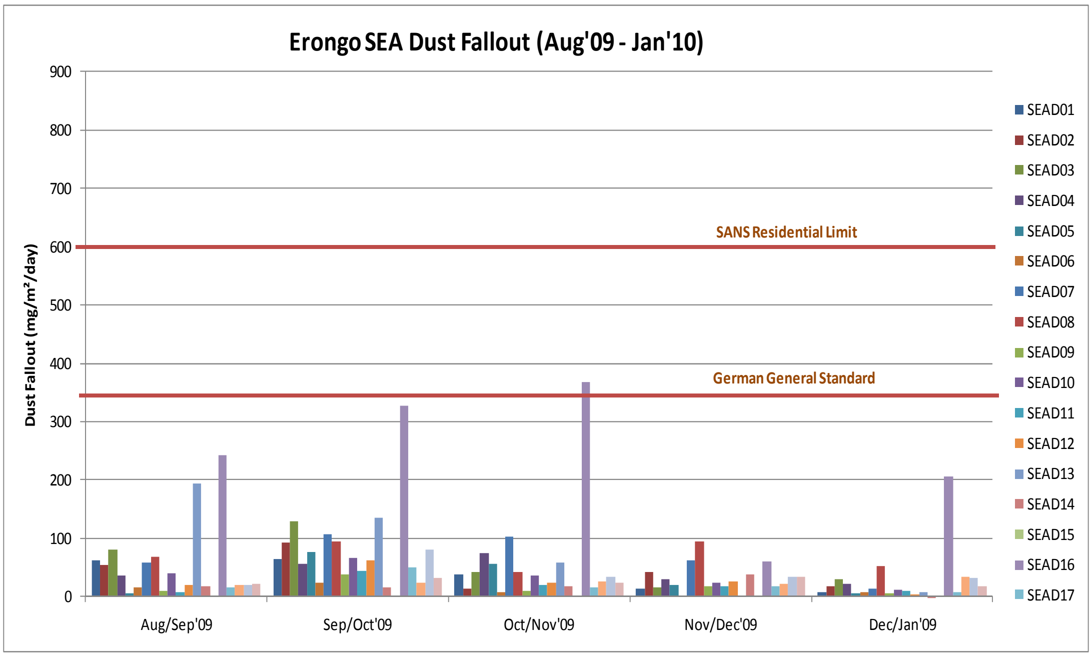


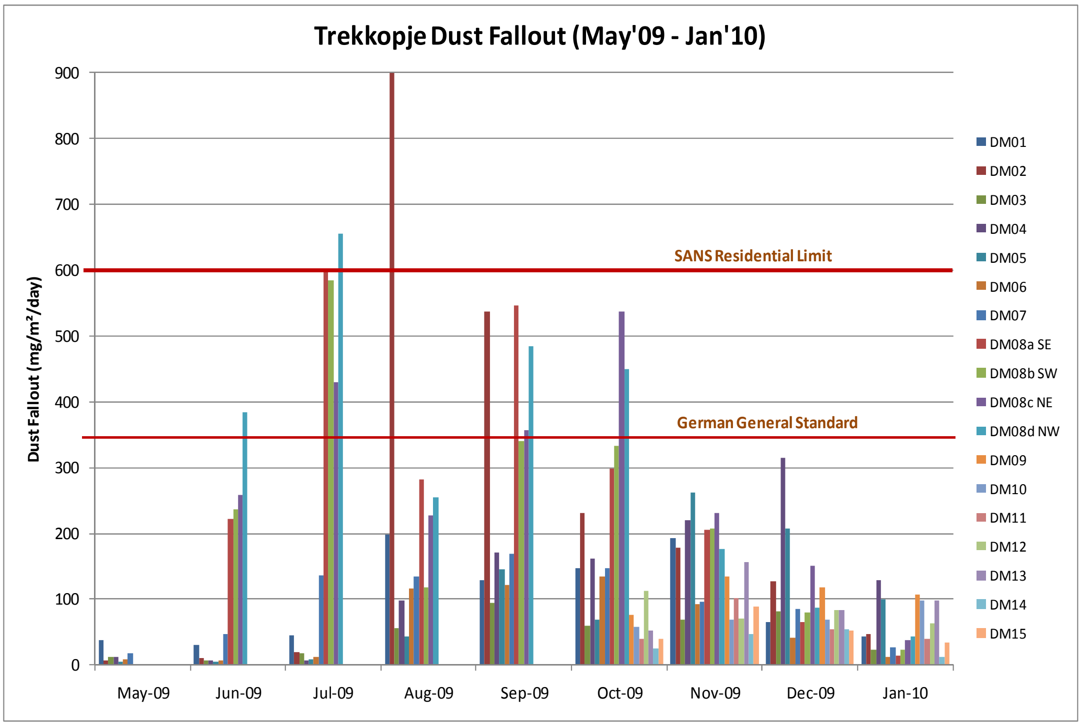
Figure 7.11.1: The SEA dust fallout monitoring network in the central Namib.

In order to provide an indication of the significance of the recorded dust fallout, reference is made to the maximum monthly dust fallout limits as provided by Germany and South Africa (as SANS). The results are presented in Figure 7.11.2 and the main findings are summarised as follows:

- In general, dust deposition throughout the Erongo Region is slight (< 150 mg/m²/day). Dust fallout samples collected at all the SEA buckets were below the SANS residential limit of 600 mg/m²/day and most were below the German standard of 350 mg/m²/day (for general areas). SEA_D16 (located north of the Walvis Bay airport) collected, on average, the highest dust fallout over the five months with a maximum of 368 mg/m²/day in November 2009, exceeding the German standard. An overall decrease in dust fallout levels occurred during November/December and December/January, which possibly reflects a combination of less windy conditions and a reduction in traffic on the D1984 due to the Christmas holidays.

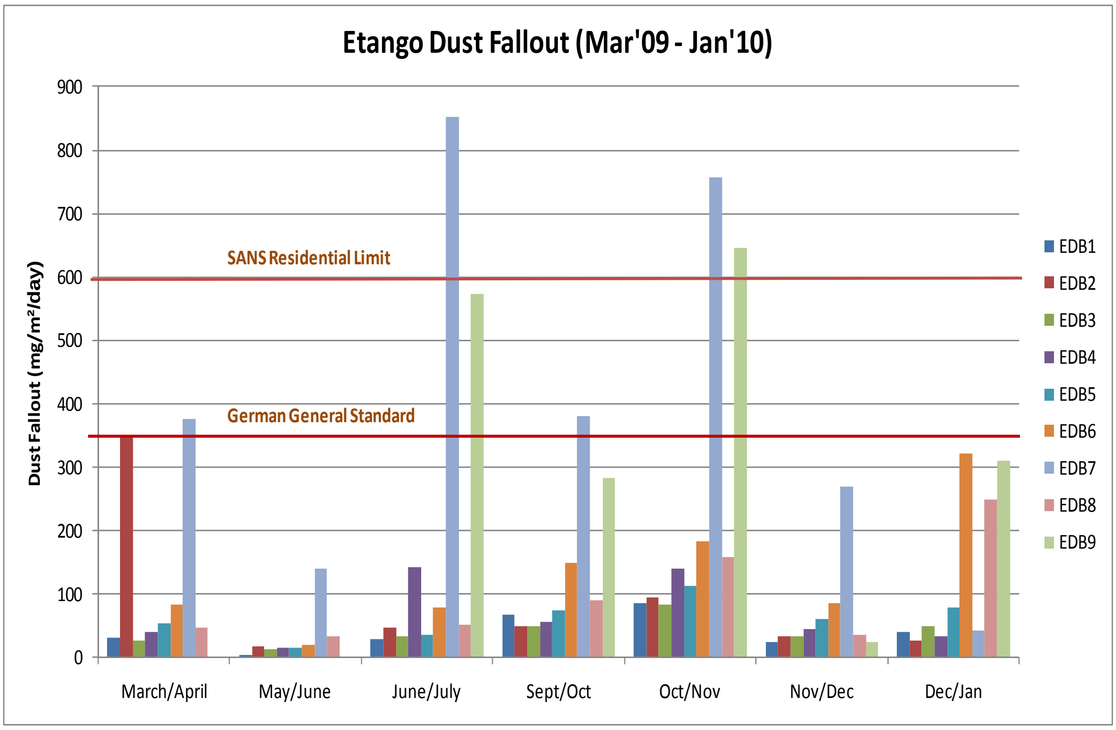


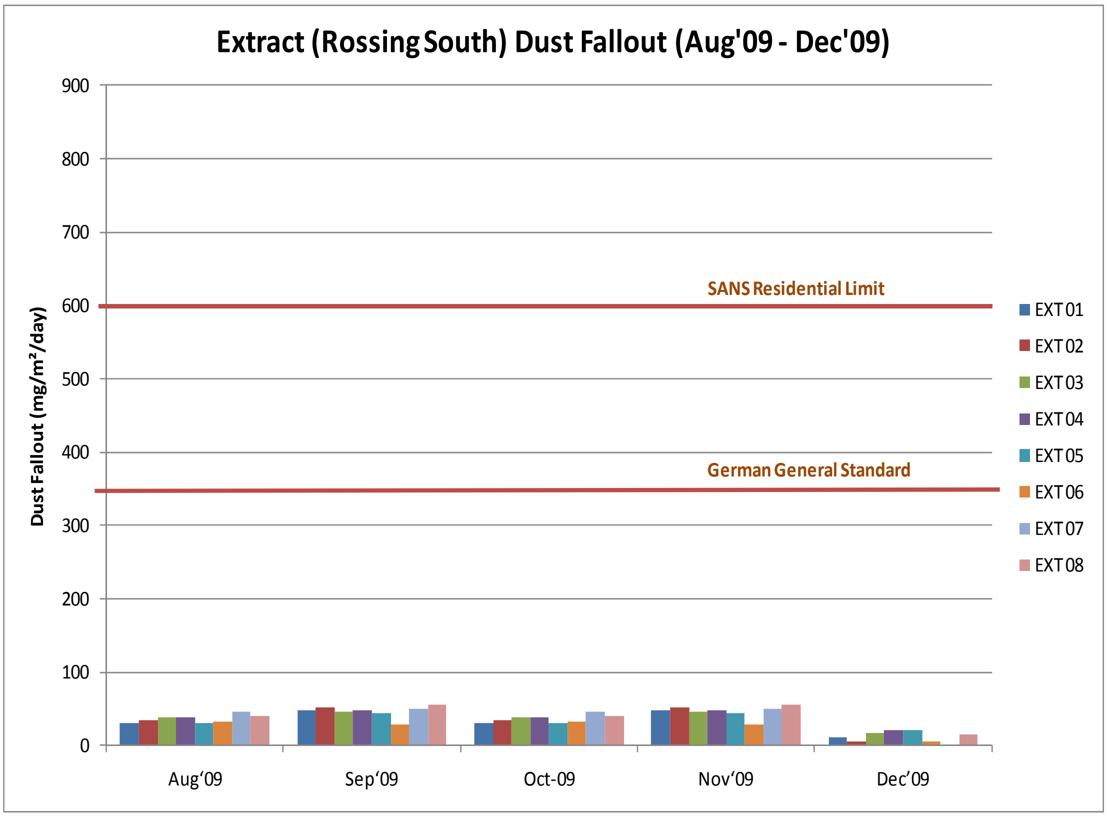
(a)



(b)

Figure 7.11.2: Measured dust deposition at: (a) SEA monitoring network; (b) Trekkopje; and on next page (c) Etango network; and (d) Extract network.


Etango Dust Fallout (Mar'09 - Jan'10)
Dust Fallout (mg/m²/day)
900
800
700
600
500
400
300
200
100
0
SANS Residential Limit
German General Standard
March/April
May/June
June/July
Sept/Oct
Oct/Nov
Nov/Dec
Dec/Jan
EDB1
EDB2
EDB3
EDB4
EDB5
EDB6
EDB7
EDB8
EDB9
(c)


Extract (Rossing South) Dust Fallout (Aug'09 - Dec'09)
Dust Fallout (mg/m²/day)
900
800
700
600
500
400
300
200
100
0
SANS Residential Limit
German General Standard
Aug'09
Sep'09
Oct-09
Nov'09
Dec'09
EXT01
EXT02
EXT03
EXT04
EXT05
EXT06
EXT07
EXT08
(d)

- Results from the Trekkopje mine dust fallout network reflect very low dust fallout levels in May 2009, increasing during the months of July to November 2009, probably due to a combination of the winter easterly Berg wind conditions which usually occur during this time and construction activities taking place in the area. The SANS limit was exceeded once at three locations and the German standard was exceeded at a number of sites between July to November 2009. Again dust fallout decreased at some of the sites between November and January with all sites indicating lower dust fallout in December and January 2010.

- The results from the Etango monitoring network are similar to that of the SEA network, i.e. the results are primarily below 150 mg/m²/day. EDB07, located next to the road at Goanikontes, collected the highest dust fallout exceeding the SANS limit on two occasions and the German standard during four months. Fairly high dust fallout (exceeding the German standard during two months) was collected at EDB09 located at a residence next to the Swakop River. Similar to the SEA network results, a decrease in dust fallout was noted for the period November to January.

- The Extract dust fallout network located at the proposed Rössing South exploration area collected low dust fallout (< 50 mg/m²/day) over the five months (August to December 2009). A marked reduction in dust fallout was also noted for December 2009.

7.11.1.2 Background situation - PM10

As part of the Erongo SEA project, two PM10 samplers were deployed, one at Swakopmund and one at Gobabeb (as background). Additional PM10 data were made available for this study: Etango project (March to November 2009) and Trekkopje (September to October 2009). Available results are shown in Figure 7.11.3 and indicate the following:

- At Swakopmund, the maximum PM10 concentration recorded is 283 µg/m³ with an average of 21µg/m³ over the 129 days. The WHO AQG IT-3 was exceeded 28% of the time.
- Analysis of the measurements taken at the Etango site, located approximately 35 km east-southeast of Swakopmund, resulted in a period average PM10 concentration of 40 µg/m³ for the nine-months. The highest daily concentration recorded was 329 µg/m³ and the World Health Organisation's (WHO) IT-3 of 75 µg/m³ was exceeded 11% of the time.
- A maximum of 56 µg/m³, with no exceedances of the WHO AQG IT-3 daily concentrations, was recorded at Trekkopje's PM10 sampler during September/October 2009.
- The aim of locating a PM10 sampler at Gobabeb was to record background PM10 concentrations. The highest daily average PM10 concentration is 57 µg/m³ with an overall average of 23 µg/m³. The WHO AQG was exceeded for only one day over the six-month period.

It is clear from the results of the background dust monitoring that high dust levels can be expected throughout the area, especially during the strong winter Berg wind conditions. However, dust levels are exacerbated by traffic on the gravel roads and from areas where the natural desert soil crust has been disturbed. On the other hand, during calm, cool conditions, atmospheric clarity is one of the characteristic hallmarks of the desert environment.

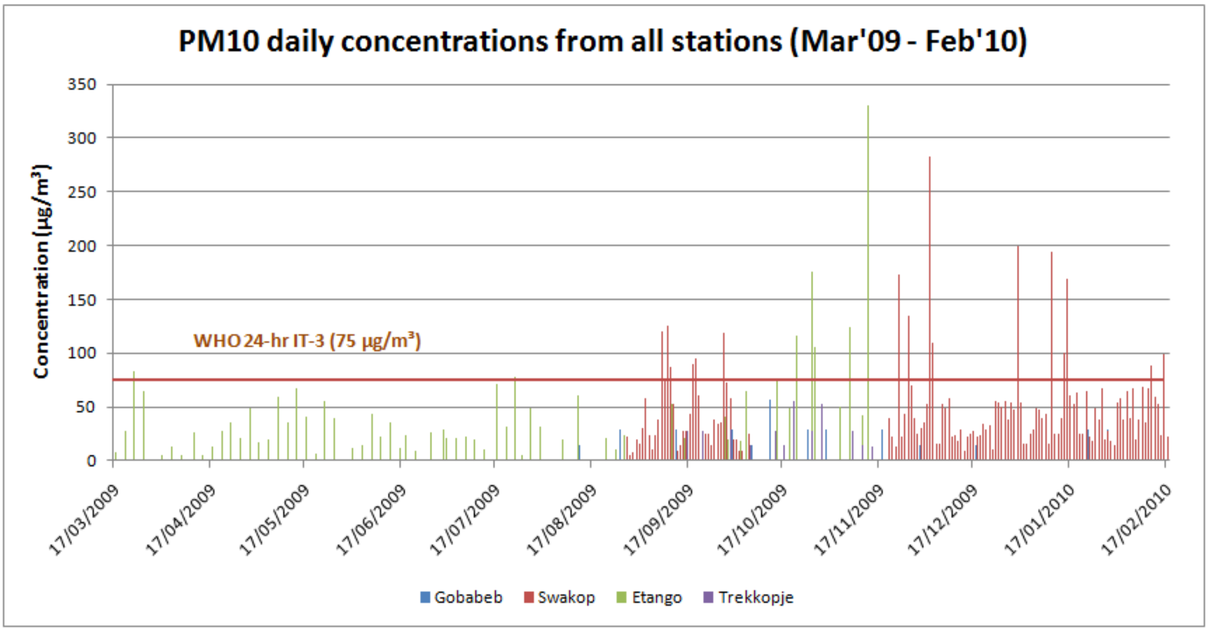


Figure 7.11.3: Ambient monitored PM10 concentrations from Gobabeb, Swakopmund, Etango and Trekkopje for the period March 2009 to February 2010.

7.11.2 <u>Analysis of cumulative impacts</u>

There are a number of activities in a mining operation that generate dust, especially in an arid environment. The main sources of dust emissions are:

- Excavation, crushing and screening, materials transfer, and drilling and blasting;
- Vehicle (equipment) movement on paved and unpaved roads;
- Wind erosion from tailings storage facilities, waste dumps and other stock piles; and,
- Stacks from processing operations (e.g. acid plant, bag house, scrubber).

Possible air quality impacts per scenario were modelled using available meteorological data, supplemented with the ambient air quality monitoring data for TSP and PM10 as described above. For the possible new mines, mining conditions were simulated for each new mine location based on the predicted size of the mine and the nature of the deposit (alaskite or calcrete ore body).

The contribution from natural background sources was accounted for in the dispersion simulations as best possible (crusting of the surface layer was estimated). The accuracy of the simulations was verified using the limited ambient PM10 monitoring data described above. The modelling area covered the entire Erongo Region with residential areas and small-scale farming locations included as sensitive receptors. The modelled simulations included the mines identified in section 4.5 for each scenario, current traffic on all trunk, main and district roads (see section 7.3) and windblown dust resulting from natural background sources. Details of the models used are contained in the Air Quality Theme report which will be made available by MME as a stand-alone report. The results, discussed below need to be read bearing in mind the following comments:

- The model tends to over-predict wind speeds in areas where there are no measured meteorological data. Thus the absence of measured weather data for the area from Swakopmund northwards means that the dispersion simulations for wind erosion seem to have been ***over-predicted*** in the north-western parts of the region specifically around Henties Bay and Wlotzkasbaken when compared to measured data;

- Wind erosion is an intermittent source of fugitive dust. High wind speeds exceeding 10 m/s occurred for only 2% of the time in 2007 and 2008. The model averages the predicted concentrations over the entire period, thus not reflecting the temporal variation between days and months;

- For the rest of the area, the predicted concentrations compare well with that measured. A good correlation was found between predicted PM10 GLC and that measured at the Gobabeb, Etango and Trekkopje PM10 stations. The modelled results for Swakopmund were over estimated slightly at Swakopmund, due most probably to the absence of local meteorological data for the area as explained above.

Predicted impacts from Scenarios 1, 2 and 3 are shown in Tables 7.11.1 and 7.11.2 and Figures 7.11.4 to 7.11.8 and can be summarised as follows:

- Scenario 1: Wind erosion and roads remain the main sources of ground level concentrations (GLC) of PM10 and dust fallout at the various receptors. The addition of Trekkopje mining operations is reflected in the PM10 GLC at Swakopmund, Walvis Bay, Arandis and Goanikontes. Valencia Uranium only contributes slightly to the concentrations at Goanikontes. The only mining source contributing to Gobabeb's PM10 GLC is Langer Heinrich Uranium with Rössing Uranium the main mining source impacting on Arandis and Goanikontes. Increased traffic volumes on the roads result in higher PM10 GLC and dust deposition predicted for Swakopmund and Walvis Bay.

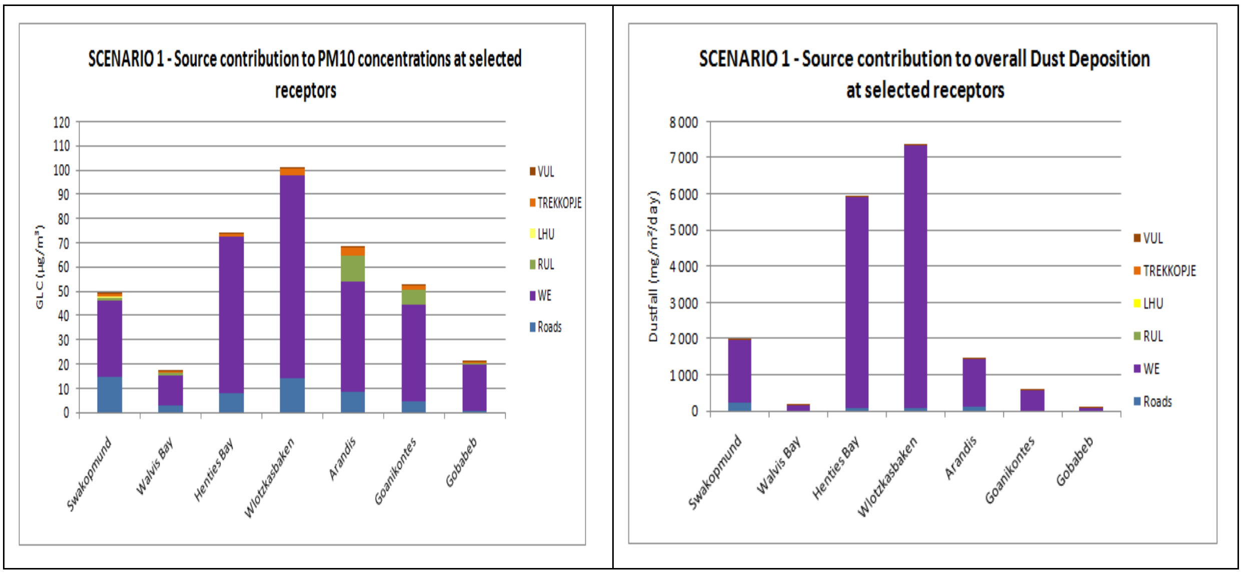


Figure 7.11.4: Source contribution to the predicted Scenario 1 impacts at the selected communities for: (a) PM10 ground level concentrations; and (b) dust deposition.

- Scenario 2: Predicted impacts are similar to Scenario 1, but with slight increases in PM10 GLC and dust deposition at most locations (except Goanikontes) due to increased traffic volumes. The 13 µg/m³ increase in predicted PM10 GLC at Goanikontes is primarily due to the Etango Project (contributing 15%), with a 13% contribution to dust deposition at the same location. Rössing South contributes slightly to the PM10 GLC at Arandis (3%), Goanikontes (4%) and Swakopmund (1%).

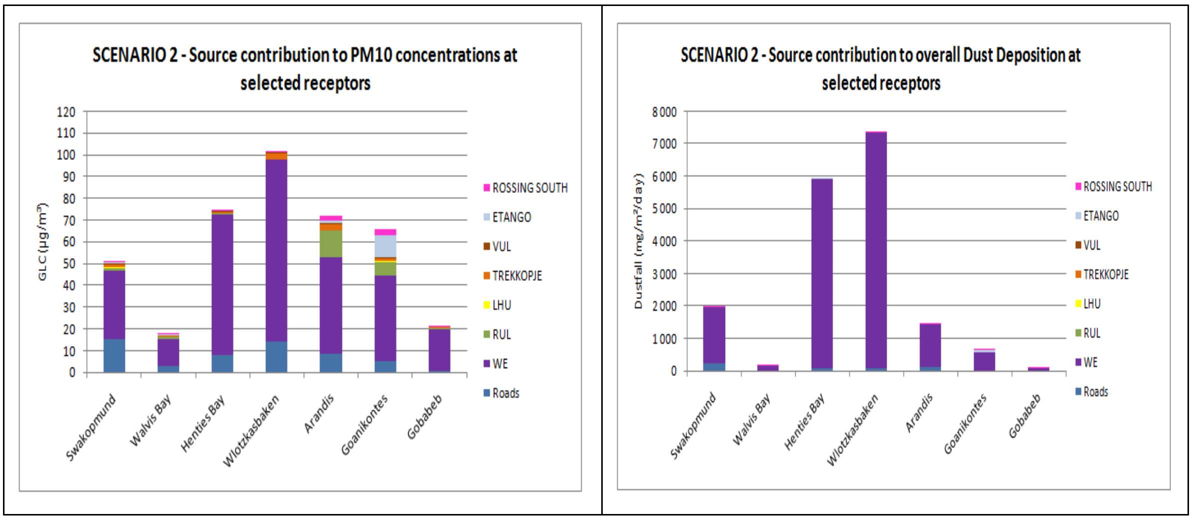


Figure7.11.5: Source contribution to the predicted Scenario 2 impacts at selected communities for: (a) PM10 ground level concentrations; and (b) dust deposition.

- Scenario 3: Limited information was available for the Reptile Uranium (e.g. Tubas-Oryx-Tumas) and Marenica mines and use was made of best estimates in the source strength quantification. For Reptile, the layout and source information for Langer Heinrich was used and for Marenica information from Trekkopje. Based on the predicted impacts, these two mines would have a slight contribution of 1% to the PM10 GLC at Walvis Bay (Reptile) and Henties Bay (Marenica). Dust deposition remains fairly unchanged from the estimates for Scenario 2.

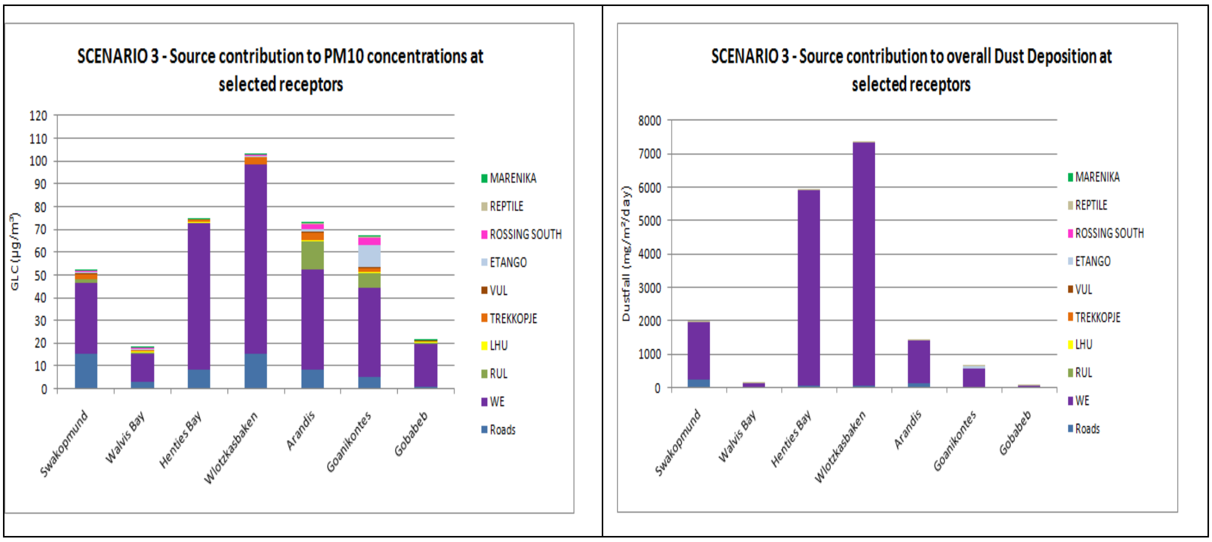


Figure 7.11.6: Source contribution to the predicted Scenario 3 impacts at the selected communities for: (a) PM10 ground level concentrations; and (b) dust deposition.

Table 7.11.1: Predicted PM10 ground level concentrations at selected receptors (µg/m^3)

	Swakop-mund	Walvis Bay	Henties Bay	Wlotzkas-baken	Arandis	Goani-kontes	Gobabeb
Baseline situation	46	16	72	95	65	50	20
Scenario 1	50	17	74	101	69	53	21
Scenario 2	51	18	74	102	72	66	21
Scenario 3	52	18	75	103	73	67	21
% increase (Baseline: Scenario 3)	13%	13%	4%	8%	12%	34%	5%

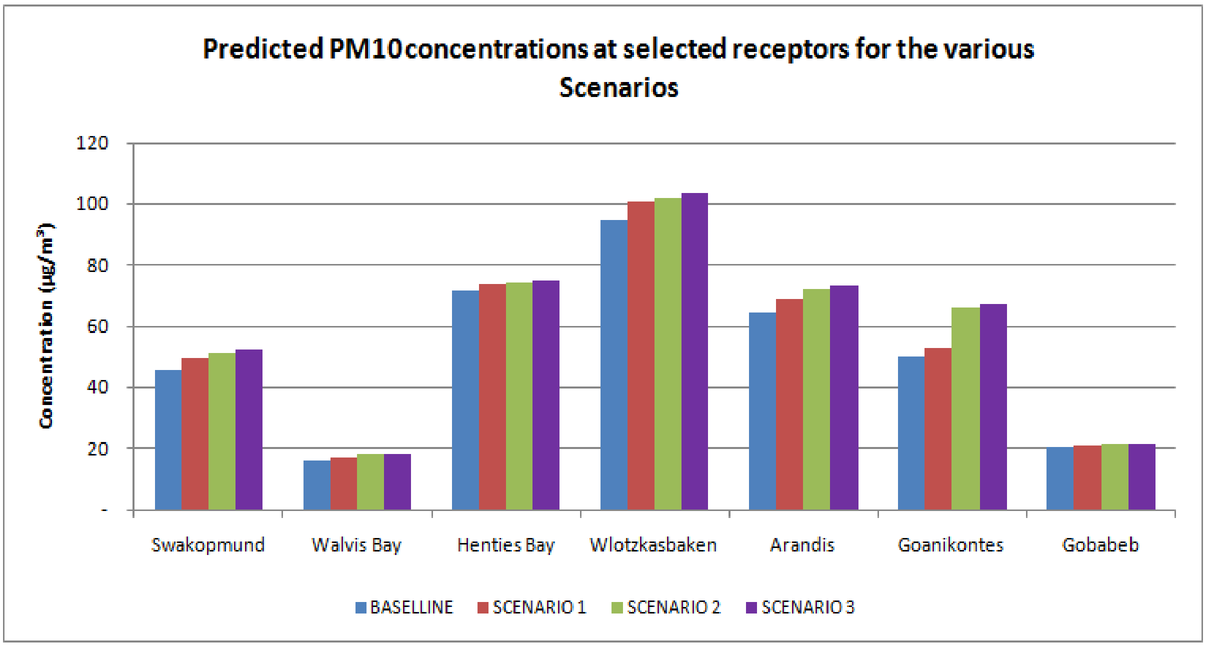


Figure 7.11.7: Predicted PM10 concentrations at selected receptors for the various scenarios

Table 7.11.2: Predicted dust deposition at selected receptors (mg/m^2/day)

	Swakop-mund	Walvis Bay	Henties Bay	Wlotzkas-baken	Arandis	Goani-kontes	Gobabeb
Baseline situation	1883	145	5916	7306	1421	552	75
Scenario 1	1941	145	5921	7321	1423	554	75
Scenario 2	1952	146	5922	7322	1425	635	75
Scenario 3	1953	146	5918	7327	1426	635	75
% increase (Baseline: Scenario 3)	4%	1%	0%	0%	0%	15%	0%

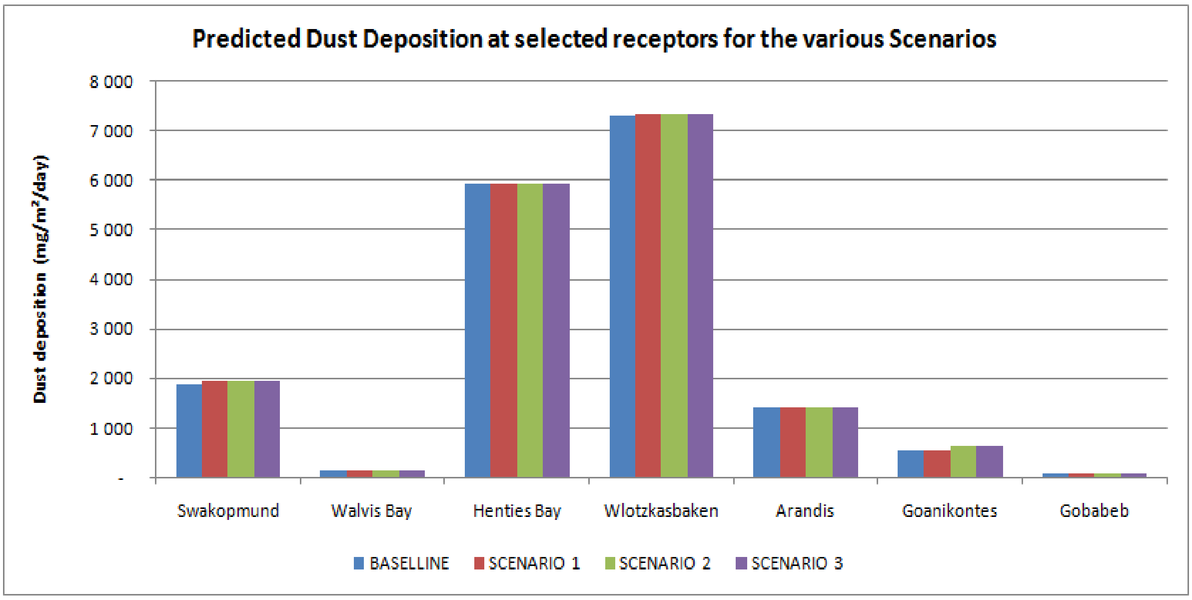
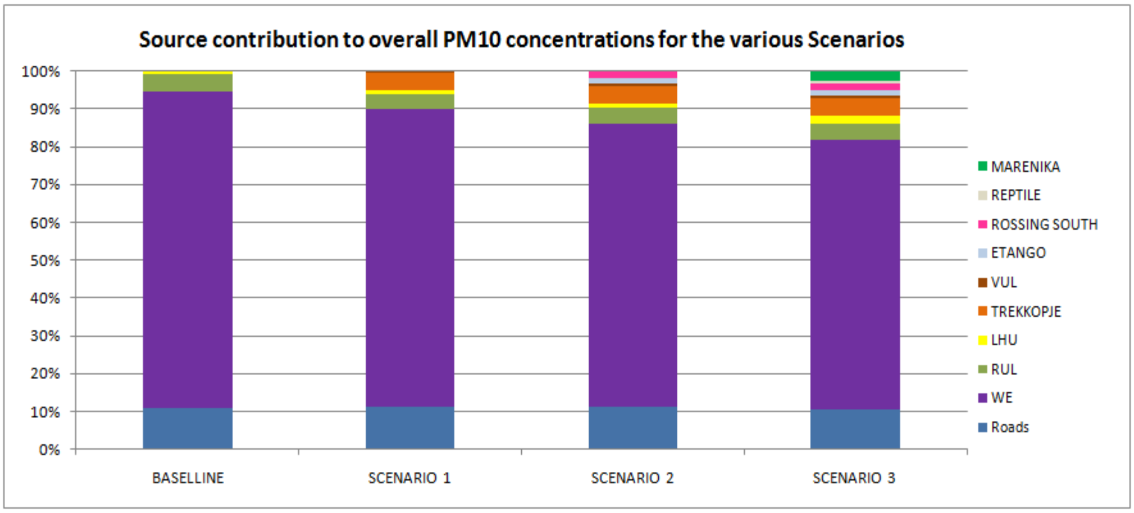


Figure 7.11.8: Predicted dust deposition at selected receptors for the various scenarios

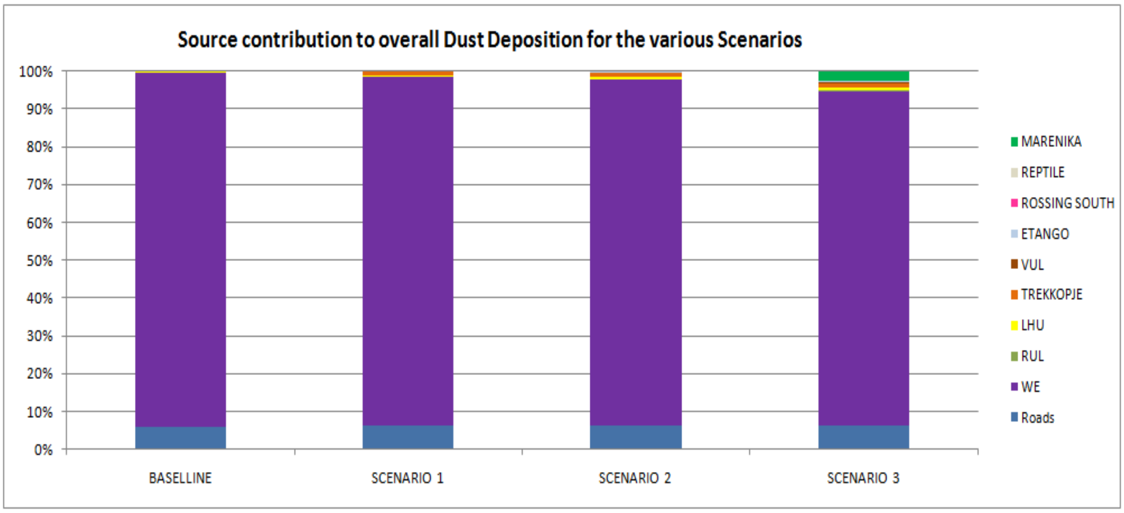
The significance of the predicted cumulative impacts can be summarised as follows:

- The spatial distribution of PM10 GLC over an annual average changes slightly between the Baseline and Scenarios 1, 2, and 3. An increase in the impact zones around the respective mining areas and roads is noted in the isopleths plots provided (Figures 7.11.10 and 7.11.11).
- Predicted impacts at selected communities indicate a noticeable increase in ground level PM10 concentrations between the various scenarios at some communities (Table 7.11.1 and Figure 7.11.7). The largest increase (compared to the Baseline situation) can be observed at Goanikontes with a possible 34% increase for Scenario 3. Swakopmund, Walvis Bay and Arandis reflect similar increases of 12-13% for Scenario 3. These increases are primarily a function of the additional mining operations and the marked increase in traffic volumes on Roads B2, C28 and C34 (see Figure 7.11.9a).
- Windblown dust is the main contributing source to PM10 concentrations and dust deposition at the various communities for all scenarios (Figure 7.11.7). Since the background wind erosion emissions remain unchanged throughout, the percentage increase between the scenarios can therefore be attributed to the increase in mining operations (Figure 7.11.9a).
- The difference in dust deposition levels between the scenarios is slight due to the dominance of wind erosion and road dust to the overall deposition levels (Table 7.11.2 and Figure 7.11.8). The 'mining contribution' to dust deposition reflects a smaller percentage due to the distance of these sources from the communities (Figure 7.11.9b). Dust deposition consists primarily of TSP (larger particles) that 'fall out' closer to the source of emission, whereas finer particulates (PM10) remain suspended in the atmosphere for longer time periods and can travel further.
- Scenario 4, the 'Boom-bust' scenario, prompts the possibility of all operating mines to close down, but without any rehabilitation taking place at the mines. From an air quality perspective, this scenario will provide an improved situation (versus all the other scenarios) due to a significant reduction in traffic volumes and no mining-related activities (e.g. excavation, drilling

and blasting, materials transfer, and mine haul roads). The only air emission sources likely to remain are tailings storage facilities, waste dumps and stockpiles likely to give rise to wind erosion. The contribution from these sources to the overall natural windblown dust have been shown slight in the other three scenarios and are regarded, when left undisturbed, to form a natural crust reducing the potential for wind erosion.

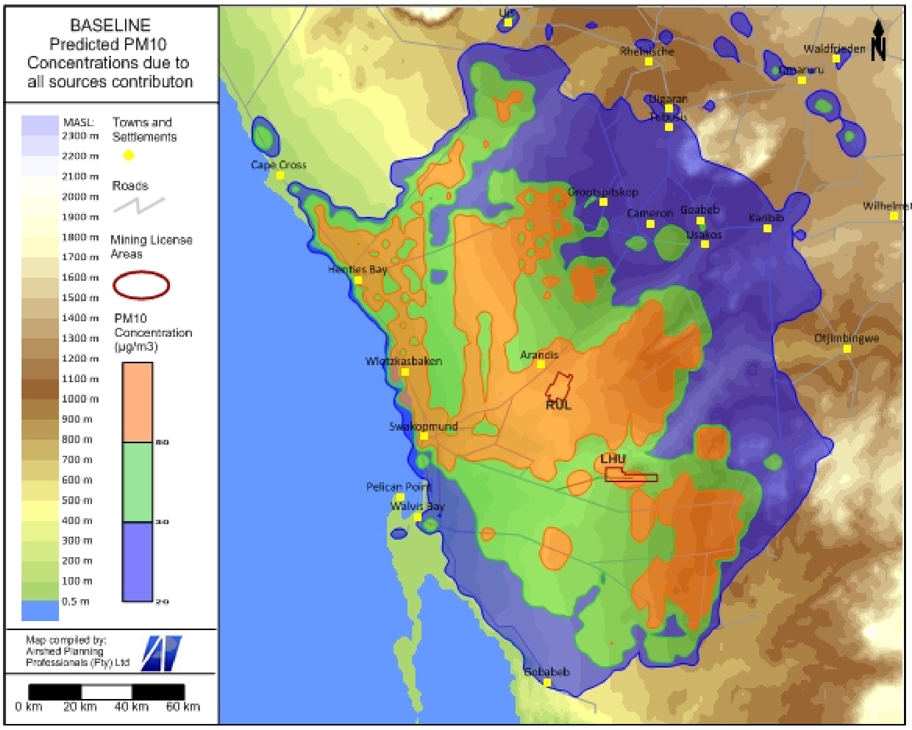


(a)

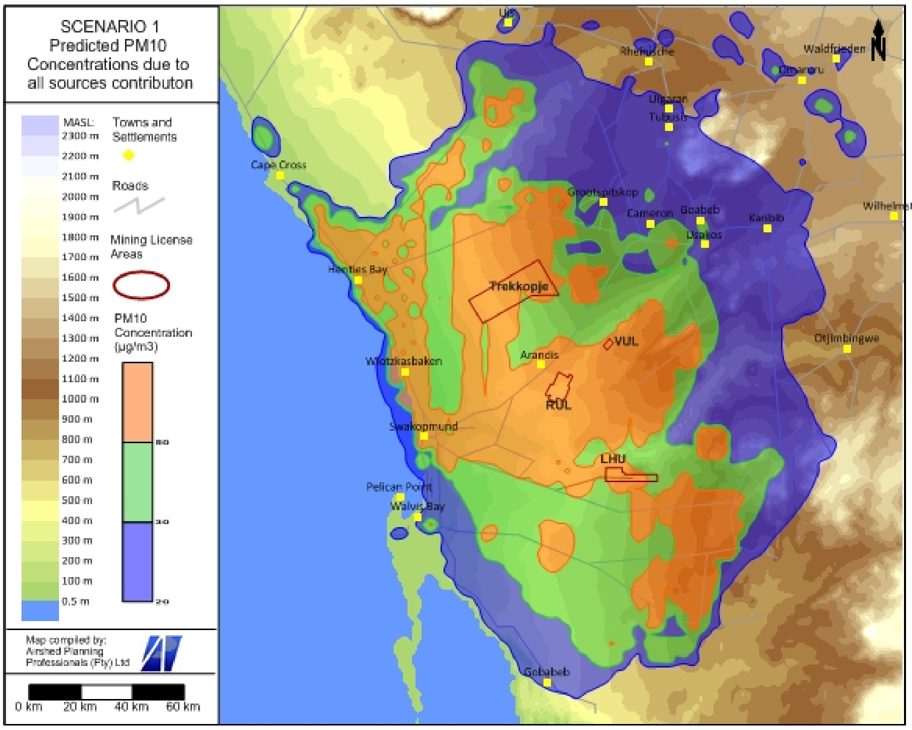


(b)

Figure 7.11.9: Source contribution to the overall predicted impacts at the selected receptors for: (a) PM10 ground level concentrations; and (b) dust deposition.

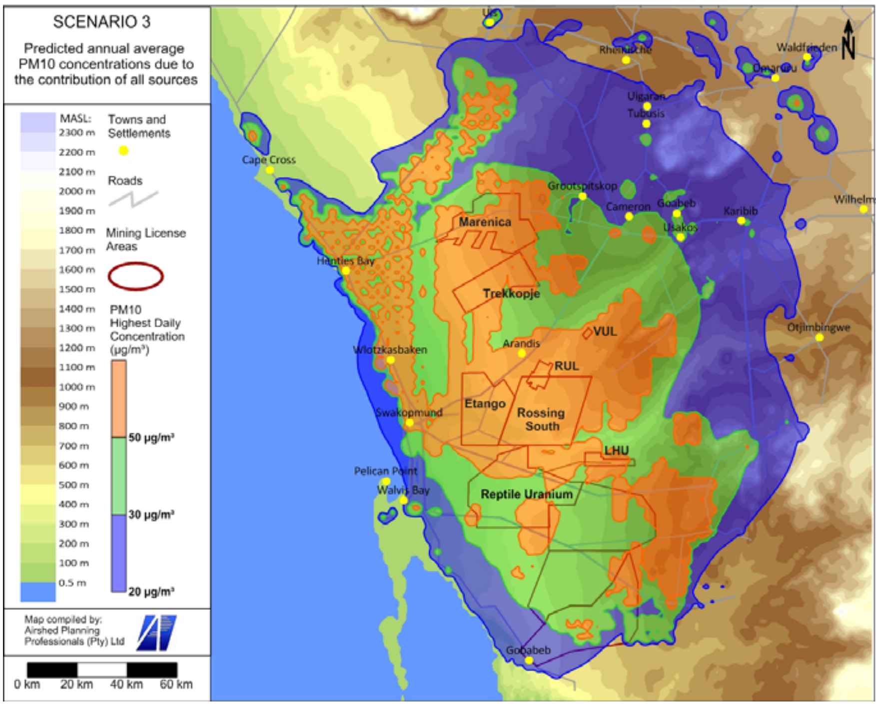


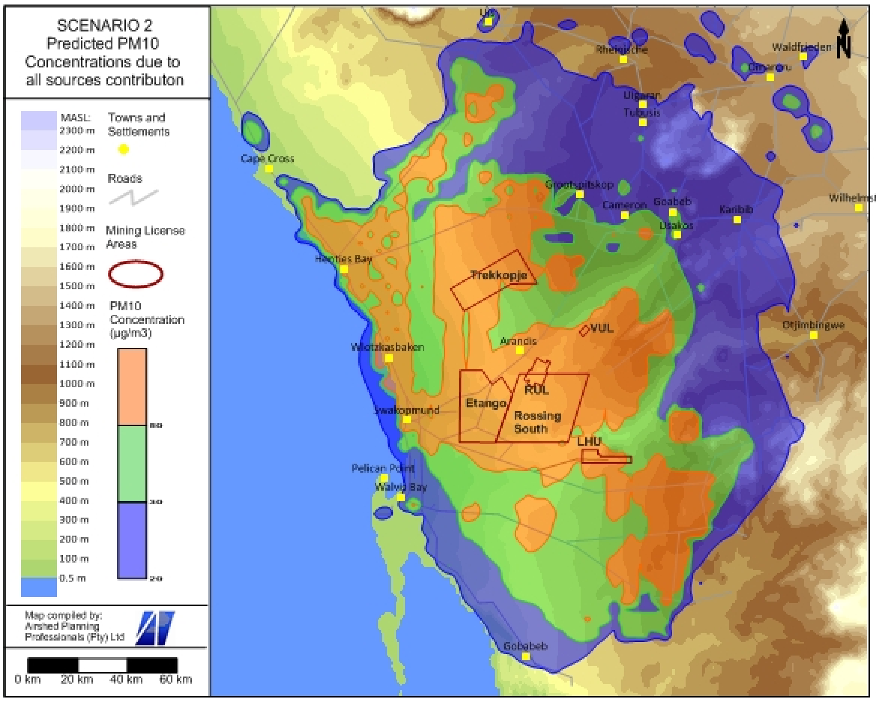
(a)

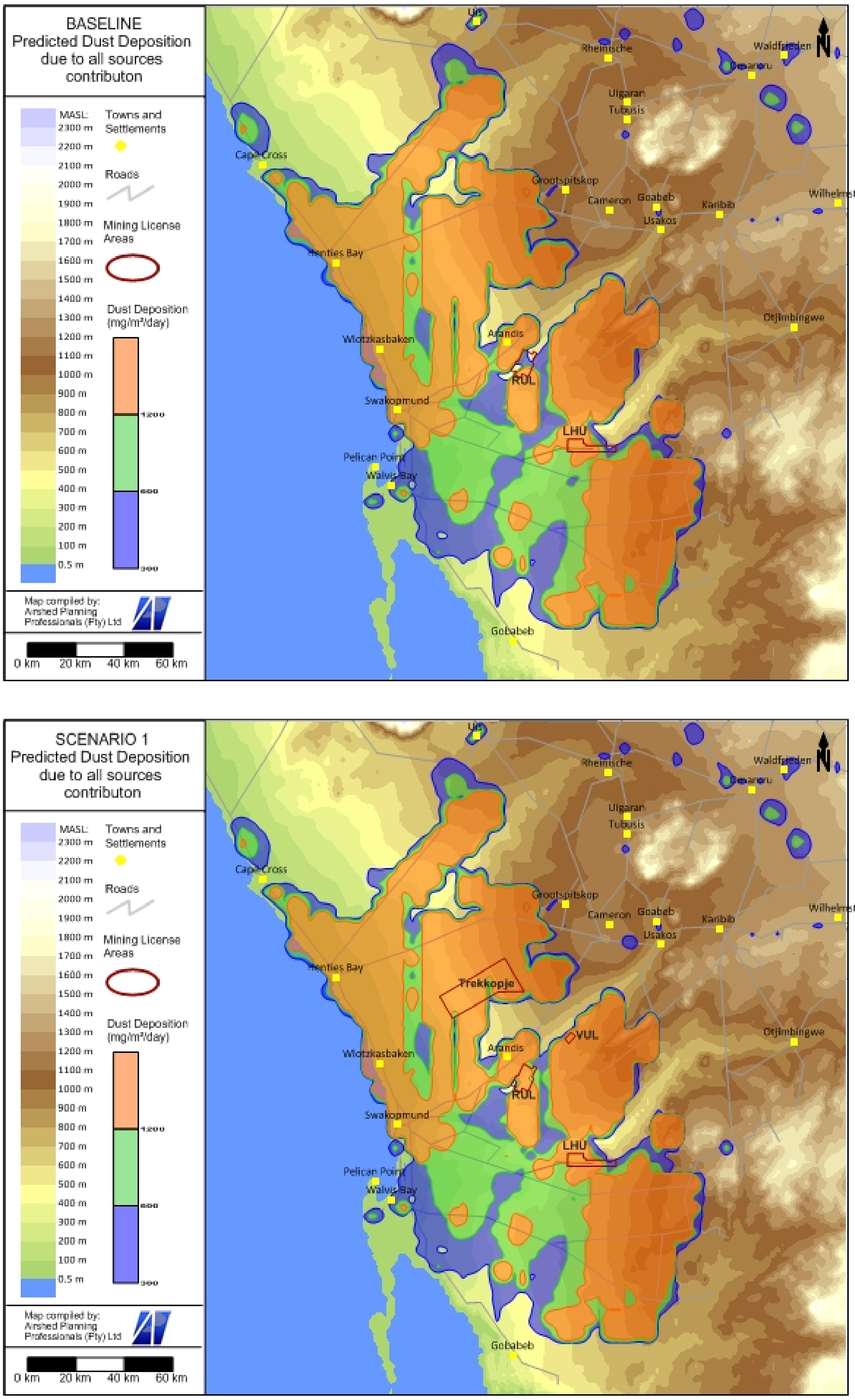


(b)

Figure 7.11.10: Predicted PM10 annual average concentrations for the baseline (a), Scenario 1 (b) and next page, Scenario 2 (c) and Scenario 3 (d)


SCENARIO 3
Predicted annual average PM10 concentrations due to the contribution of all sources
MASL:
Towns and Settlements
Roads
Mining License Areas
PM10 Highest Daily Concentration (µg/m³)
50 µg/m³
30 µg/m³
20 µg/m³
Map compiled by: Airshed Planning Professionals (Pty) Ltd
0 km 20 km 40 km 60 km
Marenica
Trekkopje
VUL
RUL
Etango
Rossing South
LHU
Reptile Uranium
Swakopmund
Walvis Bay
Henties Bay
Arandis
Gobabeb
(c)

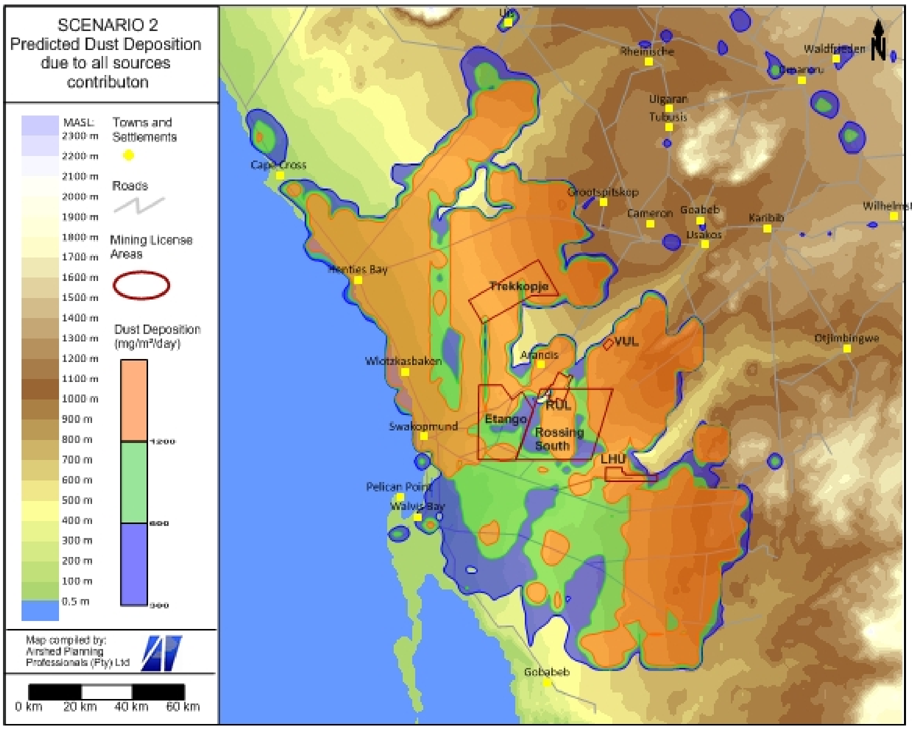

SCENARIO 2
Predicted PM10 Concentrations due to all sources contributon
MASL:
Towns and Settlements
Roads
Mining License Areas
PM10 Concentration (µg/m3)
Map compiled by: Airshed Planning Professionals (Pty) Ltd
0 km 20 km 40 km 60 km
Trekkopje
VUL
RUL
Etango
Rossing South
LHU
Swakopmund
Walvis Bay
Henties Bay
Arandis
Gobabeb
(d)

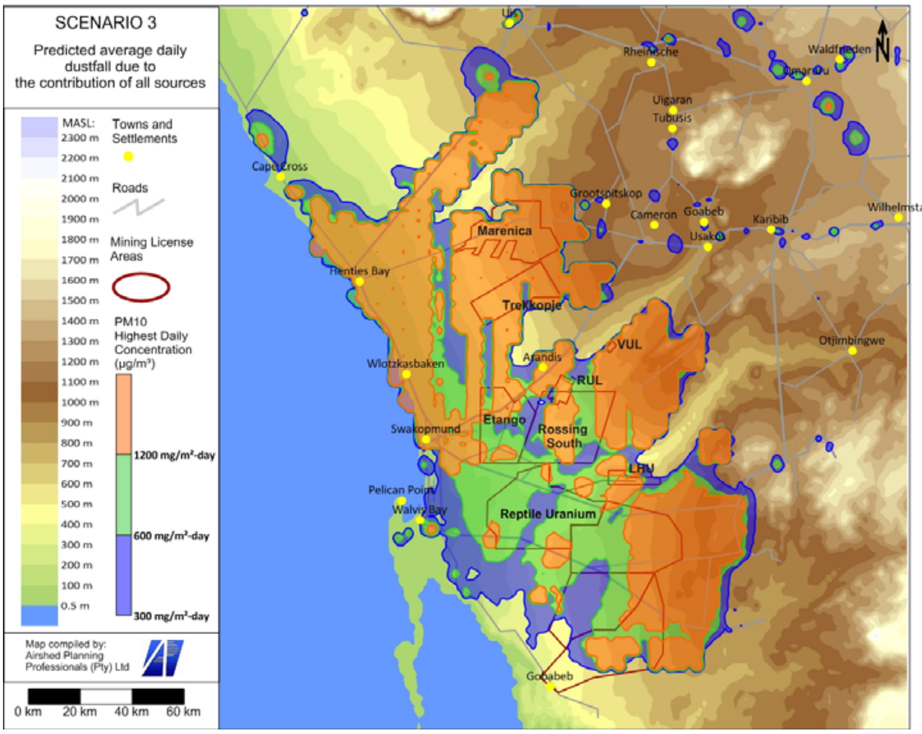


(a)

(b)

Figure 7.11.11: Predicted annual average dust deposition for the baseline (a), Scenario 1 (b) and next page, Scenario 2 (c) and Scenario 3 (d)


SCENARIO 2
Predicted Dust Deposition due to all sources contributon
MASL:
Towns and Settlements
Roads
Mining License Areas
Dust Deposition (mg/m²/day)
Map compiled by: Airshed Planning Professionals (Pty) Ltd
0 km 20 km 40 km 60 km
Trekkopje
VUL
Arandis
RUL
Etango
Rossing South
LHU
Swakopmund
Walvis Bay
Henties Bay
Wlotzkasbaken
Cape Cross
Pelican Point
Gobabeb
Rheinische
Waldfrieden
Uigaran
Tubusis
Grootspitskop
Cameron
Goabeb
Usakos
Karibib
Wilhelmstal
Otjimbingwe
(c)


SCENARIO 3
Predicted average daily dustfall due to the contribution of all sources
MASL:
Towns and Settlements
Roads
Mining License Areas
PM10 Highest Daily Concentration (μg/m³)
1200 mg/m²-day
600 mg/m²-day
300 mg/m²-day
Map compiled by: Airshed Planning Professionals (Pty) Ltd
0 km 20 km 40 km 60 km
Marenica
Trekkopje
VUL
Arandis
RUL
Etango
Rossing South
LHU
Reptile Uranium
Swakopmund
Walvis Bay
Henties Bay
Wlotzkasbaken
Cape Cross
Pelican Point
Gobabeb
Rheinische
Waldfrieden
Uigaran
Tubusis
Grootspitskop
Cameron
Goabeb
Usakos
Karibib
Wilhelmstal
Otjimbingwe
(d)

7.11.3 Desired state

As a norm, the desired state of particulate air concentrations in the Erongo Region should not exceed the particulate threshold at which adverse health effects will be experienced. The WHO AQG for PM10 indicates three targets for long-term (annual) and short-term (24-hour) that can possibly be met in the context of local constraints, capabilities, and public interest. These targets are, however, aimed at urban environments where the main concern is for very fine particles (PM2.5) due to combustion sources and where the PM10 targets were developed as surrogates for PM2.5 (WHO, 2005). The WHO also clearly states that these are guidelines intended to assist governments in the formulation of policy targets and that local circumstances should be carefully considered before adopting these guidelines as legally-based standards.

In Namibia, and specifically in the Erongo Region where the Baseline concentrations already exceed the WHO AQG at places such as Swakopmund, merely adopting these guidelines is unrealistic and will result in continuous non-compliance. For this reason the WHO IT-3 guidelines for PM10 of 75µg/m³ for 24-hours and 30 µg/m³ for annual averages were selected as indicators. The WHO IT-3 correlates with the newly developed South African limit that was developed based on similar environmental, social and economic conditions. The WHO allows three days where the 24-hour guideline can be exceeded and South Africa allows four days per calendar year. The desired state of ambient PM10 concentrations should remain as close to the Baseline as possible, given the already elevated Baseline PM10 concentrations. Should the four day exceedances prove to be unrealistic due to the incidences of easterly wind conditions, this should be revised.

Dust fallout in general is low and it is recommended that the desired state of dust fallout at receptors remain below the SANS limit for residential areas, i.e. 600 mg/m²/day not exceeding this limit for more than three months in a year and no consecutive months. The South African limit was selected as an indicator instead of the German standard since South Africa is environmentally, socially and economically similar to Namibia.

7.11.4 Recommended avoidance / mitigation or enhancement measures

The following measures need to be implemented (see also EQO in Chapter 8):

- Ambient monitoring of PM10 concentrations and dust fallout (TSP) should be conducted to provide a comprehensive dataset for dispersion model result evaluation. A permanent continuous on-line PM10 sampler should be implemented at Swakopmund as a minimum, with an additional one at Henties Bay.
- An accredited meteorological station, measuring as a minimum hourly average wind speed, wind direction, temperature, humidity, rainfall and solar radiation, should be implemented in Swakopmund. The wind monitor should be a high performance wind sensor to cover a wind speed range of up to 60 m/s, including gusts and must be accurate;
- Even though a fairly good correlation was obtained between measured and predicted PM10 GLCs, further research should be conducted into the quantification and simulation of wind erosion from natural sources. The difference in particle size distribution between soil types resulted in noticeable difference in wind erosion predictions.

- Ambient air quality guidelines and targets should be developed for the Erongo Region (and eventually Namibia) taking into consideration risks to health, technological feasibility, economic considerations, and other political and social factors. The guidelines used in this study should be adopted in the interim.
- Mines should implement best practice mitigation measures for known dust generating sources. These should include as a minimum:
    - Chemical suppressants on permanent haul roads and water sprays (in combination with chemicals to optimise water utilisation) on non-permanent unpaved roads;
    - Water sprays at material transfer points; and
    - Full or semi-enclosure of crushing and screening operations;
- Key performance indicators against which progress may be assessed form the basis for all effective environmental management practices. Performance indicators are usually selected to reflect both the source of the emission directly and the impact on the receiving environment. Dust fallout buckets provide a cost effective tool to measure dust fallout trends and to determine the improvements made as a result of mitigation measures. It is recommended that all the mines implement dust fallout networks to be operated throughout the life of mine.

7.12 Cumulative Effects Analysis - Radiation

7.12.1 Introduction

This section provides the reader with an overview of some of the key concepts of radiation, and an overview of natural background levels in the central Namib. A short description of the main health effects that may occur due to exposure to ionising radiation is provided. The existing and future mine sources of radiation are described together with the possible exposure pathways and the defined receptor groups. This is followed by a preliminary analysis of the potential cumulative effects **insofar as they could be determined from the limited amount of data available at present.** Recommendations are provided relating to the measures required to minimise radiation sources and exposure pathways, as well as the studies required to augment the current information about radiation in the central Namib.

The information contained in this section has been derived from several specialist and theme reports which were specially commissioned as part of this SEA. A great deal of background information about radiation, how it manifests itself in the environment, its health effects, the international and local Namibian legal and policy frameworks for managing exposure to radiation, and the international guidelines relating to radiation safety are contained in these reports. The full titles of these reports are listed below. These stand alone reports will be made available on request to the MME:

Liebenberg-Enslin, H, van Blerk, J and Kruger, ID (2010). Strategic Environmental Assessment (SEA) for the Central Namib ‘Uranium Rush.’ Radiation and Air Quality Theme Report. Report No.: 09MME01 Rev 1, June 2010. Report by Airshed Planning Professionals. Johannesburg, RSA.

Liebenberg-Enslin, H, Krause, N and Breitenbach, N (2010). Strategic Environmental Assessment (SEA) for the Central Namib ‘Uranium Rush.’ Air Quality Specialist Report. Report No.: APP/09/MME-02 Rev 0, September 2010. Report by Airshed Planning Professionals. Johannesburg, RSA.

Van Blerk, J, Kruger, ID, Louw, I and Potgieter, N (2010). Strategic Environmental Assessment (SEA) for the Central Namib ‘Uranium Rush.’ Radiation Impact Study. Report No.: ASC-1012A-1, August 2010. Report by AquiSim Consulting (Pty) Ltd. Pretoria, South Africa.

Krugmann, H (2010). Central Namib Uranium Rush. SEA Radiation Sources, Pathways and Human Exposure Report. April, 2010. Windhoek, Namibia.

BIWAC and Inst. of Hydrology Freiburg (2010). Numerical Groundwater Model and Water Balance of the Swakop/Khan River System. Groundwater Specialist input to the Strategic Environmental Assessment of the Central Namib ‘Uranium Rush’. BIWAC Report No. GW1-2010-3-F.V.5, July 2010.

Kringel, R, Wagner, F and Klinge, H (2010). Assessment of groundwater quality in the Khan and Swakop River catchment with respect to the geogenic background

concentrations of dissolved uranium. BMZ No: 2008.2007.6. July 2010. Hannover, Germany.

Schubert, M and Knöller, K (2010). Application of naturally occurring radionuclides and stable isotopes as environmental tracers in line with the "SEA Uranium Rush". Helmholtz Centre for Environmental Research, UFZ, Leipzig/Halle, Germany.

Snashall, D (2010). SEA Uranium Project. Theme Report: Health Effects. June 2010. St Thomas' Hospital, London, UK.

As mentioned above, this section on radiation addresses current background radiation levels in the region and what the potential cumulative effects may be per mining scenario on the general public. Community health issues relating to disease and the occupational health impacts of the Uranium Rush on workers are addressed in section 7.13.

7.12.1.1 Background radiation in the central Namib

Radiation is travelling energy in the form of electromagnetic waves or subatomic particles. Our everyday lives benefit from the many different forms of low-energy electromagnetic radiation, and its spectrum includes long wavelength radio and TV waves, the microwaves which are so ubiquitous in kitchens, to infrared, visible light and ultraviolet radiation. These forms of low-energy radiation are all referred to as 'non-ionising' because they lack the energy to ionise matter, i.e. remove electrons from the shells of atoms.

Ionising radiation on the other hand is associated with x-rays and gamma rays, and the various types of radiation emitted by radioactive elements. Ionising radiation has sufficient energy to strip electrons from atoms, which results in electrically charged particles called ions. Such ions are highly reactive and will trigger and participate in chemical reactions until they are included in new molecular arrangements. Chemical reactions that are activated by ions generated by ionising radiation can alter the chemical balance of natural processes, which may give rise to undesirable chemical products and thereby negatively affect living cells.

Not all atomic nuclei found in nature are stable. When unstable nuclei undergo a process of nuclear rearrangement they emit particles and radiation. The process whereby radiation is emitted from atomic nuclei as a result of nuclear instability is called radioactivity. The most common types of sub-atomic particles and radiation emitted during radioactive decay are alpha particles, beta particles and gamma radiation. Radioactivity is a natural process, and elements such as uranium and thorium are naturally occurring radioactive substances. Some elements can also be made radioactive, for example when producing radioactive tracers used in nuclear medicine. In our everyday lives we are exposed to ionising radiation from various natural as well as 'man-made' sources.

Natural sources of ionising radiation include radiation of cosmic origin, which is also called 'cosmic radiation', and 'terrestrial radiation' emitted by soils, rocks and groundwater, as well as radiation from radioactive dust and radioactive gases such as radon and thoron. In contrast, man-made or so-called anthropogenic sources of ionising radiation include, amongst others, x-rays as are used in medical treatments, radioactive isotopes used in nuclear medicine for the diagnosis and treatment of some cancers, and radioactive tracers used in engineering applications.

Humans are continuously exposed to ionising radiation of both natural and anthropogenic origin. Such exposure is location- and time-dependent, and any potential effects depend on the exposure dose. In order to quantify the total exposure to ionising radiation that ordinary members of the public are exposed to, for example as a result of uranium mining activities, one first has to determine the magnitude of the exposure to the prevailing natural background radiation.

The contribution from **cosmic radiation** to the natural background radiation levels in Namibia depends on the geographic location. Typically, dose rates from the exposure to cosmic radiation range from approximately 0.3 mSv/a at the coast to some 0.7 mSv/a in the central highlands of Namibia. It is interesting to note that the contribution of the cosmic background radiation dose rate is between one third and two-thirds of the dose rate limit of 1 mSv/a for incremental public radiation exposures (i.e. exposures above and beyond background exposures). Since most of the people in the Erongo Region live in coastal cities and towns (Walvis Bay, Swakopmund, Henties Bay, etc), the population-weighted[1] average of the cosmic radiation for the Region should be near the lower end of the above-noted range. This implies that the contribution from cosmic radiation to the natural background radiation levels in the Erongo region is very similar to the population-weighted world average of 0.38 mSv/a[2] (UNSCEAR, 1993) (see Table 7.12.1).

Knowledge about the natural background radiation from **terrestrial** sources in the Erongo Region has been obtained from airborne radiometric surveys that have been recently carried out by the Geological Survey of Namibia (Wackerle, 2009b). It is to be noted that the surveys only report on the terrestrial contribution of the natural gamma radiation background. Figure 7.12.1 shows the natural terrestrial *gamma* background radiation of the Erongo Region, converted to equivalent dose rates measured in units of mSv/a. As shown in Figure 7.12.1, the dose rates from natural terrestrial gamma background radiation in the Erongo Region range between close to zero to a maximum of 7.3 mSv/a, with an average value of 0.7 mSv/a (Wackerle, 2009b).[3] This is about double the global average of terrestrial radiation dose rates of 0.33 mSv/a.

However, as with cosmic radiation, the *population-weighted* average of the natural terrestrial radiation in Erongo is lower than the average terrestrial radiation in the Region, given that Erongo's population is concentrated in coastal towns where terrestrial radiation levels tend to be lower than the average for the Region. For example, Walvis Bay and Swakopmund have mean terrestrial radiation levels of only 0.33 mSv/a and 0.55 mSv/a, respectively, which are below the Erongo Regional average of 0.7 mSv/a. Higher-than-average terrestrial radiation levels are found in some smaller towns and settlements including Henties Bay (0.73 mSv/a)

[1] The population-weighted average dose takes cognizance of the relative population sizes exposed to specific doses, and then averages over the entire population living in the area under consideration.
[2] See Krugmann (2010) for a discussion of world average exposure rates for cosmic radiation.
[3] These are preliminary figures based on potentially inaccurate methods of merging data sets from different airborne radiometric surveys that used different radiometric equipment, inferring different values for the ground concentrations of significant gamma emitters (uranium, thorium and potassium isotopes) in given locations.

and Arandis (1.18 mSv/a) (Wackerle, 2009b). This suggests that Erongo's population-weighted average natural terrestrial gamma radiation exposure is comparable to the world average terrestrial radiation exposure of 0.48 mSv/a, as reported by UNSCEAR (UNSCEAR, 2000) (Table 7.12.1).

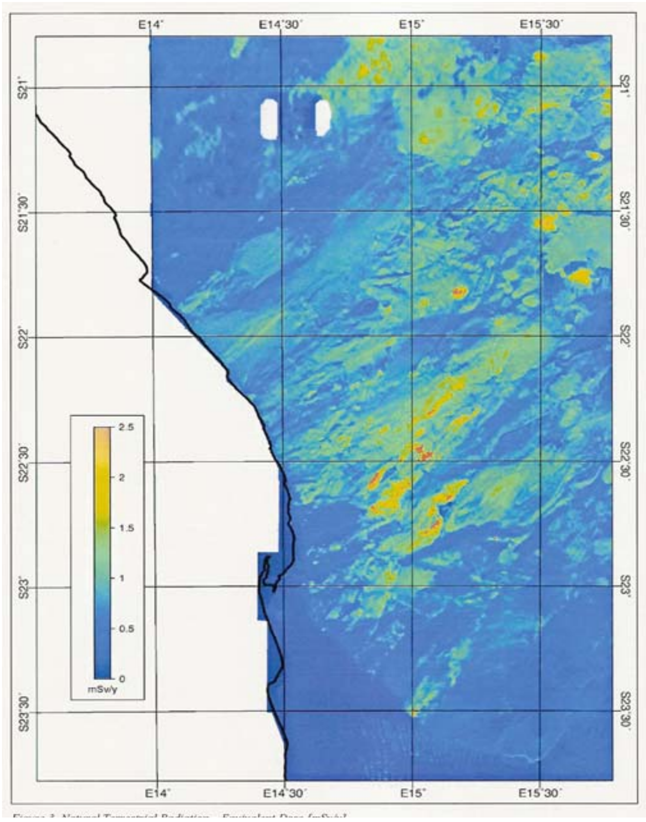


Figure 7.12.1: Natural terrestrial gamma radiation of the Erongo Region, converted to equivalent dose rate in mSv/a (Wackerle, 2009b)

Other forms of background radiation in the Erongo Region originate from radioactive dust, and from radon with its radioactive decay products. The contribution of radioactive dust to the natural background radiation, which is important in this context as dust can be inhaled, and because dust remains suspended in the air in the dry Erongo Region, was measured as part of this SEA and is discussed further below. The contribution of radioactive dust to the natural background radiation in the Erongo Region is about ten times the world average of 0.0058 mSv/a (see Table 7.12.1), as shown in Table 7.12.3 below.

Radon (Rn^{222} and Rn^{220}) is formed in soil by radioactive decay of radium (Ra^{226} and Ra^{224}) atoms. Radon is a gas, and emanates from the crystal lattice in which its parent was embedded into the pore space of the substrate material. It then diffuses through the pore space to the surface of the material, and escapes into the atmosphere. The flux of radon from the soil surface, rocks and tailings facilities is called radon exhalation.

Radon and its decay products are found in variable concentrations both indoors and outdoors, as well as in mining environments. The presence of radon in the Erongo Region was confirmed by means of a radon monitoring programme conducted specially for this SEA. More than 100 passive radon gas monitoring devices (RGMs)[4] were placed throughout the Erongo Region at locations surrounding the current and proposed future mining operations, as well as in areas where people live. The RGMs were placed on a 2-monthly deployment rotation from August 2009 to April 2010; subsequently the radon gas monitoring programme has been extended to cover a full year and was concluded in mid-August 2010.

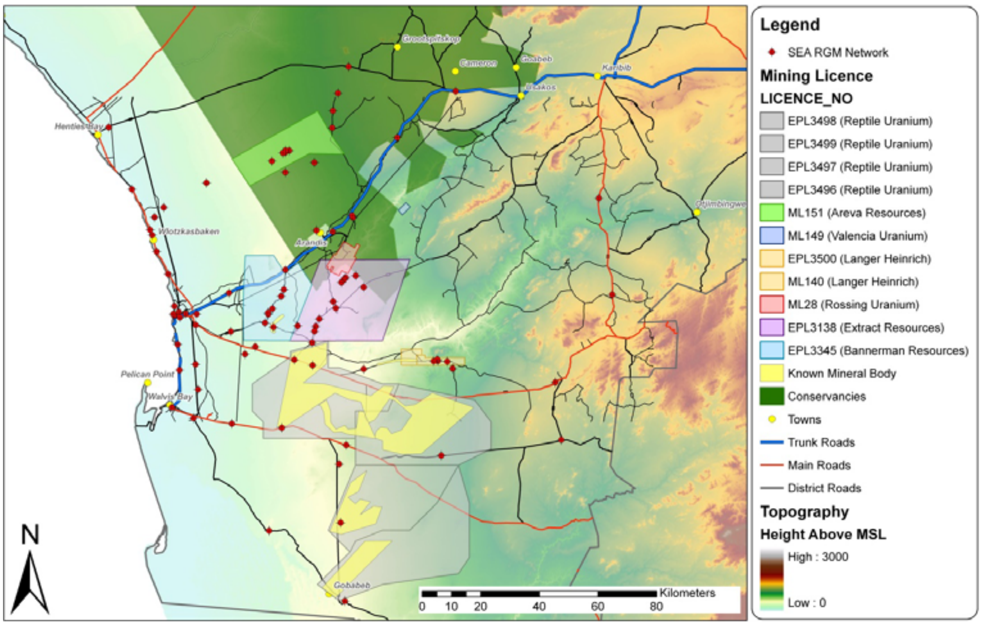


Figure 7.12.2: Map showing the environmental radon monitoring network.

Locations for placement of the RGMs were selected to cover the whole of the Erongo Region, with cognisance being taken of the local topography and geology. Monitors were placed at operational mines, active exploration sites, urban areas, isolated settlements, and along roads. The details of the monitoring programme are elaborated upon in Liebenberg *et al.* (2010). The radon monitoring locations, some of which coincided with the locations of the dust fallout buckets (see section 7.11), are shown in Figure 7.12.2.

The results in terms of a radon inhalation dose as derived from the airborne radon concentration data are presented in Figure 7.12.3. The mean radon inhalation dose for the four periods is 0.51 mSv/a, 0.52 mSv/a, 0.33 mSv/a and 0.48 mSv/a respectively[5]. Note that

[4] The RGM is a passive Radon Gas Monitor operating on the alpha particle etched-track principle. The monitor provides time-integrated readings of radon gas concentrations in the air. The RGM monitors provide for long-term monitoring of radon concentrations. It can be employed in high temperature environments, is not sensitive to gamma radiation fields and allows for a lower level of detection.

[5] These mean radon inhalation doses were derived from the regional radon concentration measurements, which found that airborne radon concentrations were in the range between 1.57 Bq/m³ and 62.5 Bq/m³. Assuming the UNSCEAR worldwide occupancy factor of 0.8 indoors and 0.2 outdoors, and equilibrium factors of 0.4 and 0.8 for indoor and outdoor exposure respectively, the combined annual indoor and outdoor radon inhalation dose

the graphs have been plotted in microsieverts and the afore-mentioned numbers are in milliSieverts.

The average regional radon inhalation dose measured over the 9 month period (August 2009 to April 2010) is 0.46 mSv/a. It should be noted that the baseline radon inhalation dose is from the natural background as well as the existing mines.

(a) (b)

(c) (d)

Comment [DW1]: insert 4 graphs as shown in van Blerk et al, 2010, page 25

Figure 7.12.3: Regional radon inhalation dose distributions based on ambient radon gas monitoring in the Erongo Region for the periods: (a) August 2009 to October 2009; (b) October 2009 to December 2009; (c) December 2009 to February 2010; and (d) February to April 2010.

Little information is available for the Erongo Region to determine the baseline dose due to the ingestion of radionuclides, either directly through the consumption of food, or via the intake of water. The population-weighted world average exposure dose due to ingestion is 0.31 mSv/a (UNSCEAR, 2000) (Table 7.12.1).

Table 7.12.1: Average human exposures to natural and man-made sources of radiation – Erongo Region and the World

	Erongo Region (Namibia)	**World Average (pop-weighted & age-weighted)**
Average Human Exposures from Natural Background Radiation	*All figures in mSv/a*	*All figures in mSv/a*
Cosmic radiation	0.3 – 0.7 assume 0.35	0.38
Terrestrial radiation	0.0 – 7.3 assume 0.55	0.48
Radioactive dust	assume 0.04	0.0058
Radon	regional average, assume 0.46 (likely to be too low)	1.095
Ingestion	probably similar to world average, assume 0.31	0.31
Sub-Total	**~1.7**	**2.3**

conversion factor of 0.0025 mSv per Bq/m³ was used to compute the radon inhalation doses from the measured radon concentrations.

Average Human Exposures from Man-made Sources of Radiation	*All figures in mSv/a*	*All figures in mSv/a*
Medical x-rays	0.02	0.37
Nuclear medicine	assume 0.001	0.03
Consumer products	assume 0.01	0.06
Nuclear weapons testing & production	assume 0.0046	0.0046
Nuclear fuel cycle	assume 0.0002	0.0002
Sub-total	**0.04**	**0.46**
GRAND TOTAL	**~1.7**	**2.7**

Exposure to **man-made sources of radiation**, including medical exposures and exposures due to the use of consumer products, lifestyle choices such as smoking and flying, are well researched in the international context (Krugmann, 2010). However, reliable baseline data are not readily available for Namibia in general or for the Erongo Region in particular.

The world average equivalent radiation dose from medical diagnostic procedures is approximately 0.4 mSv/a[6], but this is an average over the whole world population without any distinction between national health care levels across countries. UNSCEAR classifies Namibia as having health care level III, which corresponds to 1 physician for every 1,000 to 3,000 members of the population (UNSCEAR, 2000) (see also section 7.13). The average dose to the Namibian population due to x-ray procedures is reported to be 0.02 mSv/a, and nuclear medicine procedures are not reported at all. The Namibian average medical exposure dose therefore corresponds to only about 5% of the population-weighted world average figure. However, significant variations in individual exposures can be expected in Namibia, mainly because of the large differences in access to health care services between people of different income levels.

Table 7.12.1 summarises the available baseline information for the different exposure levels due to natural background radiation and man-made sources of radiation for the Erongo Region in Namibia, and compares these to average worldwide figures. Globally, average human exposures from *man-made* sources of radiation are much smaller than average exposures from *natural* radiation sources – this also holds for the Erongo Region.

7.12.1.2 Uranium and its occurrences in the central Namib

Uranium is a weakly radioactive metal that occurs throughout the Earth's crust. It is about 500 times more abundant than gold, and about as common as tin. Uranium is present in most rocks and soils, as well as in groundwater and sea water. In granite, for example, which makes up some 60% of the Earth's crust, uranium is found in concentrations of about four parts per million (ppm). In some fertilisers, uranium concentrations can be as high as 400 ppm (0.04%), and some coal deposits contain uranium at concentrations of the order of 100 ppm. These natural concentrations of uranium can be compared with the grades of

[6] See Krugmann, 2010, Annex A, section A.2.3

uranium-bearing ores that are typically found in existing and planned uranium mines in the central Namib, which have a uranium content in the range between 100 and 600 ppm (0.01 - 0.06%).

As noted in Chapter 4, uranium in the central Namib tends to occur primarily in two mineralisation forms: in primary granite-hosted alaskites, or in secondary calcrete-type deposits known as carnotite. Critically, these deposits can all be mined via open pits, which significantly reduces the adverse health impacts that are commonly found in underground uranium mines. On the other hand, open pits do increase the source area for radiation and thus they contribute to the overall dust and radon exposure of the area.

Radioactive decay of the naturally occurring uranium isotopes proceeds in multiple stages along complex decay chains. These decay processes generate a number of radio-isotopes (called ‘uranium daughters’ or ‘progeny’) before ending when the decay chain reaches a stable element (Krugmann, 2010). Numerous radioactive decay products arise during the decay of the uranium isotopes U^{238} and U^{235}, and thorium Th^{232} as contained in naturally occurring radioactive ores. Therefore, most of the radioactivity associated with uranium in the natural environment is not due to uranium minerals themselves, but due to the decay products formed by different radioactive uranium daughters in the decay chains.

7.12.1.3 Health impacts of exposure to ionising radiation

Damage to living organisms as a result of exposure to ionising radiation mainly occurs at the cellular level, and manifests itself in a variety of ways depending on the type of radiation, the radiation dose and the duration of exposure. The effects of being exposed to ionising radiation in humans range from:

- Skin burn, which occasionally manifests itself as a result of intense radiotherapy treatment;
- Cancer, which includes skin cancer and leukaemia;
- Teratogenic effects, i.e. the impairment of an embryo *in utero;* and
- Blood destruction and death within days, for example when directly exposed to high doses of radiation as would be associated with the explosion of a nuclear weapon.

An important distinction when considering exposure to ionising radiation is between ‘prompt’ or ‘acute’ effects, and ‘delayed’ effects.

Prompt effects are usually due to large exposures delivered over a short period of time, as would be the case in an explosion and fallout of a nuclear bomb, or a major accident in a nuclear reactor, and usually occur within hours or days following such exposure. Prompt effects are dose dependent or, more accurately, dependent on the total amount of energy transferred between the source of radiation and the receptor. Below a certain dose there is no discernible effect, but as the dose increases – all other things being equal – the magnitude and manifestation of the effects also increase. As there is a direct relationship between the applied dose and the resulting effects, chance is not playing a part here; dose dependent effects are therefore also called ‘deterministic’ or ‘non-stochastic’. Non-stochastic effects have exposure thresholds below which no health effects are observable, while increasing exposures to above such thresholds gives rise to physical effects which are reasonably predictable.

On the other hand, certain kinds of cancer are induced through the prolonged exposure to ionising radiation. Such effects may not occur immediately, or even within a short period following the exposure, or they may not occur at all. Because of the probabilistic nature of such delayed effects, they are also termed ‘stochastic’. No threshold exists for stochastic effects – an increase in radiation dose results in an increase of the likelihood of such effects occurring, but not of the severity of impacts. Therefore, when considering the effects of prolonged exposures to low levels of ionising radiation, as would for example occur in a population living near uranium mining and milling operations, the possibility of having delayed stochastic effects constitutes the main health concern.

In contrast to non-stochastic effects, it is far more difficult to quantify low level exposure risks and identify exposure thresholds for stochastic effects. This is partly because of the ‘all or nothing’ nature of such effects, and because it is difficult to separate out the effects of low level but prolonged radiation exposure from prevailing levels of natural background radiation. In addition, a variety of environmental effects, personal behaviour patterns (such as smoking and air travel) as well as the personal genetic predisposition all have an influence and determine whether and how substantially a person is affected by low level exposure to ionising radiation.

The actual estimation of the health risk associated with exposures to low levels of ionising radiation is a complex process, which involves determining the type of radiation, duration of exposure and amount of energy actually deposited into particular organs. When exposed to radionuclides it is important to determine the (radio)-activity of the radionuclides in question, the rate at which the body deals with and eliminates such radionuclides, and identify the target organ, i.e. the particular organ in which the radionuclides are preferentially deposited.

Another consideration when determining the health risk associated with ionising radiation is whether the exposure to such radiation is external, i.e. from the outside of the body as is the case for cosmic and terrestrial gamma radiation, or is internal, which occurs by way of ingesting radioactively contaminated food or water, or as a result of inhaling radioactive dust or gas. Occupationally exposed groups (e.g. workers in the uranium mining sector, or some hospital staff and airline personnel) tend to receive higher exposure doses over time than members of the general public. When considering a total population’s health risks from radiation, human factors also assume importance. Effects due to the exposure to radiation are generally more serious in unborn babies and children.

7.12.1.4 Health impacts of exposure to uranium

Potential health hazards associated with uranium do not only arise from its radioactivity and that of its decay products, but also from its chemical toxicity. The chemical toxicity of uranium is comparable to that of lead, both elements being heavy metals. Ingestion of uranium therefore poses a health hazard arising from the combined biological effects of the radiation that it and its decay products emit, and its chemical toxicity.

The proportion of ingested uranium that is absorbed through the intestinal walls into the blood stream is small – typically only a few percent of the total amount ingested. Once absorbed through the intestinal walls, most of the uranium is quickly excreted via the urine. The fraction that is retained tends to concentrate in the skeleton, the primary longer-term depository of uranium in the human body.

Medical data about the chemical toxicity of uranium to humans are limited. The World Health Organisation has established the tolerable daily *ingestion* of uranium in humans, based on chemical toxicity, to be of the order of 0.6 micrograms per kilogram body weight per day, i.e. some 15 mg/a for a person of 70 kg. In contrast, and based on radiological hazard considerations, the annual limit on intake for members of the public by way of *inhalation* is 75 mg/a and 4.5 mg/a respectively for the soluble and non-soluble part of natural uranium.

7.12.1.5 Sources of mining-related radioactivity in the central Namib

As described in Chapter 4, open-pit mining techniques involve drilling, blasting, loading, crushing and transportation of considerable amounts of uranium-bearing ores and waste materials. Open pit mining thus exposes ores and waste rock to the atmosphere, which accelerates the release of radon gas. Mining and crushing the ore causes dust, but the amount of dust produced depends on a number of factors such as the mining method, dust control measures in place at the mine, and whether the crushing circuit is covered or not.

The uranium processing plant separates the different uranium isotopes from the other radioactive elements contained in the mined ores (usually in an enclosed or semi-enclosed circuit). The remaining finely crushed rock is disposed of on a tailings dam or impoundment, commonly known as a tailings storage facility (TSF), but it still contains a variety of radioactive materials. As the tailings dry out, they become susceptible to wind erosion causing radioactive dust to be dispersed into the environment, but the amount of dust depends on the methods of tailings deposition, the moisture content of the tailings and the methods of dust control used by the individual mines. The TSF is also a source of radon gas.

The plant also produces various effluents and other wastes which may or may not be radioactive and which are disposed of in lined ponds, tanks and other facilities. Leaching from unlined facilities and the TSF can potentially lead to the transport of radionuclides into the groundwater in the absence of any other control measures. In order to minimise seepage into the environment, and maximise the recovery of process water in the arid, water-short Namib environment, the new generation TSFs and heap leach facilities are constructed on impermeable pads, equipped with drains and seepage detection systems. Existing mines, such as Rössing, have complex networks of dewatering wells and cut-off trenches to prevent seepage from the TSF from entering the alluvial aquifers. While these measures are aimed at reducing seepage losses to the environment, these facilities may not be 100% effective and therefore represent a potential source of pollution and radiological risk, both in the present time and well into the foreseeable future. Furthermore, if the tailings are acidic, the radionuclides they contain tend to be more mobile and are more likely to reach the water table and contaminate aquifers.

7.12.1.6 Exposure pathways in the central Namib

There are three main pathways by which members of the public can potentially be exposed to ionising radiation emanating from the various uranium exploration and mining operations taking place in the central Namib. Firstly, there is the direct exposure to gamma radiation from uranium-bearing ores, waste rock materials, process plant effluents and tailings. Secondly, radionuclides and radiation may be transmitted to members of the public via the air, i.e. the so-called atmospheric pathway. Thirdly, radionuclides may be transferred via water, which is the so-called aquatic pathway.

Limiting access to uranium mining and milling areas, and ensuring that adequate emergency procedures are in place in case of spillages usually ensures that the direct exposure to gamma radiation from mining enterprises to members of the public remains small, and is assumed to be negligible in the remainder of this section.

As part of the atmospheric exposure pathway, members of the public may be exposed to airborne radionuclides through the inhalation of radioactive dust originating during the exploration, mining and processing of radioactive ores, as well as radioactive gases such as radon and thoron. To a lesser extent, airborne radioactive constituents such as dust and gases may also lead to the external exposure of persons immersed in ‘clouds’ of such radioactive materials, which is a phenomenon commonly referred to as ‘cloud shine’.

Airborne radioactive particulates may eventually be deposited onto soils, the leaves of plants, open water sources and persons and objects. Where contaminated soils are used to cultivate crops for human consumption or as feed for animals, the radioactive particles originating from the atmosphere may be transferred to the human food chain. In this way, members of the public may be indirectly exposed to radioactivity through the ingestion of contaminated crops, or by way of consuming animal products where grazing has been contaminated by dust fall-out (Figure 7.12.4a).

The aquatic pathway proceeds via the transfer of radionuclides by way of groundwater or surface water. In the context of the Namib, the most important route is via groundwater. Members of the public may be exposed to radionuclides by drinking (leading to internal exposure due to ingestion) or washing (leading to external exposure) in contaminated water. In addition, radionuclides may enter the human food chain via crops which have been irrigated with contaminated water, or by way of ingesting contaminated animal products where such animals consumed contaminated water (Figure 7.12.4b). Other common modes of exposure, which are not relevant in the case of the Namib environment and will therefore not be considered further in this discussion, include swimming in contaminated water, and eating fish and shellfish collected from contaminated water.

By determining the contributions of the atmospheric and aquatic pathways, the radiological dose that members of the public may receive on an annual basis may be calculated. The schematic diagrams presented in Figures 7.12.4a and 7.12.4b summarise the main linkages, transfer processes and exposure modes as used in the estimation of the total annual public exposure dose in this SEA.

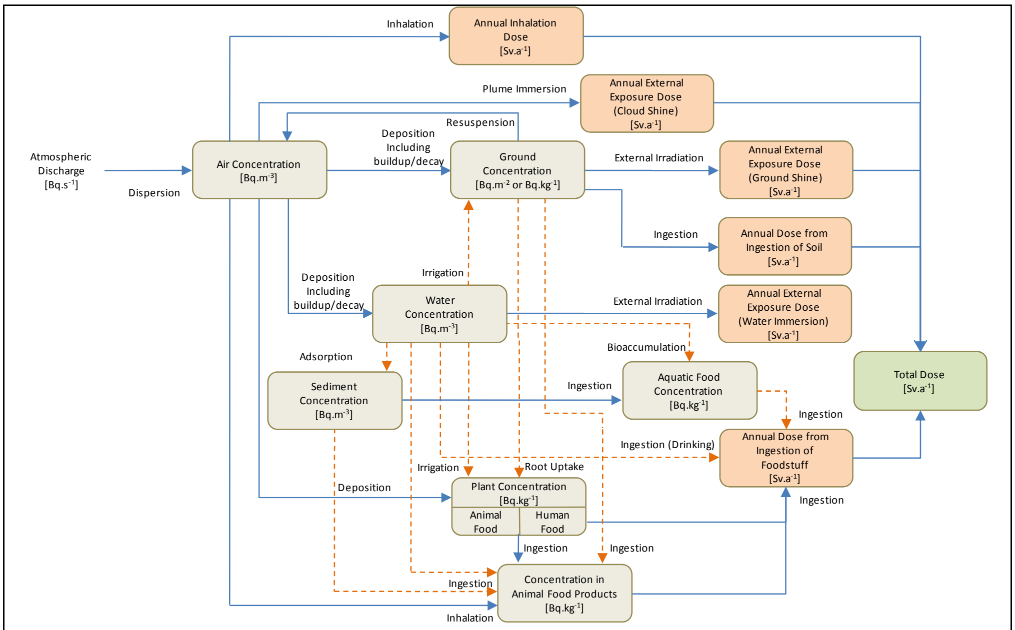


Figure 7.12.4a: Schematic representation of the main pathways and processes associated with the uptake of radionuclides from atmospheric dispersion

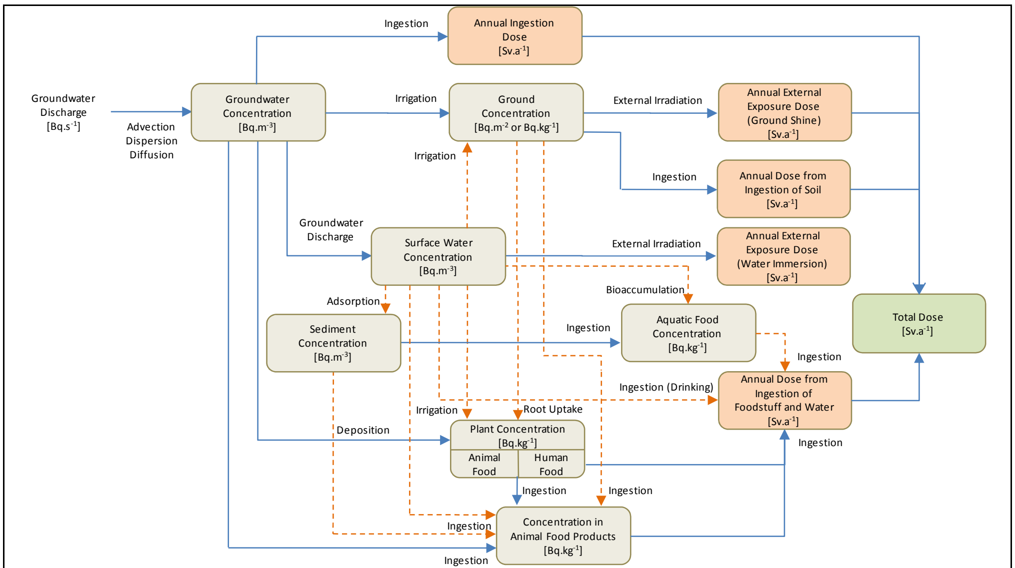


Figure 7.12.4b: Schematic representation of the main pathways and processes associated with the uptake of radionuclides from groundwater

7.12.1.7 Receptors

The selection and characterisation of the exposed population is a fundamental element in the assessment of potential risks faced by members of the public. Not all members of an exposed population are exposed to radiation in exactly the same way, and not all members of an exposed group react in the same manner to a given exposure dose. To render this challenge more tractable for assessment, the International Commission for Radiological Protection (ICRP) introduced the concept of a 'critical group' in 1965 (ICRP, 2006). The aim of a radiological exposure assessment is to identify one or several groups of people, i.e. the receptors, whose habits, location, age and other characteristics would cause them to receive a higher dose than the rest of the exposed population. Such groups then constitute the critical groups, and their exposure via the different exposure pathways is assessed.

The approach of identifying and characterising critical groups, on which the exposure assessment is based, was followed in this study. Local land use data was correlated with the results of dust dispersion and deposition results (see section 7.11) to identify the potentially highest exposed communities (i.e. the critical groups).

In as far as the description and location of critical groups is concerned, it is reasonable to expect that future land use in the Erongo Region will not be entirely different from the current use, with the dominant activities being mining, tourism and recreation, transportation, fishing and to a lesser extent, agriculture.

As described in Chapter 5 and section 7.2, the main towns, residential areas and urban infrastructure in the study area are mostly situated on the coast, with smaller settlements occurring inland associated with the mines (e.g. Arandis), and the main transport corridors and farming areas (e.g. Usakos). The entire coastal area of the Erongo Region, from Walvis Bay to Henties Bay, is a major holiday destination, with many local and international tourists visiting the area throughout the year.

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Bay to Henties Bay, is a major holiday destination, with many local and international tourists visiting the area throughout the year.

Along the lower Swakop River, a number of agricultural small holdings have been developed on the terraces adjoining the dry river bed. Twelve farms with an average size of 50 hectares are situated in the section between the Khan River and Swakop River confluence and the farm Tannenhof. Between Tannenhof and the Rössmund Country Club, twenty-five farms averaging 10 hectares in size are situated mostly on the northern banks of the Swakop River. The farms produce fresh products for Swakopmund and other urban areas. The farmers mainly use groundwater extracted from the alluvial aquifer of the Swakop River for irrigation and stock watering, but not for drinking due to its salinity. The total population of the farming community along the Swakop River, including farm workers, is estimated to be between 200 and 250 (Van Blerk, 2007).

Three principal *public* receptor groups were initially identified, namely:

- Permanent non-farming, non-mine-worker urban residents;
- Small-holding farmers in the river valleys; and
- Tourists.

Non-farming residents are assumed to live in Arandis, the closest residential area to the existing and proposed mines, as well as in the coastal towns of Henties Bay, Wlotzkasbaken, Swakopmund and Walvis Bay (Figure 7.12.5). Employed adults are assumed to work in either indoor or outdoor occupations, excluding agriculture. Residents may be exposed to radionuclides in air through inhalation and external exposure. Exposure may also occur from accumulation of low levels of radioactivity in soil, through incidental ingestion of soil, and external exposure from contaminated soils. The assessment assumed that these individuals do not produce their own food.

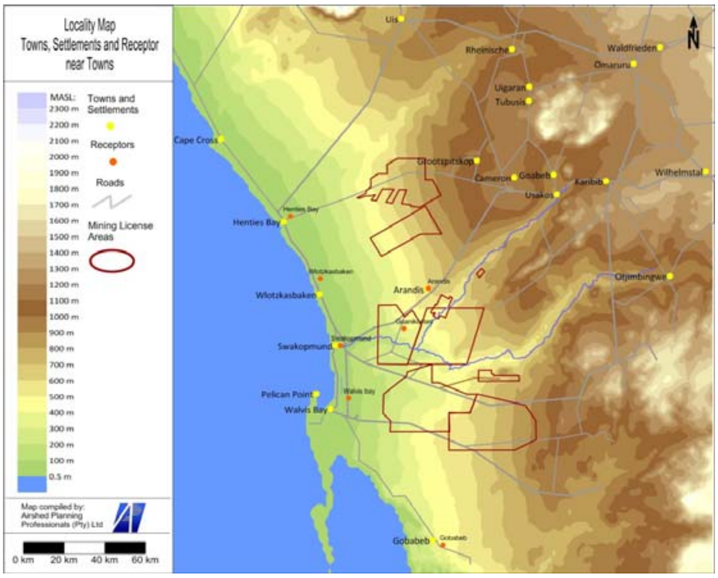


Figure 7.12.5: Locality map showing the receptor points used in the vicinity of residential areas

Small-holding farmers are assumed to live on farms along the lower Swakop River (Figure 7.12.6). These are the closest locations to the current and proposed mining activities where all of the significant exposure pathways exist. Members of the smallholding farmer critical group obtain some of the food they and their families consume, including dairy, meat products, fruit, vegetables, poultry and eggs from the farm. Many of the smallholding farmers use groundwater for irrigation and stock watering, but generally the water quality is too poor for human consumption. Smallholding farmers are also assumed to spend significant time undertaking outdoor activities.

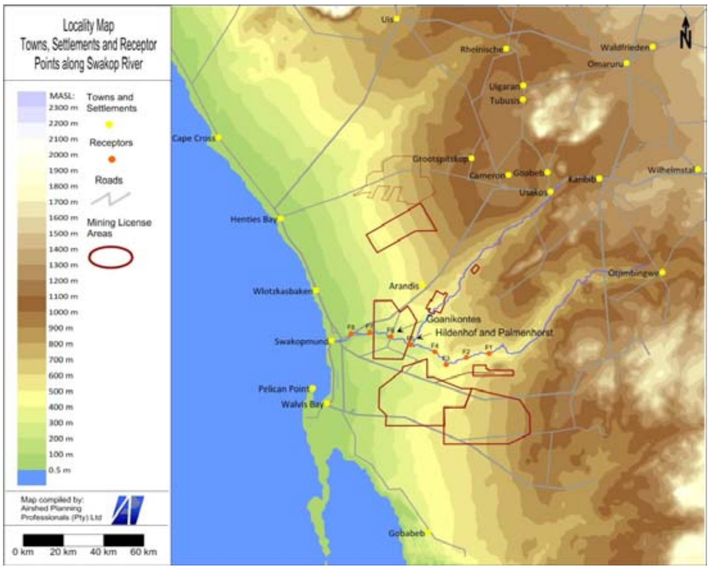


Figure 7.12.6: Locality map showing the smallholding farmer receptor points used along the Swakop River

Tourists are assumed to reside for short periods of time (i.e. days) in the coastal settlements of Swakopmund, Wlotzkasbaken and Henties Bay. They may also visit inland areas such as Goanikontes, the Moon Landscape, Welwitschia Flats and Spitzkoppe, for periods ranging from hours to days. It is assumed that they do not produce any of their own food, and they do not consume food produced in the Erongo Region. It is further assumed that the tourists live and are employed outside Erongo. They participate intermittently in some outdoor recreational activities such as sightseeing, hiking, adventure sports, playing golf and sea angling.

It should be noted that for the purposes of this assessment, only two of the receptor localities shown in Figure 7.12.6 actually exist (Palmenhorst/Hildenhof, and Goanikontes as indicated), while sites F1-F4 are hypothetical sites, and receptor localities F7 and F8 are representative of several farms located in the lower Swakop River valley.

The following exposure routes were evaluated to determine the total effective dose that members of these critical groups could receive:

- Inhalation of airborne radioactive dust;

- External exposure to contaminated air ('cloud shine') and contact with water;
- External exposure to contaminated soil ('ground shine');
- Inadvertent ingestion of contaminated soil; and
- Ingestion of contaminated terrestrial food (crops and contaminated animal products) and water.

Exposure to radon and radon progeny from uranium exploration or mining activities was not included in the assessment.

The different critical groups and their associated exposure pathways are summarised in Table 7.12.2. Highlighted cells indicate continuous exposure through the pathway and route of exposure, while cells marked with a tick indicate intermittent exposure. Empty cells indicate that the pathways and routes of exposure are extremely unlikely for the particular population group, and thus are not given any further consideration in this assessment.

Table 7.12.2: Population group dependent exposure pathway evaluation

	Inhalation of dust only	Cloud shine	Soil ingestion	Ground shine	Food ingestion	Ground-water ingestion	Ground-water contact
Non-farming residents					✓		
Small-holding farmers							
Tourists	✓	✓		✓			

From Table 7.12.2 it is evident that tourists, when compared to the permanent non-farming residents and farmers, will receive only intermittent exposure to the evaluated routes. Therefore, for the purpose of this study, the critical groups were assumed to include only farmers in the Swakop River valley, and residents of Arandis and the coastal towns.

The exposure factors for intake of environmental media (i.e. inhalation and ingestion of radionuclides) and external exposure (time spent outdoors) were selected for *adults* living in the area. This age group was selected because residents falling in this group would have been exposed to radioactive substances in the environment for the longest period and the nature of their assigned activities and behaviours (e.g. working outside on a farm and highest values of food ingestion and inhalation) would result in representative estimates of the upper limits for the cumulative exposure doses.

7.12.2 <u>Analysis of Cumulative Effects</u>

The characterisation of the baseline conditions and the various scenarios was undertaken using a two-fold process:

1) Ambient monitoring of radon gas, dust deposition, PM10 concentrations, aquifer functioning and water quality; and

2) Dispersion simulations of existing and future sources of dust within the Erongo Region.

The results of the ambient radon *monitoring* programme were discussed in sub-section 7.12.1.1 above. It is re-emphasised that no radon and radon progeny dispersion *modelling* was undertaken as part of this SEA. The discussion below therefore focuses solely on the contribution that atmospheric radioactive dust makes to the incremental exposure of members of the public to ionising radiation. A detailed analysis of ambient and predicted future dust dispersion scenarios was presented in section 7.11 of this chapter. The exposure of receptors to radionuclides in the dust is discussed in sub-section 7.12.2.1 below. The present discussion therefore needs to be read in conjunction with section 7.11.

The interim results of the baseline characterisation of the alluvial aquifers and water quality were presented in section 7.4. However, much of the groundwater work is still ongoing, and a cumulative radiological assessment for exposure to the water pathways under the three mining scenarios has not been completed yet. Thus the discussion on cumulative impacts in sub-section 7.12.2.2 below is only qualitative at this stage. It is the intention of GSN and BGR to continue this work under the jurisdiction of the SEMP office and the overall radiological dose from water will be published once the data have been collected and analysed.

7.12.2.1 Radiological exposure as a result of atmospheric dust

The estimation of an annual effective radiological dose from radioactive dust is based on the different exposure factors determined for each critical group. Numerical factors referred to as '*dose factors*' or '*dose coefficients*' are used to estimate the radiation dose associated with exposure to radioactive elements, and are provided in Liebenberg-Enslin *et al.* (2010).

It should be noted that this was a regional study based on incomplete climatic data and only a few actual soil samples. This implies that the results presented below should be interpreted with caution, and the findings are merely indicative.

Small-holding farmers

Figure 7.12.7 presents the annual total effective radiological dose (only for the exposure conditions summarised in Table 7.12.2, and excluding radon) expected for the **small-holding farmer critical group,** under exposure conditions that define the baseline scenario plus the three mining scenarios evaluated. As expected, exposure levels in close proximity to the mining operations, which are the principal source areas of airborne radionuclides, tend to be higher, mainly due to higher airborne dust concentrations and associated higher dust deposition rates. A gradual increase in exposure levels from baseline conditions to Scenario 3 is also evident from Figure 7.12.7.

The resulting effective doses extracted from the interpolated data in Figure 7.12.7 are presented in Figure 7.12.8, which illustrates the progressive increase in effective dose from the baseline to Scenario 3.

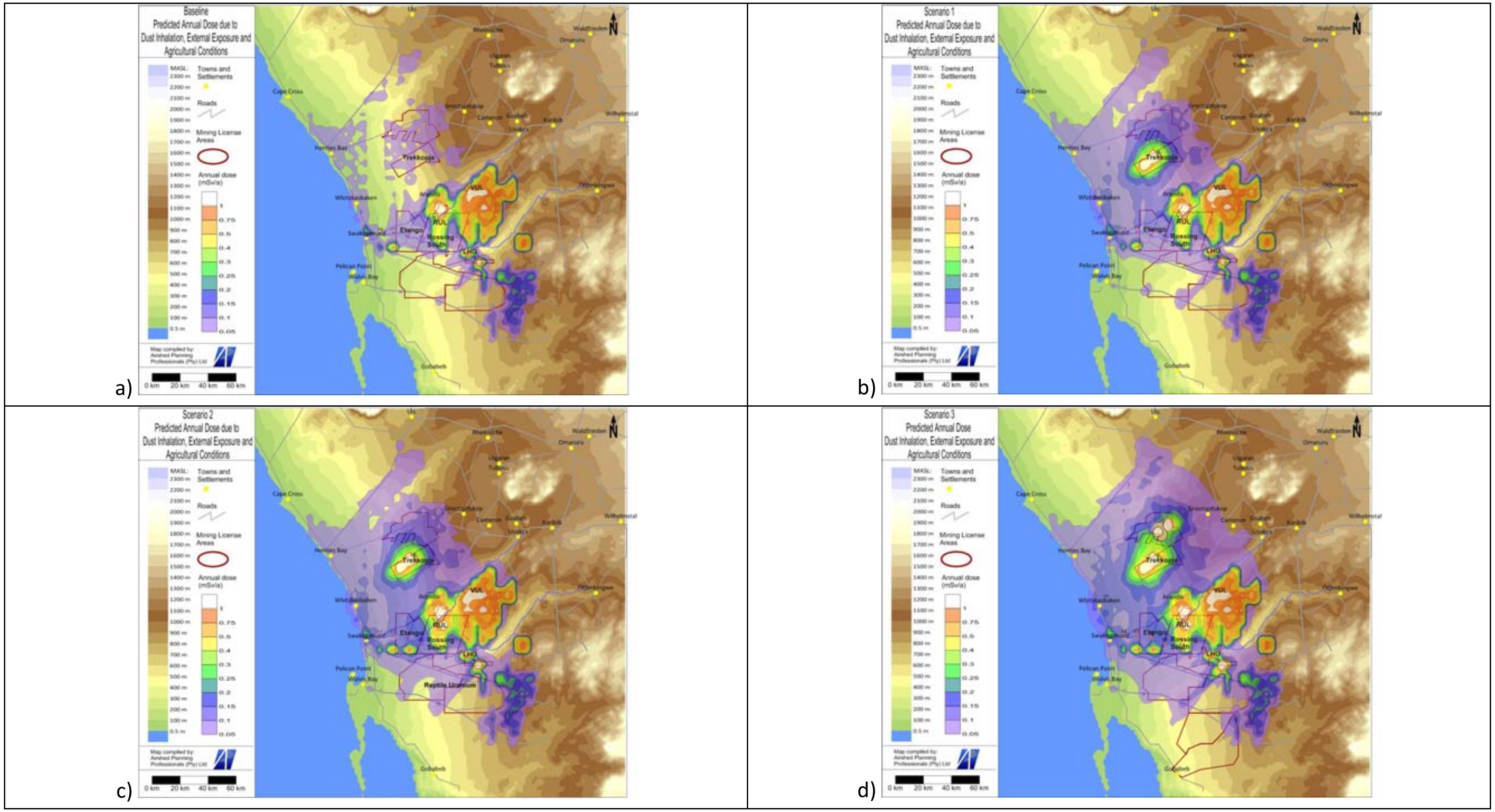


Figure 7.12.7: Annual effective radiological dose (only for the exposure conditions as presented in Table 7.12.2, and excluding radon) for the small-holding farmer critical group under a) Baseline conditions; b) Scenario 1; c) Scenario 2 and d) Scenario 3

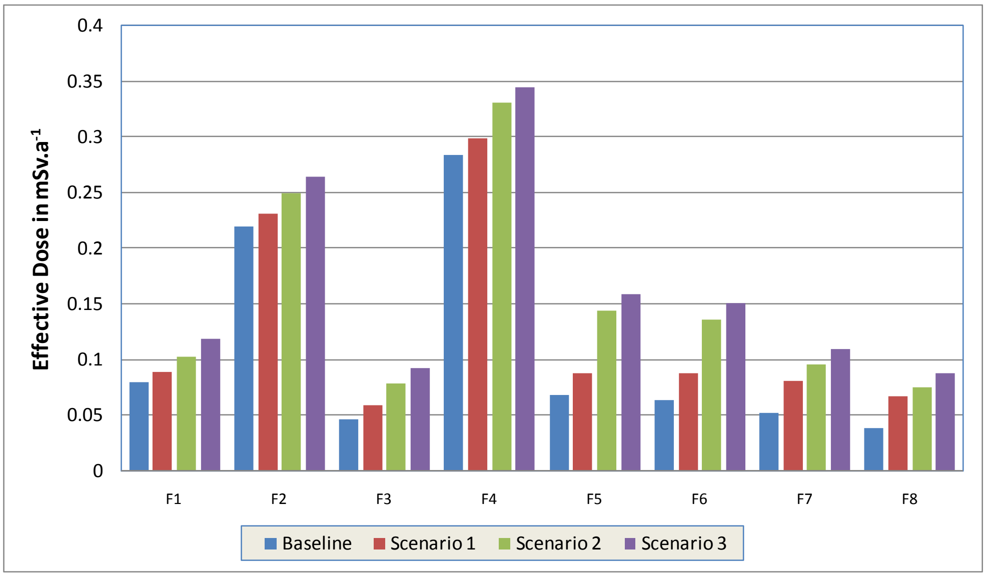


Figure 7.12.8: Effective dose calculated for the small-holding farmers at the various receptor points along the Swakop River shown in Figure 7.12.4 (for exposure conditions as presented in Table 7.12.2, and excluding radon)

Residents

Figure 7.12.9 presents the annual total effective radiological dose (only for the exposure conditions summarised in Table 7.12.2, and excluding radon) expected for the **residential critical group,** under exposure conditions that define the baseline scenario as well as the three mining scenarios. The general trend is similar to that observed for the small-holding farmer exposure group, but with overall lower effective doses. This result is expected, since the residential critical group is subject to fewer exposure pathways when compared to those assumed for the small-holding farmer group. In addition, most members of the residential group considered are located further away from the mines.

The resulting effective doses extracted from the interpolated data in Figure 7.12.9 are presented in Figure 7.12.10. From this graph, it is clear that the contribution of the mining operations for all 3 scenarios is relatively insignificant along the coast. As expected, residents in Arandis are subject to the highest radiation exposure, but this is still below 0.3 mSv/a, even for Scenario 3.

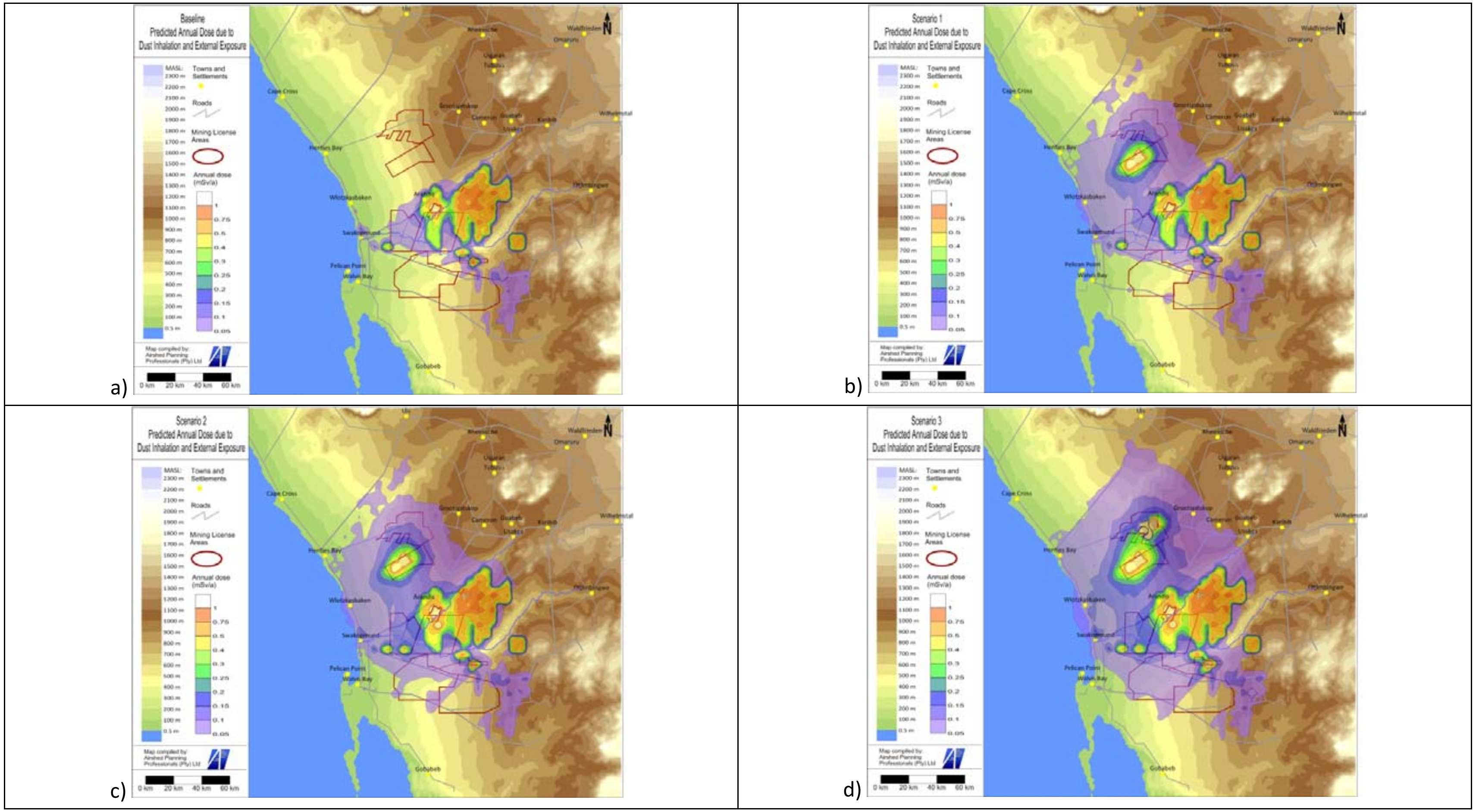


Figure 7.12.9: Annual effective radiological dose for the residential critical group under a) Baseline conditions; b) Scenario 1; c) Scenario 2 and d) Scenario 3 (only for the exposure conditions summarised in Table 7.12.2, and excluding radon)

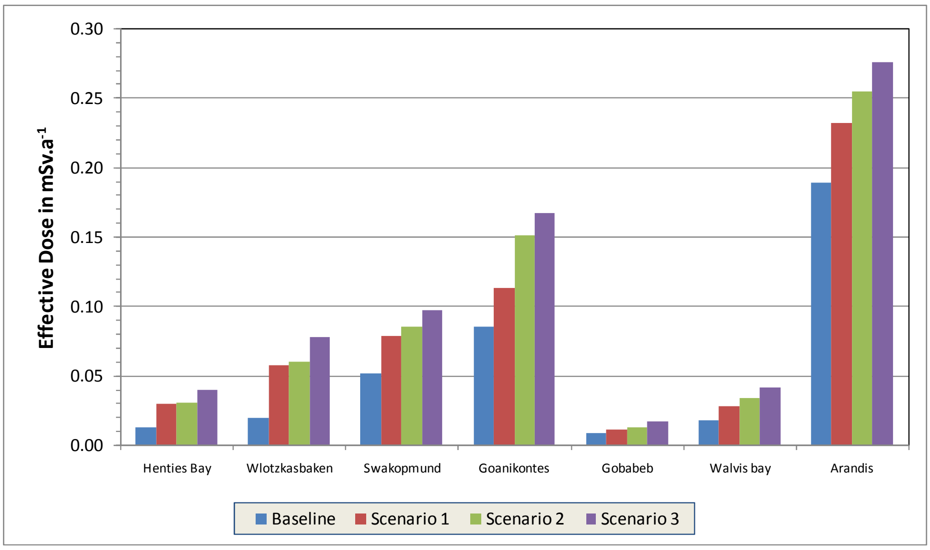


Figure 7.12.10: Effective dose calculated for the residential area exposure condition at the various receptor points shown in Figure 7.12.3 (only for the exposure conditions summarised in Table 7.12.2, and excluding radon)

To summarise, the estimated radiological doses to which members of the two critical groups, i.e. small-holding farmers and residents, may be exposed to under the baseline and 3 scenarios were evaluated at specific receptor points. These receptor points were selected to be close to the residential areas and farms on the banks of the Swakop River, where the respective members of the critical groups reside. The estimated effective doses for the exposure conditions summarised in Table 7.12.2, and explicitly excluding the cumulative effects of radon and radon progeny, at the various receptor points, are summarised in Table 7.12.3.

Table 7.12.3: Summary of the estimated effective doses to the residential and small-holding farmer receptor points (for exposure conditions summarised in Table 7.12.2, and excluding radon) (van Blerk *et al.*, 2010)

Residential Areas	**Baseline**	**Scenario 1**	**Scenario 2**	**Scenario 3**
	mSv/a			
Henties Bay	0.01	0.03	0.03	0.04
Wlotzkasbaken	0.02	0.06	0.06	0.08
Swakopmund	0.05	0.08	0.08	0.09
Goanikontes	0.08	0.10	0.14	0.16
Gobabeb	0.01	0.01	0.01	0.02
Walvis Bay	0.01	0.02	0.03	0.04
Arandis	0.13	0.17	0.19	0.21
Farm Locations	**mSv/a**			
F1	0.08	0.09	0.10	0.12
F2	0.22	0.23	0.25	0.26
F3	0.05	0.06	0.08	0.09
F4	0.28	0.30	0.33	0.34
F5 Hildenhof and	0. 07	0.09	0.14	0.16

Palmenhorst				
F6 Goanikontes	0.06	0.09	0.14	0.15
F7	0.05	0.08	0.10	0.11
F8	0.04	0.07	0.07	0.09

From the above, it can be seen that the additional radiological dose due to atmospheric dust increases as the number of mines increases. It is noted that the incremental dose for residents, based only on the exposure conditions summarised in Table 7.12.2, and explicitly excluding radon and radon progeny, is significantly below the international public exposure limit of 1 mSv/a (over and above the natural background).

The incremental radiological dose for small-holding farmers also increases from the baseline to Scenario 3, noting that the estimates are solely based on the exposure conditions summarised in Table 7.12.2, and explicitly exclude exposure to radon and radon progeny. All predicted values are below the public exposure limit of 1 mSv/a.

7.12.2.2 Radioactivity in groundwater

In order to obtain a comprehensive picture of the groundwater resources in the Erongo Region and the ambient water quality, GSN in cooperation with BGR initiated a number of studies, as mentioned at the beginning of this section. These independent studies have provided significant insights into the characteristics of groundwater flows in the alluvial aquifers of the Khan and Swakop Rivers, modes of recharge and water quality, and indeed, further follow-up work is ongoing. The main purpose of these projects has been to determine and assess the risk of pollution from existing and future mining operations on the groundwater resources of these two rivers. Unfortunately, the radiological dose from groundwater has not yet been calculated, but based on the initial findings, preliminary comments can be made on the current status and future risks of such radiological contamination.

Part of the difficulty in characterising radionuclides in groundwater is that uranium found in the aquatic environment cannot always be assigned clearly to a particular source. The identification of sources however, is important in order to distinguish between natural background concentrations resulting from the natural leaching, dispersion and transport of uranium, and potential sources from different mining activities or past pollution events. Potential sources of uranium in groundwater are primary uranium deposits (bedrock), uranium originating from palaeo-channels (saline aquatic environment), secondary uranium precipitates in calcrete (carnotite), treated uranium (sodium bicarbonate/sulphuric acid process), and uranium and other radionuclides leached from tailings.

In order to overcome this difficulty, naturally occurring radioactive and stable isotopes were used as environmental tracers for the localisation and the assessment of the presence of natural or mine-induced radionuclides in groundwater. Samples of groundwater, sediment and mine tailings were taken so that comparisons could be made to determine whether the radionuclides in groundwater were from natural or mine-induced sources.

The Kringel *et al.* (2010) study found that the *natural background* concentrations of uranium range between 2 µg/l and 528 µg/l in the alluvial groundwater, with a mean of 39 µg/l. These values are well above the WHO provisional Guideline Value for Drinking Water of 15 µg/l (WHO, 2004), but well within the Namibian Group A water quality limit of 1000 µg/l[7]. As expected, uranium is a common trace element and was found in all 78 water samples collected along the length of the Khan and Swakop rivers.

The spatial distribution of dissolved uranium in the Khan and Swakop alluvial sediments is shown in Figure 7.12.11. The main conclusions which can be derived from the distribution pattern are:

- Fresh groundwater in the headwater region of the Swakop River valley and in the valley upstream of the Langer Heinrich Uranium Mine shows low uranium concentrations, with values below the WHO guideline;
- Uranium concentrations in the Khan River valley are generally higher than in the Swakop River alluvial valley;
- The uranium concentrations in freshwater samples from the upper Khan River valley are generally above the WHO guideline value;
- Saline water in the lower part of the Khan River valley and the Swakop River valley downstream from the confluence has uranium concentrations of up to 230 µg/l.

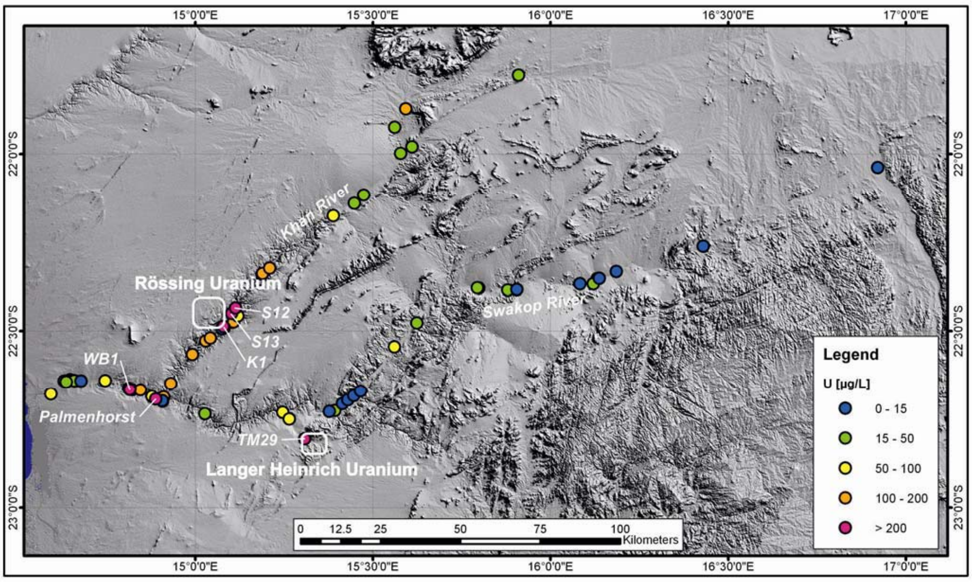


Figure 7.12.11: Spatial distribution of uranium in alluvial groundwater

If the 90th percentile of the alluvial groundwater uranium distribution is chosen to define geogenic background levels, the average background concentration would be 230 µg/l. Altogether six groundwater samples have uranium concentrations exceeding 230 µg/l. Three of the sampling points are located in the vicinity of Rössing Uranium Mine, one near Langer

[7] As noted in section 7.4, the water in the Khan and Swakop alluvial aquifers is not used for domestic consumption.

Heinrich Uranium Mine, and two samples are from wells in the Swakop River valley downstream of the confluence of the Swakop and Khan Rivers.

Process and seepage water samples from the Langer Heinrich Uranium Mine are alkaline sodium-carbonate waters, with very high concentrations of uranium, arsenic and fluoride. The samples from the Rössing Uranium Mine premises are acidic solutions with elevated concentrations of uranium, manganese and a number of trace elements like lithium, niobium and cobalt. At both sites, samples from observation wells show no clear indication of contamination by process waters.

In a further attempt to 'fingerprint' mine seepage, Schubert *et al.* (2010) investigated radon concentrations in the groundwater. Radon (Rn^{222}) is, in general, a perfect environmental tracer due to its chemically inert behaviour (appearing as a dissolved noble gas), its ubiquitous occurrence in the environment, and its straightforward detectability on site. In addition, radon as a direct progeny of radium (Ra^{226}), is a useful indicator of natural radionuclide contamination, because it is part of the U^{238} decay chain. An elevated radon concentration in groundwater therefore indicates (due to its short half life of only 3.8 days) the presence of radium, either in solution or as part of the mineral matrix. Due to these properties, radon can be used as an indicator for recent spills of seepage water enriched with radium, as well as for former spills, which most likely resulted in radium precipitation in the affected aquifer. In either case, because Ra^{226} (as well as Ra^{228}) are fairly mobile radionuclides and of high radio-toxicity, identification of radon as an indicator is extremely relevant from a health perspective.

All radon in water analyses in the Khan and Swakop River valleys were carried out directly on site, using the stripping device 'RAD-Aqua' and the radon monitor 'AlphaGuard'. Forty samples were analysed for Rn^{222}, and radon concentrations of between 0.5 and 28 Bq/l were determined. The results are shown in Figure 7.12.12 using a colour code.

Given that the Ra^{226} background activity concentration detected in the sediment of the Swakop River valley was found to be about 25 Bq/kg, it can be stated that none of the radon concentrations detected in the groundwater exceed the natural background level. Upstream radon data reveal background concentrations of up to 20 Bq/l (20 km north-east of RUL on the Khan River), while water taken from wells close to RUL showed concentrations of around 13 Bq/l. The highest radon concentration was found in a well located 9 km downstream of LHU at the Gawib-Swakop confluence (28 Bq/l). However the water did not show any mine-induced chemical peculiarities.

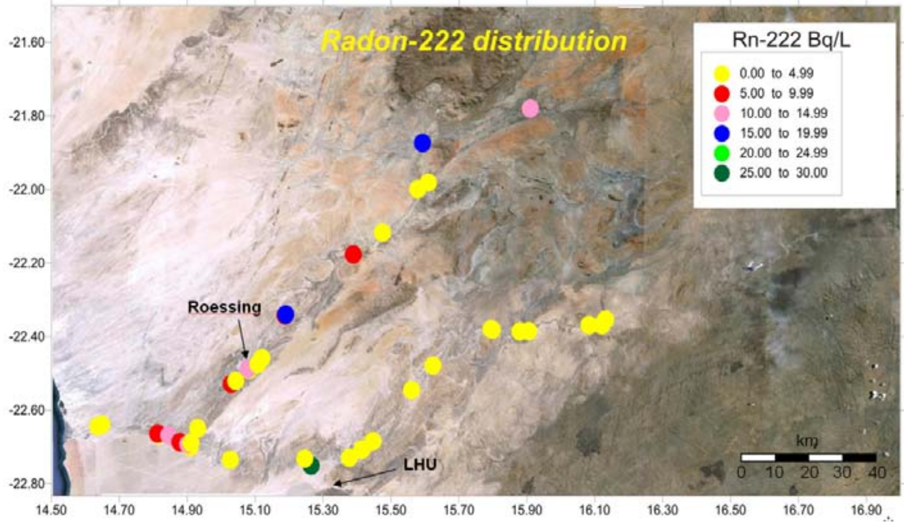


Figure 7.12.12: Radon distribution pattern determined during the SEA groundwater radon study

The various groundwater reports indicate that there is a very low risk of radiological exposure from contaminated groundwater in the lower Swakop River for three main reasons:

Firstly, as reported in section 7.4, the groundwater study by BIWAC (2010) showed that the Swakop and Khan Rivers are not homogeneous aquifers, but separated into sections or compartments. These compartments are mostly dominated by vertical flow components, in the form of evapo-transpiration and recharge. The stored water volumes are only replenished by occasional flood events and the resulting recharge. This implies that lateral or downstream flow of water in the alluvial aquifers is extremely slow (on timescales of the order of decades), and any pollution event would be 'caught' within the affected compartment.

Secondly, both the Kringel *et al.* (2010) and Schubert *et al.* (2010) reports found that in general, natural uranium is ubiquitous in the catchment area. Concentrations of uranium in the upper and middle parts of the Swakop and Khan ephemeral rivers tend to be lower than in their lower parts, with some exceptions, and uranium concentrations tend to increase towards the lowest parts of the Swakop and Khan rivers, again with some exceptions (lower values). This seems to suggest that the uranium found in the alluvial aquifers is of geogenic rather than anthropogenic origin.

Thirdly, the Schubert *et al.* (2010) study concluded that the *radon* distribution pattern mapped in the Khan and Swakop River valleys, and the *radionuclide* concentrations detected in the tailings materials of LHU and RUL, do not indicate seepage of tailings water into the alluvial aquifers. Radon concentrations appear to correspond with the radium background concentration typical of the sediments in the river beds.

A preliminary conclusion from the above is that the existing farmers in the lower Swakop River are exposed to a low radiological dose due to the presence of natural background uranium concentrations in the groundwater. The investigations so far also indicate that there has been no seepage of radium-rich tailings water into the groundwater from the existing uranium mines.

7.12.2.3 Total radiological dose from all sources

In summary, various studies have been commissioned to characterise and determine the baseline and possible future cumulative impacts of the Uranium Rush in the central Namib. This section of the SEA presents the results of the atmospheric dust dispersion model which assesses and quantifies the cumulative radiological impact that the dispersion and deposition of radioactive dust has on two distinct critical exposure groups. This is a complex exercise, and although the knowledge about the radiological environment in the Namib has increased significantly as a result of this SEA, not all the information is available yet to provide a definitive estimate of the cumulative doses. Specifically, and not included in this SEA, are the cumulative radiological impacts of atmospheric radon and radon progeny under the future scenarios. In addition, because cumulative radiological impacts on the groundwater depend critically on how tailings facilities and effluent disposal from uranium mines are managed in future, this aspect is also not further assessed in this SEA.

As with everything else in this SEA, an *indicative* exposure dose which provides a first estimate of the radiological contribution of atmospheric dust generated in the future scenarios has been determined, and can be compared to existing baseline exposure doses in the Erongo Region, as well as global averages. This is seen as a first step to comprehensively quantify the multitude of radiological impacts of the Uranium Rush.

Table 7.12.3 shows the annual average exposure doses as a result of atmospheric dust emissions generated in the baseline and 3 main scenarios. For example, for residents of Arandis who are members of the critical group of residents, the exposure dose contributions of the atmospheric dust emissions generated in the 3 main scenarios over and above the baseline, range between 0.04 mSv/a and 0.08 mSv/a for Scenario 1 and Scenario 3 respectively. It is emphasised that this incremental exposure *only* includes the exposure routes summarised in Table 7.12.2, and that any additional exposure to radon and its progeny, and as a result of potential future radionuclide contaminations that may occur in groundwater, is not included. It is realised that the contributions of radon, and radionuclides in water, may contribute to the incremental public exposure dose under the different scenarios, but the magnitudes of such potential contributions have not been assessed in this SEA.

Subject to the conditions assumed for the purpose of this SEA and given the results presented in this section, it can be concluded that the different scenarios postulated would not lead to unacceptable public exposures to radiological risks as a result of naturally occurring radionuclide concentrations in atmospheric dust. The highest estimated radiological doses for the two critical groups assessed are reported for exposure conditions representative of Scenario 3, where all proposed future and current mining operations are operational.

Overall, the results indicate that the incremental exposure dose contributions to the total effective dose due to atmospheric dust are below 1 mSv/a for both critical groups for all scenarios evaluated.

7.12.3 Desired State

There is no safe level of radiation, but there is also no place on Earth which is free of radiation. It is therefore in the interest of the public and workers exposed to radiation that any radiation exposure is managed according to the national regulatory requirements set by Namibia's National Radiation Protection Authority, which is based on internationally recognised guidelines (IAEA, 2004, and ICRP, 2007).

The International Commission for Radiological Protection (ICRP) has developed principles and standards of radiological protection for radiation workers and members of the public, which are used by countries throughout the world as a basis for national radiation safety, radiation management and protection standards. These principles and standards of radiological protection apply to any activity, event or situation causing radiation exposures beyond those received from natural background radiation, including uranium exploration, mining and decommissioning activities.

According to the 2007 recommendations of the ICRP (ICRP, 2007), the system of radiological protection is based on three principles which are as follows:

The Principle of Justification[8]
Any decision that alters the radiation exposure situation – e.g. decisions to introduce a new radiation source, reduce existing exposure, or reduce the risk of potential exposure – should do more good than harm.

The Principle of Optimisation of Protection[9]
The likelihood of incurring exposures, the number of people exposed, and the magnitude of their individual doses should all be kept as low as reasonably achievable (ALARA), taking into account economic and societal factors.

The Principle of Application of Dose Limits[10]
The total dose to any member of the public from regulated sources in planned exposure situations (other than medical exposure of patients) should not exceed the appropriate limits recommended by ICRP, as summarised below.

Dose Rate Limits for Public Exposure
The estimated average doses to the relevant critical groups of members of the public that are attributable to practices (including uranium exploration, mining and processing) shall not exceed the following limits:

- An effective dose of 1 mSv in a year;
- In special circumstances, an effective dose of up to 5 mSv in a single year provided that the average dose over five consecutive years does not exceed 1 mSv per year;
- An equivalent dose to the lens of the eye of 15 mSv in a year;
- An equivalent dose to the skin of 50 mSv in a year.

[8] This principle is source-related, and applies in all exposure situations.
[9] Like the principle of justification, this principle is source-related and applies in all exposure situations.
[10] This principle is individual-related and applies in planned exposure situations.

The adoption of internationally accepted radiation safety, management and protection standards as guidelines for national systems of regulating industries handling radiation, such as the uranium exploration, mining and processing industry, serves as a valuable best practice.

Namibian regulatory radiological protection standards, as per the draft regulations to the Atomic Energy and Radiation Protection Act, are indeed modelled in line with ICRP's and IAEA's international guidelines and recommendations. Namibia's proposed public dose limits conform to those recommended by the ICRP and IAEA as listed above.

7.12.4 Recommendations

- Increments in the cumulative public dose from ionising radiation from uranium and uranium decay chain daughter radionuclides in air and water that originate from uranium mines, must be small enough not to give rise to incremental radiation exposures to members of the public exceeding 1 mSv per annum (i.e. the regulatory annual dose limit for members of the public);
- Incremental exposure to ionising radiation of uranium exploration and mine workers and contractors (above and beyond natural background exposures) must not exceed the internationally established regulatory limit for occupational exposures of 20 mSv/a (which is reflected in Namibia's draft regulations on radiation protection);[11]
- Mill tailings and waste disposal facilities must be constructed and operated in a way that corresponds to established procedures for radioactive waste management (as per international IAEA guidelines, and to be reflected in Namibian regulations);
- Continuous and statistically significant groundwater monitoring must be obligatory for all uranium mines in Namibia, and all results including radionuclide analyses must be reported semi-annually to the National Radiation Protection Authority, the Department of Water Affairs and Forestry, and the Geological Survey in the Ministry of Mines and Energy;
- Transport of radioactive materials must be managed in a way that corresponds to established international and national procedures for the transport of radioactive substances, including the use of containers and drums containing radioactive materials that meet international and national standards (as per international IAEA guidelines, and to be reflected in Namibian regulations);
- Uranium mines must be closed and mine sites stabilised and rehabilitated in a way that corresponds to established international and national procedures and standards for mine closure and mine site stabilisation and rehabilitation (as per international IAEA guidelines, and to be reflected in Namibian regulations);
- Uranium exploration, transport, mining and processing facilities must draw up operation-specific Radiation Management Plans, which are to be approved by the National Radiation Protection Authority, and serve as a binding monitoring and reporting tool for all aspects pertaining to operation-specific occupational and public radiation safety;

[11] Averaged over a 5-year period, with doses in any one year not to exceed 50 mSv/a.

- Dose constraints must be formulated and applied (as reflected in Namibia's draft regulations on radiation protection);
- The quantification of the cumulative radiological dose to members of the public is to continue, and is recommended to include:
  - determination of the contribution of radon and radon progeny to the total incremental public exposure dose for the mining scenarios in the Erongo Region;
  - refinement of the background radon emissions based on longer term data sets;
  - installation of a network of weather stations in and north of Swakopmund to allow the acquisition of statistically significant local and regional weather data;
  - refinement of the dust dispersion models based on improved weather data;
  - additional research on uranium fingerprinting in the alluvial aquifers of the Khan and Swakop Rivers, including the definition of radioactive anomalies in these river valleys;
  - calculation of the total incremental radiological dose through radon, radon progeny and groundwater for the small-holding farmer critical receptor group, and the residents' critical group.
- A comprehensive air and groundwater quality monitoring programme must be set up according to international protocols and procedures, and the results must be posted regularly on the SEMP office website;
- The Namibian drinking water quality standards must be amended to reflect the updated WHO guideline values for drinking water quality, especially in regard to uranium.

7.13 Cumulative effects analysis - Health

7.13.1 Introduction

Large-scale mining always has health consequences, both positive and negative for both the workforce employed and the community. The main deleterious effects on workforce health are usually accidents, dust related lung disease and specific metal toxicity. All these are preventable. Positive effects are related to employment itself – particularly better economic prospects and simply a chance to work, but that in turn is sometimes offset by separation from family and attendant psychosocial problems. Effects on wider community health may similarly be positive and negative – incomers may bring infectious diseases and social problems, but mines bring prosperity and even improved health care if there is adequate corporate social responsibility and taxes and levies are invested responsibly by government.

In order to determine the cumulative effects of the Uranium Rush on the health of workers and the general public in the central Namib, it is necessary to determine the baseline in terms of the current health status and, when dealing with radiation, to determine the background radiation to which people are already being exposed. The latter was described in the previous section (section 7.12). A further component of the cumulative assessment of health is to look at the current capacity of health care facilities in the Erongo Region to evaluate what impacts the uranium Rush will have on them.

7.13.1.1 Health care facilities

The Erongo Region has three State hospitals in Swakopmund, Walvis Bay and Usakos respectively, 5 health centres[1] and 12 health clinics. These hospitals, health centres and clinics are said to be inadequate at present in terms of capacity, equipment, and accessibility. Ambulance services are similarly inadequate to cope with the already high number of road traffic accidents, as well as general medical emergencies[2].

A private healthcare system operates in parallel to the public health system and there are private hospitals in Swakopmund and Walvis Bay. Private health insurance is available but only to the wealthy or those in good employment, including mine workers.

Namibia suffers from a critical shortage of healthcare workers at 3.0 health workers per 1000 of the population[3], however many of these healthcare workers work in the private sector. The public sector has a level of healthcare workers well below the WHO acceptable benchmark of 2.2 per thousand. In order to overcome this problem, the government initiated a programme to boost the number of health care professionals in the country by contracting foreign doctors. However, there are abnormally long processes to obtain or renew work permits for these foreign doctors and recently there has been the sudden resignation of five state and four CDC (Centre for Disease Control[4]) medical doctors in the Erongo Region who have gone back to their countries of origin.

[1] Health centres have 10-15 in-patient beds for short-term, uncomplicated admissions and are manned by nurses with doctor services provided on a sessional basis
[2] Annual Report, Erongo Health Directorate, Ministry of Health and Social Services 2008-2009.
[3] WHO; MoHSS Annual Report 2006-07 – HRD Policy and Planning World Health report 2006. WHO Global Atlas of the Health Workforce
[4] CDC is a NGO.

7.13.1.2 Community health

Over the past few decades, the general health of the population improved as health care advanced, but in the last 20 years, several key indicators have declined due to a combination of HIV/AIDS and the burden of a rapidly increasing population on limited health care facilities.

Life expectancy in the Erongo region may be higher than the rest of the country but it has declined from 61 in 1991 to 43 years in 2000. Reduction in adult life expectancy is largely attributable to communicable diseases of which the most significant (67%) is HIV/AIDS[5]. HIV/AIDS prevalence is very high at 20%, no doubt much more prevalent than that in specific groups. This has major implications for the Uranium Rush due to the decimating effect it has on the workforce and skills availability, the increased pressure on facilities and the psychosocial impacts on communities as a whole. It also contributes to the high and rising maternal mortality rates of 4.49 per 100,000, as well as high rates of infant mortality (3.8%), both exacerbated by poor obstetric services.

Other health indicators in Erongo relate to infectious diseases especially in the young, including tuberculosis (400 new TB cases per quarter). Tuberculosis rates are amongst the highest in the world, particularly related to HIV/AIDS, but also because of poor living conditions, high levels of malnutrition, poor public health infrastructure and difficulties in accessing regular treatment on account of distance.[6] Amongst the older population, stroke and heart failure account for most of the mortality.

It is noted in the Ministry of Health and Social Services' 2008/9 Annual Report that as a consequence of the uranium boom, population growth is already being experienced in all towns leading to crowding of single quarters and back yard squatting, creating discrepancies between national census figures and real figures on the ground. This has probably facilitated the spread of AIDS, tuberculosis and crime. Other unwanted effects have been an increase in commercial sex workers, drug and alcohol abuse.

Interestingly cancer as a health problem does not feature prominently in the broad analyses of Namibia's health situation. The incidence of cancer is totally overwhelmed by the more pressing health problems previously mentioned. It is however of obvious interest in the context of radiation induced ill health.

In most economically developed countries it has been possible to create cancer registries. This is because cancer is a leading cause of death in such countries, the diagnosis can usually be made very precisely and there is good linkage between medical systems and death certification. A countrywide cancer registry is valuable because it can help the understanding of the distribution and causes of cancer, how the incidence rate changes from year to year and how it varies from region to region, between the sexes, the ages and the different socio-economic and ethnic groups. The first Namibian cancer registry was published to cover the period 1995-1998[7]. The registry was started in 1995 when Rössing Uranium Mine in cooperation with the Namibian Ministry of Health and the Cancer Association collected all cancer cases reported to the Windhoek state pathology laboratory and the single existing private pathology laboratory from 1979 to 1994. Later clinical cases were

[5] Namibia Household Income and Expenditure Survey 2003-2004 Team analysis
[6] Namibia Household Income and Expenditure Survey 2003-2004 Team analysis
[7] Report on Namibian Cancer Registry Data 1995-1998, A collaboration between the Namibian Cancer Registry (MRC/cansa/nhls/wits), Cancer Epidemiology Research Group and South African National Cancer Registry and WHO/ IARC

also reported for four regions of Namibia including Erongo. Those cases of Namibians diagnosed in South Africa were also reported in Namibia.

The register shows that prostate cancer was the leading cancer amongst males overall and increasing in frequency. It was much more common in the white population due perhaps to early detection and treatment. Kaposi's sarcoma was the third most common cancer among males, wholly related to HIV disease. Those cancers related to tobacco and alcohol consumption, i.e. oral cavity, larynx, oesophagus and lung were among the five leading cancers in both males and females in many of the ethnic groups. Lung cancer would have been due principally to smoking: 8% of women and 24% men use tobacco in Namibia; of those smokers, 31% of women and 26% of men smoke 10 or more cigarettes per day.

Unfortunately, the data in Namibia's first cancer register are unreliable because of the multifarious methodological problems encountered in its construction. It did however pave the way for a further report published in 2009[8]. This provided data from 2000 to 2005. The leading cancers amongst men were Kaposi's sarcoma followed by prostate cancer, then lung, trachea and bronchus, then mouth cancer, non-Hodgkin's lymphoma and cancers of the larynx, tongue and colon. The incidence rates of prostate cancer and lung, trachea and bronchus cancer seem stable over the period. Cancer of the lung/ trachea/ bronchus was the sixth most common cancer among women. This study also has its limitations, some of them similar to those of the previous study. The actual number of cancer cases reported by the Register was only 60% of that reported in the previous period. This, together with increasing population size, results in an apparent decline in the incidence of all cancers. The reason for this is unclear and it is not known whether the first or second report gives the truer picture.

Thus, the existing cancer registries give a rough and incomplete overview of cancer in Namibia and the data is likely to be so skewed that definite attribution to particular causes is not possible. Cancers known to be induced by radiation such as lung cancer and leukaemia do feature in the reports but there is no way these data could give information as to whether radiation is contributing or not.

7.13.1.3 Occupational health status

Many of the impacts identified in this SEA are speculative in nature because the full scope of the Uranium Rush is not yet known and much research and data collection is still required. However the Rössing Uranium Mine has been in operation since 1976 and therefore there is a considerable amount of data available and several studies have been conducted at the mine on issues relating to occupational health. One such study conducted at the mine over the period 1993 to 2008, involved workers who had been active in specific areas of potential high occupational exposure for the major part of their employment[9]. The exposures examined were predominantly to uranium dust, volatile chemical fumes and welding fumes. Workers exposed to these potentially hazardous substances were compared with other employees of Rössing who worked in the administrative areas. Thus this was an ongoing (i.e. not a retrospective) study, which also recorded other health and lifestyle attributes including smoking, body mass index, blood pressure, HIV/AIDS and diabetes. Some of these factors are obviously important as they may contribute for example to lung cancer and non-

[8] Cancer in Namibia 2000-2005. Data collected by the Namibian Cancer Register published Feb 2009

[9] Joubert JR (2008). Prospective Study of Respiratory and Systemic Disease of Uranium Workers at Rössing Mine 1993-2008. Unpublished.

malignant lung disease. All those examined had worked for more than 10 years and represented 21% of the total Rössing staff on and off the site during 1993.

The results showed that general lung function was not worse amongst workers in those areas where dust exposure was higher (if one ignores smokers from the sample, since they had a predictably worse lung function). However, hypertension and diabetes rose in prevalence during the period of the study (probably as a consequence of lifestyle factors).

Occupational diseases which might have been expected as a result of exposure to radiation and dust (i.e. lung cancer and pneumoconiosis) were conspicuously absent from the respiratory, medical termination and death groups. The author of the study points out that this may well be a reflection of Rössing's good control over radiation exposure, although the study only covered the last 15 years. He also points out that in any medical study of an occupational group such as this, the 'healthy worker effect' tends to operate whereby employed populations, simply by virtue of the fact that they are in employment, have better health outcomes than unemployed populations. This is usually a combination of selection into employment of fitter people but may also be contributed to by good working conditions and benefits. In the case of hazardous employment however, health hazards may outweigh the health benefits conferred by the healthy worker effect. There is some reassurance from this study, therefore, that health deterioration in that part of the Rössing workforce exposed to the greatest hazards, does not seem to have occurred.

In addition to special studies such as the one described above, the Rössing workforce is monitored for a range of occupational exposures, on a programmed, regular basis. The type and frequency of personal monitoring depends on the work area and potential exposure. The radiation monitoring programme in place at the mine comprises the monitoring of three exposure pathways:

- Internal exposure (mostly to lungs and airways) to alpha radiation, mainly from the inhalation of the short-lived decay products of radon;
- Internal exposure to alpha radiation from the inhalation of the long-lived radio-nuclides occurring in uranium ore dust;
- External exposure to gamma radiation, mostly from ore outcrops, ore stockpiles and from extracted uranium oxide stored on-site.

To determine whether uranium dust has been ingested, urine samples are taken regularly from Rössing employees and analysed for uranium – previously at a laboratory in South Africa but now in Swakopmund at the Uranium Institute.

The exposure to radiation measured by personal monitoring of the workforce at Rössing is available to the public in aggregate form and is graphically illustrated by comparing the readings against the annual exposure standard of 20 mSv/a[10]. External radiation, radon and dust are measured and the proportional contribution of each is presented in Figure 7.13.1. Not surprisingly office workers receive the least dose – under 1 mSv/a in total and the final product recovery staff receive the highest dose of just over 5 mSv/a. The office workers, proportionally, receive most of their dose via radon and the final product recovery staff, from external radiation with a slightly higher proportion than other workers from dust. It must be noted that the dosimeters record what the

[10] This unit of measurement – the Sievert – incorporates the "quality" factor and was originally developed to represent the cancer inducing power of a given dose of ionising radiation. The limit of 20mSv/a has been globally accepted as the recommended individual dose limit averaged over five years.

worker could *potentially* inhale; all employees are required to wear the FFP2 dust mask in designated areas which affords a protection factor of 10 and therefore these results do not reflect the actual received dose.

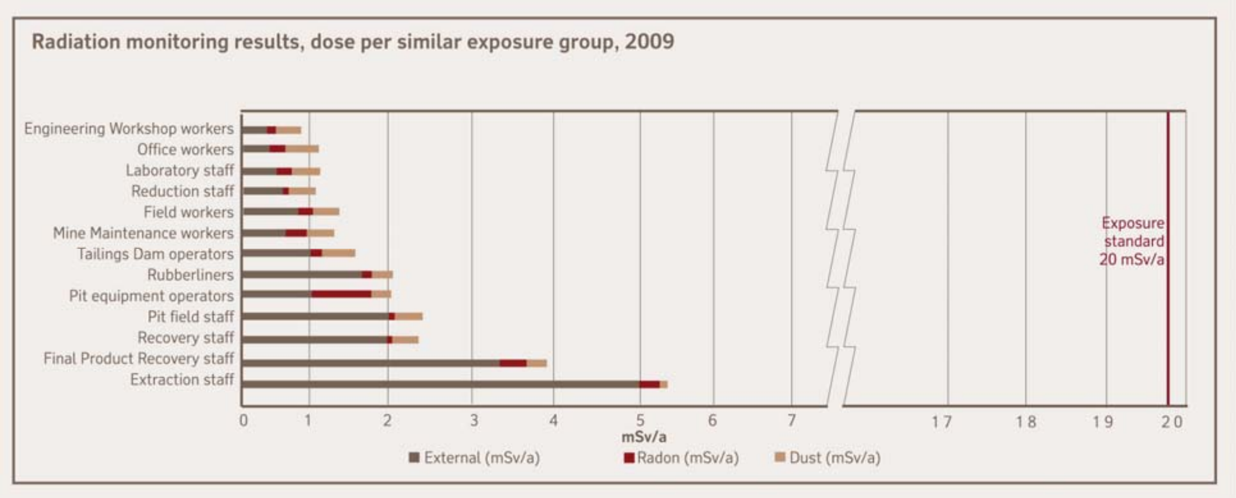


Figure 7.13.1: Rössing radiation monitoring results, dose per similar exposure group (SEG), 2009. Note that averages include all contractors working in the respective SEGs. (Source: www.rossing.com)

Dust exposure is also measured (Figure 7.13.2) and published in aggregated fashion so that it can be seen as total dust exposure (not split into particle size) of various workers at Rössing. The occupational limit is set at 0.45 mg/m^3. The majority of the staff fall under that exposure limit – laboratory staff and open pit field staff receive a higher dose but this exposure is mitigated by the use of FFP2 dust masks by relevant personnel as mentioned above.

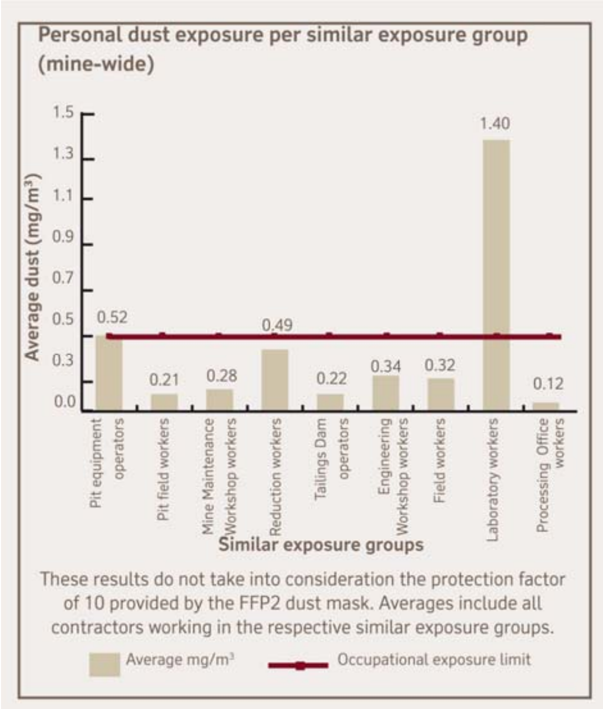


Figure 7.13.2: Rössing dust monitoring results, dose per similar exposure group (SEG) in 2009. (Source: www.rossing.com/health_management)

RUL has been operating for more than 30 years and complies with international standards for radiological protection (e.g. ICRP). However, these results cannot be extrapolated to other mines (existing or future). Each mine will have to develop its own system of occupational health surveillance and submit to external review by accredited agencies.

7.13.2 Analysis of cumulative effects

Generally speaking, more mines mean more people, more dust, more radiation exposure of the workforce and public and more accidents both at work and on the roads. However, the impacts of radiation and dust exposure under Scenarios 1, 2 and 3, are unlikely to have deleterious effects on health so long as proper radiation and safety measures are in place. On balance, Scenario 4 will be the worst in terms of public health due to the legacy of unrehabilitated sources of radiation (radon, dust and radio-nuclides in groundwater). The greatest impacts on health therefore will not be from increased radiation but more likely from the spread of disease and road traffic accidents.

7.13.2.1 Health care facilities

There will be escalating demands on health services and other social infrastructure with the predicted influx of people to the area (see below). Given that the health care facilities are already stressed it is predicted that indicators such as the number of people per health care practitioner and the number of people per hospital bed will all increase. This in turn will have a major impact on the quality of life for the current population as well as the newcomers. It may also become a stumbling block for attracting skilled people to the mines and associated industries.

As mentioned elsewhere in this SEA, it is difficult to predict exactly how many people will be resident in the area over the next 10 years due to the uncertainties surrounding the mine scenarios and how many jobs can be filled by local people and how many new workers (and their families) will arrive. Thus it is not possible to *quantify* the cumulative impact on health care facilities, but what is clear is that there will be a significant impact *unless* additional health care facilities are built and staffed with appropriately trained care givers.

7.13.2.2 Community health

The main stakeholders are the inhabitants of Arandis, Swakopmund, Walvis Bay, Henties Bay and Usakos. During this SEA, stakeholders expressed concerns about the possibility of radioactive material reaching them in the form of dust or in abstracted groundwater thus exposing individuals to ionising radiation, which could be inhaled or ingested.

Probably the greatest public fear is that radioactive material, exposed through mining activities, or the sudden, unplanned abandonment of waste materials in the boom and bust scenario (Scenario 4), might give rise to excessive and long-term increased exposure to ionising radiation for the population of the Erongo region. The main public concerns are the dispersion of radioactive dust to surrounding areas and the possible contamination of water supplies. In the near vicinity of the mines there is concern about increased radon levels.

Boice *et al*. (2007) examined health trends in communities close to uranium mining and milling activities between 1950 and 2001 in the USA. They did case control studies of cancer mortality[11,12]. No unusual patterns of cancer mortality were noted in populations around the uranium operations in Texas. Similarly in the Colorado experience there was an absence of elevated mortality rates for cancer except for male cases of lung cancer, very likely due to prior occupational exposure to radon and cigarette smoking amongst the underground miners.

The research, background investigations, monitoring and modelling of radiation exposure conducted for this SEA, although incomplete as discussed in section 7.12, together with other regional studies, indicate that any increase in exposure to mine-related radiation is going to be negligible, compared with background.

As mentioned previously, people throughout the world are exposed to natural background ionising radiation. Background levels differ according to geographical location, altitude and a number of other variables. There has never been any suggestion that normal variation in background radiation across the world causes ill health except in the case of radon where there are measurable increases in lung cancer rates in populations who live in areas where radon exhalation from rocks or building materials are high or where poorly ventilated homes built on radon emitting ground, concentrate the gas and lead to high indoor exposures[13].

Currently, operating mines have in place systems to limit radioactive emissions (dust, radon and seepage) from tailings storage facilities via atmospheric and water pathways. All uranium mines require dust, radon and water quality monitoring programmes and this is done by strategically placing monitors and sampling points on and around the mining areas. On mine closure, mines will be required to close and rehabilitate the mines in order to ensure that no pollution will take place and that dust emissions and radon exhalation are minimised, based on a full risk assessment.

[11] Boice JD *et al*. (2007). Cancer and non-Cancer Mortality in Populations Living near Uranium and Vanadium Mining and Milling Operations in Montrose County, Colorado, 1950-2000. Radiation research 167 (6): 711-726.
[12] Boice JD *et al*. (2003). Cancer Mortality in a Texas County with prior Uranium Mining and Milling Activities 1950 to 2001. Journal of Radiation Protection 23, 247-262.
[13] Darby S, Hill D, Auvinen A *et al.* (2004). Radon in homes and risk of lung cancer: collaborative analysis of individual data from 13 European case control studies. BMJ, Doi: 10.1136/BMJ.38308.477650.63. 21st December 2004.

A further health concern relates to the transportation of final product (yellowcake). As with any hazardous chemical, the transportation of this low radioactive material requires monitoring and surveillance all the way from the mine to the exit port. There is no danger to the general public from this activity because the metal drums containing the yellowcake are effective barriers to the emanation of any radiation. However, if there was a transportation accident and members of the public were directly in contact with yellowcake or if material was stolen, emergency measures would have to be taken (as with any other hazardous chemical).

Probably the more significant hazard relates to general road traffic accidents or spills of chemicals such as sulphuric acid. As indicated in section 7.3, traffic on the B2 between Arandis and Swakopmund could increase between 54-59% over the next 10 years depending on the mine scenario, while the C28 gravel road between Swakopmund and Langer Heinrich could experience up to an 80% increase under Scenario 3 (see Table 7.3.1). Much of this will be made up of heavy vehicles and buses. The combination of increased traffic, poor visibility due to fog and dust and the current poor state of all the roads in the study area, means that road accidents will become more frequent.

Another significant cumulative impact on health will be the influx of large numbers of people attracted to the area to work directly on the mines or in the burgeoning support industries, together with their families. The rough estimates of the numbers of people who may work directly for the uranium rush and associated industries were discussed in Chapter 4 and are summarised in Table 7.13.1 below.

Table 7.13.1: Estimated numbers of direct employees on the mines and associated industries during peak construction and operations

Scenario	Construction	Operations
Scenario 1 (1-4 mines)	4,000 (2011-12)	<3,500
Scenario 2 (5-7 mines)	8,500 (2011-12)	6,100
Scenario 3 (8-12 mines)	9,000 (2011-12)	7,000
Scenario 4 (boom and bust)	9,000 (2011-12)	1,500

In addition to direct employment, the Uranium Rush will trigger a number of new or expanded service industries, ranging from transportation, banking, schools, clinics, shops and mine support industries. If a job multiplier of 8 is assumed, it is possible that a total number of new jobs in the economy could be in the order of 48,000 under Scenario 3. Given that the total *urban* population of Erongo is only some 108,000 and that approximately 34% of the economically active age group are unemployed (i.e. some 18,000)[14], it is clear that many of the new job opportunities cannot be filled by local people even if all the right skills were present. This means that there will be a significant influx of people into the area from all over Namibia, southern Africa and even from overseas.

The health effects associated with this influx are difficult to quantify, but the effects will be in some way proportional to the population size. Secondary negative effects will likely be an increase in infectious diseases such as HIV/AIDS, tuberculosis and sexually transmitted disease. These consequences always follow mass movements of workers in time-limited ventures such as construction sites or mines.

[14] Figures from the 2001 census as reported in Speiser Environmental Consultants, 2009.

The positive effects could be increased wealth and improved housing and health care for workers and the possibility of health education and health promotion in the various work places.

7.13.2.3 Occupational health

A number of studies[15,16] have been conducted throughout the world and over a period of decades, looking at a variety of radiation workers, including uranium miners (mainly underground). Those studies conclude that:

- High dose radiation (from underground mines, medical applications, nuclear bombs and nuclear accidents) has long-term health effects such as cancer and leukaemia and possibly other effects;
- There is little evidence that low doses of radiation (as is the case here) over a prolonged period – as long as they are controlled – give rise to cancer and leukaemia;
- *Underground miners* exposed to radon have an increased rate of lung cancer;
- The validity of radiation protection measures and in particular standards promulgated by the International Commission on Radiological Protection, seems sound.

The dose limit for practitioners working with radiation sources, e.g. industrial radiographers, medical radiographers, radiologists (doctors) and mine workers is 20 mSv/a averaged over five years, i.e. 100 mSv over a five year period with a ceiling of 50 mSv/a in a single year. Compare this with the occupationally exposed workers at Rössing mine who, in the most highly exposed cases (final product recovery staff) are exposed to 5.29 mSv/a.

In contrast, medical applications, even ordinary X-rays can be much more radioactive – a whole body CT scan delivers 12 mSv to the patient and the operators of nuclear medicine equipment are regularly exposed to up to 100 mSv/a, with no ill effects.

Thus if the exposure of workers is kept below the occupational limits, cumulative health effects are unlikely because the sum of the mines under any scenario will not affect the exposure of workers at each individual mine.

7.13.3 Desired state

The ultimate environmental quality objective for health is that workers and public health improves as a result of the Uranium Rush (see EQO3 in Chapter 8). This can be defined further as:

- Improved healthcare facilities and services are able to meet the increased demand for healthcare resulting from the Uranium Rush;
- Disease rates amongst the public and employees of the mining and associated industries are not increased as a result of the Uranium Rush;

[15] Muirhead CR, O'Hagan JA, Haylock RGE, Phillipson MA, Willcock T, Berridge GLC, Zhang W (2009). Mortality and cancer incidence following occupational radiation exposure: 3rd analysis of the National Registry for Radiation Workers. British Journal of Cancer. Vol 100. Issue 1 pg 206-212, 2009

[16] Shore RE (2009). Low dose radiation epidemiology studies: status issues. Health Physics Vol 15 97/5 (481-6) 1538-5159, November 2009

- Annual radiation exposures to the public are not significantly increased as a result of the Uranium Rush and do not exceed the ICRP limits for public exposure anywhere beyond the mine boundaries;
- Annual radiation exposures to the mine workers are not significantly increased and do not exceed the ICRP limits for occupational exposure;
- Annual human exposures to particulate concentrations are acceptable (WHO Guidelines).

7.13.4 Recommendations

Medical services, both diagnostic and therapeutic are currently inadequate in Erongo[17]. The development of better quality or extended facilities in Swakopmund or Arandis will be absolutely necessary in order to cope with an increased population of newcomers.

One of the first tasks identified by the newly formed Atomic Energy Board is to upgrade the national cancer register in association with the Namibian Cancer Association. This is urgently required to provide a valid baseline against which the future impacts of the Uranium Rush on cancer can be assessed.

With an increase in mine activity, accidents, both occupational and road traffic accidents will likely increase and this must be countered by a variety of proven preventive measures. Recommendations for improved road safety were made in section 7.3.4. The mines are legally required to implement their own health and safety plans.

Dust in an open pit mine, in a dry region can be a problem but the inhalation of dust can easily be controlled by the use of personal protective equipment (masks). The exposure of the general public to increased dust will require each individual mine to implement dust suppression measures at all exposed sources (haul roads, access roads, open pit, crushing circuits and tailings dams). It is also strongly recommended (in section 7.3.4) that the C28 gravel road should be tarred along the entire section between the Swakopmund turnoff and Langer Heinrich mine if Scenario 2 eventuates.

Given the predicted influx of people to the area and the high incidence of HIV/AIDS and TB, it is strongly recommended that the local authorities embark on a major health awareness and disease prevention campaign. This will need to be backed up by an obligation being placed on all contractors to implement their own health campaigns and to do everything in their power to prevent the spread of disease.

Similarly, the mines will need to have their own health awareness campaigns and wellness programmes to prevent the spread of disease and to promote healthy living. This in turn will help to relieve the burden on the health care facilities in the area.

Addressing stakeholder concerns requires all the mines to design and implement a management and monitoring system that conforms to international standards for the protection of the public and workforce alike. General guidelines and regional targets have been identified in the SEMP (Chapter 8 of the SEA report) and each individual mine will be required to implement the measures necessary to meet those targets.

[17] Annual Report, Erongo Health Directorate, Ministry of Health and Social Services 2008-2009.

Mine operators are obliged by law to follow international and national guidelines on the radiological protection of workers. This would include regular environmental monitoring and personal radiation monitoring of individuals as well as biological monitoring and, where indicated, biological effect monitoring. The latter two elements might well comprise urinary uranium monitoring or monitoring for kidney function.

The two currently operating uranium mines, Rio Tinto's Rössing Uranium Mine and Paladin's Langer Heinrich Mine have both established a comprehensive medical service rendering preventative, curative and rehabilitation services and occupational health services. Both mines have well trained and fully equipped emergency services including ambulances. As a result, these mines have excellent safety records; their objectives being to achieve zero harm to their workers. These standards of occupational health management must be maintained at these and all new mines, as required by law.

Of direct relevance to this report, the Namibian Atomic Energy Act gives guidance in support of Regulation 40 relating to health surveillance. This prescribes a series of actions for which the occupational health services to the mines are responsible. Ultimate responsibility will be that of the mine employer. The programme should:

- Assess the health of workers, ensuring that they are fit to undertake the tasks assigned to them;
- Establish and maintain records that can be used in case of:
    - Accidental exposure or occupational disease;
    - Statistical evaluation of the incidence of diseases that may relate to working conditions;
    - Assessment for public health purposes of the management of radiation protection in facilities in which occupational exposures can occur;
    - Medico-legal enquiries;
- Make arrangements for dealing with accidental exposures and over exposures;
- Provide an advisory and treatment service in the event of personal contamination or over exposure.

The responsibilities of the occupational physician are to:

- Carry out medical examinations on workers prior to their employment, periodically when they are employed and upon termination of their employment;
- Advise management periodically on the fitness of workers;
- Take responsibility for case management in the event of over-exposure;
- Advise on the arrangements for hygiene at work and the removal of radio-nuclides from wounds;
- Various medical examinations are prescribed with guidance on communications of the results to both worker and employer.

There is also an obligation to ensure that workers are fully informed of hazards. This applies particularly to female workers of childbearing age. There is guidance on how to proceed should there be an accident and who should be informed and how medical advice to mine management should be given. The employer should make available suitable facilities for medical examinations in the vicinity of the workplace; confidential medical records should be kept.

Furthermore, mines under the legislation (see Chapter 6) are obliged to publish a radiation management plan covering a technical description of the operation, pre-operational safety assessments, organisational arrangements and occupational radiation protection programmes, medical exposure control, a public exposure monitoring programme, a waste management programme, emergency preparedness and response, a transport plan and a control methodology for ensuring the safety of radiation sources.

7.14 Cumulative effects analysis - institutions and governance in Namibia

7.14.1 Introduction

Managing the Uranium Rush will be a considerable challenge for Namibian institutions, be they government, parastatal, regional and local authority, private sector or civil society. Throughout the process of compiling this SEA, a recurrent theme has been questions about the ability and willingness (or otherwise) of Namibians at all levels to cope with the Uranium Rush. These questions centre not only on actual ability, but also on the issue of conflicting interests and the necessary political will to do what is required to minimise negative impacts and maximise the expected benefits. 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. The bottom line is governance.

The concept of 'governance' is not new. It is as old as human civilization. Simply put 'governance' means: the process of decision-making and the process by which decisions are implemented (or not implemented) (www.unescap.org). 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.

Since governance is the process of decision-making and the process by which decisions are implemented, this analysis of institutions and governance focuses on the formal actors involved in decision-making and implementing decisions around development planning in general, and prospecting and mining in particular. This chapter provides an overview of the most important institutions relevant to the Uranium Rush. From a strategic perspective, it examines key roles and assesses what needs to be done to improve capacity and governance.

7.14.2 Current situation, cumulative impacts and key recommendations

There are many institutions with core responsibilities in terms of facilitating, regulating and monitoring prospecting and mining in Namibia.

The **Ministry of Mines and Energy (MME)** is essentially responsible for the management of the Uranium Rush and for coordinating government's response with sister organisations. MME is the custodian of Namibia's mineral, geological and energy resources, and facilitates and regulates the responsible development and utilisation of these resources for the benefit of all Namibians.

The Ministry's objectives are to:

- Promote investment in the mineral and energy sectors;
- Ensure the contribution of geological and energy resources to the socio-economic development of Namibia;
- Create a conducive environment for the mineral and energy sectors;
- Regulate and monitor the exploration and exploitation of mineral and energy resources;
- Minimize the impact of exploitation of mineral and energy resources on the environment; and

- Provide professional and customer focused services.

MME is heavily under-resourced (e.g. there are 70% vacancies in the Directorate Geological Survey) in most aspects and will struggle to manage the Uranium Rush. Nevertheless, MME has an active capacity building programme and many young geologists are currently undergoing training, e.g. within the German-Namibian Cooperation Project of GSN and BGR. There is concern, however, that the private sector will 'poach' the more competent geologists from government and that training efforts are essentially a never ending task.

Issue of concern	**Recommended solutions**
Inadequate care in allocation of prospecting and mining rights, especially in protected areas.	• MME must ensure that proper safeguards are in place before prospecting and mining rights are issued. • Maintain the moratorium on issuing new EPLs until the approval procedures for new mineral licence applications in red and yellow flag areas have been formalised.
Capacity shortage	• Quickly and significantly widen capacity building programmes, both internally and with cooperation partners such as BGR
Inadequate monitoring and enforcement, causing some prospecting and mining proponents to ignore set environmental safeguards	• MME must work more closely with MET to improve monitoring and enforcement. • Improve cooperation and coordination with MET and MoHSS • MME chould consider using external experts to assist them with monitoring and inspections – the mining/prospecting companies should be expected to pay for this. • MME and MET invest in adequate modern monitoring equipment and ensure training of staff members to monitor the uranium industry

A key partner to MME in the context of the Uranium Rush is the **Ministry of Environment and Tourism (MET),** whose mission is "to maintain and rehabilitate essential ecological processes and life-support systems, to conserve biological diversity and to ensure that the utilisation of natural resources is sustainable for the benefit of all Namibians, both present and future, as well as the international community, as provided for in the Constitution".

The <u>Directorate of Parks and Wildlife Management</u> is responsible for the management of national parks and other declared conservation areas. The Directorate deals with wildlife management issues both inside and outside national parks. The <u>Directorate of Environmental Affairs</u> (DEA) is responsible for environmental policy, planning and coordination, both on the green side (natural resource management) and on the brown side (waste management and pollution control), including all matters pertaining to international environmental conventions and their implementation in Namibia. The Directorate is also in charge of coordinating the EIA process, and working with other line ministries to evaluate and approve EIAs for projects falling under these line ministries' thematic areas of jurisdiction. The DEA's staff is all Windhoek-based, for which reason DEA relies on Department of Resource Management staff for field-based activities and information.

The MET is currently under-resourced and the Uranium Rush will apply even greater pressure on their staff. Even though the envisaged Office of the Environmental Commissioner is likely to be established soon, it will be some years before this office is likely to have sufficient capacity to deal with its workload.

Issue of concern	Recommended solution
Inadequate environmental awareness	• Improve awareness amongst high-level decision makers (within MET) about the fragility of the Namib and the need for consistency in decision making • MET needs to sensitise other GRN institutions and the private sector about the importance of the environment and its link to livelihoods and the economy. • MET needs to be more proactive and supportive of civil society organisations that are or could be valuable partners in environmental awareness building.
Inadequate legislation	• See Chapter 6
Escalating habitat destruction from prospecting and mining.	• MET needs to reassert itself at high level so that there is improved consideration of environmental issues in decision making in MME. • MET HQ needs to involve field staff more pro-actively in considering concession applications and in setting conditions. • MET must work with MME to agree on which important conservation/sensitive areas can be restricted in terms of prospecting and mining activities (red and yellow flag areas). • Use independent experts to help guide and evaluate EIAs. • Improve post-implementation monitoring, auditing and enforcement.
Sensitive and ecologically important areas inadequately protected	• Proclaim Namib-Skeleton Coast National Park. • Apply legally-binding zonation (e.g. strict protection) of red and yellow flag areas. • MET should be supportive of civil society groups that provide a range of voluntary services aimed at conserving important conservation areas.
Inadequate capacity in MET to enforce existing and emerging legislation	• MET HQ needs to involve field staff more pro-actively in considering concession applications and in setting conditions. • Improve post-implementation monitoring (could use independent experts to help with this task). • Form partnerships with Civil Society and international NGOs – they can help MET to undertake a variety of tasks. The idea of 'Honorary Park Wardens' merits consideration. • Create opportunities for the general public to be more involved in conservation.

In terms of archaeological resources, the **National Museum** is the legal repository of archaeological heritage material and documentation, while the **National Heritage Council** (NHC) is the authority responsible for the implementation of the National Heritage Act. Both of these institutions reside under the **Ministry Youth, National Service, Sport and Culture (MYNSSC).** One of the more important functions of the NHC is the establishment and maintenance of the Namibian Heritage Register. This function is not yet in operation, and the NHC has not appointed professional staff with the requisite training to carry this out.

The NHC has inadequate professional archaeology capacity and no regulations or guidelines have been formulated to allow practical implementation of the National Heritage Act.

It stands to reason that the escalation of prospecting and mining in the central Namib and elsewhere in Namibia will place even greater pressure on this authority.

Issue of concern	Recommended solution
Inadequate capacity within the NHC	• Hire more professional staff. • Make more use of independent experts. • Consider appointing Honorary Heritage Inspectors.
Important archaeological landscapes and sites threatened by prospecting and mining.	• NHC must work with MME to agree on which important archaeological areas can be excluded from prospecting and mining activities (red and yellow flag areas).

The **Ministry of Agriculture, Water and Forestry (MAWF)** is expected to:

- Promote and facilitate environmentally sustainable development; and
- Manage agricultural resources and the utilization of water resources to achieve sound socio-economic development together with all citizens.

In the context of the Uranium Rush, the main task of the Ministry is the sustainable management of agriculture and water resources.

As with many other government agencies, capacity is limited and the Department of Water Affairs has lost much of its technical expertise in recent years. This is a concern given that this institution is responsible for ensuring the integrity of hydrological systems and aquifers. Even in Scenario 1 of the Uranium Rush, it is doubtful whether adequate due diligence is exercised in the issuing of groundwater abstraction permits and whether there is adequate monitoring of both abstraction and discharge. The paucity of knowledge about Namibia’s aquifers suggests under-investment by government in obtaining adequate knowledge about this vital aspect of Namibia’s natural capital.

Issue of concern	Recommended solution
Potable water quality standards are	• DWA needs to update water quality standards.

less stringent than international norms	
Regulations concerning the discharge of industrial effluents are not gazetted	• Regulations need to be gazetted.
Inadequate due diligence in allocating water abstraction permits	• More caution required: o No abstraction of groundwater should be allowed for mining operations in the central Namib uranium province; o Groundwater abstraction for construction only to be permitted if thorough research shows proven resources and sustainable yield.
Inadequate capacity in DWA to carry out monitoring of pollution and enforcement of laws and regulations	• Increase technical capacity in DWA to carry out inspections. • Create partnerships between DWA and other organisations so that the inspectorate role is shared between many organisations. • Use consultants to fill capacity gaps (short term).

The mission for the **Ministry of Local and Regional Government, Housing and Rural** Development (MLRGHRD) is to provide support to Regional Councils (RCs) and Local Authorities (LAs) to ensure effective and efficient provision of shelter, physical town planning and municipal services in order to improve social and living conditions in general and of low-income groups (in particular) within the concepts of sustainable human settlements development.

In terms of Chapter 12 of the Constitution of the Republic of Namibia, each unit of regional government was to be governed by a RC. The mandate of RCs is as follows:

- "To undertake the planning and development of the region (with due regard to the powers, duties and functions of the National Planning Commission) with a view to:
    - the physical, social and economic characteristics of the region;
    - the distribution, increase, movement and urbanisation of the population;
    - the natural and other resources and the economic development potential of the region;
    - the existing and planned infrastructure;
    - the general land utilisation pattern; and
    - the sensitivity of the natural environment.
- To establish, manage and control settlement areas;
- To assist any LAs in the exercise or performance of its powers, duties and functions;
- To exercise any power assigned to RCs by the laws governing communal land;

- To exercise in connection with its region such powers, and to perform the duties and functions connected with such powers, as may be delegated by the president to the Regional Council in terms of section 29 of the Constitution;
- To exercise any power assigned to the Regional Council by the law governing land which vests in the Government of Namibia by virtue of the processions of Schedule 5 to the Namibian Constitution, or any other power so assigned by or in terms of any other law.”

Under the *status quo*, the RCs will probably not be affected much by the Uranium Rush, although it would be useful if they could become more involved at a strategic level. Local Authorities are likely to be more challenged by the Uranium Rush, since they are expected to maintain the towns where almost everyone involved in mining and other developments, will live. Towns such as Walvis Bay and Swakopmund will probably cope with the cumulative impacts (because their tax base will improve considerably and they have some technical skills), but others may struggle (e.g. Arandis and Usakos).

Issue of concern	**Recommended solution**
RCs do little/no development planning or environmental management	• Closer cooperation between RCs and line ministries is needed to reduce ‘the battle of the plans’ – where sector plans sometimes undermine each other.
RCs structures are not functioning optimally.	• Improve capacity of RCs, but not only through appointing new/more officials. Forging strategic partnerships with other GRN agencies, NGOs, private sector and experts may yield positive results.

The Local Authorities Act 1992 (No 23 of 1992) establishes the system of **Local Government** in Namibia and defines the powers, duties and functions of local authority councils. In terms of this Act, three types of local authority council may be established: a municipality (e.g.Walvis Bay, Swakopmund); a town (e.g. Henties Bay) or a village (e.g. Wlotzkasbaken).

As noted earlier, the Act does not impose any specific obligation on local authorities to address environmental conservation or to promote sustainable development. However, it does grant certain powers that can be used for these purposes. For example, a local authority may, after consultation with the Minister, make regulations in the Gazette concerning “…the restriction, regulation and control of the use of common pasture and town land…”

All scheduled local authorities (including Walvis Bay, Swakopmund, and Henties Bay) are required, in terms of the Ordinance, to prepare a Town Planning Scheme for their area. Whilst a Town Planning Scheme is potentially a very powerful planning and governance mechanism, the council has the power to propose amendments to the Scheme and also, in some circumstances, to allow specified categories of development on merit. In this way, the honest administration of the Scheme is subject to decision makers who may have political or other agendas not perfectly aligned with the Scheme intentions. Fortunately, the final decision on Scheme amendments (rezonings) rests with the Minister, thereby providing an additional level of governance. In addition, most local authorities have begun to require that all major development applications are accompanied by an EIA prepared by a competent environmental consultant. Whilst this is consistent with Namibia's Environmental Assessment Policy, governance in this regard is variable and often inadequate.

Issue of concern	Recommended solution
Inadequate legislation regarding town planning and conservation	• Complete and enact the draft Urban and Regional Planning Bill.
Fast growing towns promote inappropriate and unsustainable development	• Promote the development of Structure Plans that each consider environmental/ sustainable development considerations. • Ensure good governance in the implementation of structure plans. • LAs must promote civil society participation – reduce the current trend of secrecy and poor transparency. • Ensure consistent use of EIA.

The **Ministry of Trade and Industry (MTI)** is tasked with creating an enabling environment for Namibia's economic diversification and growth through the promotion of investment and industrialization and the expansion of export trade. Although the MTI has no land use planning or natural resource management mandate, its activities could affect the management of the Uranium Rush. In consultation and cooperation with local and regional authorities, MTI spearheads the implementation of three major sector programmes:

- Industrial development programme;
- Investment promotion programme; and
- Trade promotion programme.

Various components of the Industrial Development Programme are implemented through the Namibia Development Corporation (NDC), a parastatal linked to MTI. It is the MTI's policy to ensure that all industrial development projects are subjected to EIAs (though practice and policy are not always consistent). A Special Industrialisation Programme was launched in the early 2000s to fast-track the Industrial Development Programme by facilitating the setting up of targeted manufacturing plants, again subject to EIAs. The promotion of domestic and foreign direct investment and foreign trade remain priorities of GRN. Trade and investment promotion is done by enhancing investors' confidence, providing for repatriation of profits, legal protection of investments, and creating a conducive business environment.

One important initiative taken to create a conducive environment for foreign investment and trade was the Export Processing Zone (EPZ) Programme, which commenced in 1996, following the promulgation of the EPZ Act in 1995. The Act provides beneficiaries with exemption from all forms of taxation and allows for the holding of a foreign currency account. Furthermore, the EPZ Act provides for the establishment of the Offshore Development Company, which is mandated to administer and promote the EPZ regime, in conjunction with the Namibia Investment Centre (NIC).

The single largest EPZ project (representing more than 95% of all EPZ investments to date) is the Scorpion Zinc Mine.[1] An EPZ could be located anywhere in Namibia and several specially designated industrial zones and parks have been established, including one at Walvis Bay.[2]

Although the performance of the EPZ programme is generally considered to have been modest in terms of employment creation, the number of newly established EPZ enterprises has been growing. Single EPZ enterprises (and more so specially designated EPZ zones / parks like Walvis Bay, where a number of EPZ enterprises are clustered together) do tend to have an economic multiplier effect on other businesses, infrastructure development, economic diversification and enhanced export activity.

Issue of concern	Recommended solution
Inadequate knowledge of environmental issues in MTI, resulting in failure to guide investors appropriately	• Sensitise MTI staff about environmental issues and the sensitivity of the environment. MTI needs to be more consistent so that it does not cause inter-sectoral tensions by not fully disclosing national requirements to investors.
Whilst the Foreign Investment Act has a discretionary clause that could be used by the Minister (of MTI) to ensure that an EIA is conducted for certain projects, it is thought not to have been used to date.	• MTI should be more pro-active in commissioning Strategic Environmental Assessments for, *inter alia*, EPZs that will contain a number of different industries that might result in cumulative impacts.
Interaction between MME, MTI, MET, MFMR and DWAF to be improved	• MTI must be more pro-active in seeking the advice of appropriate line ministries regarding the avoidance/mitigation of environmental impacts resulting from projects that it facilitates.

The **Ministry of Works, Transport and Communication (MWTC)** is tasked with ensuring the availability and quality of transport infrastructure and specialised services, as well as maintaining government buildings and other infrastructure. Some important parastatals fall under this ministry, including the Roads Authority, TransNamib and Namport – all of which are key stakeholders in the Uranium Rush. As noted in Chapter 7.3, there is an urgent need to upgrade a number of roads in the central Namib, whilst the harbour and rail systems need substantial expansion. An opportunity exists for public-private partnerships to be established to develop new railways for the transport of uranium-related inputs and outputs, as well as commuters.

[1] NDP2, Chapter 19 (Trade and Industry), p.317.
[2] The other existing EPZ zones / parks are at Oshikango and Katima Mulilo, and a similar infrastructural development is planned for the Katwitwi outpost on the border with Angola.

7.15 Summary and Discussion

It is clear from the Cumulative Effects Analysis in this chapter that the effects of the Uranium Rush are wide-ranging, complex and difficult to predict and measure. Although the Terms of Reference for this SEA required the study to focus on the Erongo region, the impacts of the Uranium Rush will ripple through the economies of the region – particularly those of Namibia and South Africa.

7.15.1 Regional Impacts

The Namibian economy is relatively small due to the low population (± 2 million). Thus any new mining project will have a profound impact on employment, GDP and the economy as a whole. The Skorpion Zinc project in southern Namibia is a recent example of where one mine had a major impact: at a local level (the population of Rosh Pinah more than doubled), at a regional level (the expansion of the Port of Lüderitz for example), at a national level (Skorpion boosted GDP by 4%) and at international levels through the procurement of turnkey construction from South African companies and the supply of technology from several overseas companies. Therefore it is reasonable to predict that the Uranium Rush, featuring as a minimum, four operating mines (Scenario 1), and up to eight mines in Scenario 3 by 2020, will have a significant and far-reaching effect throughout southern Africa. The demand for skilled and semi-skilled labour is likely to exceed local supply and employees will be drawn from the more populous parts of Namibia, as well as from neighbouring countries such as Angola, Botswana, South Africa, Zimbabwe and Zambia. How many employees will be sourced from these countries and the economic and social impact this will have on those countries is, however, almost impossible to estimate at this stage.

By its nature, mine construction requires the involvement of large, experienced turnkey contractors, many of whom are based in South Africa. Much of the specialised engineering work, mining plant and building materials will have to be obtained from South Africa and/or overseas. The equipment and materials from South Africa are most likely to be transported by road through Botswana from Gauteng. This will have both positive and negative impacts in Botswana. However, the size and scale of such impacts are extremely difficult to predict since it will depend on which scenario eventually pans out, and the timing of mine development in Namibia and actual procurement practices.

Indeed the impacts of the Uranium Rush will be experienced even further afield: as was noted in Chapter 4, most of the companies identified in the scenarios are based overseas (Canada, Australia, UK and France) and therefore mining development in Namibia will also contribute to the economies of these countries in a small way.

Therefore, while it is acknowledged that the Uranium Rush will cause impacts in many countries in southern Africa and even globally, this analysis focuses on the impacts which will be experienced in the Erongo Region only.

7.15.2 Linkages

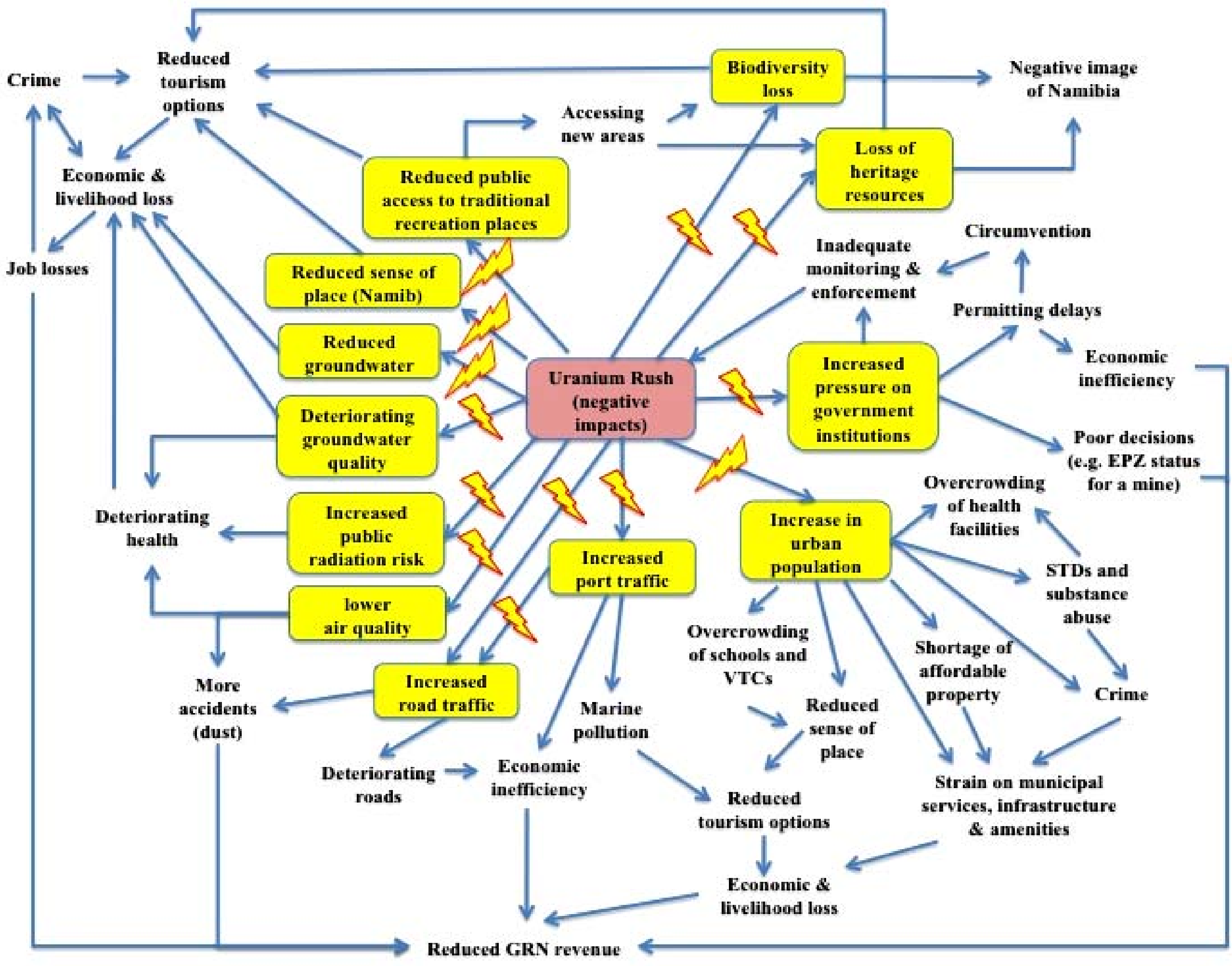
The second difficulty in predicting the impacts of the Uranium Rush is that the impacts are extremely complex and inter-linked. While the direct (primary) impacts may be fairly obvious, the knock-on effects (secondary, tertiary etc. impacts) become more speculative, with multiple outcomes possible.

We have tried to convey this complexity in linkage diagrams (Figures 7.15.1 and 7.15.2). The starting point is the Uranium Rush in its totality and we have constructed a linkage diagram for both the positive and negative impacts associated with the Rush. From the central box (the Uranium Rush), the direct impacts are identified in yellow boxes. Each one of these then becomes a ‘cause’, which has one or more ‘effects’. The diagram is populated by asking ‘if-then’ questions. For example, in Figure 7.15.1, *if* there is increased pressure on government institutions to deal with the Uranium Rush, *then* there may be delays in obtaining permits. *If* there are delays in permitting, *then* projects could be delayed (economic inefficiencies) *and/or* companies may be tempted to circumvent due process. *If* companies do not comply with the necessary legal permit requirements, *then* there will be a reduction in government revenue (from non-payment of permits, delays in project commissioning etc), *and/or* Namibia will get a poor reputation for bureaucratic delays and/or a lax legal environment – neither of which support a good Namibian ‘brand’.

The bottom line in Figure 7.15.1 is that poor management of the Uranium Rush (at whatever level) will ultimately have a profound negative impact on government revenues – either directly through a reduction in the tax base, reputational risks or there may be the need to spend more money on fixing problems retrospectively (rather than spending less through proactive implementation). If the government has a reduced revenue stream, it will have less to spend on addressing other pressing societal needs in Namibia, such as meeting its obligations in terms of the Millennium Development Goals. All of this will tarnish Namibia’s reputation and it may become another casualty of the ‘Resource Curse’.

On the other hand, Figure 7.15.2 shows how, with careful planning, good management and proactive decision-making, the Uranium Rush could become the catalyst for significant economic development, which in turn could contribute to the national fiscus. If, as recommended in this SEA, the GRN sets up some form of ‘Sovereign Wealth Fund’ for sustainable spending on social upliftment projects, Namibia could go a long way towards meeting its MDG obligations in both the short- and long-term. This will ultimately result in an improved quality of life for all Namibians and help realise Vision 2030.

Thus the aim of the linkage diagrams is to demonstrate that one action can have a complex, ripple effect with several unforeseen consequences. The difficulties lie in managing these effects and trying to ensure that the unforeseen negative consequences do not occur or that the impacts are minimised, or that the positive effects are maximised and opportunities taken. The problem is that the responsibilities for managing these disparate effects largely do not lie with the mining companies; the responsibilities rest with a multitude of institutions such as: national government agencies and parastatals, local government, industry and commerce and even NGOs and the research community. Thus management will require strong, multi-disciplinary coordination and sound governance to ensure that the negative consequences are avoided or minimised and the positive effects are maximised. This is addressed in Chapter 8.



Figures 7.15.1: Negative linkages

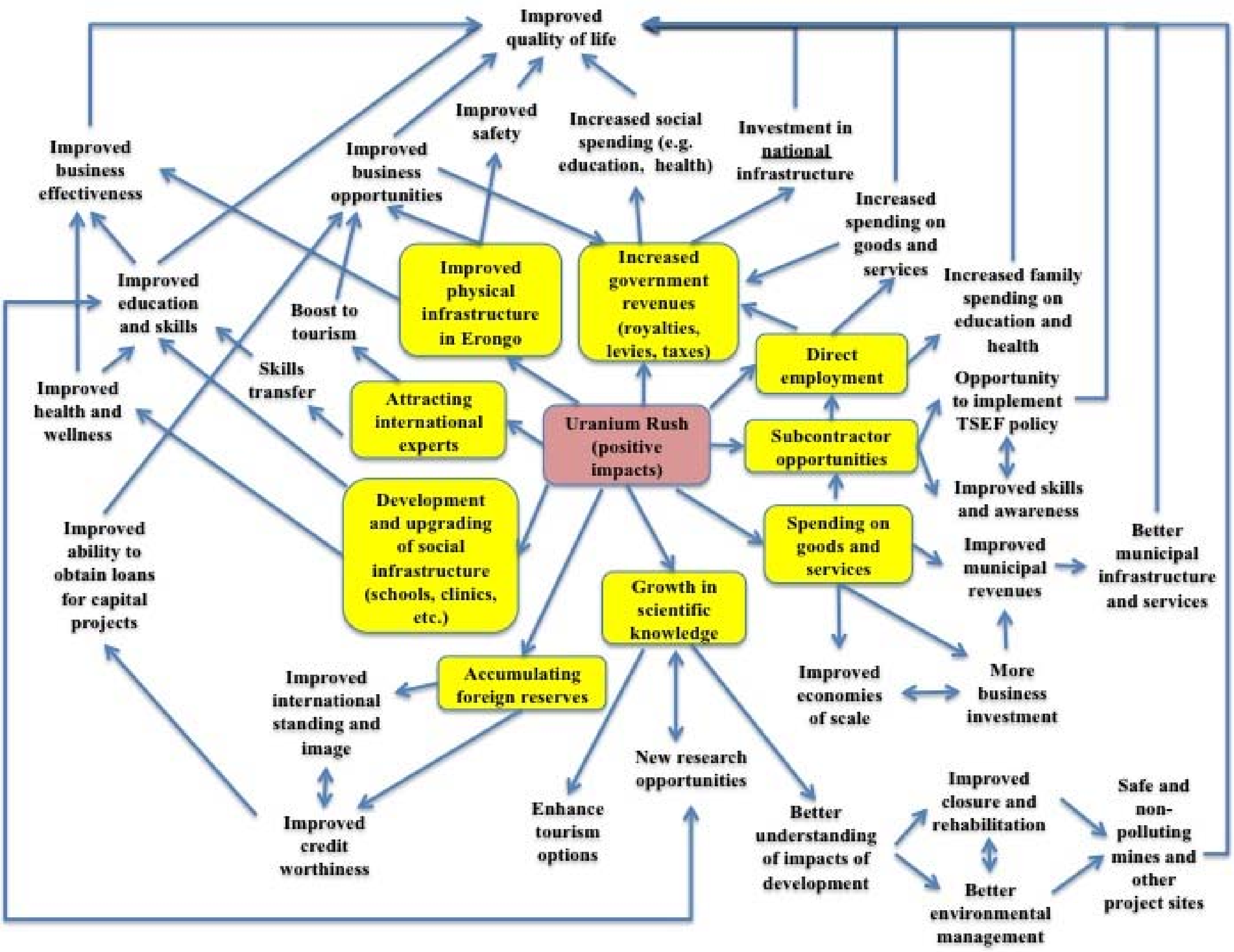


Figure 7.15.2: Positive linkages

7.15.3 Cumulative impacts

One of the main differentiating features between a reactive, project-based EIA and an SEA, is the ability to identify cumulative effects. The Canadian Environmental Assessment Agency defined cumulative effects as "*...changes to the environment that are caused by an action in combination with other past, present and future human actions*." (Hegmann et al. 1999). According to the US Council on Environmental Quality (1977), cumulative effects occur when:

- Impacts on the environment take place so frequently in time or so densely in space that the effects of individual impacts cannot be assimilated; or
- The impacts of one activity combine with those of another in a synergistic manner.

Thus cumulative impacts can occur over different temporal and spatial scales by interacting, combining and compounding so that the overall effect often exceeds the simple sum of the causes (DEAT, 2004).

Table 7.15.1: Examples of different types of cumulative effects and how they relate to the Uranium Rush (after DEAT, 2004)

Type of cumulative effect	Characteristic	Examples from the Uranium Rush
Time crowding	Frequent and repetitive effects	Several mines being developed at the same time.
Time lags	Delayed effects	Potential for a pollution plume to move downstream over many years.
Space crowding	High spatial density of effects	Up to 8 mines within an 80km radius of Swakopmund. Influx of people to the coastal towns.
Cross-boundary	Effects occur away from the source	Road deterioration in Botswana due to import of heavy mining equipment and building materials. Boost for South African construction companies.
Fragmentation	Change in landscape pattern	Fragmentation of habitat by multiple linear developments e.g. mine access roads, water pipelines, power lines, railways etc.
Compounding effects	Effects arising from a multiple sources or pathways	Radiation exposure from aqueous and atmospheric pathways.
Indirect effects	Secondary effects	Development of support industries e.g. Gecko Chemicals, desalination plants
Triggers and thresholds	Fundamental changes in system functioning	Climate change

In view of the speculative nature of the Uranium Rush, we can postulate some of the cumulative effects but it is difficult to assess them further in typical EIA terms of magnitude, extent, duration and significance. Thus in order to visually depict the cumulative impacts of the Uranium Rush, we have 'stacked' up the positive and negative effects in Figure 7.15.3 to show which environmental aspects will be most affected. As would be expected, there are both positive and negative effects for all aspects, but the actual scale of the relative contribution of each impact to the total cumulative effect is impossible to determine at this stage.

Predictably, the sense of place of the desert will be most negatively affected by the Uranium Rush through visual impacts, noise, increased dust, traffic, people and the intrusion of infrastructure in the open, untrammelled landscapes of the Namib, most especially in the National Park. These impacts will undermine the very aspects of the environment that tourists value and come to experience. Furthermore, even with the best efforts of mitigation and mine closure, the sense of place in the Namib will be altered forever. However, it is believed that tourism offsets i.e. developing other sites of interest away from the influence of the mines could help to minimise the overall impacts on tourism. In addition, there will be far more people residing in the coastal towns which could give rise to more opportunities for the tourism sector and an increase in business tourism can also be expected. In spite of these benefits, there will be a net loss of sense of place.

Linked to the above, is the cumulative impact of the Uranium Rush on biodiversity. New mines and all related infrastructure will have a direct impact on biodiversity through species loss and displacement due to landscape disturbance. It is also expected that the linear infrastructure corridors will act as barriers to species movement thus further disrupting natural processes. Due to the high levels of endemicity in the Namib and the very localised distribution and small populations of some species, these two types of impacts could lead to changing relative abundance and predator-prey relationships, diminishing populations of some species, and the dying out of others, including the extinction of range-restricted species in some instances. Again, avoidance and mitigation measures can help reduce the impacts to a limited extent, but there will be a net loss of biodiversity caused by the Uranium Rush and few benefits (Figure 7.15.3).

Figure 7.15.4 shows the combined Red and Yellow Flag areas for tourism, biodiversity and archaeology. It can be seen from this map that the sensitive areas overlap in several key places indicating that it is the combination of spectacular scenery, rich and unusual biodiversity and a long record of human habitation that makes these areas so special and worthy of protection in the long-term. Fortunately, most of these areas are not directly affected by the mines currently envisaged under Scenario 3 e.g. Brandberg, Erongo, Messum, Spitzkop etc, but some areas will be directly and indirectly affected, as highlighted in this report. These areas include the Khan, Swakop and Kuiseb valleys, the gravel plains of the NNP and the Welwitschia Flats which all coincide with the main uranium province.

Health and social structures will also experience a high level of negative cumulative effects (Figure 7.15.3). As discussed in section 7.12, increased exposure of the public to radiation via groundwater or atmospheric pathways is unlikely, but there will be far more people exposed to radiation at an occupational level.

Health	Water pollution	Air pollution	Radiation	Road accidents	Stress on health care facilities	Risk of AIDs, TB etc	Increase in occupational health risks & mine accidents			
	Improved health care facilities	Increase in personal spending on health care	Improved health awareness and wellness	More job opportunities for health care workers						
Infra-structure	Increase in traffic on roads	Road deterioration	Cost to upgrade roads	Inadequate capacity in GRN to manage major projects	Port congestion due to increase in shipping	Economic inefficiencies				
	Improved/upgraded road infrastructure	Improved road safety	Improved power supply to coast	Improved port infrastructure	Improved railway network	More job opportunities in the transport sector				
Sense of Place	Increase in urban population	Landscape changes	Aesthetic impacts (visual, noise etc)	Increase in traffic	More industrial development	Reduced tourism options	Reduced public access to recreation areas in desert	Loss of national park integrity		
	Tourism offsets	Increased business tourism	More job opportunities in the tourism sector							
Water	Potential for water pollution	Possible reduction in groundwater flows & yield								
	Improved availability of water at coast	Improved economic opportunities due to water availability	More job opportunities in the water sector							
Government Revenue	Inadequate GRN capacity to implement projects	Loss of revenue due to granting EPZs to mines	Inefficient tax & royalty capture							
	Increase spending on national education	Increase spending on national health care	Incr. spending on municipal service delivery	Incr. spending on capital projects	More business investment	Accumulation of foreign reserves	Improved credit worthiness	More job opportunities n the government sector		
Social Structures	Influx of job seekers to coast	Increase in population	Increase pressure on schools	Increase pressure on municipal services & amenities	Increase in house prices	Increase in informal settlements				
	Increase in direct employment	Increase in employment of subcontractors	Increase spending on goods and services	Increased personal spending on education & health care	Increase in international experts	Increase opportunities for skills development & transfer	Increase in municipal tax base	Improved quality of life	Improved municipal infrastructure e.g. roads, sewerage	Improved social infrastructure e.g. schools, amenities etc
Biodiver-sity	Direct loss of species	Fragmentation of habitat	Reduced biodiversity	Smaller populations of species	Possible extinctions	Reduced tourism opportunities				
	Growth in scientific knowledge	Research opportunities	More informed rehabilitation & closure of mines							

Figure 7.15.3: Cumulative impacts of the central Namib Uranium Rush

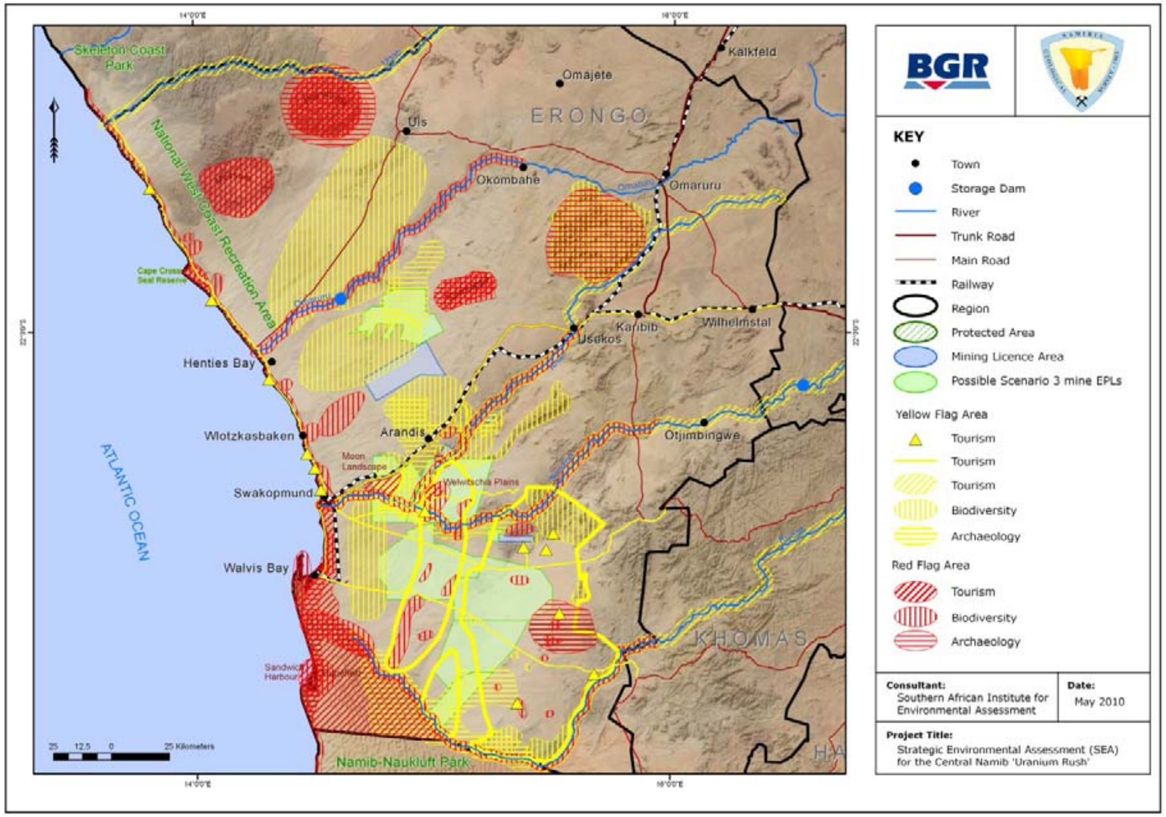


Figure 7.15.4: Combined Red and Yellow Flag areas for tourism, biodiversity and archaeology

Probably the greater impact on community health will be from an increase in the transfer of communicable diseases due to the influx of people to the coast and road traffic accidents. In section 7.13, it was found that there is a high risk of HIV/AIDS, other STDs and TB increasing in prevalence. The higher population coupled with the potential increase in disease could place considerable strain on an already overburdened health care system, if no further facilities are provided. On the positive side, a new health care facility catering specifically for occupational health issues relating to uranium mining is being built in Swakopmund, but more general health care facilities and personnel will be needed to cope with the increase in numbers. Furthermore, greater employment should have the twin benefits of increased spending on family health and mine-wide wellness programmes. The cumulative impact of radiation exposure from the existing new mines was found to be negligible, even under Scenario 3 and at the closest receptors (Arandis and the farms at Hildenhof and Palmenhorst).

Social structures and demographics will be profoundly affected by the influx of people from all over Namibia, southern Africa and overseas to the live in the Erongo Region. The larger towns of Swakopmund and Walvis Bay should be able to assimilate the increase in population more easily than the smaller towns of Arandis and Usakos, where social infrastructure is poor. However, all towns will feel the strain on aspects such as schools, amenities and sports facilities, waste management, sewerage and house prices (Figures 7.15.1 and 7.15.3). Having said that, the towns will also experience the most benefit from the Uranium Rush (Figures 7.15.2 and 7.15.3); a larger population will mean a bigger municipal tax base and commerce and industry should thrive.

The Uranium Rush in its widest sense will also result in both positive and negative impacts on infrastructure. A significant increase in traffic on the main tarred roads, as well as the unpaved gravel roads in the NNP, will cause a deterioration of the road surface and this, plus the increased amount of traffic will likely result in an increased risk of road accidents. In order to avoid this, the GRN will have to spend a considerable amount on road upgrading in the region. The Port of Walvis Bay is currently operating at capacity and needs to be expanded to prevent congestion. Delays at the port will cause considerable economic losses for those mines dependent on imports for uninterrupted operation and for the export of uranium oxide. If however, the government by itself or in partnership with the mining companies or other financial development agencies decides to fund large capital projects relating to road upgrading, port expansion, provision of electrical power and strengthening of the railway network, there will be huge benefits for the coastal communities, as well as for other parts of the economy (Figures 7.15.2 and 7.15.3).

One of the most contentious and important issues at the coast is water. During the public meetings the public expressed major concerns over the availability of water, the cost of water and the potential impact that the mines may have on water quality. First of all, water for the mines will have to come from desalination plants and therefore there should be greater availability of groundwater for coastal users in the short-term at least. Secondly, DWA has stated that the higher cost for the desalinated water should be borne by the mines, until such time as domestic demand also has to be met by a portion of desalinated water and therefore current pricing structures will not change in the near future. Finally, the groundwater investigations and modelling done for this SEA (see section 7.4 and stand alone reports to be made available by MME) showed that the water quality in the lower Swakop River used by irrigation farmers is unlikely to be affected by the mines, even if a local pollution event does occur. It is therefore expected that the Uranium Rush will have a net benefit on water.

The biggest beneficiaries of the Uranium Rush should be the nation and people of Namibia, so long as GRN can manage the Uranium Rush efficiently and can effectively capture resource rents and taxes. The increased flow of money into the fiscus should, if managed carefully, allow the government to increase its budget allocations for schools, health care, service delivery and capital projects throughout the country. Increased revenue should also help improve the government's balance of payments and improve its international credit ratings. All of this will boost the investment climate in Namibia and thus the country will become more favourable for business investment (Figures 7.15.2 and 7.15.3). The Uranium Rush should therefore have a net positive benefit on government revenues and quality of life for all Namibians.

8 STRATEGIC ENVIRONMENTAL MANAGEMENT PLAN AND INDICATORS

8.1 Introduction

Since SEA is driven by the concept of sustainability, the logical consequence of an SEA should be guidance on how sustainability principles can be mainstreamed throughout the life cycle of activities and projects. This guidance is provided through the Strategic Environmental Management Plan (SEMP) which will be overseen by a broad-based SEMP Steering Committee and managed by a dedicated SEMP office (see section 8.3 below).

The SEMP is an **over-arching framework** and roadmap for addressing the cumulative impacts of a suite of existing and potential developments. The manner in which this is achieved is by setting limits of environmental quality (i.e. performance targets) that need to be achieved by the proponents of individual projects. In situations where a SEMP exists, individual EMPs prepared for each mine or project, will need to incorporate all relevant environmental management specifications (Figure 8.1). Thus, the SEMP does not remove the obligation from a developer for conducting a project-specific Environmental Impact Assessment (EIA) and abiding by a site-specific Environmental Management Plan (EMP). On the contrary, all projects listed in the Environmental Management Act (EMA) of 2007, must undergo an EIA prior to authorisation and implementation. Moreover, each project has a number of permit obligations that must be met for the developer to be in full compliance with the law.

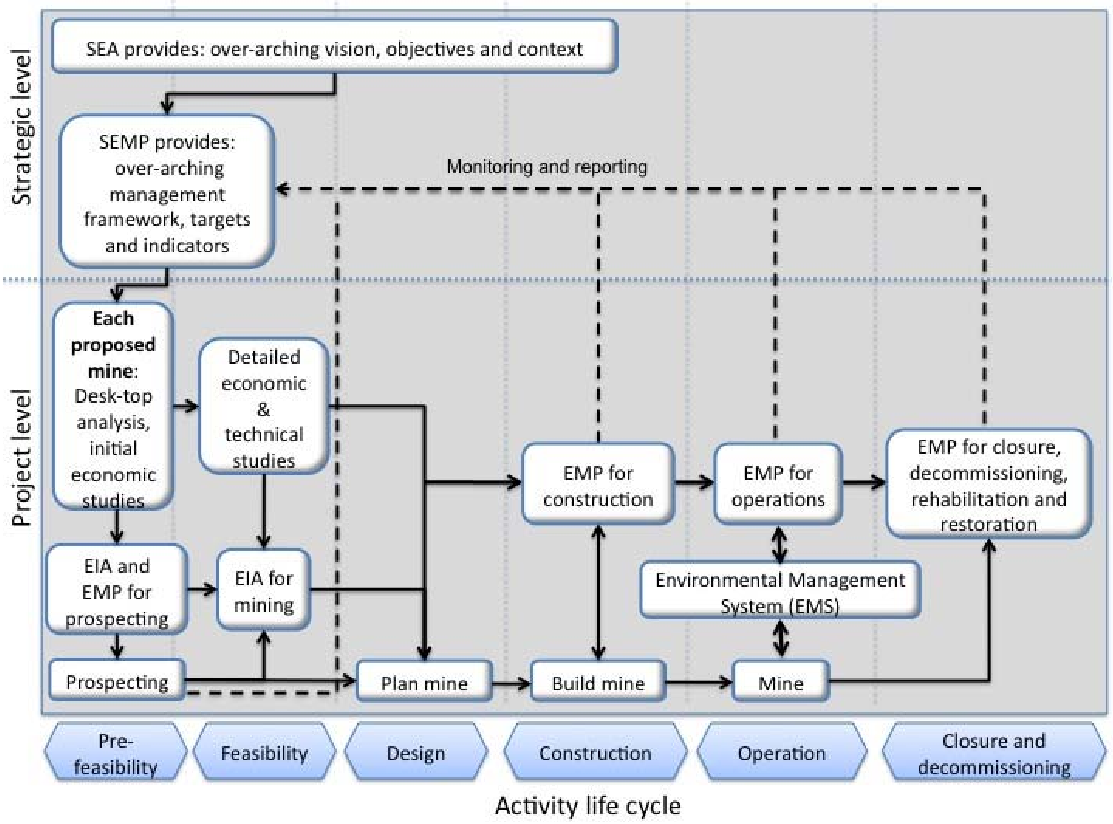


Figure 8.1: Planning hierarchy from strategic to project levels (source: modified from DEAT 2002)

In most examples found in the literature, a SEMP follows a broad land use planning process or Regional SEA, in which case it directs what should be allowed in an area and how it should be implemented. However, the Central Namib Uranium Rush is neither a policy, plan nor programme, but rather a collection of mining and related projects, each being conducted by individual companies that are not related to each other, and in many cases, undertaken in isolation of each other. The SEA will not stop any of these projects, as some (e.g. Rössing Uranium mine) have been in operation for many decades and others are in an advanced stage of planning. However, since all projects need to revise their implementation plans and strategies from time to time, the proponents will still benefit from the SEA and the accompanying SEMP. In many cases, there are projects still at the pre-feasibility stage, and some not yet identified. These 'newcomers' will gain a great deal from the SEA and SEMP. Thus, the SEMP is intended to guide both mining and other related industrial developments in the Erongo Region so that they do not unnecessarily compromise the natural, social, economic and physical environments.

In order to present a SEMP that is useful for guiding development along a sustainable pathway, the SEA initially developed a good understanding of the 'forces and dynamics' of the uranium industry, and the extent to which mining has led to the development of other industries (e.g. chemical production), the need for infrastructure (e.g. roads, pipelines and powerlines) and the need for other resources (e.g. water, energy, labour and social infrastructure). In this way, it was possible to understand the cumulative impacts of the Uranium Rush.

However, uranium mining is only one part of the picture. In the central Namib, there are other industries that have individual and cumulative impacts, and many activities beyond the Erongo Region and Namibia add to the multitude of positive and negative impacts that need to be managed. Whether global, national or local, coupled or stand-alone, a multitude of activities and projects **drive the economy**. It is important in the context of Namibia and the Erongo Region's relatively small economy, to maintain and increase the diversity of investments so that the country can withstand shocks such as the recent global economic crisis. Also, a diversified economy will be less vulnerable when the Uranium Rush tails off or ceases altogether.

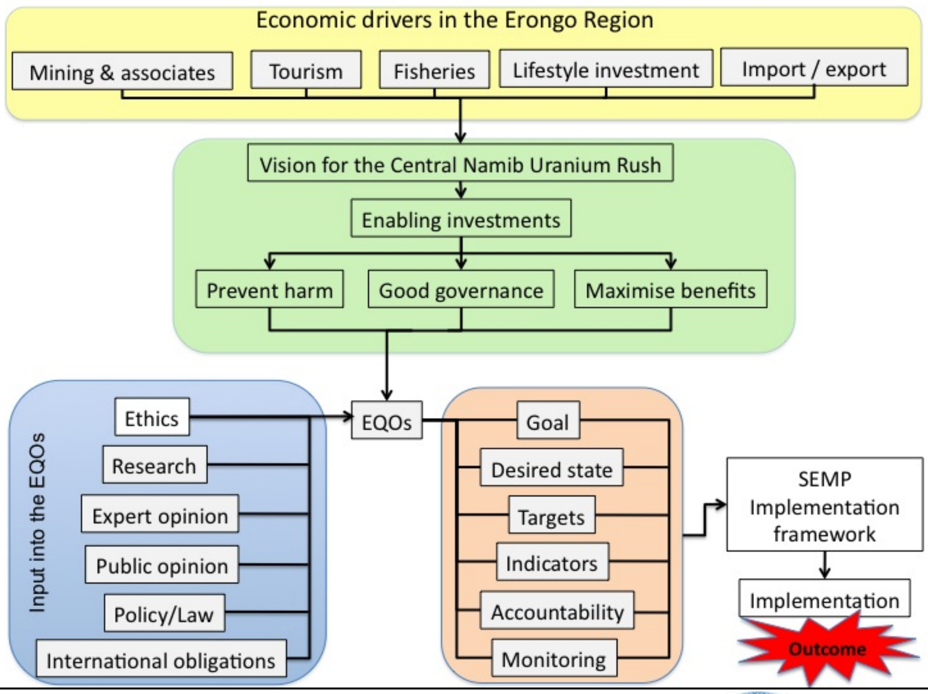


Figure 8.2: The broad sequence of activities that culminated in SEMP development

An understanding of the development drivers and the vulnerability of the receiving environment has led to the identification of the **responses needed at strategic levels** – particularly from high level decision makers, be they government, parastatal, local authority or corporate. They are primarily responsible for ensuring that public fears are addressed and aspirations are met, and that an enabling environment is created for sustained growth and development. Similarly, developers are responsible for implementing best practice, whether defined by local legislation or industry norms. Good practice means doing more than the bare minimum. The uranium industry (and others) must contribute willingly and generously to worthy community initiatives, co-invest in physical, social and human development and help maintain ecological integrity. Paying taxes and royalties is the bare minimum; best practice requires an extra effort.

Fundamental to the development of the SEMP was setting the Environmental Quality Objectives (EQOs) to try and define the limits of acceptable change that can be tolerated due to the Uranium Rush. As noted in Figure 8.2, and in Chapter 2, developing the EQOs required a combination of public and expert opinion, scientific research and an examination of policy, ethical and legal requirements. These informants constituted the **'input'** into the EQOs. The EQOs each articulate a specific goal, provide a context, set standards and elaborate on a small number of key indicators that need to be monitored. These collectively make up the SEMP (see section 8.4), which is the framework within which individual projects need to be planned and implemented and within which a number of institutions need to undertake certain actions. If the required investments are made (e.g. physical and social infrastructure), institutions are strengthened and partnerships are forged, governance is improved and individual projects are well planned and implemented, there is a good chance that the Uranium Rush will contribute significantly to the goal of sustainable development of the Erongo Region and Namibia. This is the desired **outcome**.

8.2 Vision, EQOs and indicators

For the Erongo Region to achieve its vision of producing an environmentally-friendly uranium 'brand', there needs to be a concerted and sustained effort by all stakeholders to commit to the EQOs and the recommendations made in this SEA. Of course, this commitment requires the 'bottom line', or in this case 'triple bottom line', to be articulated in precise and practical terms.

Knowing what needs to be done, and what can realistically be done to avoid or reduce negative impacts, enhance benefits and maintain good governance, required months of research, extensive public participation and careful analysis of issues and options. Having done this, the SEA team identified 15 Environmental Quality Objectives (EQOs) that are a collective proxy for measuring the extent to which the Uranium Rush is moving the Erongo Region towards or away from a desired future state. There are 30 desired outcomes, 43 targets and 118 indicators spread across the EQOs (Figure 8.3).

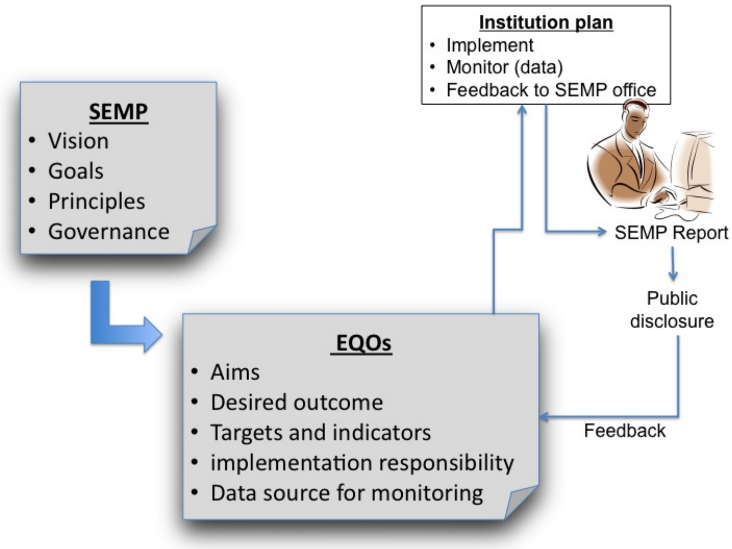


Figure 8.3: The structure of the SEMP and the public disclosure process

An EQO is typically a non-enforceable goal, which specifies a target for environmental quality which, it is hoped, will be met in a particular environment. If EQOs are set by regulation, they are usually referred to as Environmental Quality Standards. For the purposes of the Uranium Rush SEA, we use the term EQO, whether the objective is defined by 'society', policy, law or International Agreement(s).

In some cases, EQOs are a vague form of generally desirable objectives, but in other cases, they might be concrete quantitative measures. Wherever possible, they should be acceptable to all key stakeholders, quantifiable, verifiable and outcomes oriented.

Implicit within all EQOs is a minimum management objective that any changes to the environment must be within acceptable limits and that pro-active intervention will be triggered by the responsible party to avoid unwanted changes that breach a specified threshold. Whilst many of the EQOs are interrelated and thus difficult to compartmentalise, they are arranged under broad themes for purposes of illustration (Figure 8.4).

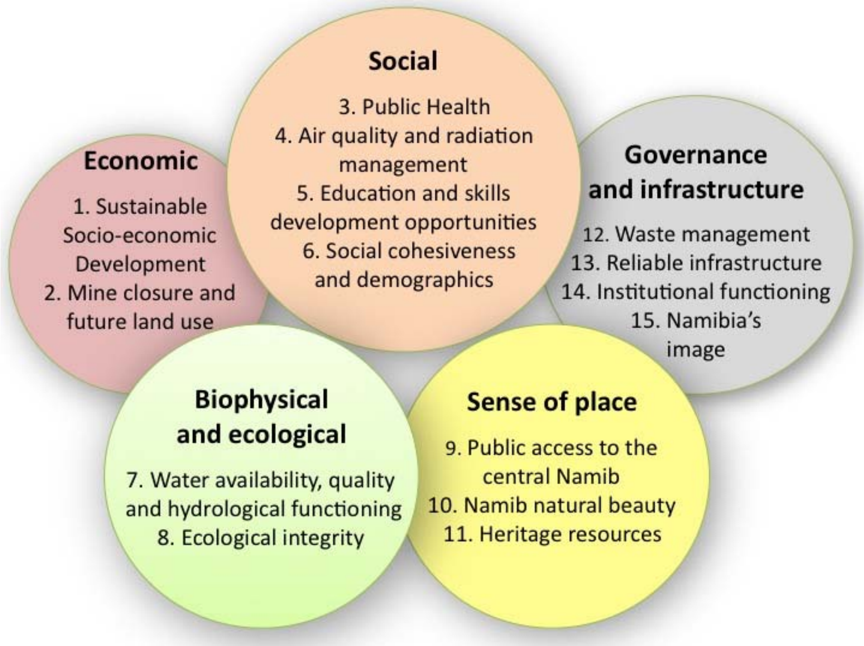


Figure 8.4: The 15 EQOs clustered within broad themes[1].

8.3 Management, monitoring and reporting

Throughout this SEA, stakeholders repeatedly asked "who will manage the Uranium Rush"? This is a valid question given that Namibia has a shortage of skills generally, and especially at management level.

The best way for Namibia to manage the Uranium Rush is for decision makers at all levels to enter into meaningful partnerships with each other, so that the country can utilise all available skills. However, it is recommended that Government take overall responsibility for implementing the SEMP, through a close partnership between MME and MET. There thus needs to be a broad-based steering committee that oversees the functioning of an office to administer the SEMP (hereafter referred to as the SEMP office), that should be based both in Swakopmund and Windhoek (Figure 8.5).

The SEMP office needs only a small number of full-time staff members, who will manage all the monitoring, communication and reporting. The SEMP office must collate the data required to assess the key performance indicators listed in the EQOs (see section 8.4) and compile the annual SEMP report. Data for many of the indicators are already being collected by various institutions for various purposes (e.g. tourist satisfaction surveys, wildlife monitoring, infrastructure inspections), but more work may be required to set up new monitoring programmes and establish the necessary sampling and reporting protocols (radiation, groundwater and air quality). Therefore the SEMP office will have to manage field work programmes with support from specialist institutions such as Gobabeb, GSN and DWA. Tasks such as questionnaire surveys could be conducted by students or tour operators, etc. Ideally, the work could be done efficiently and cost-effectively, but the quality and integrity of data must not be compromised.

Seed funds for capacity building in MME have been secured through the current BGR-GSN Project

[1] The EQOs are not presented in order of priority – all are equally important.

for Technical Cooperation. MME, MAWF and MET will need to integrate their specific tasks into their strategic plans. It is expected that the uranium industry will contribute towards funding the SEMP office in the future, and that the Chamber of Mines will facilitate this.

It is recommended that the SEMP Steering Committee meets twice per annum, early in the year (February) and then again in October. The first meeting will approve the annual work plan, while the second meeting will review the draft SEMP report. After this meeting, the SEMP office will be in a position to finalise the report so that it can be released to the public by end November each year.

The proposed Terms of Reference for the SEMP Steering Committee are as follows:

- Voluntarily serve the SEMP process (i.e. no salary, sitting allowance, per diem, etc.);
- Appoint/reappoint[2] the SEMP coordinator and assistant (should be a 3-year contract, renewable);
- Approve annual work plan, responsibilities and budget;
- Source funds for the budget;
- Review and approve the annual SEMP report;
- Advise GRN on SEMP and Uranium Rush progress and dynamics (i.e. refine/adjust scenarios).

The SEMP coordinator should be an institution, which is contracted by the GRN through the Steering Committee, to develop and nurture partnerships, oversee monitoring and data gathering, and compile the SEMP annual report.

Monitoring and auditing of the implementation of the plan or programme is required to assess whether the sustainability criteria are being met and the guidelines are being adhered to. A monitoring and auditing programme should be developed for this purpose. The sustainability indicators, formulated as part of the SEA, are tools that can be used for monitoring the extent to which the sustainability criteria are being met. Monitoring and auditing guides the adjustment of the plan and projects, as well as the extent to which enabling investments are being made and institutions are functioning adequately (Figure 8.6).

[2] Through MME

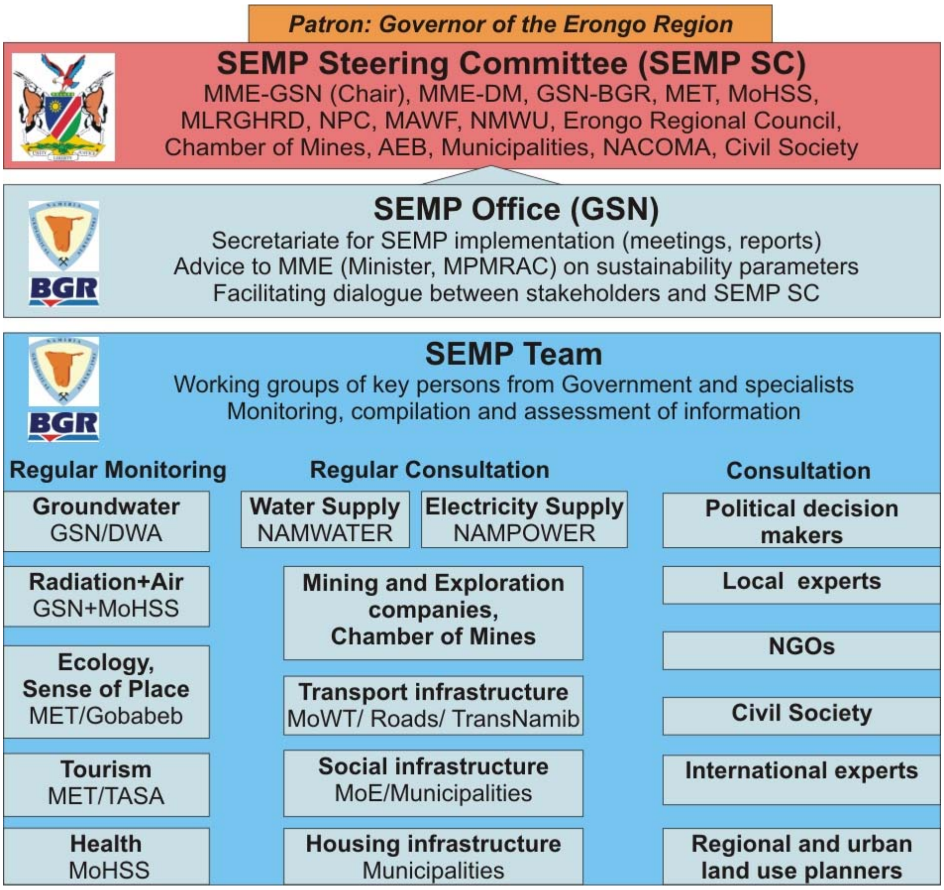


Figure 8.5: Proposed structure for the management of the SEMP

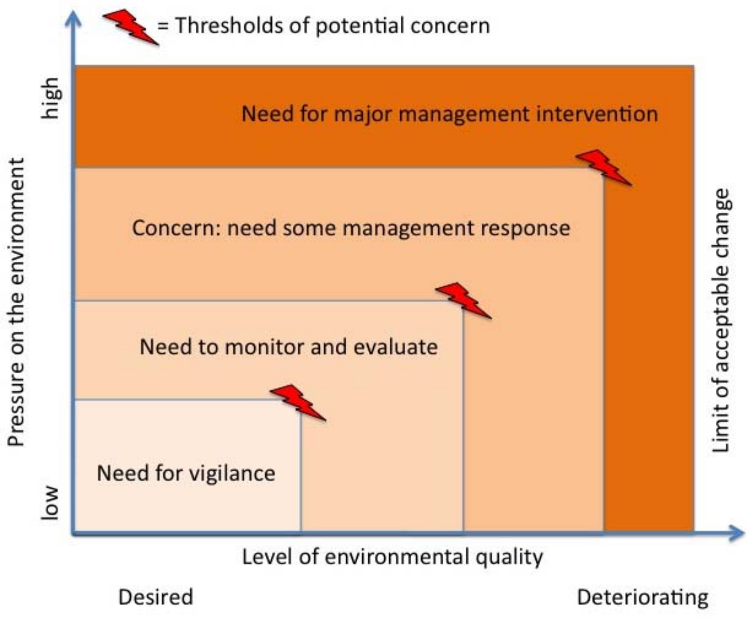


Figure 8.6: Using a precautionary approach to managing strategic impacts in relation to the limits of acceptable change (Source: adapted from Binedel and Brownlie, 2007)

The information obtained through monitoring and auditing is required for completion of an annual

SEMP report and refinement of the EQOs, their indicators and data gathering methods. It is important that procedural arrangements are established and maintained to ensure that the monitoring system runs effectively and that data from year to year are replicable, comparable and auditable. Also, it should be noted that monitoring does not end with the collection of environmental information but includes their evaluation, interpretation, reporting and recommendations for corrective action. Information received through monitoring can be of assistance when considering appropriate remedial action by the relevant stakeholders.

Thus, the SEMP office, with assistance from its many partners, must produce an annual SEMP report that provides a clear indication of what targets are being exceeded, met or not met. The recommended structure for the SEMP report is shown in Box1.

BOX 1: EXAMPLE OF THE TABLE OF CONTENTS FOR THE ANNUAL SEMP REPORT

Title and period: e.g.

- Uranium Rush SEMP Report, 2010
- Compiled by (Name) and date completed

Inside page

- Address of main author(s)
- Citation (e.g. Uranium Rush SEMP Report, 2010. Published by the Government of the Republic of Namibia, Ministry of Mines and Energy, Windhoek)
- Disclaimers (if any)
- Place where copies of the report may be obtained (e.g. GRN website)

Executive Summary (<5 pages, includes key findings, conclusions and recommendations)

Acknowledgements

- Co-authors
- Data gatherers and data providers
- Sponsors
- Steering Committee

EQOs and indicators (keep this succinct – preferably < one page per indicator)

- Name of EQO
- Description of targets and indicators
- Status of performance: Exceeded/met/not met/unsure
- Assessment: Narrative report on status of performance – include tables/graphs that illustrate the most important trends. Key questions are:
  - What are the root causes for good/poor performance?
  - Are there lessons to be learnt?
  - Is there a need for modifying the indicator?
  - Do we need to improve/change monitoring methods?
- Data source: List who provided the data, and the locality of the data (for future reference). The data do not need to be in the SEMP report – they could be bound into a separate report.
- Public consultation and input:
  - List the extent to which communications or submissions were received from the public. Space permitting, letters/faxes/emails or SMSs can be attached, or at least referenced.
  - List dates, venues, agendas and minutes of meetings held (if any).

Annexures (results, lab reports etc)

8.4 Environmental Quality Objectives

As illustrated in Figure 8.4, the following 15 EQOs are grouped according to the following themes:

- Economic: EQO 1-2
- Social: EQOs 3-6
- Biophysical and ecological: EQOs 7-8
- Sense of Place: EQOs 9-11, and
- Governance and infrastructure: EQOs 13-15.

Since the EQOs are a synthesis of the content and analysis provided in Chapter 7, the reader is referred to Chapter 7 for more detailed background information. The EQOs presented below provide the key targets and indicators, together with the relevant organisation(s) responsible for the implementation of the actions required to meet the targets. The sources of the data needed for monitoring, are also indicated.

EQO 1: SUSTAINABLE SOCIO-ECONOMIC DEVELOPMENT

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

Desired outcome	Target[3] and performance indicators	Party responsible for implementation	Data source
1. Income and economic opportunities from the Uranium Rush are optimised	**Target**: Contribution of mining to the economy increases over time **Indicators:** • Royalties are paid in full by mining companies • Corporate taxes are paid in full by mines and associated companies	• Mines must pay the royalties, taxes, and other fees • MME & MoF must ensure that payments are done	• GRN budget documents (estimates of income) • GRN accountability report (e.g. show any deviations on default rates) • Mine and MME annual reports
	• Increasingly, inputs are sourced locally rather than imported	• Mines • Chamber of Mines must provide encouragement	• Mine and CoM annual reports
	• Uranium mines are not granted EPZ status	• MTI	• MTI

[3] There are other indicators relevant to this EQO that are not included here, such as minimising opportunity costs, co-investing in infrastructure, etc. They are omitted because they are covered by other EQOs.

EQO 2: MINE CLOSURE AND FUTURE LAND USE

Aim 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.

Desired outcome	Performance targets and indicators	Party responsible for implementation	Data sources
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**: • 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 stakeholder 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 review. • Closure plans must have written GRN approval. **Indicators**: • The contents of the plan are consistent with the IAEA guidelines, Namibian regulations and policies and the Namibian Mine Closure Framework.	• Mines • MME	• Mine closure plans • MME

2. Mines have adequate financial resources to close operations responsibly and to maintain adequate aftercare.	**Target:**
	• 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.
	
	Indicators:
	• Closure cost estimations contained in the closure plan
	• Financial audit reports of the closure fund.
		• Mines
		• MME
		
		• Mines in conjunction with the regulators
			• Mine closure plan
			
			• Financial audit reports

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:**
	• Adequate regulations applicable to mine closure are contained in the relevant legislation.
	
	Indicators:
	• 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.
		• MME	• Regulations to the Minerals Act

EQO 3: PUBLIC HEALTH

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

Desired Result	Targets and Performance Indicators	Party responsible for Implementation	Data Source

1. Disease rates amongst the public and employees of the mining and associated industries are not increased as a result of the Uranium Rush	**Targets:**
	• 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 does not exceed 1 mSv per annum above background.
	• Dose limits for practitioners working with radiation sources, e.g. mine employees, industrial radiographers, medical radiographers, radiologists (doctors) do not exceed 20 mSv per annum averaged over 5 years, i.e. 100 mSva over a 5 year period with a ceiling of 50 mSv per annum in a single year.
	• 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
		• Mines (which must undertake regular environmental and health monitoring)
		• Chamber of Mines
		• Ministry of Mines and Energy
		• Ministry of Health and Social Services
		• Ministry of Environment and Tourism
		• National Radiation Protection Authority
		• Ministry of Works, Transport and Communications.
			• Individual mines
			• Chamber of mines
			• Namibian Cancer Register
			• Road accidents statistics

	• Industrial dermatitis. • No increase in road accidents directly attributable to Uranium mining and its support industries. **Indicators:** • Public dose assessments produced by each mine project • Measured change in absorbed radiation dose of uranium mine workers and medical professionals (designated radiation workers) • Measured change in the incidence rate of industrial diseases amongst uranium mine workers. • Measured change in the incidence rate of diseases scientifically attributed to radiation amongst members of the public, uranium mine workers and medical personnel • Measured change in the rate of road accidents in Erongo Region directly attributable to uranium mining		
2. Improved Healthcare Facilities and Services[4] are able to meet the increased demand for healthcare resulting from the Uranium Rush	**Targets:** • An increase in qualified health workers available to all in the Erongo Region, reaching 2.5 per 1000 of the population by 2020 • 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 • An increase in ambulances in Erongo, reaching 1 per 20,000 by 2020 **Indicators:** • Number of available qualified healthcare personnel: 2.5 per 1000 of population • Number of available registered healthcare facilities: 1 per 1000 • Number of available ambulances: 1 per 20000 • Number of Medical Practitioners: 1 Per 1000 of population	• Ministry of Health and Social Services • Private Healthcare providers	• National and local statistics

- [4] There is no consensus on the ideal number of healthcare workers per 1000 of population, which differs from region to region depending on a large number of fundamental factors. The figures stated here are based on the consensus opinion of the group of local medical practitioners in Erongo region.
-

	• Number of Dental Practitioners: 1 per 2000 of population • Number of nurses: 2.5 per 1000 of population • Pharmacists: 1 per 2000 of population		

EQO 4: AIR QUALITY AND RADIATION MANAGEMENT

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

Desired Outcome	Target and performance indicators	Party responsible for implementing the EQO	Data Sources
1. Annual radiation exposures to the public via air are not significantly increased as a result of the Uranium Rush	**Target:** More accurate public dose assessments shall demonstrate that the cumulative radiation dose to members of the public does not exceed 1 mSv/a, or that the dose to members of the public does not exceed 0.25 mSv/a for contributions from any single operation. **Indicators to be monitored in air:** • Radon exhalation rates from ground through continuous monitoring. • Gross alpha/beta-analysis and determination of uranium and thorium by NAA within the inhalable (PM10) fraction of air filters • Gross alpha/beta-analysis and determination of uranium and thorium by NAA within dust fallout samples.	• Mines must prevent contamination of water and air and must monitor air quality • The NRPA must ensure compliance by the mines • Road authorities must maintain national transport infrastructure • MME, MLSS and NRPA must ensure that mines comply with (or exceed) permit requirements	• Mine radiation management reports (that are sent to the NRPA) • DWA and NRPA verification reports • Transport Authority reports • MME Annual Reports • Chamber of Mines annual reports

2. Annual human exposures to particulate concentrations are acceptable (IFC Standard)	**Target:** Ambient PM10 concentrations at public locations 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. **Indicators:** • Ambient PM10 monitoring (µg/m^3) at Swakomund, Walvis Bay, Arandis, Goanikontes and Henties Bay • Installation of an accredited meteorological station at Swakopmund measuring hourly average wind speed, wind direction, temperature, solar radiation, humidity and rainfall. **Other performance targets:** • 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. • PM10 samplers can be implemented by individual mines to track progress with mitigation measures. PM10 samplers should not be placed close to main dust generating sources at the mine but rather some distance away within the main zone of impact. • Public roads that will act as main access routes to mining operations should be paved or changed into salt roads. This will reduce dust generation from these roads. **Other monitoring objectives:** • Calibration of PM10 samplers and meteorological station as per manufacturer's specification. • Use of accredited laboratories in the analysis of PM10 sample	• Mines must monitor and mitigate dust generating sources • The Ministry of Health and Social Services must ensure compliance with air quality requirements from the mines • MME must implement and operate PM10 samplers at identified receptors • MME must have an Erongo based monitoring programme that provides overall picture – and this must feed back to the public and individual mines	• Mine air quality management reports • MME Annual Reports • Chamber of Mines annual reports • Erongo PM10 and dust fallout monitoring database

	filters. • Quality checks must be performed on meteorological data including span checks and data availability. • Develop a monitoring database providing information on measured PM10 concentrations. This information should be available to the public in a format that is both scientifically sound and understandable.		
3. Nuisance dust resulting from the Uranium Rush is within acceptable thresholds	**Target:** Dust fallout levels at residences in towns should not exceed the recommended limit of 600 mg/m^2/day. **Indicators:** • Continuous dust fallout measurements (mg/m^2/day) on a regional scale e.g. maintain existing SEA dust fallout network. • Mines must implement a dust fallout network, measuring dust fallout at main dust generating sources and mine license boundaries. **Other performance targets:** • 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. • Public roads that will act as main access routes to mining operations should be paved or changed into salt roads. This will reduce dust generation from these roads. **Other monitoring objectives:** • Use of accredited laboratories in the analysis of dust fallout. • Develop a monitoring database providing information on measured dust fallout levels. This information should be	• Mines must monitor and mitigate dust generating sources • The Ministry of Health and Social Services must ensure compliance with air quality requirements by the mines • MME must continue with the current dust fallout network • Chamber of Mines • MME must have an Erongo based monitoring programme that provides overall picture – and this must feed back to the public and individual mines	• Mine air quality management reports • MME Annual Reports • Chamber of Mines annual reports • Erongo PM10 and dust fallout monitoring database

	available to the public in a format that is both scientific sound and understandable.		

EQO 5: EDUCATION AND SKILLS DEVELOPMENT OPPORTUNITIES

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.

Desired Result	Target and performance indicators	Party responsible for implementation	Data Source
1. Improved quality of school education	**Target**: Improved results **Indicators:** • 75% of grade 1 enrolments complete grade 10 • 75% of grade 10 graduates obtain a NSSC • National Examination Results in Grade 10 and 12 in maths, English and science is a D or better for more than 50% of learners from public (GRN) schools • Region improves performance in reading and mathematics	• MoE (Regional Office)(under office of the governor), assisted by the Private Sector (esp. uranium industry) • Individual schools assisted by the Private Sector (esp. uranium industry)	• Directorate of National Examinations and Assessment, MoE. • SACMEQ reports
2. Increased availability of technical skills in Erongo	**Target:** More qualified artisans, technicians, geologists, accountants and engineers **Indicators**: • Increasing number of graduates from NIMT, Polytechnic of Namibia, proposed VTC facility in Walvis Bay and UNAM • Every mine has/funds a skills development programme for employees (3% of wage cost) ▪ Each mine has 10% more bursary holders than work-permit holders	• The aforementioned institutions – bursaries from the GRN and Private Sector, especially the uranium industry. NTA training levy to be utilised by the VTCs	• Namibia Training Authority • Polytechnic of Namibia, UNAM

EQO 6: SOCIAL COHESIVENESS AND DEMOGRAPHICS

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

Desired outcome	Target and performance indicators	Responsible Party for EQO implementation	Data source
1. Mainly locals are employed	**Target:** Uranium companies hire locally where possible **Indicators:** During operational phase all companies to comply with their employment equity target (certificate)	• Mines	• Mines HR department, via Chamber of Mines
2. Existing, proclaimed towns are supported	**Target:** Most employees are housed in proclaimed towns **Indicators:** • Mines do not create mine-only townships or suburbs • There are no on-site hostels during the operational phase of a mine	• Mines, supported by the municipalities	• Municipalities

EQO 7: WATER AVAILABILITY, QUALITY AND HYDROLOGICAL FUNCTIONING

Aim 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.

Desired outcome	Target and performance indicators	Responsible Party for implementation	Data source
1. Water for urban and rural communities is of acceptable quality	**Target:** Uranium Rush does not compromise community access to water of appropriate quality[5]: • Urban users • Rural communities supplied by DWA • Commercial farmers (own supplier) • Lower Swakop River small holdings **Indicators:** • Aesthetic/physical, inorganic, radio-nuclide and bacteriological determinants conform with minimum required quality as prescribed in the national water quality standards.	• DWAF Mines & other developers • Municipalities • SEMP office • NamWater	• Accredited laboratory test reports
2. The natural environment, urban and rural communities have access to adequate water	**Target:** Uranium Rush does not compromise surface and groundwater movement[6] and availability **Indicators:** • No unusual loss of wetland and riparian vegetation • No unusual loss of phreatophytes, • Borehole levels fluctuate within existing norms • Aquifer water will be made available to domestic users at approved NamWater rates • All water supply infrastructure is maintained • Disaster management plans are in place and implemented.	• DWAF • Mines & other developers • NamWater • Farmers • Basin Management Committees (BMCs) • Municipalities	• Land owner(s) • DWAF • Mining Companies • Public

[5] It is acknowledged that groundwater in some areas is naturally brackish or saline and does not conform to the national water quality standards
[6] It is specifically recommended that no groundwater be used for any mining operations, other than water made available through pit dewatering

Desired outcome	Target and performance indicators	Responsible Party for implementation	Data source
3. Water for industrial purposes is available and reliable	**Target:** Additional water resources (notably desalinated water) are developed to meet industrial demand. **Indicators:** • Desalinated water meets mine demand by 2011 • Industrial investors are not lost because of water unavailability • Water availability exceeds 99%	• NamWater, with collaboration by industry, DWA, LAs	• NamWater • LAs • NCCI

EQO 8: ECOLOGICAL INTEGRITY

Aim 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.

Desired Outcome	Target and performance indicators	Responsible Party for implementation	Data source
1. The paucity of biodiversity data for the Central Namib is addressed	**Target:** Biodiversity studies and monitoring programmes are initiated in order to develop a better understanding of biodiversity issues in the central Namib **Indicators:** • More research has been undertaken and there is continuous improvement in the understanding of biodiversity in the Namib. • A landscape assessment of biodiversity in the Erongo region is undertaken • The broadly defined red and yellow flag areas identified in the SEA have been refined. • Studies on range restricted endemics have been conducted.	MET responsible, but need technical support from NGOs and specialist institutions (e.g. Gobabeb) and funding from mines and other proponents	• MET • Mines • Gobabeb
2. The ecological integrity of the central Namib is maintained	**Target:** 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. **Indicators:** • Mining in protected areas is avoided wherever possible • Important biodiversity areas [red or yellow flag areas (see Figure 8.7)] are taken into consideration when adjudicating prospecting and mining applications. As far as possible these areas should be avoided. If this is not possible biodiversity offsets must be sought to offset loss occurring in the area. If an offset is not possible then the no-go option should be explored.	• MME • MET – application of Environmental Management Act • Mines – SEMP office to be involved in verification – MET and MME must enforce • Mines, in collaboration with infrastructure utilities – such as NamWater,	• EMA (2007) compliance figures • Mines provide information– SEMP office and MET to verify • Feasibility studies and plans • EIAs

Desired Outcome	Target and performance indicators	Responsible Party for implementation	Data source

	• 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.
	• Mines have specific programmes and projects to actively avoid, mitigate, restore or offset their impacts, with impact AVOIDANCE predominating
	• Biodiversity footprints of mines are minimized
	• 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'
	• Mines share infrastructure as much as possible, thus minimizing infrastructure proliferation
	• Infrastructure planning and investment takes into account future demand, thus reducing the need for additional impacts (e.g. 1 pipeline, not 3)
		NamPower, Roads Authority, Electricity and water tariff regulating authorities	

3. Mining industry becomes a conservation partner	**Target:** Mines and associated industries support conservation efforts in Namibia **Indicators**: • Mining companies (particularly those operating in the NNP) partner with conservation organisations to effectively manage their biodiversity impacts (both direct and indirect) • Mining companies commit to sustainable offset initiatives to ensure a 'no nett loss' to biodiversity as a result of their operations. This will involve partnering with long term conservation partners (GRN, NGOs and communities) • <u>Additional conservation projects</u> 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	• Mines – through the SEMP office, stakeholders identify priority actions • MET and mines for the creation of offset areas (policy requirements, land tenure etc.)	SEMP office – with input from stakeholders

Desired Outcome	Target and performance indicators	Responsible Party for implementation	Data source
	• Protection and management of key biodiversity offset areas is supported (e.g. NW Kunene, Messum, Spitzkoppe, Brandberg and other special areas in Namibia)		
4. No species[7] become extinct because of the Uranium Rush	**Target**: Authorisation to mine is denied if the extinction of a species is likely. **Indicators**: • All EIAs must consider extinction possibility, and resources must be available for reasonable investigation. • GRN refuses project authorization if extinction likely.	• Mines (commission and fund EIAs) • MET and MME (support through Inter-ministerial Committee) that approve/deny project implementation • SEMP office to verify	EIAs and RoDs
5. No secondary impacts occur	• Offroad driving, poaching, illegal camping, littering by mine personnel, are explicitly prevented by mining companies • Improved vigilance and visibility of law enforcement personnel, with structured support from civil society (e.g. Honorary Wardens) reduces park/conservation transgressions.	• Mines, with input from MET • MET to control and enforce, supported by mines, who could help to fund the Hon. Wardens inside and outside parks.	MET – with input from Honorary Wardens and the SEMP office. Farmers and conservancies will also be sources of information.
6. Water quality and quantity does not decrease to the extent that it negatively affects biodiversity	**Target:** Water table levels, and water quality standards are described and ephemeral river ecosystems are monitored to ensure that these standards are not compromised. **Indicators:** • Regular monitoring of indicator species in all ephemeral rivers is in place • Results from monitoring are fed back to regulators and impacting companies so that negative impacts on riverine vegetation, springs and	• MET responsible, but need technical support from DWAF, NGOs and specialist institutions (e.g. Gobabeb) and funding from mines	• MET • DWAF • Mines • Gobabeb

[7] There is incomplete knowledge of Namib biodiversity, and it is therefore not possible to know exactly what species occur and where. Thus, in the short term, developers must

Desired Outcome	Target and performance indicators	Responsible Party for implementation	Data source
	pans can be dealt with appropriately.	and other proponents.	

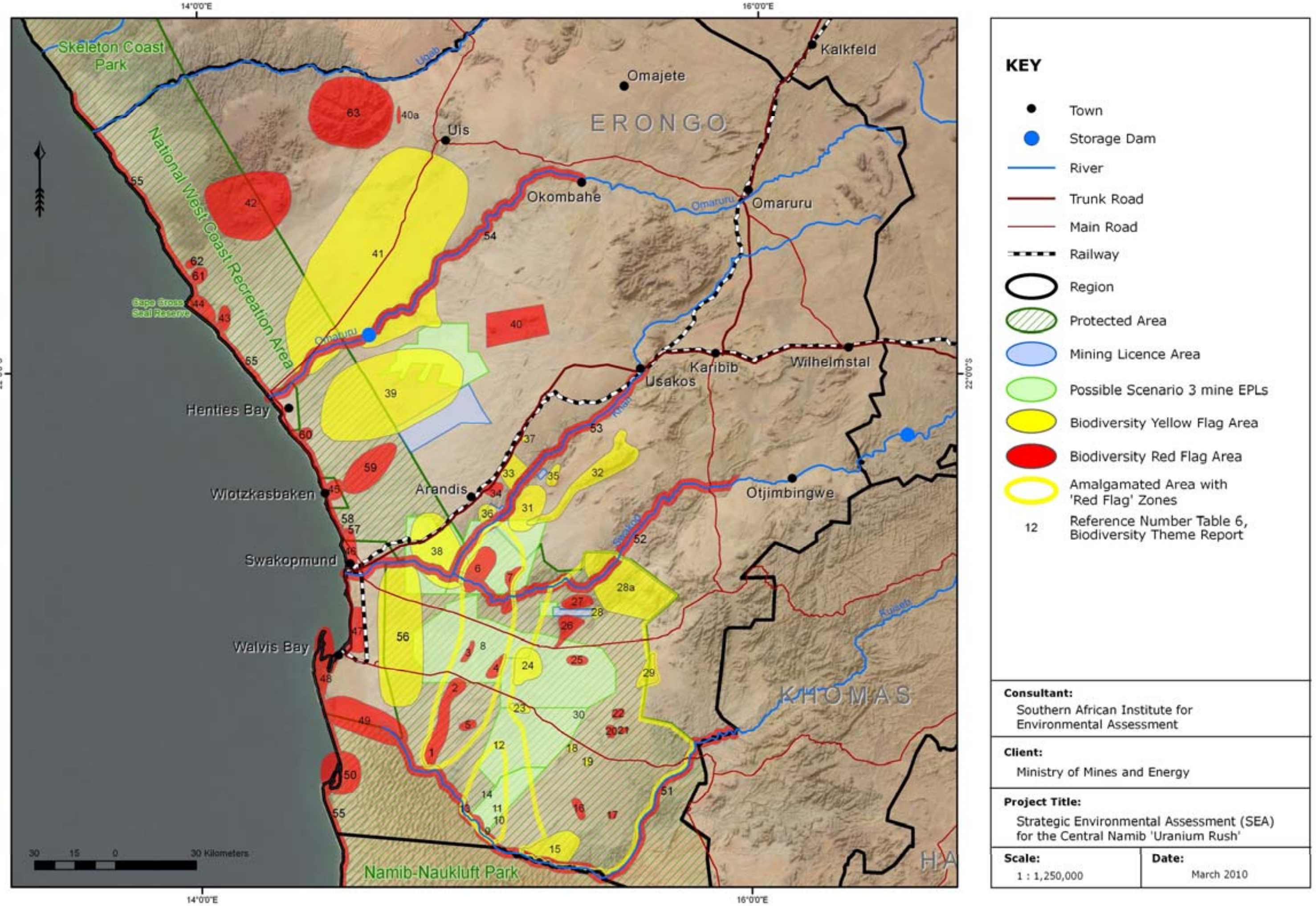


Figure 8.7: Red and yellow flag areas based on ecological criteria

EQO 9: PUBLIC ACCESS TO THE CENTRAL NAMIB

Aims of this EQO: 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.

Desired result	Target and performance indicators	Party responsible for implementation	Data source
1. Central Namib is accessible to the public (within the regulations of the National Park)	**Target**: Uranium Rush does not result in net loss of publicly accessible areas **Indicators:** • Areas of importance for recreation[8] that are not yet alienated by mining or prospecting are declared 'red flag' for prospecting or mining. These include: The Walvis-Swakop dunes, Messum Crater, Spitzkoppe (Gross and Klein), Brandberg, the Ugab, Swakop, Khan, Kuiseb and Swakop Rivers, the coastal area between the Ugab River Mouth and the tidal mud banks south of Sandwich Harbour (between lower mark and the main coastal road), the Welwitschia Drive (can possibly be offset) and Park campsites (can be offset).	• MME to agree on red flag areas • MET (implement PMPs) • NHC	• MME - proof of withdrawal will be a GRN announcement and a map • The public – at least 100 coastal residents who own a 4x4 vehicle must be sampled randomly in an annual public survey • NHC
	• All new listed developments[9] undergo an EIA and EMP prior to final design and implementation, and in all cases, the issue of public access is assessed in a specialist report • All projects are closed, decommissioned and rehabilitated in such a way that addresses public access needs.	• Developers must comply • MME and MET must enforce • COM must encourage best practice.	• EIA report and specialist study • EMP report • Closure plan • Proof of funds available for closure, decommissioning and rehabilitation • The DEA must keep a copy of above reports and specialist studies.

[8] These are the places regarded as commonly used for recreation by locals.
[9] Listed means the activity is required to have an EIA under the Environmental Management Act of 2007.

EQO 10: NATURAL BEAUTY OF THE NAMIB

Aim 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.

Desired outcome	Target and performance indicator	Responsible Party for EQO implementation	Data source
1. Uranium Rush does not significantly reduce the visual attractiveness of the Central Namib	**Target:** Direct and indirect visual scarring from the Uranium Rush is avoided or kept within acceptable limits. **Indicators:** • All developers commission EIAs prior to final design, and outcomes-based EMPs guide implementation and decommissioning. In all cases, visual impacts and sense of place are addressed.	• Developers to commission EIAs and implement EMPs. DEA must ensure quality of both. • Mining companies and MET must plan mitigation and alternative tourism routes • Collaboration between tour companies and mines to diversify tourism (geology etc.).	• EIA reports – look for visual impact specialist study, EMP report and decommissioning and restoration plan, with funds.
	• 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.	• As above, but tour operators, tourists and the general public must also limit their environmental impacts.	• Tour operators – at least 70% (randomly selected) operators working in the Swakopmund/Walvis area must be sampled annually.
	• Tourists expectations are 'met or exceeded' more than 80% of the time in terms of their visual experience in the central Namib.	• As above.	• Tourists – at least 200 tourists that undertook a desert excursion must be sampled.

Desired outcome	Target and performance indicator	Responsible Party for EQO implementation	Data source

2. Areas of significant natural beauty or sense of place[10] are afforded proper protection (without undermining existing legal rights).	**Target:** Improved protection of listed areas.
	Indicators:
	• 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)
	• 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.
		• MME
		• MET – appropriate revision of Protected Area & Wildlife Bill needs to be made and the Bill needs to be passed and implemented
		• MET – needs to manage and monitor other sectors that impact these "red" and "yellow" areas, notably recreation, tourism, infrastructure projects, aquaculture and urban development.
		• SEMP Office
		• National Heritage Council (NHC).
			• MME

[10] In this case, sense of place takes into account natural beauty, biodiversity, heritage value, tourism value and environmental vulnerability.

EQO 11: HERITAGE RESOURCES

Aim of this EQO: Uranium exploration and mining - and all related infrastructure developments - will have the least possible negative impact on archaeological heritage resources[11]. The degree of impact will be determined on the basis of empirical data gathered by direct assessment of specific projects, using established criteria of significance and vulnerability, and by means of explicit methods of survey and description. In applying these principles, the negative impacts of mining activity in the Erongo Region will be mitigated, and partly offset. Thus, survey, assessment and mitigation will result in significant advances in knowledge of archaeological heritage resources, so that their conservation status is improved and their use in research, education and tourism is placed on a secure and sustainable footing.

Desired outcome	Target and performance indicators	Party responsible for implementation	Data source
1. The integrity of archaeological and palaeontological heritage resources is not unduly compromised by the U-rush	**Target**: Mining industry and associated service providers avoid impacts to archaeological resources, and where impacts are unavoidable, mitigation, restoration and /or offsetting are achieved. **Indicators**: • All mining and related developments are subject to archaeological assessment • No unauthorised impact occurs	• Mining companies and other developers must commission and pay for the assessment.	• National Heritage Council and National Museum as repositories of data and materials.
	• Mining companies adhere to local and international standards of archaeological assessment.	• Mining companies and other developers • Chamber of Mines must encourage Best Practice	• National Heritage Council and National Museum as repositories of data and materials.

[11] This EQO and the related thematic study are limited in their scope, to the material record of past human activity in the relevant part of the Erongo Region. The most severe impacts of mining activity affect the pre-colonial and early colonial archaeological record, most of which is undocumented and therefore at greater risk than sites and other remains mainly in urban areas and other formal settlements. In general use, and in terms of the National Heritage Act (27 of 2004) "heritage" has a broader meaning which goes beyond the scope of this assignment, to include the intangible cultural values of living communities, the architectural heritage, and numerous other manifestations of cultural activity such as museums, memorials and places of interest.

Desired outcome	Target and performance indicators	Party responsible for implementation	Data source
2. Integration of archaeological and environmental knowledge in a balanced working model of Namib Desert environmental processes.	**Target:** Development of a general research framework to identify gaps in scientific knowledge. **Indicators:** • Research in progress, • Working model of Namib desert developed • Model providing information to guide decision making about development in the Namib	• National research institutions • Local and foreign scientists concerned with the development of environmental monitoring.	• Gap analysis and research framework (National Heritage Council).
	• Development of diachronic models to determine the effects of climatic and other environmental changes.	• As above.	• Diachronic model (National Heritage Council).

EQO 12: WASTE MANAGEMENT

Aims of this EQO:

- To ensure that there is sufficient capacity in the existing licensed waste disposal sites to accommodate the amount of waste that will be generated by the mines without causing pollution to the air, soil or water;
- To ensure that the collection and disposal of waste is carried out in a safe, responsible and legally-compliant manner;
- To ensure waste re-use and recycling is optimised;
- To ensure that the recycling agencies have sufficient capacity to handle an increased waste stream.

Desired outcome	Targets and performance indicators	Responsible party for implementation	Data source
1. Waste sites have adequate capacity.	**Target**: All sewage, non-hazardous and hazardous waste sites are properly designed and have sufficient capacity for next 20 years, taking into account the expected volumes from Scenario 3 mines and all associated industries. **Indicators** • Municipalities increase capacity of sewage works and waste sites based on predicted volumes of waste • Independent audit proves sufficient capacity of Walvis Bay and Windhoek hazardous waste sites; and Swakopmund, Walvis Bay, Arandis and Usakos non-hazardous waste sites with a 20 year life-span • All new waste sites undergo an EIA prior to construction and receive a licence to operate.	• Walvis Bay Municipality, notably the Water, Waste and Environmental Management Department • Windhoek City Council, notably the Solid Waste Management Division • MET – compliance monitoring and MHSS through the Pollution Control & Management Act.	• Independent audit.

Desired outcome	Targets and performance indicators	Responsible party for implementation	Data source
2 Waste sites are properly managed	**Target:** The management of waste sites meets national standards. **Indicators**: • Waste site managers are adequately trained • Site manifests which record all wastes, volumes and origins are kept. • Only hazardous waste classes for which the sites are licensed are accepted. • Water and air quality monitoring data show no non-compliance readings. • Municipal budgets are sufficient to comply with the site licence requirements relating to pollution control.	• Waste site operators maintain their licence to operate. • Staffing levels in the solid waste management departments are adequate. • Walvis Bay Municipality: Water, Waste and Environmental Management Department • Windhoek City Council: Solid Waste Management Division • Swakopmund Municipality: Health Services • Arandis Town Council • Usakos Town Council: Technical Department	• Independent auditors • Waste site operators. • Site manifests • Water and air quality monitoring data • Municipal records: budgets and staffing of waste management departments.
	Indicator for tailings: • Tailings dams are designed and managed in a way that avoids pollution to the air, soil or water.	• Mines	• Mines
3 Recycling is common practice in the central Namib.	**Target:** A sustainable waste recycling system is operational in the central Namib, servicing the uranium mines and the public. **Indicators**: • A waste recycling depot established. • Waste recycling operators have sufficient capacity to collect, transport and recycle waste in a safe and responsible manner • Volumes of waste disposed to landfill per capita decreases.	• Mines • SMEs (recycling) • Municipalities.	• Mines • Municipalities.

EQO 13: RELIABLE INFRASTRUCTURE

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

Desired outcome	Targets and performance indicators	Responsible Party for EQO implementation	Data source
1. Roads in Erongo are adequate for Uranium Rush and other traffic.	**Targets:** Roads are designed for maximum safety and are in good condition **Indicators**: • All key gravel roads (C28, Moon landscape (D 1991) Welwitschia drive, Goanikontes (D 4570), Walvis to Kuiseb (C 14)) are graded timeously to avoid deterioration. • Un-surfaced roads carrying >250 vehicles per day, need to be tarred • The B2 tar road is free of pot-holes and crumbling verges • Road markings and signage are in place and in good condition • Accidents at intersections and turn-offs decline from current trends.	• Roads Authority	• Roads Authority • Independent survey report (SEMP Office) • NAMPOL – where accidents are reported
2. Traffic flows optimally and safely.	**Targets:** Roads are designated for specific uses, thus reducing inconvenience and enhancing safety **Indicators**: • D1984 (Swakopmund to Walvis-Bay east of dunes) is tarred and designated an industrial vehicle route • 90% of traffic on the B2 coastal road (between Swakopmund and Walvis Bay, west of the dunes) is light vehicles (< 3 tons) • No industrial or mining traffic on designated tourist routes.	• Roads Authority • Roads Authority, • NAMPOL • Mines	• Traffic census (Traffic officials and SEMP office) • Traffic census • Traffic census

3. Optimum use of rail infrastructure.	**Target:** Most bulk goods are transported by rail **Indicators:** • >80% of all bulk goods (all reagents and diesel) delivered to mines and associated industries, are transported by rail	• Mines and associated industries, in collaboration with MWTC and TransNamib	• TransNamib • Namport • Mines
4. Walvis Bay Harbour is efficient and safe	**Target:** The harbour authorities provide reliable, accessible and convenient loading, offloading and handling services **Indicators:** • Average loading/offloading rate for containers is >25 containers per hour • Average waiting time for ships to obtain a berth is <12 hours • No oil/ chemicals/ contaminants/ sewerage spills enter the Ramsar site	• Namport	• Namport
5. Electricity is available and reliable	**Target:** The public do not suffer disruptions in electricity supply as a result of the Uranium Rush **Indicators**: • No uranium and associated industry investor is lost because of electricity unavailability, and planning is in place to accommodate other sectors • Electricity quality of supply meets ECB standard • Electricity provision (generation, distribution and transmission) does not compromise human health • Mines and associated industries pursue renewable power supply options as far as possible	• NamPower and MME, in collaboration with REDs and LAs • ECB, in collaboration with NamPower, REDs and LAs	• Feasibility studies • NCCI • NamPower • ECB

EQO 14: INSTITUTIONAL FUNCTIONING

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.

Desired outcome	Performance indicator and target	Responsible Party for EQO implementation	Data source
1. Prospecting and mining avoids environment-tally high value, sensitive areas.	**Target:** Sensitive areas in need of protection, are not generally available for prospecting or mining **Indicators:** • Declared 'red flag' areas undergo the required high level of scrutiny before mineral licenses are considered (see other EQOs for lists & Figures 8.8 and 8.9 for the required decision making process) • Where possible, red flag areas remain undisturbed by mining or other developments that have high impacts on biodiversity, heritage and or sense of place. • If development (especially mining) is to take place in a yellow flag area, strict conditions are attached with the approval certificate • No new powerlines, pipelines or roads linked to the Uranium Rush are routed through red flag areas, and preferably also not through yellow flag areas.	• MME • Parastatals • Individual mines.	• MME • Parastatals • Physical inspection
2. Good governance is maintained in the issuing of mineral licences.	**Target:** The defined process is always followed in the allocation of all kinds of mineral licences and the establishment of supporting infrastructures **Indicators:** • Mineral licences[12] 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) • No evidence of corruption in the allocation of mineral licences • 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: o Clear TORs o Use of independent consultants	• MME • MET • MAWF • Other GRN • Civil Society involvement required.	• As before • EIA and EMP reports • EIA/EMP RoDs • Court cases.

	o Public consultation o Specialist studies o Consideration of alternatives o Avoid and/or minimise adverse impacts o Include an EMP and closure and restoration plan o Professional review of EIA and EMP.		

3. Prospecting and mining activities are properly monitored.	**Target:** Post-implementation monitoring is regular, efficient and outcomes-based **Indicators:** • GRN agencies (notably MME, MET, MAWF, MHSS) inspect active mines at least once per annum, and closed mines at least once every 3 years • Honorary conservators are appointed by MET to assist with monitoring, including of unauthorised secondary (off-mine) activities such as offroad driving, poaching and littering. • Above agencies take accurate and consistent measurements of key indicators • International agencies regularly inspect mines and provide independent opinion on their performance • Results of monitoring improve practice and are disclosed to the public through existing channels and in an annual SEMP report, or more regularly • Where appropriate, the public are able to participate in physical monitoring. • Through existing channels and /or the SEMP office, the public can report observations of illegal activities or unwanted impacts.	• MME to take the lead – support needed from MET and other GRN agencies. • Civil Society involvement required. • CoM to provide support.	• GRN reports • Consultant reports • SEMP report.
4. Non-compliance is rectified.	**Target:** Transgressions are noted and acted upon timeously **Indicators**: • The activities of proponents/ developers/ service providers who have caused unauthorised negative impacts, are suspended, and they are forced to remedy impacts • If impacts are not remedied, the operation is closed and the project authorisation is cancelled • Fines are issued for non-compliance • All incidences of non-compliance are publicised through the media and noted in the annual SEMP report.	• MME to take the lead – support needed from MET and other GRN agencies • CoM to encourage best practice.	• GRN reports and corres-pondence • SEMP report.

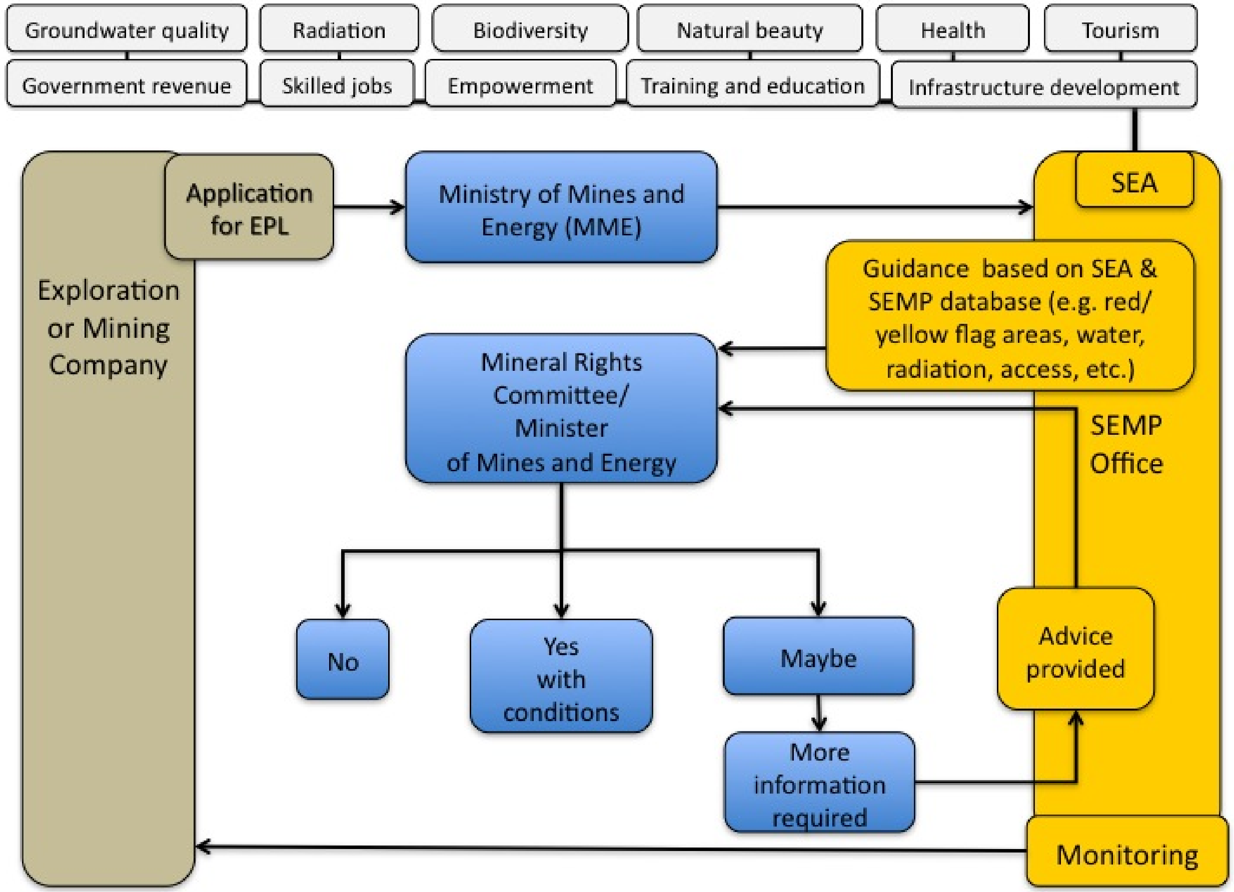


Figure 8.8: Decision-making process for EPLs in red and yellow flag areas

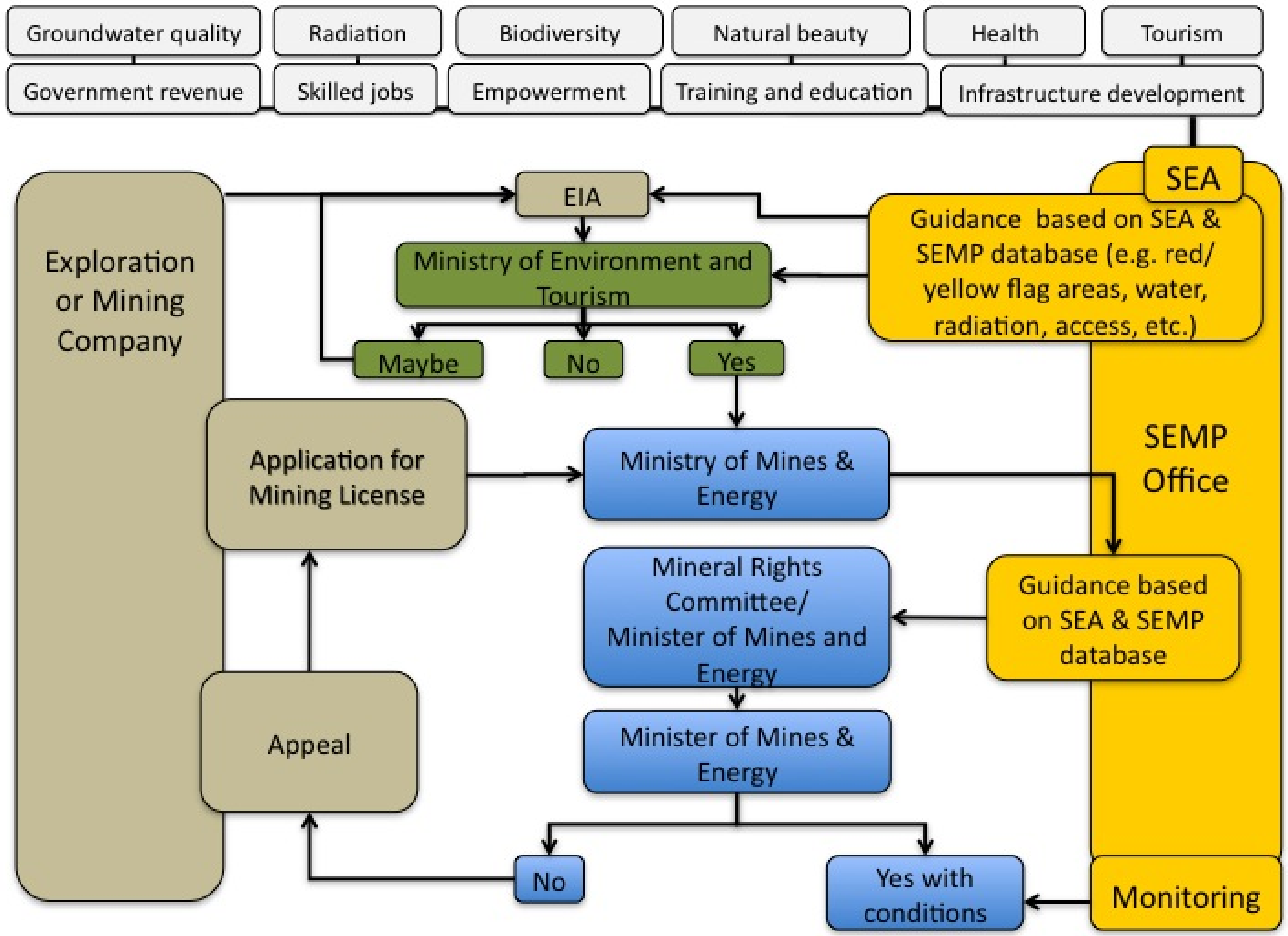


Figure 8.9: Decision-making process for MLs in red and yellow flag areas

EQO 15: NAMIBIA'S IMAGE

Aim 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.

Anticipated result	Targets and performance indicators	Responsible Party for EQO implementation	Data source
1. Namib uranium is regarded as a 'green' product.	**Target:** 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. **Indicators**: • No 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) • There is no evidence of unreliable, unethical and/or environmentally, socially and financially irresponsible conduct by operating uranium mines or prospecting activities.	• GRN, especially MME, MET MHSS (National Radiation Protection Authority) and DWA • Mines • Chamber of Mines	• Professional journals (like Mining Weekly) • Relevant websites • Foreign travel agencies and tourism operators • SEMP annual report • Environmental Commissioner's Office • National Radiation Protection Authority • MoHSS • Geological Survey of Namibia/MME • Ministry of Labour • Tax Authority/ Ministry of Finance • Ministry of Foreign Affairs • IAEA • Tourism operators • Tourists • Members of the public.

9 CONCLUSIONS

The Uranium Rush presents significant opportunities for Namibia in terms of growth and development. However, in order to realise these benefits, all tiers of government, the mining companies and civil society (to a lesser extent) will have to overcome some major challenges and constraints. There will also need to be a commitment from all parties to implement all the necessary measures outlined in this Strategic Environmental Assessment (SEA) and Strategic Environmental Management Plan (SEMP).

On the other hand, these benefits will come at a price – the Uranium Rush is partly located in a proclaimed national park and one of the most popular tourist hotspots in the country. Unless it is well managed and the necessary safeguards are in place, the Uranium Rush will negatively affect the environment – both at individual mine level and on a cumulative basis, which in turn will affect sense of place, tourism, lives and livelihoods. To ensure that the Uranium Rush has a positive influence on future development, the GRN, mining companies, local authorities and civil society must work together to eliminate, reduce or offset the negative impacts and enhance the benefits and synergies. For the Uranium Rush to leave a sustainable legacy, the recommendations made in the Strategic Environmental Management Plan (Chapter 8) must be successfully implemented.

For the purposes of analysis in this SEA, we constructed four possible scenarios of mine and associated industrial development up to 2020. Scenario 1 represents the current situation with two operating mines (Rössing and Langer Heinrich) and two other mines under construction (Trekkopje and Valencia). Scenario 2 includes these four mines plus two others; the projects which are the most advanced at this stage are Bannerman's Etango project (formerly known as Goanikontes) and Extract Resources' Rössing South or Husab project. These projects are likely to be accompanied by the construction of NamWater's desalination plant, an emergency diesel power plant, a coal- or gas-fired power station and two chemical plants to supply the mines with reagents. Scenario 3 builds on Scenario 2 with the addition of two more mines, possibly Reptile Uranium's Omahola Project and West Australian Metals' Marenica Project, but this is mere speculation and there could be other projects appearing as better candidates over the next few years. The fourth scenario is a 'boom and bust' scenario and could happen to any of the three scenarios described above. This scenario will arise in the unlikely, but highly consequential event of a nuclear accident, world war or other cataclysmic event, which will either send the world into recession or damage the future of nuclear power development on a permanent or temporary basis. Under this scenario, it is assumed that most or all of the mines will close down at a similar time on an unplanned basis, leaving an unrehabilitated legacy of mine infrastructure, mass unemployment and excess capacity in all public and private infrastructure.

As time has progressed from the beginning of this SEA in January 2009, it is evident that Scenario 2 is looking very likely. The opportunities, constraints and threats of the Uranium Rush, as manifested under each of these scenarios, are discussed below.

9.1 Opportunities

The Uranium Rush offers a number of opportunities and benefits which, if translated into actions, could result in a range of **positive** impacts:

- Increased government revenues;
- Accumulation of foreign reserves;

- Economic stimulus to the Namibian economy;
- Employment and skills development;
- Infrastructural development and upgrading;
- Public – private partnerships for social, environmental and economic development;
- Greater awareness of radiation risks, and upgraded health care facilities;
- Improved implementation of the Transformation of Economic and Social Empowerment Framework (TESEF);
- Enhancement of Namibia's international standing and reputation.

9.1.1 Increased government revenue

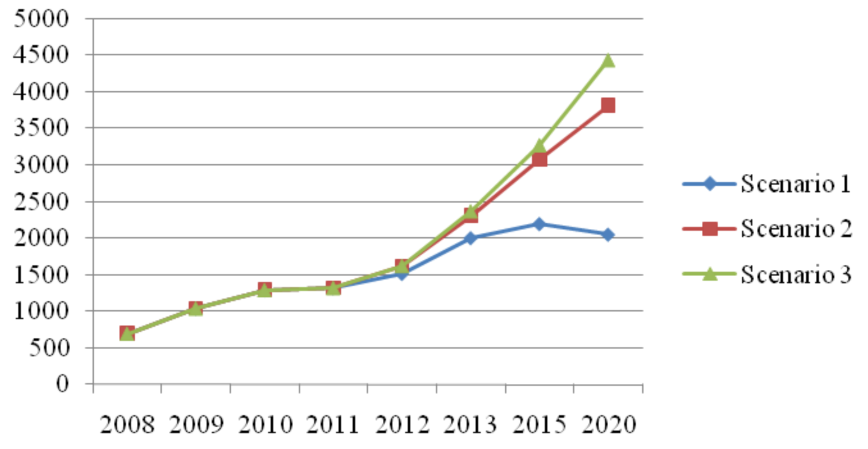
The Uranium Rush could become a significant source of government income. While the companies contributed about 3.2% to total government revenue in the form of royalties, pay-as-you-earn, non-Namibia resident shareholders tax and corporate taxes in 2008, this share can increase to 6.2% (Scenario 1) or 8% (Scenario 3) in 2015. We assume an average growth rate of government revenue of 8.3% according to the Medium-Term Expenditure Framework. This growth rate could accelerate to 9.5% in Scenario 1 (2011) or 9.8% in Scenario 3 (2013) due to income from additional uranium mining activities. In the case of full production, government could benefit in 2020 from additional revenue from the uranium mining industry ranging between N$2.6 - 5.3 bn in Scenarios 1 and 3 respectively.[1]

Taxes and royalties payable to GRN are eventually dependent on the commodity price. Using the price range of US$50 to US$90 per pound (lb) of uranium, total GRN revenue from the uranium mining industry could amount to between N$1.7 and 2.7 bn (Scenario 1) or N$3.3 to 5.5 bn (Scenario 3) in 2020. This would account for between 4.7% and 7.7% or 6.7% and 10.6% of total Government revenue for Scenarios 1 and 3 respectively. The benefits of this revenue stream could be severely compromised if any more of the mines are granted EPZ status, thereby exempting them from several taxes and other burdens.

Based on the National Accounts for 2008, uranium mining contributed about 4% to total GDP. Assuming mining companies operate on average at 90% of full capacity, the contribution of uranium mining companies to GDP could almost double in Scenario 1 from about N$3,000 m to some N$5,126 m in 2020, and increase almost fourfold in Scenario 3, to over N$11,476 m. In the most optimistic Scenario 3, GDP growth would increase from 5.1% in the baseline scenario to 8.2% in 2011. This would be the second highest GDP growth rate recorded in Namibia in recent years, only exceeded in 2004 (12.3%), when the textile company 'Ramatex' and the Skorpion zinc mine and smelter started operations.

[1] Note that uranium oxide is priced and traded in US Dollars and therefore Namibian production is very susceptible to fluctuations in the N$: US$ exchange rate. The rate used throughout this document was stated in Table 7.9.1 (as well as other assumptions relating to the economic analysis) and is N$8 = US$1.

Figure 9.1: Total contribution by uranium mining to GRN revenue



The share of uranium mines to GDP could increase from 3.3% in 2008 to some 6.5% in 2012 for Scenario 1 and 11.5% in 2015 for Scenario 3 but decline slowly thereafter. In comparison, the diamond-mining sector contributed 10.1% to GDP in 2002 and 7.6% in 2008. Based on the three Scenarios it is likely that the uranium industry will become the strongest contributor to GDP. If mines are running at full capacity, their contribution to GDP could reach 7% and 13% in Scenario 1 and 3 respectively and result in GDP growth rates of up to 8.6%.

Traditionally, government revenues from mining go directly to the state revenue fund and are included in the national budget. Whilst this in itself is a benefit, there is a major opportunity for the Namibian government to create a special ‘Uranium Fund’ for long-term sustainable social and economic development in Namibia, similar to the Botswanan Pula Fund or the Norwegian Petroleum Fund. The latter was set up to ensure that petroleum revenues were used, not only by the current generation, but also for the benefit of future generations. In Namibia, this type of fund could be used by GRN to meet the Millennium Development Goals (MDGs) and other development objectives set out in Vision 2030. This rational and prescient use of uranium revenues would place Namibia into the select group of countries which are not afflicted with the so-called ‘Resource Curse’, such as Nigeria and Angola, but can consider themselves ‘Resource Rich’ in the widest possible interpretation of the term – socially, environmentally and economically.

9.1.2 Accumulation of foreign reserves

The value of exports in the scenarios is expected to increase from N$5.4 bn in 2008 to at least N$12 bn (Scenario 1) or up to N$26 bn (Scenario 3) by 2020 assuming a contract price of US$70 and that the mines run at 90% of their production capacity.

Even with the most modest scenario (Scenario 1), export earnings are expected to double. The contribution of uranium exports to total exports is to increase from 13% to 28% in Scenario 1 or to about 62% in the most optimistic scenario. Total uranium exports are expected to increase by 123% (Scenario 1) or 370% (Scenario 3) between 2008 and 2020. If the mines operate at full capacity until 2020, their contribution to export earnings will reach N$30.5bn (Scenario 3) and account for 73% of total exports (see Table 7.9.5).

On the other hand, imports will increase due to the demand by additional uranium mining operations. About 33% of intermediate consumption of mining activities is imported, which accounted for roughly 2.2% of total imports in 2008. This share is expected to increase to between 5.0% (Scenario 1) and almost 11% (Scenario 3) in 2020 unless it becomes profitable to produce more inputs locally, such as chemicals.

The increase in exports will boost Namibia's foreign reserves and hence help maintaining the currency peg of the Namibia Dollar to the South African Rand and improve the import cover.[2] Import cover is an important economic variable that illustrates the country's ability to pay for her import requirements. The import cover could increase from 15 to 22 weeks (Scenario 1) or up to 34 weeks (Scenario 3). Should the mines operate at full production, the import cover in 2020 could range between 23 and 39 weeks.

The improved balance of payments will also increase Namibia's credit rating and thus her ability to raise development loans from international financial institutions.

9.1.3 Economic stimulus to the Namibian economy

Not only will Namibia benefit from substantial amounts of Foreign Direct Investment from the development and operation of uranium mines, there will also be a huge boom in the economy in general, due to the growth of secondary industries, support services and the retail sector to meet the cumulative demands of the new mines and their employees. Since much of this economic activity will be located in urban and industrial centres close to the mines, the greatest impact will be felt at local authority level. An increase in local municipal tax revenues and spending will provide a major economic stimulus to the towns of Walvis Bay, Swakopmund and Arandis, and to a lesser extent, Usakos and Henties Bay. Windhoek, as the nation's capital, will also benefit from the overall increase in economic growth. An increase in the municipal income stream should result in improved service delivery in these towns, revitalisation of town economies (e.g. Arandis and Usakos) and higher spending on community facilities and services to the benefit of all residents.

9.1.4 Employment and skills development

It is expected that the uranium mining sector and directly related new industries will employ between 1,700 (Scenario 1) and 7,000 workers (Scenario 3) by 2020. In addition, a significant number of new jobs will be created in other sectors of the economy due to increased demands for goods and services by the uranium mining sector.

Furthermore, wages and salaries in the mining sector are usually above average and therefore contribute to additional consumer demand and government revenue from taxes on income. Since the industry employs mainly skilled and semi-skilled workers, the additional demand for labour could drive up wages. Last but not least, employees in the mining sector often support their families in the northern rural areas and hence their transfers contribute to poverty alleviation.

Not only would the Uranium Rush create direct and indirect employment, there is an opportunity for the mines to embark on skills development programmes to improve the skills levels of their employees at all levels, including management, which will have long-term benefits for the country (see also section 9.1.8).

[2] The Bank of Namibia is required to back-up every Namibian coin and banknote that it issues by foreign currency, be it South African Rand or any other convertible currency. The favourable foreign reserves allowed the Bank of Namibia to maintain a lower repo rate during 2008 and the first half of 2009 than the South African Reserve Bank.

An increase in employment and disposable income often leads to many other social benefits such as improved health care and education for the employee and all his/her dependents, all of which contributes to the attainment of the MDGs and other Vision 2030 goals. An increase in wealth, especially in the lower socio-economic bracket, can also go a long way to reducing Namibia's high GINI co-efficient.

9.1.5 Infrastructural development and upgrading

Another potential benefit of the Uranium Rush is that the crumbling and overstretched physical infrastructure at the coast may be improved. Major road upgrading is required to reduce the congestion and dangerous driving conditions currently prevailing on several roads at the coast, especially the B2 between Walvis Bay and Swakopmund, the B2 from Swakopmund to Arandis, as well as the C28, up to the Langer Heinrich turnoff. The expected increase in traffic (up by as much as 59% on the B2, 80% on the C28 and 56% on the C34 under Scenario 3), justifies the need for significant spending on road upgrading. If the D1984 from Walvis Bay to Swakopmund behind the dunes is tarred and designated as the main through route for all heavy vehicles (except for local coastal traffic), it would have a significant benefit for the users of the coastal road, including a reduction in the number of accidents. The B2 from Swakopmund to Arandis will experience more than a 50% growth in traffic volumes (under all scenarios), particularly in the numbers of heavy vehicles and commuter buses. Widening and resurfacing this road would help to relieve congestion and reduce traffic accidents. Alternatively, an opportunity presents itself to build a commuter rail link between Swakopmund and Arandis, with a transport hub at Arandis providing transport to Valencia, Rössing, Rössing South and Trekkopje mines. This would help relieve the pressure at peak times on the B2 and would present several business opportunities in Arandis.

The demand for rail transport for bulk goods such as fuel, acid and other chemical reagents used on the mines, could stimulate a much-needed upgrade of the current rail infrastructure and rolling stock. Again, the potential exists for Arandis to become a railway junction, with spur lines leading to the various mines, and/or a bulk materials transfer point for mine-bound products from rail to road.

Another benefit for the coastal economies from the Uranium Rush is that the electricity grid will be strengthened by the addition of a new ring-feed line and there will be an increase in generating capacity at the coast, through the construction of an emergency diesel plant, as well as a gas- or coal-fired power station. These developments will combine to provide coastal users with a more stable and reliable power supply and will reduce dependence on Eskom and the Southern African Power Pool.

Finally, the Uranium Rush has created the economies of scale required to construct desalination plants at the coast. The use of desalinated water by the mines will relieve pressure on the alluvial groundwater aquifers of the Kuiseb and Omaruru rivers, which are currently being over-exploited to meet demand. Furthermore, the traditional constraint on coastal development – not enough water – will be removed if desalination proves successful without any long-term negative consequences for the marine and coastal environment.

The need for government spending on major capital projects, such as those described above, will in itself, create jobs, promote secondary industries and stimulate the Namibian economy.

9.1.6 Public – private partnerships for social, environmental and economic development

Traditionally, responsible mining companies throughout Namibia have developed their own Corporate Social Responsibility (CSR) programmes, which have benefitted the recipient communities to a greater or lesser extent. The Rössing Foundation (established in 1978 - long before CSR became fashionable) is an example of a CSR programme. The Rössing Foundation undertakes a number of activities relating to governance, education, health, poverty alleviation, innovation, the environment and enterprise development. Much of its success can be ascribed to the partnerships that it has formed with local, regional and national government bodies and NGOs.

The Uranium Rush could see up to six companies operating uranium mines by 2015 (Scenario 2) and up to eight under Scenario 3. While it would be laudable for each company to set up its own CSR programme, it would be a missed opportunity to capitalise on the economies of scale that could be gained by the creation of one Foundation to which all mines would contribute. Such a Foundation would be able the apply the joint funds on a holistic basis to a range of deserving projects, across several sectors such as health care, education and training, conservation, scientific studies, social development, entrepreneurship, governance etc. These projects would have to be submitted to the Foundation, screened and prioritised against Vision 2030, the MDGs and other development frameworks, so that the projects fit into an overall plan. Implementation would need to be carried out by partnerships created between the private sector (mines), government and NGOs.

9.1.7 Greater awareness of radiation risks, health and safety

The Uranium Rush has the potential to raise public and worker awareness about radiation risks. Increased understanding will empower people to understand and manage their risks to exposure in an informed way. It is also likely that coastal hospitals will be better equipped to detect occupational health problems.

In addition, most mines run wellness programmes which aim to improve awareness in the workforce about a range of health and safety issues, both on the mine and at home. Topics covered in these programmes typically include: fitness, nutrition, smoking, substance abuse, safety in the home etc. The cumulative effect of these programmes on a substantial number of people – up to 7,000 direct employees and their dependents (up to 28,000), will have a significant positive spin-off in terms of improved health, lower work absenteeism and reduced pressure on health care facilities.

9.1.8 Implementation of Namibia's TESEF Policy

The Uranium Rush presents an opportunity for the Namibian government to roll out its Transformation of Economic and Social Empowerment Framework (TESEF) in a structured, rational way. The aim of TESEF is for historically disadvantaged Namibians to obtain company ownership, board positions and equity in management positions. Companies will score points based on their own corporate demographics and their procurement from local companies who are also TESEF-compliant.

9.1.9 Enhancement of Namibia's international standing and reputation

Even under Scenario 1, the envisaged uranium production will catapult Namibia from being the fourth largest to the largest producer in the world. Assuming all other countries' production remains constant, uranium production under Scenario 2 would mean that Namibia will produce around 32% of the world's uranium and under Scenario 3, this could increase to a maximum of 37%. This in itself would significantly enhance the country's reputation in the mining world, but if the development of these mines was also being done along the principles of sustainable development for the extractive industries, with a Uranium Fund (see section 9.1.1 above) dedicated for long-term social development, then Namibia's international reputation would be substantially enhanced.

9.2 Constraints

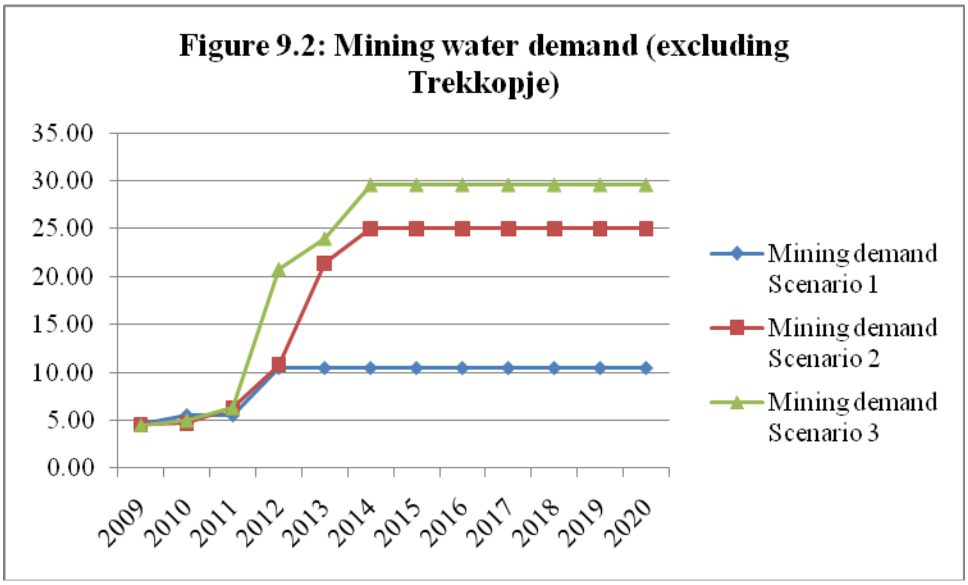
It can be seen from the discussion above that the potential benefits (positive impacts) of the Uranium Rush for the Namibian economy and the country's reputation are significant, but there are a number of constraints, which if not adequately and timeously addressed, could delay the flow of benefits into the economy, or even worse, could mean that the benefits may not be realised at all. The main constraints relate to:

- The timely availability of desalinated water;
- Availability of skills;
- Sufficient social amenities and services;
- The capacity of physical infrastructure;
- Environmental and heritage protection; and
- The capacity of government at all levels to cope with the Uranium Rush.

9.2.1 The timely availability of desalinated water

First and foremost of these constraints, and on the critical path, is the need for sufficient desalinated water to be produced by 2011 to meet the demand from the uranium mines (excluding Trekkopje mine which has its own desalination plant, currently under construction at Wlotzkasbaken). A second desalination plant is being planned by NamWater, but current estimates indicate that this plant will not be operational until 2014 at the earliest. However the demand for water from the mines will increase dramatically from its current level of about 5 Mm^3/a to approximately 11 Mm^3/a (Scenario 1), 25 Mm^3/a (Scenario 2) and almost 30 Mm^3/a (Scenario 3) by the year 2014. Thus the 25 Mm^3/a desalination plant being planned by Namwater will not have sufficient capacity to supply the demand under Scenario 3 after about 2014.

While some of this demand can be met in the meantime from other sources such as groundwater (limited availability), surplus from the Trekkopje plant (6 Mm^3/a) and possibly 4 Mm^3/a from the Gecko Chemicals plant from about 2012, there will still be insufficient water available to meet the Scenario 2 and 3 mining demand from 2013 onwards. This poses a major risk to investors, who will have to decide whether to delay mine development until water is assured, build their own desalination plants at great cost, threatening their profitability and Internal Rate of Return, or cancel their projects in Namibia. All of these options have significant cost implications for the mining companies and the country as a whole, because the potential benefits described above will not be realised.



It is therefore imperative that the NamWater desalination plant is fast-tracked so that it can be completed as soon as possible. A quicker and more economic solution would be to re-enter into negotiations with Trekkopje to use their intake structures (designed and built for double capacity) and add another module to the desalination plant. This option is recommended in this SEA for a number of environmental and economic reasons. It must be noted however, that even with the two proposed desalination plants water will remain the key limiting factor for development at the coast.

9.2.2 Availability of skills

During construction, the demand for labour will peak at over 10,000 for Scenario 3, 9,500 for Scenario 2 and about 4,200 for Scenario 1. Direct employment numbers on the mines and related industrial developments will level off at about 7,000, 6,100 and 3,400 for the three scenarios respectively during operations. Many of these workers will need to be skilled or semi-skilled and there is already a shortage of artisans in Namibia and indeed in SADC generally. Thus although the uranium mines will create a substantial number of direct and indirect employment opportunities, it may not be possible to meet this demand locally (Erongo Region) or even nationally. Even with skills development programmes in place at the new mines, NIMT and the proposed Millennium Challenge Account-funded COSDECs, the immediate need for skills may have to be met by non-Namibians. While this will not slow down or impede mine development in Namibia, it will reduce the local economic benefits that would come if the majority of employees were Namibians.

A further constraint is the high rate of HIV/AIDs prevalence in the target workforce which has a number of consequences for the mines and society in terms of work efficiency, absenteeism, high staff turnover, burden on health care facilities and transmission of the disease to non-infected members of society.

9.2.3 Social amenities and services

It is clear from the above that many employees will need to move to the Erongo Region, either from elsewhere in Namibia, or from other countries to meet the demand for skilled and semi-skilled labour and management positions. While some may choose to leave their families at ‘home’ and reside in single quarters or flats, many employees may move their families to the Erongo Region, thus placing a demand on affordable housing, health care facilities, schools, policing, amenities and municipal services (water, waste management, sewerage etc). If these demands cannot be adequately met, the area will not be able to attract the required skills and calibre of personnel, which in turn will make it difficult for the mines to function efficiently and compete effectively in the global market.

Thus it is important that the local municipalities and relevant government departments proactively plan and budget for the increased demands for social amenities and services, now, before it is too late.

9.2.4 The capacity of physical infrastructure

At present the road, rail, power and port infrastructure at the coast is at the limits of its capacity to meet current needs, let alone those envisaged due to the Uranium Rush and associated industrial developments. A significant amount of government spending is required upfront to upgrade this infrastructure on a proactive, rather than reactive basis. One of the aims of this SEA is to analyse the potential cumulative effects of the Uranium Rush on aspects such as infrastructure, so that the GRN can proactively plan its infrastructure budget for capital projects and ongoing maintenance. Unfortunately, this spending is required in advance of the full tax and royalty revenue stream from the mines being realised. It is also required now, in order to meet the commissioning of Scenario 2 mines in 2013-14.

While a crumbling and over-stretched infrastructure (power, roads, rail, port) may not in itself delay or prevent the Uranium Rush from happening, it could become a hindrance to the efficiency of the mines. Unreliable and expensive power, potholed, dangerous and congested roads, port and rail delays could individually and together cause reduced production. This in turn will mean that the profits, employment, government revenues and all the possible positive impacts will not be optimised. Indeed, failures in infrastructure could lead to a premature, planned closure if the costs and frustrations of doing business in Namibia are too high. This would undermine all the long-term sustainability benefits that would accrue from a long-term uranium industry in the country.

9.2.5 Environmental and heritage protection

Most of the existing and proposed uranium mines are in or adjacent to national parks and protected areas. These areas are protected because of their special landscapes, biodiversity and heritage resources. While the Policy on Mining in Protected Areas allows mining and prospecting in Protected Areas, it is also possible in terms of the proposed Parks and Wildlife Management Bill of 2009, for MET and MME to agree to withdraw certain areas within parks from mining. One of the recommendations of this SEA is that certain biodiversity, tourism and heritage hotspots should be given Red Flag status, and that these areas be unavailable for mining and prospecting. This could limit the expansion of the uranium mines into certain areas in future, but at present there are numerous, extensive ore bodies which do not fall in the proposed Red Flag areas (see sections 7.6, 7.7 and 7.8).

9.2.6 The capacity of government to cope with the Uranium Rush

All of the constraints relating to water, skills, social services and amenities and infrastructure can be readily removed or minimised with a combination of political will and money. However, there are several constraints within GRN and the parastatals which may hamper the full realisation of the potential benefits of the Uranium Rush. Firstly, our analysis shows that there is inadequate capacity in GRN and the parastatals to administer the additional burden of the Uranium Rush in terms of implementing, contracting and building the necessary infrastructure, as well as permitting, licensing, authorising, enforcing and monitoring the mining companies and all related developments. To ensure that all the necessary social and physical infrastructure is in place in time to meet the needs and demands of the uranium mines, relevant GRN ministries and parastatals will need to increase their staff complements, budgets and other resources (computers, vehicles etc). The consequences of delays in upgrading the infrastructure were discussed above, but the ramifications of delays in other aspects such as issuing permits and licences, work visas, company registrations, providing erven and municipal services, building schools, skills training and health care facilities, and training/employing the necessary staff to run these facilities, will all cause frustrations and lead to mining companies delaying investment, or pulling out of Namibia altogether.

Another constraint for effective governance is that the legal framework is incomplete, with the following either not yet enacted or finalised:

- Water Resources Management Act, 24 of 2004;
- Environmental Management Act, 7 of 2007;
- Parks and Wildlife Management Bill of 2009;
- Urban and Regional Planning Bill;
- Pollution and Waste Management Bill.

These shortcomings mean that Namibia is still implementing outdated and inadequate legislation (e.g. the Water Act, 54 of 1956), or there is a complete lack of the necessary legal instruments to control activities (e.g. the Environmental Management Act (EMA)). Furthermore, some of the Acts which have been promulgated have shortcomings which make them difficult to implement as originally intended (e.g. there is no requirement to compile EMPs in terms of the EMA). A weak legislative structure has two major consequences: it allows for weak or ineffective control and enforcement and secondly, it attracts less scrupulous mining companies who cannot/will not comply with more stringent legal requirements elsewhere. Neither situation is desirable in Namibia.

9.3 Threats from cumulative impacts

The Uranium Rush will inevitably have a number of negative impacts on the environment (in its widest sense), both at the scale of individual mines and at a regional level due to the cumulative effect of several mines operating within a relatively small area with similar construction and operating timeframes. The individual EIAs for the new mines and the environmental management systems in place at the existing mines deal with the impacts caused by the individual mines. This SEA however, has been able to consider the cumulative spatial and time-crowding effects of various possible Uranium Rush scenarios. The cumulative impacts or threats identified in this SEA can be categorised under the following headings:

- Impacts on natural physical resources;
- Impacts on biodiversity and heritage landscapes;
- Impacts on health;
- Stress on physical infrastructure;

- Impacts on public recreation and tourism;
- Impacts on towns and social structures; and
- Stress on government ministries and parastatals.

These are discussed in the following sub-sections.

9.3.1 Impacts on natural physical resources

Many of the known impacts on water resources caused by mining operations are extremely localised and it will be the responsibility of each mine to control these impacts through their own mine-specific EMPs. However, there are two major potential cumulative effects on water resources that may result from the Uranium Rush: pollution of the primary aquifers; and over-abstraction of water from the primary aquifers.

All of the current and possible future mines identified in the scenarios will have large-scale potential sources of pollution. Section 23(1) of the Water Act, 54 of 1956 states that it is "…*an offence to commit an act which could pollute any public or private water, including underground water, or sea water in such a way as to render it less fit for the purposes for which it is or could be ordinarily used by other persons …for legitimate purposes.*" Thus all new mines should be designed as 'zero effluent discharge' mines and those with existing water permits must ensure that the permit conditions are being rigorously monitored and enforced, both by themselves, the Department of Water Affairs and Forestry and MET.

The consequences of non-compliance of Scenario 3 mines would particularly affect the Khan and Swakop Rivers, with the main pollutants being sulphate, sodium, chloride, nitrate, uranium and other radio-nuclides and trace metals. The mines using the sulphuric acid leach process could cause the pH of the groundwater to drop since the effluent and tailings water can have a very low pH, whereas, the mines using an alkaline leach process would cause an increase in the pH.

However, following specialist groundwater studies conducted by BGR-GSN for this SEA, two major factors have been identified which will militate against the downstream migration of pollution plumes: the first is that the alluvial aquifers are compartmentalised by bedrock outcrops at or near surface, which inhibit the subsurface flow of water to the downstream compartment. Secondly, recharge of the aquifers by surface flow is only occasional – a situation made worse by the construction of dams on the upper reaches of the Swakop River. The combination of these two factors means that water within the alluvial aquifers in both the Khan and Swakop Rivers moves downstream extremely slowly, as demonstrated by the long residence time (several decades) of water found in these aquifers. Thus if a pollution event were to occur, it would not be able to migrate downstream far enough to affect any of the lower Swakop River users.

Should any of the EPLs along the Omaruru or Kuiseb be developed into mines in the future, extra care will have to be taken to ensure that no pollution whatsoever reaches the primary aquifers, as these supply all domestic users in the coastal region.

The second potential cumulative impact relating to water is the possible lowering of the groundwater table in the river beds. If each mine is allowed to extract its permitted maximum from the alluvium, this may result in a general decline in water levels, but only within the affected compartment of that river. Over-abstraction above the sustainable yield in a given compartment would affect the vegetation of that river reach and all the dependent ecosystems, as well as borehole yields of the farmers who abstract water from that compartment. This impact would last for as long as over-abstraction is allowed to continue and for some years afterwards until water table levels are naturally restored, but due to the compartmentalised nature of the aquifers, the impacts will be localised and should not affect downstream users.

It is imperative therefore that the abstraction permits granted to the mines take into account the cumulative rates of abstraction to ensure that the permitted amount is within sustainable limits.

9.3.2 Impacts on biodiversity and heritage

The main threats from the Uranium Rush on biodiversity and heritage include the direct loss of species or sites through landscape disturbance; and the indirect loss of species through habitat loss, degradation and fragmentation.

Part of the problem in quantifying the threat of the Uranium Rush on biodiversity and heritage resources is that in spite of sporadic research over the years (usually mine-site specific and short-term), our information about species, ecosystem functioning and the archaeological history of the central Namib is poor, with many gaps in the data base. Thus our understanding of species and processes is incomplete and it is therefore impossible to quantify the cumulative impacts of the Uranium Rush in terms of numbers of species lost, habitats fragmented and archaeological landscapes disturbed.

Nevertheless, it has been possible as part of this SEA to provide a **preliminary** delineation of the sensitive biodiversity and archaeological areas (Red and Yellow Flags) and to identify which exploration and mining companies are currently active in areas where these sensitive sites occur. It would seem that all the companies are, or could impact on one or more of these sensitive sites. Furthermore, even if they do not cause direct destruction, impacts such as noise, general disturbance, poaching, road kills, illegal collecting of species and artefacts and pollution, could all directly contribute to the loss or displacement of species. The direct loss of heritage sites means that there will be a permanent loss to the record of human history in the central Namib.

In addition to the direct impacts on species and habitats through land disturbance by the mines themselves (up to 577 km^2 may be disturbed), another major threat is posed by the proliferation of infrastructure (roads, railways, powerlines and pipelines) throughout the central Namib. While the cumulative actual ground disturbance caused by the construction and future existence of this infrastructure is relatively small (compared to the mining footprint) at about 14 km^2, the greater impact lies in the barrier effects to animal movement and habitat fragmentation. Furthermore, the construction of this infrastructure will increase dust levels throughout the region – which will impact both fauna and flora, and it will also inadvertently introduce more people into the wilderness areas.

Therefore the Precautionary Principle needs to be applied and great care must be taken by all mining and prospecting companies to avoid impacting these special areas of biological and heritage importance. A proposed decision-making process for dealing with the Red and Yellow Flag areas is proposed in Chapter 8.

9.3.3 Impacts on health

There are four potential impacts on human health that could be caused or exacerbated by the Uranium Rush, namely: an increase in sexually transmitted and other diseases; an increase in road accidents; possible increase in public radiation dose; and a potential for an increase in inhalable dust.

As mentioned above, the Uranium Rush will increase the levels of employment in the country in general and in the Erongo Region in particular. Unfortunately, people with cash earnings tend to use alcohol in social contexts, which increases the likelihood of unprotected sex and the spread of HIV. The influx of job seekers may also increase over-crowding in the urban areas, which is conducive to the spread of diseases such as TB (Speiser, 2009).

An increase in traffic on deteriorating road infrastructure is likely to result in an increase in accidents. This risk is heightened by the differential speeds and journeys on the affected roads, with a combination of slow moving heavy vehicles, tourists, faster moving commuters and delivery vehicles. On single-lane roads in foggy or dusty conditions, inappropriate overtaking is a frequent cause of accidents on the coastal area roads. With the predicted increases in traffic loads, the accident rate is likely to rise, but it will be exacerbated if the GRN does not carry out the necessary road upgrades to improve traffic flows and driving conditions.

The specialist studies on air quality, groundwater quality and radiation that were commissioned for this SEA identified potential sources of radiation, transport pathways and receptors (farmers, urban residents, game animals) who may be affected. The findings showed that there is no evidence of mine-related pollution in the groundwater of the Khan and Swakop Rivers. The groundwater study also showed that if a pollution event did occur, the downstream migration of a contamination plume would be very slow and hindered by the presence of natural barriers (bedrock) along the rivers. Therefore the potential for exposure to additional radiation via groundwater pathways is unlikely.

The specialist study of airborne radiation risk found that the cumulative exposure risk of the *farmers* to airborne radiation from the inhalation of radio-active particulates (PM10) and radon does increase slightly with each scenario (i.e. with more mines), but the doses are all still well below the international exposure limit of 1 mSv/a. The study found that the contribution of the mines to the radiation dose of *residents* in the coastal towns is insignificant, and even in the town of Arandis, which is closest to the mines, the highest radiation exposure for residents is still below 0.3 mSv/a, even for Scenario 3. The potential for health risks from radiation is therefore very low.

The air quality study models showed that the major contribution to dust in the region is from natural wind erosion of the desert surface and from traffic on the gravel roads. Even under Scenario 3, these two are the main contributing factors to dust. The amount of *inhalable dust* (PM10) will increase, especially at Goanikontes (by 34% in Scenario 3 over baseline), but at the towns the increases in PM10 are predicted to be less than 13%, even under Scenario 3. Thus there could be an increase in respiratory problems for residents in the vicinity of Goanikontes.

The impact of the mines on *total particulates* in the towns is negligible, except at Goanikontes, where a 15% increase in nuisance dust levels may be expected in Scenario 3.

9.3.4 Stress on physical infrastructure

The components of physical infrastructure which will be most affected by the Uranium Rush are the roads. The main cumulative impacts arising from the increases in traffic (as mentioned above) are:

- Higher wear on the roads, necessitating more maintenance, especially on the gravel roads; if the maintenance is not sufficient to handle the increased traffic, roads will degrade (potholes and erosion along the edges of the tarred surface) and become very dangerous;

- Higher loads on the roads which were not built for such weights. This also results in road deterioration;
- More dangerous driving conditions (see above in section 9.3.3);
- Greater need for traffic control and policing;
- Greater need for emergency response vehicles, ambulances etc.;
- Congestion causing delays for road users, which can also negatively impact on the competitiveness of the various trade corridors.

The potential increase in rail traffic on existing lines will have a few cumulative impacts. These would include:

- Localised and intermittent noise from an increased number of trains on existing lines;
- Increased potential for spillages of diesel and oil (from train locomotives);
- Increased risk of accidents resulting in major chemical spills;
- Congestion in shunting and loading yards causing delays.

Even if the proposed Gecko Chemical plants supply the mines with process chemicals locally, there will be a demand for increased port capacity to import sulphur, coal and other bulk raw materials to meet the expected higher demands from the mining industry. This could have an impact on port activities, handling times and port infrastructure.

Increasing congestion will require NamPort to expand the harbour facilities if it wants to continue to attract shipping for local and continental customers. This will have several negative impacts on the environment, which are being documented in a separate EIA for the expansion project (CSIR, 2009). One of the options to relieve this pressure is to build a bulk goods jetty north of Swakopmund to supply the proposed Gecko Chemicals plants.

Although NamPower is not currently in a position to meet the predicted electrical energy demand of the Uranium Rush from existing sources and Power Purchase Agreements (PPAs), it is actively investigating a number of additional generation and PPAs within the Southern African Power Pool to meet power demand in the short-, medium- and long-term.

9.3.5 Impacts on public recreation and tourism

Residents and tourists to the coastal zone define their quality of life as being enhanced by opportunities for sport, exploring the desert by vehicle, relaxing on the beach, angling or adventure activities. Tourism products in the central Namib include adventure tourism (e.g. parachuting and quad biking), business tourism (e.g. workshops and conferences), consumptive tourism (e.g. hunting and fishing) and ecotourism (excursions into the desert). There is also the use of the desert landscapes for filming of documentaries, adverts and feature films. In the context of public recreation and tourism, the main impacts likely to result from the Uranium Rush are: visual impacts, leading to compromised natural beauty and deteriorating sense of place; and loss of access to recreation and tourism destinations.

The **natural beauty and ambience** of the desert will be compromised by the Uranium Rush, because even with the best environmental management plans in place, prospecting and mining will result in visually intrusive infrastructure, dust and noise, and will scar the Namib for decades or longer. At present, the largely undisturbed desert with its dramatic landscapes, interesting biodiversity and sense of place and space attracts numerous tourists very year. The tourism sector is of considerable importance to the Namibian economy, providing over 18,000 direct jobs (5% of total employment), and N$1,600 million pa in revenue (3.7% of GDP).

The sector has seen significant growth over the past fifteen years, with tourist arrivals increasing more than threefold between 1993 and 2006 (NTB 2007). In a survey conducted by NTB (2006-2007) the most desired destination in Namibia was Swakopmund, borne out by the fact that the coastal region provides 16% of national bed occupancy (an indicator of tourism popularity) and bed occupancy in Swakopmund was 10% higher than the national average. However, the very aspects that attract tourists and local residents to the desert – unspoilt landscapes, peace and quiet, will be significantly affected by the numerous cumulative impacts which will be caused by the Uranium Rush. The proliferation of mining related infrastructure (e.g. powerlines, pipelines, roads and railways), added to the alienation of land for mining of areas previously used for public recreation and tourism, effectively means that mining may displace tourism if not properly managed, resulting in losses for the tourism industry.

In addition to the erosion of aesthetics and sense of place, the existence of EPLs and mines, and their right to **exclude locals and visitors** from their areas, limits the places available for tourism and recreation. For example, the popular Moon Landscape and Welwitschia Flats may both be compromised by nearby mining of the Etango and Rössing South mines respectively. This may be partially remedied by the development of new tourism products (e.g. mine tours) and the creation of new tourist and public roads, and alternative viewpoints and campsites, so that there would be no net loss in terms of tourism and recreation opportunities.

9.3.6 Impacts on towns and social structures

The large influx of people to the coastal towns, drawn directly or indirectly by the Uranium Rush, will inevitably change the current ambience and structure of the coastal towns.

Stakeholders expressed concern about the cumulative impacts of increased mining on the town of Swakopmund, which is marketed as a leisure and tourism destination. They stress the need to maintain the aesthetically interesting architecture, holiday ambience and peaceful nature of the town. There was a concern over the influx of mining personnel, as well as ancillary industries already established, and to be established in Swakopmund to support the Uranium Rush. It is expected to change the ambience to a more industrialised, busy centre.

Some social and cultural norms in Namibian urban society are not necessarily desirable. Rapid urbanisation tends to lead to a loss of community, a weakening of social networks and often an increase in crime (Speiser, 2009). Thus the influx of people will inevitably lead to an escalation in crime – not just in proportion to the increase in population, but because aspirant job seekers may resort to crime until they can find a job and crime syndicates may move in, attracted by the amount of disposable income, assets and cash in circulation.

The influx of people will also place a demand on housing and erven and because there is a shortage of properties and erven in some economic brackets, the price of properties will be driven upwards. While this could be seen as a benefit by property owners, it will force entrants to the property market to look elsewhere, rent or settle for something less expensive (and less desirable).

More people in towns will place pressure on the ability of GRN to provide the necessary school and health care facilities and staff. A possible additional 20,000 school-aged children may be expected in a region which currently accommodates 27,000 in its schools with some difficulty. Thus there are clearly not enough schools to meet current demands, let alone those of the future.

The Uranium Rush is likely to result in a larger revenue stream for local authorities. While this is a major benefit by itself, it needs to be translated into service delivery such as the provision of waste management services, sewerage, water and power distribution networks and the development and maintenance of public amenities such as parks, gardens, sports facilities, beach front promenades etc. The quality of life in the coastal towns could deteriorate significantly if the municipalities do not increase spending on service delivery. However, this could be difficult to achieve if staff and physical resources are not augmented.

9.3.7 Stress on government ministries and parastatals

As noted earlier, managing the Uranium Rush will be a considerable challenge to Namibian institutions, especially government, parastatals and regional and local authorities. The President of the Republic of Namibia has recognised this challenge and, in his 2009 re-election speech, he called for greater efficiency and accountability within government and related structures.

There is no doubt that the Uranium Rush will add to the workload of all of the relevant institutions and that drastic measures are needed to bring about the required improvements. Political will, technical capacity, enabling policies and laws, and mutually-beneficial partnerships are needed to ensure that adequate capacity exists. In combination with strong capacity, transparency and consistency in decision making will ensure that the Uranium Rush is a blessing and not a curse. The bottom line is the need for good governance.

This SEA has shown that the Uranium Rush has the potential to contribute significantly to long-term sustainable development in the country, particularly in the spheres of social development and economic viability. However, under any of the mining scenarios envisaged, these benefits will be at the cost of the biophysical environment which will be a net 'loser'. This SEA, through the Strategic Environmental Management Plan (SEMP) has therefore provided a wide range of recommendations to ensure that the positive impacts on sustainability are enhanced and the negative impacts are avoided, reduced, controlled or offset as far as possible, to minimise the threats to the environment and all those who depend upon the central Namib for their livelihoods.

10 RECOMMENDATIONS

In Chapters 7 and 8 of this SEA we identified a number of significant opportunities presented by the Uranium Rush which will benefit the Namibian economy at every level. This study also identified a number of cumulative negative impacts which need to be carefully managed to ensure that the adverse effects are minimised. Thus we have formulated our recommendations around the measures that need to be put in place to enhance the benefits on the one hand, and those that are needed to mitigate the negative impacts on the other hand. These are set out in detail in the SEMP in Chapter 8, together with the desired targets and indicators and the parties responsible for implementing them. Thus the recommendations below are a summary of the SEMP.

10.1 Recommended measures to enhance the benefits and mitigate the negative impacts of the Uranium Rush

It is clear that in order to manage the opportunities and threats of the Uranium Rush, the GRN and the mining companies will have to make a number of investments in a range of capital projects, staff, staff training and physical resources. In section 7.9, several investment models were discussed to facilitate the delivery of the required development programmes. The GRN will receive revenues in the form of taxes and royalties, as well as through proposed rehabilitation funding options (Environmental Trust Funds or Bonds). There are numerous good and bad examples around the world where revenue from natural resources is used to the benefit of the country and its inhabitants as a whole, or for the selective enrichment of a few respectively.

One of the ways in which Namibia can position itself to capitalise on a ‘green’ brand of uranium is to implement the recommendations of this SEA, one of which is to set up some form of Sovereign Wealth Fund which could be used to fund social projects now and into the future for the benefit of all Namibians. This Fund would be built up using mining royalties and other uranium-derived revenues.

Mining legislation needs to be amended to include the specific requirements and standards of rehabilitation. The Government could work in consultation with the Chamber of Mines of Namibia towards finding the financial mechanism for rehabilitation as proposed (Environmental Trust Funds or Bonds) in the Mineral Policy of 2002. This has been done in other countries. A thorough study needs to be carried out by the industry to weigh the costs and benefits of each strategic option. Setting up a rehabilitation fund would require upfront payment from government, since costs for rehabilitation are incurred immediately with the development of the mine, while the mining companies only receive income once production has commenced. A mechanism needs to be developed to ensure that government is reimbursed by the mining companies over a specific period of time for this seed fund.

10.1.1 <u>Social amenities and services</u>

Under any of the three mine growth scenarios contemplated in this SEA, there will be an increase in the population of the towns in the central Namib. In order to ensure that the quality of life is maintained and the areas remain desirable places to live, the GRN and local municipalities will need to proactively invest in a number of projects, such as:

- Mining companies must house their employees in existing towns to promote socio-economic development in those towns, and to prevent the proliferation of mine townships and hostels in the region. The latter are neither sustainable nor desirable from a social perspective;
- Implement an integrated development approach to town and regional planning (incorporating some of the recommendations made in this report) in order to preserve the sense of place in the coastal towns, where this exists;
- The development of serviced erven, particularly in the lower price bracket, especially in Swakopmund and Arandis;
- Construction of structurally-sound and appropriately designed houses;
- The inclusion of public open spaces, recreation and sports facilities in the new town planning schemes, as well as public facilities such as post offices, schools, libraries and community halls;
- Improve crime prevention through the training and appointment of additional police, the development of community police forums, establishment of neighbourhood watch systems and improving the investigative capabilities of the police force;
- Strengthen the criminal justice system and increase the capacity of prisons;
- Improve the capabilities of the traffic police to protect road users from speeding, unlawful driving and overloaded vehicles;
- It is recommended that the municipalities should proactively determine the potential waste quantities which may be generated over the next 20 years and make plans and budget for an increase in disposal capacity – for all categories of waste.
- All waste site managers need to be properly trained and competent and the municipalities must have sufficiently qualified staff resources to manage their waste sites in a safe, responsible and legally compliant manner;
- All new waste sites (whether at the mines or in towns) must undergo an EIA and receive a licence to operate;
- A sustainable waste recycling depot needs to be opened in the central Namib, servicing the uranium mines and residents, in order to reduce the volumes of waste needing disposal.

10.1.2 Radiation and health

An increase in the number of uranium mines in the central Namib will inevitably result in more dust, noise, traffic, people, radiation and disease, all of which could have an adverse impact on health. On the other hand, the prosperity brought by the Uranium Rush could bring significant benefits for health in the form of more disposable income to spend on health care, improved health care facilities and greater awareness of health issues through mine wellness programmes and care.

The SEA found that the health effects from an increased exposure to radiation in the form of radioactive dust, radon and radionuclides in groundwater would be negligible, both for the public and mine workers, so long as the following are implemented:

- Increments in the concentrations of uranium and uranium decay chain daughter radio-nuclides such as Ra^{226} (above and beyond background concentrations of uranium and uranium decay chain daughter radio-nuclides) in air and water (ground and surface) that originate from uranium mines, must be small enough to give rise to incremental radiation exposures to members of the public of no more than 1 mSv per annum (the regulatory annual dose limit for members of the public);
- Incremental radiation exposures of uranium mine workers and employees (above and beyond natural background exposures) must not exceed the internationally established regulatory limit for occupational exposures of 20 mSv/a (which is reflected in Namibian regulations on radiation protection);[1]
- Mill tailings and waste disposal facilities must be constructed and operated in a way that corresponds to established procedures for radioactive waste management (as per international IAEA guidelines and reflected in Namibian regulations);
- Transport of radioactive material should be managed in a way that corresponds to established international and national procedures for radioactive transports, including use of containers and drums containing radioactive materials that meet international and national standards, as per international IAEA guidelines and reflected in Namibian regulations;
- Uranium mines must be closed and mine sites stabilised and rehabilitated in a way that corresponds to established international and national procedures and standards for mine closure and mine site stabilisation and rehabilitation, as per international IAEA guidelines and reflected in Namibian regulations;
- Research and quantification of the cumulative radiological dose should continue. This includes:
    - Installation of more weather stations in and north of Swakopmund;
    - Refinement of the dust dispersion models based on better weather data;
    - Refinement of the background radon emissions based on a longer term data set;
    - Additional research on uranium fingerprinting in the alluvial aquifers of the Khan and Swakop Rivers, including the definition of radio-active anomalies in these river valleys;
    - Calculation of the total radiological dose through groundwater for the smallholding farmer receptor group and the residents critical group.
- A comprehensive air and water monitoring programme should be set up according to international protocols and procedures and the results must be posted on the SEMP office website;

[1] Over 5-year period, with doses in any one year not to exceed 50 mSv

- The Namibian drinking water quality standards need to be amended to reflect the updated WHO guideline values for drinking water quality, especially for uranium.

The greater impact on health will be from an increased amount of dust, the influx of people to the area and the potential for communicable diseases such as HIV/AIDS and TB to spread. It is also likely that there will be an increased incidence of road traffic accidents due to the fact that the amount of traffic, especially heavy vehicles, will increase significantly. In order to ensure that the negative health effects are minimised, the following are recommended:

- Dust in an open pit mine in a dry region can be a problem but the inhalation of dust can easily be controlled by the use of personal protective equipment (masks). The exposure of the general public to increased dust will require each individual mine to implement dust suppression measures at all exposed sources (haul roads, access roads, open pit, crushing circuits and tailings storage facilities);

- Given the predicted influx of people to the area and the high incidence of HIV/AIDS and TB, it is strongly recommended that the local authorities embark on a major health awareness and disease prevention campaign. This will need to be backed up by an obligation being placed on all contractors to implement their own health campaigns and to do everything in their power to prevent the spread of disease;

- Similarly, the mines will need to have their own health awareness campaigns and wellness programmes to prevent the spread of disease and to promote healthy living. This in turn will help to relieve the burden on the health care facilities in the area;

- Addressing stakeholder concerns requires all the mines to design and implement a management and monitoring system that conforms to international standards for the protection of the public and workforce alike. General guidelines and regional targets have been identified in the SEMP (Chapter 8 of the SEA report) and each individual mine will be required to implement the measures necessary to meet those targets;

- Medical services, both diagnostic and therapeutic are currently inadequate in Erongo. The development of better quality or extended hospital, clinic and ambulance facilities in Swakopmund or Arandis will be necessary in order to cope with an increased population of newcomers;

- One of the first tasks identified by the newly formed Atomic Energy Board is to upgrade the national cancer register in association with the Namibian Cancer Association. This is urgently required to provide a valid baseline against which the future impacts of the Uranium Rush on cancer can be assessed.

10.1.3 Employment, education and skills development

In order to maximise the benefits of the Uranium Rush for all Namibians, each mine must adopt a policy of preferential employment of Namibians. The uranium mines and processing plants require skilled and semi-skilled labour and experienced managers in order to operate in a safe and efficient manner. While this demand may not be able to be met from Namibians in the short-term, the objective should be to develop the local skills base over time. This can be done by:

- The construction of new primary and secondary schools as well as the training and appointment of competent and qualified teachers and administrators;
- GRN must fast-track the development of its new skills and development centres, expand institutions such as NIMT and extend UNAM and Polytechnic mining and engineering faculties;
- The mining companies need to invest in and develop ongoing skills development programmes e.g. bursaries, courses, on-the-job training and mentoring programmes;
- The mining companies need to embrace the roll out of TESEF.

10.1.4 Economic and infrastructure development

In order for the Uranium Rush to materialise and for mines and associated industrial developments to function efficiently and economically, it will be necessary to provide an enabling environment. This will include good social services and amenities, water supply and sound infrastructure.

Significant investments are required in road upgrading, particularly:

- The B2 between Swakopmund and Arandis, which needs to be widened to 4 lanes and strengthened;
- The D1984 gravel road running along the east side of the dunes between Walvis Bay and Swakopmund needs to be tarred and all heavy through traffic must use this road to relieve pressure on the coast road and in the town of Swakopmund;
- Unsurfaced roads carrying more than 250 vehicles per day e.g. the C28 from Swakopmund to the Langer Heinrich turnoff, need to be tarred and strengthened with proper intersections to the mines;
- Road signs, road markings and mine intersections need to be clearly marked;
- No industrial or mining traffic should be allowed on routes designated for tourist traffic only.

Much greater use will be made of the railways and therefore a number of actions are recommended:

- Encourage the use of rail for the transport of bulk goods;
- Increase the size of the shunting area at Walvis Bay harbour;
- Add to, and upgrade existing rolling stock;
- Improve rail freight efficiencies;
- Construct new rail links and sidings;
- Consider the construction of a commuter rail link between Swakopmund and Arandis to replace the current bus system of mass transport, with a transport hub in Arandis.

The Port of Walvis Bay is already planning an expansion to meet increased continental import-export freight demand.

NamPower needs to implement the necessary short-, and long-term measures required to supply sufficient, stable power to the coast i.e. new power station(s), transmission and distribution lines. These must be located taking cognisance of environmental impacts relating to air pollution, visibility from tourist routes, bird flight paths, red and yellow flag areas etc., as well as the broad infrastructure corridors suggested in this SEA. See additional recommendations under 10.1.6 below.

The mines should be encouraged through subsidies and incentives to investigate alternative sources of renewable power and to install energy saving devices.

10.1.5 Water

The availability of desalinated water is on the critical path and therefore the NamWater desalination plant needs to be fast-tracked in order to be up and running as soon as possible. A quicker and more economic solution would be to re-enter into negotiations with Areva to use their intake structures (designed and built for double capacity) and add another module to the desalination plant. This option is strongly recommended because it will ensure the timely delivery of water, it will cost significantly less than constructing a new set of intake structures and it will have a much lower environmental footprint.

All new mining operations should adopt a policy of zero-effluent discharge and water conservation measures must be implemented at each mine. Existing mines must rigorously enforce their water permit conditions. Recommendations regarding the routing of water infrastructure in corridors and proactive, long-term design options are made in section 10.1.6 below. The use of groundwater to meet mining demand must be determined based on the sustainable yield of the affected aquifer, taking into account all other existing and potential users.

Standards and protocols for pollution monitoring should be developed by the SEMP office in conjunction with DWAF, using the findings of the Kringel *et al*. and BIWAC reports. Future monitoring should take into consideration the vertical variation in groundwater quality, particularly in the saline downstream areas. Future monitoring should also take into account the likely mine process chemicals and ore body characteristics in determining the list of parameters to be monitored so that the signature of mine-related pollution can be readily detected. All future monitoring should also include sampling and analysis of important uranium daughter elements at selected stations. The monitoring data collected should be evaluated and used for regular reporting by the SEMP office. The monitoring data should also be maintained in a central database at the SEMP office and a hydrogeological information system should be developed to facilitate reporting, response to requests and the implementation of groundwater policies and management.

10.1.6 Environment and heritage

One of the recommendations of this SEA is that certain biodiversity, tourism and heritage hotspots (red flag areas) should be set aside and thus be unavailable for mining and prospecting. The study further recommended a strict procedure for evaluating exploration or mining licence applications in yellow flag areas to ensure that the precautionary principle is applied prior to granting an exploration or mining licence. This could limit the expansion of the uranium mines in Namibia in future, but at present most of the EPLs and MLs contain one of more of these sites. The purpose of highlighting these sensitive biodiversity, landscape and heritage areas is to make the individual mining and prospecting companies aware of those sites which fall within their EPL or ML areas and to make sure that they are avoided, protected and actively conserved.

Another way in which the impacts on biodiversity and heritage landscapes can be minimised is to ensure that all the infrastructure to the mine (access roads, powerlines, pipelines and railways) are kept as far as is technically possible, in corridors, following the shortest feasible routes. Recommendations in this respect have been made in section 7.3. Another suggestion is that the responsible parastatals should ensure that when they build new infrastructure that it has sufficient capacity to meet future predicted demand wherever possible. A single, larger capacity pipeline, for example will be more expensive to construct initially, but it will be much cheaper in the long-run than building, operating and maintaining several parallel pipelines and all associated structures. In addition, it is also recommended that where additional capacity is required in, for example a powerline or pipeline, the existing line should be removed and replaced with the larger capacity unit. This will prevent the creation of ranks of parallel powerlines and pipelines.

Mines, associated industries and GRN utilities should actively try to avoid, minimise, mitigate, restore or offset their impacts, with emphasis being placed on ‘avoidance’ as a priority. If sensitive biodiversity, heritage or tourism sites cannot be avoided, every effort must be made to minimise the footprint of the impact and to develop effective mitigation and restoration programmes. If this is not possible, then the possibilities of offsets, particularly for tourist sites, should be investigated.

The development of new tourist sites to replace those that may be lost or negatively affected by mining will help to make the Uranium Rush more acceptable to local tourism operators. Construction of new access roads, signage, waste management and maintenance of these new sites by the mines would be part of their ‘social licence to operate’ in the central Namib. This could help to augment the current tourism product, along with historical and new mine tours. It is also strongly recommended that a Mining Licence should be denied if there is a possibility that a species may be made extinct as a result of mining activities.

Another recommendation is that the mines should support conservation efforts in the Namib through e.g. funding long-term research programmes into aspects such as: desert life, mine rehabilitation, and species rescue and relocation. Actual activities could include the restoration of old, abandoned mine sites in the national park, protection of heritage sites, protection of sensitive sites within a mine property, and biodiversity monitoring programmes.

10.1.7 Governance

All of the above recommendations need to be supported by improved governance at every level and across a range of ministries, departments, agencies and parastatals. Actions required include:

- Strengthening of the legislation, particularly where Bills have not been passed, Acts have not been promulgated or where regulations have not yet been produced. Of particular note in this regard are the following: the Water Resources Management Act, 24 of 2004; the Environmental Management Act, 7 of 2007; the Parks and Wildlife Management Bill of 2009; the Environmental Investment Fund of Namibia Act, 13 of 2001; the Urban and Regional Planning Bill; and the Pollution and Waste Management Bill;

- Fundamental to ensuring the sustainable development of the Uranium Rush and all the other developments associated with it (infrastructural development, desalination plants etc.) is the need for EIAs and EMPs to be completed, guided by the recommendations and EQOs provided in this SEA;

- Although due diligence will be required to ensure that permits, licences, registrations, visas etc., are not issued lightly, it will be imperative to ensure that the process of administration and decision-making is efficient, transparent, even-handed and without undue delays. This will require a sufficient number of competent staff and resources;

- Post-implementation monitoring will be necessary as part of the SEMP, to ensure compliance, monitor effects, provide information to the general public and that the principles of best practice are being applied. Transgressions should be noted and acted upon timeously.

10.2 SEMP Office

One of the most important recommendations made in this SEA is the need for an office to manage and oversee the implementation of the Strategic Environmental Management Plan (SEMP) as set out in Chapter 8. This will be crucial in ensuring that the Uranium Rush, as a whole, is moving towards sustainability and not away from the goals of sustainable development in the context of extractive industries. Although the successful implementation of the Uranium Rush will require strong partnerships between the public and private sectors, it is recommended that the GRN should take overall responsibility for implementing the SEMP, through a close partnership between MME and MET. There thus needs to be a broad-based steering committee that oversees the functioning of an office to administer the SEMP (hereafter referred to as the SEMP office).

The SEMP office needs adequate staffing to manage the processes of sub-contracting, monitoring, communication and reporting. The SEMP office must collate the data required to assess the key performance indicators listed in the EQOs (see section 8.4) and compile the annual SEMP report. Data for many of the indicators are already being collected by various institutions for various purposes, but more work may be required to set up new monitoring programmes and establish the necessary sampling and reporting protocols. Therefore the SEMP office may need to outsource some field work to specialist institutions to conduct most of the biophysical and ecological work. Tasks such as questionnaire surveys could be conducted by students or tour operators, etc. Ideally, the work could be done efficiently and cost-effectively, but the quality and integrity of data must not be compromised.

Regular feedback on performance through the annual SEMP Report will ensure that praise may be given where it is due and corrective actions can be implemented in a timely and coordinated fashion. In this respect, the SEMP report will act as a scorecard, with each indicator being measured against each EQO.

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APPENDIX B: STAKEHOLDER ENGAGEMENT PROCESS

Steering Committee for the SEA

Name	Organisation
Dr Gabi Schneider	Chairperson, Geological Survey of Namibia
Dr Rainer Ellmies	Technical Cooperation BGR-GSN
Mr Israel Hasheela Ms Rosina Leonard Ms Kaarina Ndalulilwa Ms Alina Haidula	Geological Survey of Namibia
Mr J.A. Kasheeta	Ministry of Regional and Local Government and Housing
Mr Rainer Schneeweiss Ms Michelle Yates Mr Veston Malango Mr Mike Leech	Chamber of Mines
Mr Bro J.K. Hangari	Mineworkers Union of Namibia
Dr Joh Henschel Dr John Irish	Gobabeb Training and Research Centre
Mr Greg Christelis	Ministry of Agriculture, Water & Forestry
Mr Teo Nghitila Ms Saima Angula Ms Zuna September Mr Rob Davis	Ministry of Environment and Tourism
Mr Rod Braby	NACOMA
Dr Wotan Swiegers	Atomic Energy Board
Ms Merrilyn Leippert Dr Hu Berry Mr Danie van Niekerk	Tour and Safari Association of Namibia
Ms Margaret van der Merwe Mr Helmut von Maltzahn	NamPower
Ms Pippa Howard Mr Rob Brett	Flora Fauna International
Mr Nicolaas du Plessis	NamWater
Mr Andre Brummer	Municipality of Walvis Bay
Mr Izak Isaaks Mr Tuhafeni Haufiku Mr Joseph E Jantze	Municipality of Usakos
Mr CL Lawrence	Municipality of Swakopmund
Mr D van Wyk Mr T !Gonteb	Erongo Regional Council
Mr Axel Tibinyane	Ministry of Health and Social Services
Dr Chris Brown	Namibia Nature Foundation
Mr Abraham Iilende Mr E Shivolo	Ministry of Mines and Energy
Mr M Menjengua	Ministry of Regional and Local Government, Housing and Rural Development

Mr Colin Namene	Arandis Town Council
Mr P Gurirab	Municipality of Henties Bay
Ms Beatrix Callard	Steering Committee secretary and minute taker

B.1 Notices for all the public meetings (first and second rounds)

- **Radio announcements:**

Public Announcement:

Public meetings will be held to allow the public an opportunity to provide input into a Strategic Environmental Assessment on Uranium Mining in Erongo. The assessment will determine the impacts of the entire Uranium mining industry in Erongo on the natural, social and economic environment.

The meetings will be held in Windhoek (Safari Hotel, 18h30, 9 March), Usakos (Bahnhof Hotel, 17h30, 10 March), Arandis (Town Hall, 17h30, 10 March), Swakopmund (Ministry of Fisheries Auditorium, 18h30, 11 March),Walvis Bay (Kuisebmond Training Centre, 18h30, 11 March) and Henties Bay (Municipal Hall, 10h00, 12 March) .

All welcome, refreshments will be served.

For more information contact Morgan Hauptfleisch on 061 220 579

Publieke Kennisgewing:

Publieke vergaderings word gehou om alle belangstellendes 'n geleentheid te bied om kommentaar te lewer oor die impakte van Uraan Myn aktiwiteite in die Erongo streek, as deel van 'n strategiese Omgewingstudie vir die bedryf in die Erongo streek.

Almal is Welkom, verversings sal voorsien word.

Die vergaderings vind as volg plaas:

Windhoek (Safari Hotel, 18h30, 9 Maart), Usakos (Bahnhof Hotel, 17h30, 10 Maart), Arandis (Dorp Saal, 17h30, 10 Maart), Swakopmund (Ministerie van Visserye Ouditorium, 18h30, 11 Maart),Walvis Bay (Kuisebmond Opleidingsentrum, 18h30, 11 Maart) en Hentiesbaai (Munisipale Saal, 10h00, 12 Maart) .

Vir meer inligting skakel Morgan Hauptfleisch by 061 220 579

- **Press release:**

Public Meetings to identify issues relating to the social, economic and environmental impacts of uranium mining in Erongo Region.

A Strategic Environmental Assessment (SEA) has been commissioned by the Ministry of Mines and Energy to investigate the impact of the uranium mining "rush" in the Erongo Region. The idea was conceived by the Ministry in collaboration with the Chamber of Mines, and is supported by the German-Namibian Technical Cooperation Project of the Geological Surveys of Namibia (GSN) and Germany (BGR). The assessment started in February and is expected to be completed by the end of 2009.

The SEA will be conducted by the Southern African Institute for Environmental Assessment (SAIEA), which has assembled a team of experts in fields such as: Radiation and human health, biodiversity, tourism, economics, hydrology and social infrastructure. Dr. Peter Tarr will be the team leader for the assessment, and a Steering Committee consisting of Government, NGO, mining and civil society representatives has been appointed to oversee the work.

A Strategic Environmental Assessment is different from an Environmental Impact Assessment in that it can determine the negative and positive cumulative impacts on the environment, as well as the social and economic development impacts, and then investigate and recommend ways to avoid or minimise negative impacts and enhance positive impacts.

There is much speculation and ongoing rumours about how many mines will open, what their respective lives will be, and what their benefits, opportunities and impacts are for Erongo and Namibia as a whole. No one can predict the future, but a strategic assessment is a tool to understand likely scenarios, using 2020 as a time horizon.

Right from the start we need to know what issues the public believe are important to investigate, as uranium mining impacts on the environment of the people who live and work in the region. For this reason a series of open public meetings will be held in March where members of the public can raise concerns and issues relating to the uranium industry in Erongo. Interested and affected parties are also welcome to contact SAIEA to raise issues if they are unable to attend the meetings.

The meetings will be held in Windhoek (Safari Hotel, 18h30, 9 March), Usakos (Bahnhof Hotel, 17h30, 10 March), Arandis (Town Hall, 17h30, 10 March), Swakopmund (Ministry of Fisheries Auditorium, 18h30, 11 March), Walvis Bay (Kuisebmond Training Centre, 18h30, 11 March) and Henties Bay (Municipal Hall, 10h00, 12 March) .

For more information contact Morgan Hauptfleisch at SAIEA on 061 220 579 or morgan.hauptfleisch@saiea.com

Advertisement for the first round of public meetings:

NOTICE

PUBLIC MEETINGS

The Southern African Institute for Environmental Assessment (SAIEA) on behalf of its client invites all stakeholders to attend public meetings in order to:

- To identify the important environmental, social and economic issues resulting from mining activities in the region and the impacts these will have on other economic activities, the environment and socio-economic development;
- To ensure information on important issues arising from uranium mining are shared with business leaders, decision-makers and planners in key national and local government departments, as well as lending institutions.

Public Meeting Date and Venue

9 March, Windhoek 18h30 @ Safari Hotel
10 March, Usakos -17h30 @ Bahnhof Hotel
10 March, Arandis – 17h30 @ Town Hall
11 March, Swakopmund – 18h30 @ Ministry of Fisheries, Auditorium
11 March, Walvis Bay – 18h30 @ Kuisbemond Training Centre
12 March, Henties Bay – 10h00 @ Town Hall

For more information contact Morgan Hauptfleisch
Tel: 061 220 579

Advertisement for the second round of public meetings:

NOTICE

Ministry of Mines and Energy

URANIUM RUSH STRATEGIC ENVIRONMENTAL ASSESSMENT - REPORT-BACK MEETINGS

The Southern African Institute for Environmental Assessment (SAIEA), on behalf of its client (MME), invites all stakeholders to attend public meetings in order to:

- Receive feedback on the findings of the strategic assessment;
- Address questions to SAIEA and MME representatives.

The meetings will serve as a 'first delivery' of the SEA report. The final report will be available to the public in May 2010.

Public Meeting Dates and Venues

AMENDED

19 April, Swakopmund 18h00 @ Municipal Bungalows Conference Room
20 April, Arandis 18h00 @ Town Hall
21 April, Windhoek 18h00 @ Geological Survey Auditorium

For more information contact John Pallett
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B.2 Minutes of public meetings and attendance lists (first and second rounds)

Summary of outcomes of Public meetings to identify Key Hopes and concerns relating to the Uranium Rush in the Erongo Region (Public meetings first round)

The following lists of issues raised at the public meetings are given in summarised bullet form:

Usakos

Hopes and expectations

Economic:

- Economic growth in Usakos and better infrastructure
- Increased jobs, money, standard of living
- Generate own nuclear power
- Beneficiation of uranium

Social:

- More education and training

For the study:

- Expand study to beyond Erongo

Concerns

Social:

- Increase in crime
- Spiritual decay

Economic

- Uranium exported raw – no beneficiation

Health / radiation

- Wind – dust dispersion
- Health – radiation dangers – humans and all life

Environmental

- Waste management
- Impact of desalination on oceans
- Closure issues – keep Namib beautiful and safe

Political / institutional

- Uranium used for weapons

- Inadequate skilled labour in region (& all education)
- Inadequate skilled labour training
- Loss of uranium as a resource – regulated extraction
- Inadequate government regulations & monitoring

Infrastructure:

- Maintenance of our infrastructure
- Water & power availability.

The Usakos meeting was not well attended. People felt that they had not seen much added activity in Usakos as a result of the Uranium "Rush. The most pressing concern was over the effect of the dominant westerly wind, which was expected to carry dust from the mines to the east of Usakos to the town, with the associated radiation risk.

Arandis

Hopes and expectations

Social:

- More schools will be built
- More jobs
- There needs to be tight control over job seekers.

Economic:

- Economic development for the good of Namibia – the government must invest the money from mining for better futures, better quality of life, poverty reduction, improvements in infrastructure etc

Health / radiation:

- Improved health services
- A radiation-free community

Environmental:

- The mines must employ sustainable mining practices

Political / institutional:

- Namibian Government should own 50% of each mine
- This SEA will form the basis for transparent planning

Infrastructure:

- The uranium rush will force GRN to address the water and power shortages
- Improvements in Arandis e.g. shops, petrol stations
- Happy for the new developments
- The government should build nuclear enrichment plants and reactors to generate our own electricity
- The uranium rush may result in better water supplies

Concerns

Social:

- Social evils
- Potential for increase in HIV/AIDS
- Noise pollution
- Influx of job seekers
- Farmers may lose land
- Risk that people may be moved from Arandis and security of tenure in Arandis
- Job security and unethical mining companies (pension, medical aid etc).

Health / radiation:

- Radiation impacts on health and the environment
- Increased risks of transporting U_3O_8 and chemicals e.g. acid

Environmental:

- Lack of adequate rehabilitation
- Mining is not sustainable
- Impacts on the environment including pollution from waste water, impacts on biodiversity etc
- Water crisis

Political / institutional:

- Lack of planning

Infrastructure:

- Inadequate waste management
- Availability of electricity and prospect of higher costs
- GRN services will not be able to cope e.g. schools, ambulance, police especially as the current medical facilities are inadequate

The Arandis meeting was well attended, and a few very specific issues were raised:
Concern was raised that the Rössing rehabilitation fund was used to prop up the company a few years ago during a financial crisis. It was suggested that the SEA should recommend that rehabilitation trust funds should be untouchable for any other use and that mechanisms should be put in place by MME to ensure that this does not happen again.
Someone expressed concern over the final use of uranium oxide and that it should not be used for military purposes. Assurance was given that Namibia is a signatory of the Non-proliferation Treaty and that product stewardship is closely monitored by the International Atomic Energy Agency (IAEA).

Walvis Bay

Hopes and expectations

Economic:

- Mines must find and set up alternative ways for local communities to benefit from the economic boom – not just through employment (as this lasts only as long as the mine itself)

Health / radiation:

- Compile a thorough baseline for occupational health – related diseases in Erongo e.g. cancer from radiation.
- Workman's compensation under Social Security Act is also granted for radiation diseases

Political / institutional:

- Parastatals and govt must track the U rush scenarios and respond with their plans. E.g. growth in desal plants and pipelines should be in tune with the growth in mines, and should also have 'abandonment' plans in case Scenario 4 occurs.
- The hopes identified in the PP process should be linked to the targets set in Vision 2030, ongoing NDPs, MDGs etc. SAIEA's work in setting up the SEMP should be guided by national plans and strategies e.g. tourism strategy

Concerns

Social:

- Adequate compensation should be given to landowners impacted by mines and infrastructures.

Economic:

- Vulnerability of the U rush to US$ fluctuations. If US dollar crashes, the U rush will be abandoned.
- Influx of foreigners is causing property prices to skyrocket. Why should Namibians suffer from this inflation if the economic boom is supposed to be good for the country?

Health / radiation:

- Risks from nuclear waste. Future supply contracts (individual mines as well as the country) must specify a condition that binds the users to dispose of waste safely. But there is no safe
- Effect of radiation on Arandis residents
- Disaster plans must be properly in place before any mining starts, in the event of a radiation accident. There must be accountability for such accidents if they occur, so that innocent public are not put at risk.

Environmental:

- Mines may use their decommissioning funds during the operational phase, leaving inadequate funds for proper closure (accusation made that Rössing has done that).

The Walvis Bay meeting was not well attended. It was suggested that other means of making stakeholders aware of the meetings should be used in future, e.g. Church briefs, community centres.

A specific concern over the health impacts of the Uranium mining was raised very strongly. One attendee stated: "No health (esp. cancer) baseline for Erongo has ever been done. It is already too late to do a 'pre-uranium mines' baseline study because Rössing has been causing cancers since 1976.". It was suggested that Prof Johnny Myers, based at UCT or Tygerberg Hospital could be approached to assist the SEA on health aspects.

Swakopmund

Hopes and expectations

Social:

- Employment opportunities, jobs
- Skills development
    - mining-specific
    - general

Economic:

- Economic growth & revenue
- Local social investment
- All projects will develop into mines
- Lots of subcontracting opportunities for locals

Environmental:

- Effective monitoring and management of impacts
- New scientific knowledge of env. & how to manage impacts
- Protection of the natural environment

Political / institutional:

- Inter-sectoral co-operation
- Co-ordinated planning
- More/effective government regulation

Infrastructure:

- Infrastructure development
    - national
    - local

For the SEA study:

- SEA-sustainable development
- Learn from past experience and examples

Concerns

Social:

- Social impacts e.g. crime, safety
- Impacts of closure
- Influx of people to area
- Brain drain to mining industry

Economic:

- Impact on the tourism industry
- Revenue all leaves Namibia due to foreign ownership

Health / radiation:

- Impact on health & hygiene
- What to do with radioactive waste

Environmental:

- Degradation of the environment
- Impact on National Parks
- Impact on air quality
- Impacts on ground water
- Depletion of natural resources
- Tailings management

Political / institutional:

- No long-term sustainability – beyond 2020?
- Fly-by-night exploration companies give industry a bad name
- Environmental restrictions could cause delays
- Cumulative impacts of other developments & mines, e.g. desalination plant, dimension stone
- Lobbying & corruption

Infrastructure:

- Impacts on infrastructure e.g. roads, ports, waste disposal
- Impacts on social infrastructure e.g. schools
- Lack of water & power

The Swakopmund meeting was well attended. A number of stakeholders from government, environmental NGOs, mining companies and the media attended the meeting. Dominant concerns were related to mining vs tourism activities in the Namib, and their possible co-existence. Varying environmental practices within the industry was also raised as an issue, with the fear that "fly by night" prospecting outfits were giving the industry a bad name.

Henties Bay

Hopes and expectations

Social:

- Uranium used only for peaceful purposes
- Increased quality of life (locally)

Economic:

- Uranium is not sent out as raw product (beneficiation)

Environmental:

- All recycle water (mines)
- The environment is not polluted

Political / institutional:

- Regulations are enforced

Infrastructure:
- Better infrastructure for Henties bay

Concerns

Social:
- Increased human density

Economic:
- Loss of land for other uses
- Loss of access to desert for recreation

Health / radiation:
- Cancer from radiation

Environmental:
- Inadequate closure/rehabilitation
- Impact on lichen fields
- Impact on wildlife
- Over-use of desert roads
- Disturbance to Messem crater

Political / institutional:
- Institutions cannot manage/regulate the uranium rush
- Corruption
- No inter-ministerial co-operation

Infrastructure:
- Power shortages
- Water availability (not enough)

The Henties Bay meeting was poorly attended. One participant noted that Henties Bay residents did not see themselves directly affected by the Uranium industry, while another explanation was that the town consisted mostly of pensioners with little interest in the industry.

Windhoek

Hopes and expectations

Social:
- Skills development & technological development
- Improved infrastructure e.g. water, roads, waste disposal facilities

Economic:

- Economic development
- Employment of Namibians
- Increased revenue
- Reduction in poverty
- Benefits to other sectors
- Namibia will develop its own nuclear energy industry

Environmental:
- No mining
- Namibia to develop alternative, renewable sources of energy

Political / institutional:
- SEA will add value to policy & legal development & decision-making
- International focus on Namibia

Infrastructure:
- Development of towns in Erongo
- Improvements in Social infrastructure e.g. schools, clinics

For the SEA study:
- SEA will provide a better understanding of the environment
- SEA will make recommendations re. zoning, number of mines, no-go areas, bio-integrity, property rights etc.
- SEA will ensure proper closure planning and funding

Concerns

Social:
- Influx of people
- Increase in HIV/AIDS
- Increased poaching and illegal harvesting
- Impact on farms & farming
- Potential loss of heritage resources

Economic:
- Increased energy demand will impact price, availability
- Impact on tourism
- Loss of access to land
- Not sustainable in long-term

Health / radiation:
- Impact on workers' and public health

Environmental:
- Pollution (noise, dust, g/w, soil, radiation)

- Waste disposal
- Loss of sense of place exp. National parks
- Impacts on biodiversity (e.g. lichens)
- Increased consumption of water and impact on availability

Political / institutional:

- Increase in corruption
- Institutional capacity to cope with Uranium Rush
- Lack of transparency in Government decision-making & information

Infrastructure:

- Impact on social infrastructure (clinics, schools)

The Windhoek meeting was well attended, and much opportunity was given for informal discussion around the Uranium industry in Namibia.

Additional thoughts and comments stemming from the public meetings:

Much informal discussion was stimulated around concerns regarding the Uranium industry in Namibia. These discussion points, or questions raised to the SEA team, are summarised below:

- Are there enough skills to monitor and enforce impacts?
- Lack of Capacity of National government departments to cope
- Radiation impacts and adequate capacity to manage this risk
- Namibia has no nuclear legislation
- Inadequate co-ordination between line ministries
- Lack of integrity regarding rehabilitation Funds – need stronger guaranties regarding use of rehabilitation funds
- Inadequate water legislation (outdated) and WMA not yet enacted: no protection
- SEA needs to look at occupational health issues (e.g. protocols regarding pre-employment screening, compensation?)
- Tracks (especially by exploration companies) – no compensation/rehabilitation funds for exploration
- Need to have social and economic accountability to deliver on 'promises"
- Need better structural framework for issuing licences (more transparency)
- Need to make exploration companies accountable – can use international media
- The Trekkopje desalination plant technology is outdated and very expensive – Namwater should investigate other cheaper technologies such as the one being used in Las Palmas. Then the price of water would not be so high. This suggestion will be passed on to Namwater.
- Is the Government prepared to build enrichment plants and nuclear reactors in Namibia? In reply, Dr Tarr explained that enrichment plants and nuclear reactors were very expensive and that the current levels of demand in Namibia would not justify this expense.

- There is concern over pollution of the groundwater at the Rooibank aquifer and is it possible to clean up an aquifer after it has been polluted? In response the participants were assured that the Rooibank aquifer is not under threat at present from mining contamination and that if any mines were to be constructed in an area which might threaten the Rooibank aquifer, then there would have to be detailed groundwater studies conducted to ensure that there would be no risk. Any risk would be considered a fatal flaw.
- How will MME/MET monitor and audit compliance with all the EIAs and EMPs?
- How can the community be empowered to ‘police’ the operations and to ensure that the mining companies deliver on their promises e.g. number of jobs etc? It was suggested in response that a private ‘watchdog’ committee was required which would be funded by all the mines to commission independent monitors during mine operation and after closure.
- Someone expressed concern over the final use of uranium oxide and that it should not be used for military purposes. Assurance was given that Namibia is a signatory of the Non-proliferation Treaty and that product stewardship is closely monitored by the International Atomic Energy Agency (IAEA).
- Is uranium oxide going to be stockpiled by the government for future use? Various options were discussed whereby the actual U3O8 is not stockpiled but that the government should create a special fund for infrastructure development (viz. Norway and Botswana), or where uranium revenues could be used to invest in people through education.
- Concern was raised that the Rössing rehabilitation fund was used to prop up the company a few years ago during a financial crisis. It was suggested that the SEA should recommend that rehabilitation trust funds should be untouchable for any other use and that mechanisms should be put in place by MME to ensure that this does not happen again.
- Shortage of land especially for waste, sewage needs better, long-term planning
- How are we going to incorporate findings from NACOMA and this SEA?
- Scenario 0 – i.e. no mines at all – are we considering this?
- Hope – insist on underground mining
- Need to carefully assess actual mine targets vis a vis tourism activities and landscape Concern – long-term viability of low-grad deposits i.e. need to assess long-term sustainability and risk.

MINUTES OF THE SWAKOPMUND PUBLIC MEETING

STRATEGIC ENVIRONMENTAL ASSESSMENT FOR URANIUM MINING IN ERONGO

Swakopmund Bungalows Conference Centre

19th April 2010 at 18h00

Present: Dr G Schneider (GS), GSN
Dr R Ellmies (RE), BGR
Mr M Hauptfleisch (MH), SAIEA
Ms B Walmsley (BW), SAEIA
Dr B Dalal-Clayton (BDC), IIED (via Skype Video)
Interested and affected parties (see registration list attached)

Agenda:

1 Introductions and Welcome (MH, GS)
2 Presentation by the External Reviewer (BDC) via Skype
3 Presentation of the SEA and its key findings (BW)
4 Questions and answers

Questions and answers

Q: Dr G Obermair.

1 Explain gap in uranium demand and supply – is it real?
2 How realistic is it that the income from the Uranium Rush will be used sustainably by the government? Increased national spending would be a good thing if the money is used to improved quality of life for all Namibians.

A: The supply gap for uranium is real – there is a shortage of uranium oxide. The apparent decline in the spot price is due to the bubble effect and the price has stabilised at a realistic level ($40/lb) (but still higher than it was before the bubble). The long-term predicted price is still estimated to be around $60-70/lb.

The SEA has presented the many benefits and opportunities of the Uranium Rush for the Erongo region, as well as nationally and it is hoped that the government will use the income and revenues wisely. There are numerous indicators in the SEMP to monitor this.

The assessment of the Rush in four scenarios will also cover the effects of fluctuations.

Q: Frank Lohnert

1 Has the SEA quantified the impacts of the Uranium Rush on health and tourism in an unbiased and objective manner?
2 He has heard that open pit mining for uranium has been banned – is this true?

A: The health specialist was carefully chosen to ensure that he had not previous ties with Namibia and no vested interests in the Uranium Rush, so the report is an objective analysis of the health risks and impacts. The specialist report will be made available.

The economic study modelled a number of macro-economic indicators, including the impact on tourism. The specialist report will be made available.

There is no truth whatsoever that open pit mining has been banned. Indeed open pit mining for uranium is the preferred mining method because of the radon health risks associated with underground mining.

Q: Siegfried, Swakopmund resident

You have outlined 4 scenarios including a boom and bust scenario. Have you considered normal planned mine closure and the effect this will have on the economy? How will mine closure be monitored and enforced by government?

A: Normal mine closure has been considered in the SEA as an integral part of mine life (exploration, construction, operation, decommissioning and closure). Typically the life of mine is difficult to predict and mine's usually prolong their operations as new deposits are found and mine economics change. So we have not been able to say with any certainty when any of the mines will close down. And while some may close, others could open. The idea of the scenarios is to suggest that there may be a number of mines operating at any one time, not necessarily all the ones named in the scenarios.

The mines are required by law to prepare and submit mine closure plans to the authorities as part of their Mining Licence conditions. One of the tasks of the SEMP office will be to monitor this and MME has been named in the SEMP as the responsible authority. Thus we hope that closure planning will be kept up to date and implemented.

Q: Rod Braby, NACOMA

Are there going to be two separate desalination plants or will they be combined into one (at Wlotzkasbaken)?

A: One desalination plant is strongly recommended in the SEA from the point of view of timing (it will be much quicker to expand the Wlotzkasbaken plant than start a new one from scratch) and from an environmental perspective (less disturbance).

Q: Luisa d'Andrea, Rio Tinto

Have exploration impacts been considered in the SEA?

A: The specific impacts of exploration should be looked at in the individual EIAs and EMPs for exploration. However, all new applications for EPLs will be routed via the SEMP office and their location checked against the environmental sensitivity map and the red flag and yellow flag areas. This will help guide decision making re future EPL applications.

Q: ??, Swakopmund Resident

1 Also had a question about exploration in a National Park (as per the previous question) and likes the idea of the EPL/ML decision making framework.
2 There are current problems in Swakopmund relating to overcrowding in schools and clinics, but nothing seems to be done about it. How will this SEA help? Is the government committed to the SEA process?

A: Both schooling and healthcare have an Environmental Quality Objective in the Strategic Environmental Management Plan (SEMP), setting minimum standards that need to be achieved (according to the government's own policies) and the relevant ministries have been listed as the responsible parties.

The government took over the SEA initiative from the Chamber of Mines because of its commitment to the process and future implementation.

Q: ??,Swakopmund resident

What is the relationship between the SEA and the individual EIAs being conducted for the mines and other projects? Isn't the SEA a bit after the fact?

A: the SEA was a bit late in starting, but it is difficult to predict a 'rush'. The SEA will provide the overall framework for future planning e.g. defining infrastructure corridors etc and it is hoped that the individual mining companies and their consultants will buy into this planning. Several meetings have been held with the mining companies and they are represented on the Steering Committee along with the Chamber of Mines. Many of the suggestions being made in the SEA have already been taken up by these companies and incorporated into their planning and design.

Q: Dr von Oertzen, VO Consulting

We are very lucky to have had this SEA done and have had the opportunity to participate in it – not many countries have experienced such a process.

He noted that the mines being talked about are *uranium* mines and they have radiation risks associated with them. He is concerned that the cumulative health effects of e.g. radon have not been quantified and reported per scenario and would like to see this in the final report.

A: It was noted that the health impact study is being finalised and will integrate the findings of the air pollution study and the groundwater study in order to present a comprehensive analysis of the pathways and exposure risks to radiation. This information will be presented graphically, as well as numerically.

Q: M Stanton, Environmental lawyer

1. how much local employment will there be given the skills shortage?
2. What happens when the mines close especially for communities like Arandis?
3. Isn't mining in the National Park in conflict with the Namibian Constitution?

A: The EQOs state that local employment and procurement should occur as a priority, but there will not be enough skills locally and there will therefore be an influx of people to the area, which in turn will place pressures on housing, house prices, schools, clinics etc.

It is hoped that the proposed mines will operate for many years and it is also expected that even if some close, others will open or expand and therefore the positive impacts on communities such as Arandis should be sustainably for several decades.

The Policy on Mining in National Parks was found not to be in conflict with the constitution. The powers of the Minister of Environment and Tourism to stop any mining in a national park has never been exercised in terms of the current Nature Conservation Ordinance of 1975. This Ordinance will hopefully be replaced by the forthcoming Parks and Wildlife Act, which will give the Minister increased powers. The EPL and ML applications are looked at by a Committee which includes MET and so they are involved in the decision making process. The proposed framework for future decision making developed as part of this SEA will further help ensure that more informed decisions about mining in sensitive areas are taken.

Q: Rod Braby, NACOMA

Will the no-go (red flag) areas be enforced?

A: the red flag areas have been selected using defensible scientific criteria e.g. world heritage sites and these should be enforced as no-go areas as per the set objectives in the EQOs.

Q: Robert van Rooyen

Please add medium size enterprises to your stakeholder list.

A: noted.

Q: (after the meeting was finished)

You mention that ethics was one of the inputs to the EQOs – by what standard will you measure this? The 'right thing to do' may be different for various people.

A: thank you for your useful comment. We will endeavour to clarify this in the final SEA report.

MINUTES OF THE ARANDIS PUBLIC MEETING

STRATEGIC ENVIRONMENTAL ASSESSMENT FOR URANIUM MINING IN ERONGO

Arandis Town Hall

20th April 2010 at 18h00

Present: Dr G Schneider (GS), GSN

Mr I Hasheela (IH), GSN

Mr M Hauptfleisch (MH), SAIEA

Interested and affected parties (see registration list attached)

Agenda:

1 Introductions and Welcome (MH, GS)
2 Presentation of the external review findings for the SEA (MH)
3 Presentation of the SEA and its key findings (MH)
4 Questions and answers

Questions and answers

Comments and Questions: Mr.J English (SME owner)

1 The presentation is very good, it is the first time the positive and negative aspects of Uranium mining is explained, providing a good perspective.
2 How will the dust and blasting from all the mines affect Arandis?
3 Mining companies have held public meetings at Arandis as part of their EIA processes and made empty promises. Most have not been seen since.

A: The SEA process does not intend to judge or promote Uranium mining. It gives a balanced view and tries to find ways of minimising negative cumulative impacts, and enhance the positives of the rush.

Mining companies have EIAs which identify impacts at a local level, this includes dust and blasting, and there are measures in place to mitigate these. The SEA does include an air quality study, but results of this study are not yet available.

Mining companies have EMP’s which have resulted from their EIAs, and these need to be adhered to. MME takes note of your comment regarding empty promises.

Q 2: Mr. D.

1 There are consistent vibrations in the houses of Arandis from Rössing mine. Will this be worse when new mines are established?

2 Is there a legal requirement to conduct this SEA?

3 What procedure is applied before giving mines EPLs or MLs?

4 EMPs are not adhered to and not enforced by government. Arandis does not even have a medical doctor.

A: MME or the SEA team are not aware of the vibrations, it is recommended that the community approach Rössing mine in this regard. The SEA did not consider blasting vibrations, as this is addressed at EIA level. The distance of possible new mines are far from Arandis, therefore there should not be a cumulative effect.

The SEA is not required by law, but is an important decision making tool for MME, other government institutions and the mining industry to ensure that the Uranium rush (which is already underway) benefits the nation and region and causes minimal harm to the environment.

MME acknowledges that the Uranium Rush came very quickly. They have awarded a number of EPLs for Uranium, but then placed a moratorium on the issuing of new ones until they had a good grip on the situation. The SEA is key to understanding the Rush and making informed decisions about the issuance of licences going forward.

MME take note, and the SEA requires mining companies to adhere to their EMPs, and any non-compliance will be reflected in the SEMP report.

Mr. D. Tsaneb

1. The mines will leave holes behind, will this affect the people through radiation?
2. How will our comments be taken up in the SEA?

A: The SEA has an EQO dealing specifically with mine closure, and each mine should have a plan on how they will close the mine. Radiation impacts are being studied, and the results will be available with the final report.

The final SEA report will ensure it has addressed your concerns. The SEMP is a dynamic document / process, and it will be adapted over time, public input will therefore be ongoing, and feed into the SEMP.

Mr. D. Venter (Owner of Africa Mining Solutions)

1. How will people get compensated for their houses suffering damage from blasting?
2. What controls are in place to ensure revenue from the Uranium Rush is re-invested in Erongo region?
3. How does Uranium cause disease?

A: This is a matter which will be sent on to the relevant mine for action. Mine specific impacts are not considered in the SEA.

As Uranium is a national resource, benefit should go to the whole of Namibia and not just Erongo. However, significant investment in infrastructure is needed to allow for the Rush to take place, and these will benefit Erongo.

Process briefly explained, but the Health study will contain all details of the potential impact on human health.

MINUTES OF THE WINDHOEK PUBLIC MEETING

STRATEGIC ENVIRONMENTAL ASSESSMENT FOR URANIUM MINING IN ERONGO

Ministry of Mines and Energy Auditorium

21st April 2010 at 18h00

Present: Dr G Schneider (GS), GSN
Dr R Ellmies (RE), GSN, BGR
Mr I Hasheela (IH), GSN
Mr M Hauptfleisch (MH), SAIEA
Mr J Pallett (JP), SAIEA
Dr B Dalal-Clayton (BDC) External Reviewer
Interested and affected parties (see registration list attached)

Agenda:

1 Introductions and Welcome (MH, GS)
2 Presentation of the external review findings for the SEA (BDC)
3 Presentation of the SEA and its key findings (MH)
4 Presentation of preliminary findings of Air Quality, Groundwater and Health studies (RE)
5 Questions and answers

Questions and answers

Comments and Questions: Q1: Ms.B Weidlich (Journalist)

1 Will the final report be reviewed by BDC?

A: This has not yet been confirmed.

Q 2: Mr.R. Sherbourne (Economist)

1 The references to the three legs of sustainability should have an addition of a fourth leg (political). There is a sense that Namibia is allowing its mineral resources to be plundered, and the country is not getting enough out of it.

A: The macro-economic section of the SEA traces the revenue streams associated with the SEA. It analyses the losses and recommends where more benefits can accrue to the country and the region.

Q 3: Mr. C. Loftie Eaton (Engineering consultant)

1. The awarding of EPZ status for Areva is a worrisome development. This needs to be noted.
2. Are sectors other than Uranium mining and exploration also included in the study (e.g. NamWater, NamPower, Ports etc.)?

A: Noted

All sectors likely to influence or be influenced by the Uranium Rush were consulted. Many focus group meetings were held. Details of sector-plans and how they are to be affected by the Uranium Rush are contained in the Infrastructure section of the SEA report.

Q 4: Unannounced person

4. Are the environmental costs greater than the benefits of the Uranium Rush or vice versa?

A: A cost-benefit analysis such as this is impossible to conduct at this scale. It would also not provide much value as the Uranium Rush is already happening, and the SEA seeks to minimise harm and maximise benefits.

Q 5: Mr. H. Zauter

1. How will the monitoring (SEMP) be financed long term?
2. Will contraventions to the SEMP be punishable?

A: This is yet to be decided, but it is recommended that mining companies contribute towards it, and government pay the balance.

The SEMP is not a legally regulatory document. It will monitor the Uranium Rush for signs of cumulative impacts and trigger responses. The responses are not enforceable by law (some may be under current laws), but are actions recommended in cooperation with mining companies.

Q 6: Ms. A. PUZ (DWA)

1. What happens once the SEMP data is collected?
2. Will the general public pay for the increased infrastructure (water / electricity etc) required by the Uranium Rush? In other words are the public expected to subsidise the mining companies for this infrastructure?

A: A SEMP report will be produced, which will be available to the broader public, to track the progress of the Uranium Rush in relation to targets set in terms of minimising negative and enhancing positive aspects.

Mining companies pay the parastatal utilities for the required infrastructure to their mines, however general infrastructure is needed, which will not only benefit the Uranium Industry, but the region as a whole. Uranium is a national resource, therefore benefits do not only accrue to the region, but to the country as a whole.

Q 7: P Heyns (Independent Hydrologist)

1. Who will pay for the “clean-up” if the boom-bust scenario happens?

A: Government is ultimately responsible, but this is a major issue and has been highlighted in the SEA.

Q 8: Mr. F. Tjombe (SME owner)

1. Who pays for mine rehabilitation?

A: Mining companies are responsible for their rehabilitation and closure. As part of the EMPs, each mine is required to have a closure plan. Some have closure funds, which will be used to rehabilitate the mine site post closure. This is an aspect that the SEA looks at and an EQO on closure is being formulated to highlight the importance of this aspect.

Attendance registers for first round of public meetings

<u>First Round</u>
Public Meeting – Attendance List   Venue: Windhoek   Date: 09/03/2009

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Public Meeting – Attendance List Venue: Usakos Date: 10/03/2009

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Public Meeting – Attendance List Venue: Arandis Date: 10/03/2009

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Public Meeting – Attendance List Venue: Swakopmund Date: 11/03/2009

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Public Meeting – Attendance List Venue: Walvis Bay Date: 11/03/2009

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Public Meeting – Attendance List Venue: Henties Bay Date: 12/03/2009

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Second Round

Public Meeting – Attendance List : Venue: Swakopmund Date: 19/04/2010

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Public Meeting – Attendance List   Venue: Arandis   Date: 20/04/2010

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Public Meeting – Attendance List **Venue: Windhoek** **Date: 21/04/2010**

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B.4 Newspaper articles

Below are copies of a selection of newspaper articles that appeared in Namibian newspapers during the Uranium Rush SEA:

9 March 2009, Namibian Newspaper

THE NAMIBIAN BUSINESS & ECONOMICS MONDAY MARCH 9 2009 15

Uranium industry to be scrutinised

• THORSTEN SCHIER

WHAT is the current world uranium rush going to do for Namibia?

With prices skyrocketing in the past few years and international demand exceeding supply by almost 50 per cent, the industry could be Namibia's ticket out of the economic crisis.

The Erongo Region with its vast uranium deposits has become a hotbed of exploration and mining activity, and virtually the whole region is currently under some kind of prospecting or mining attention.

But uranium mining remains controversial, and some have vilified it as exploitative and detrimental to the environment and health of Namibians.

A Strategic Environmental Assessment (SEA), recently commissioned by the Ministry of Mines and Energy, might put a lot of this speculation to rest.

The SEA, which will be carried out by the Southern African Institute for Environmental Assessment (SAIEA), looks at all impacts of uranium mining.

It differs significantly in its scope from the environmental impact assessments (EIAs) usually carried out for environmentally sensitive projects.

While an EIS focuses only on environmental impacts, a SEA also looks at socio-economic impacts, policy issues and infrastructural concerns.

These include for example whether local schools are equipped to handle the large influx of children the new mining employees might bring and what the health impact of radiation from mining might be.

The study should also provide a framework for future entrants to the industry and provide guidelines which they will have to abide by.

It will also look at social issues like the impact on the quality of life in nearby towns like Swakopmund.

All in all the study will consider 37 categories in different impact fields and each of these will be done for the 57 different mining activities identified with the uranium mining process.

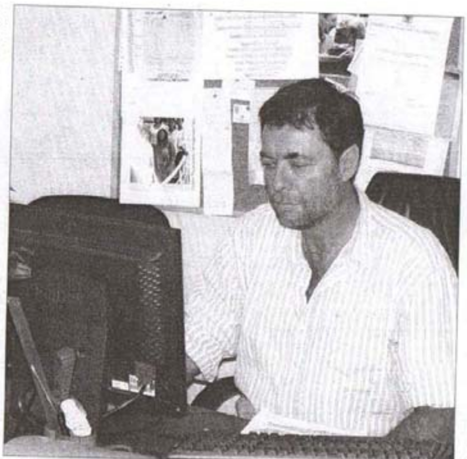

Photo: Thorsten Schier

ROLLS-ROYCE STUDY ... Peter Tarr, Executive Director of the Southern African Institute for Environmental Assessment (SAIEA), which will be carrying out a far-reaching study of the uranium industry in Namibia.

The study will consider all of these different assessments for four different possible industry scenarios.

These range from the lowest number of mines now possible (the three most current ones) to the highest (ten), according to the SAIEA.

It includes a possible 'boom and bust' scenario in which many mines open but are forced to close soon after, leaving Namibia with the environmental impact.

A staggering example of the possible impact the industry might have environmentally if the biggest number of mines open by 2015 is that Namibia will have to produce three quarters of its current total water consumption just for uranium mines.

A desalination plant then seems essential to support the industry.

On the massive scope of the study, SAIEA Executive Director Dr Peter Tarr said that "you've got to do it Rolls-Royce, not Mickey Mouse".

He says it is the first time in the world that such a detailed study has been carried out for a mining project in a relatively small area.

The project is partly funded by German donors together with the Ministry, ensuring that it is independent of the uranium industry.

According to Tarr, the project will be reviewed by international experts, whom he calls "the top people" in the field of SEAs.

He is quick to point out that the study is "not a handbrake" on the uranium industry, and that it does not have the power to stop mines from opening.

But he says it will give policymakers the information to "optimise benefits and avoid nega-

Public participation plays a key role in the study and starting from today public meetings will be held during which people can raise their concerns about the industry.

The meetings will start today in Windhoek at the Safari Hotel at 18h30, then move to the Bahnhof Hotel in Usakos at 17h30 on March 10.

Next will be the Arandis Town Hall at 17h30 also on the 10th, then Swakopmund on the 11th at the Ministry of Fisheries Auditorium at 18h30.

And the final two meetings will be held in Walvis Bay at the Kuisebmond Training Centre at 18h30 on the 11th and in Henties Bay at the Municipal Hall at 10h00 on the 12th.

But Tarr also encourages all stakeholders who feel they are affected or have an interest or concern about the uranium industry to contact the SAEIA and separate meetings can be arranged "within reason".

The institute can be contacted via Morgan Hauptfleisch at (061) 220 579 or morgan.hauptlfleisch@saiea.

12 March 2009, Republikein Newspaper

REPUBLIKEIN: 12 MARCH 2009

Uraanstormloop in Namib

• **Niël Terblanché**

'n GEDUGTE span spesialiste is byeen geroep om 'n omvattende strategiese omgewingsbepalingstudie oor die impak van die sogenaamde uraanstormloop in die sentrale Namibwoestyn te ondersoek.

Die ongekende internasionale belangstelling in Namibië se uraanbron is toe te skryf aan die groeiende aanvraag na die mineraal in sy verrykte vorm as alternatiewe energiebron. Saam met die Rössing- en Langer Heinrichmyn gaan minstens vier nuwe myne aan die einde van 2010 in gebruik gestel word en is verskeie ander reeds met finale eksploraisewerk besig.

Die studie is reeds gedurende Februarie vanjaar in opdrag van die Ministerie van Myne en Energie van stapel gestuur om die impak van die bedryf, wat gesien word as die land se vrypas uit die heersende ekonomiese krisis, in die Erongo-streek te bepaal. Om dit te laat plaasvind, is 'n groot bedrag geld benodig en na onderhandelinge met die Duitse regering het die Duitse Geologiese Opname besluit om vir 'n groot gedeelte van die studie se koste in te staan.

Volgens die projekleier, dr. Peter Tarr, is die "omgewing" in die benaming van die studie misleidend. Tydens 'n openbare vergadering met inwoners van Windhoek het dr. Tarr gesê alle aspekte van die uraanbedryf in Namibië word in die studie vervat en is dit die rede waarom dit as 'n wêreldeerste beskryf kan word.

"In die verlede het elke mynmaatskappy sy eie omgewingsimpakstudie onderneem waarin net aan die voorskrifte ten opsigte van bestuur en bewaring van die omgewing van die regering voldoen word. Die studie is daarop gemik om uiteindelik basisriglynkennis oor die ekonomiese-, sosiale-, bio-fisiese- en infrastrukturele impak van die uraanbedryf in sy geheel aan die Namibiese regering te verskaf."

Dit sal volgens dr. Tarr vir die Regering moontlik wees om 'n beleidswitskrif met die resultate van die studie saam te stel.

"Die studie is daarop gerig om die kumulatiewe effekte van die uraanbedryf beide positief en negatief te bestudeer sodat 'n beleid oor bestuur van uraanmyne saamgestel kan word."

Die Suider Afrikaanse Instituut vir Omgewingstudies is deur die Ministerie van Myne en Energie gekontrakteur om die studie uit te voer. Die span gaan ook konsentreer op die kumulatiewe effek van uraanontginning ten opsigte van bestraling, menslike gesondheid, biodiversiteit, toerisme, ekonomiese bedrywighede, hidrologie en die maatskaplike infrastruktuur gaan wees.

Die reeks openbare vergaderings het Dinsdag in Windhoek afgeskop. Vergaderings gaan ook met die gemeenskappe van Swakopmund, Walvisbaai, Hentiesbaai, Usakos en Arandis gehou word om insette van die inwoners te verkry.

ars to

ines

16 March 2009, Republikein Newspaper

maatjies teen die einde van vandeesmaand sal strek.

die hospitaal geneem is. Foto: Niël Terblanché

REPUBLIKEIN 16/3/2009

Uraanstormloop onder die loep

• **Des Erasmus**

'n VERSKROEIDE aarde met verslae gemeenskappe of 'n lokomotief vir die Namibiese ekonomie is die vlakte van uiterstes waardeur opnemers in 'n strategiese omgewingstudie in die uraanstormloop in Namib stuur. 'n Weg na voorspoed word gesoek in 'n studie waarmee vandeesweek in Windhoek en op dorpe van die Erongostreek begin is.

'n Eerste so 'n opname in die wêreld in opdrag van die Ministerie van Myne en Energie, het dr. Peter Tarr Woensdagaand op Swakopmund op 'n vergadering van sowat sestig mense gesê. Die opname word deur Geologiese Opnames in Namibië in samewerking met die Bundesanstalt und Rohstoffe (BGR) gedoen. Dit was 'n geleentheid vir die publiek om insette te lewer terwyl daar teen die einde van die jaar 'n verslagvergadering met hulle gehou gaan word oor hoe die pad vorentoe lyk.

Vir die opname is 'n span kundiges van die SA Instituut vir Omgewingsbepaling saamgestel. Bestraling en menslike gesondheid, biodiversiteit, toerisme, die ekonomie, water en die maatskaplike infrastruktuur van die uraangemeenskap word onder meer nagevors. Die leier van die span is dr. Peter Tarr. In die opname word die negatiewe en positiewe kumulatiewe trefkrag op die omgewing opgesom. Daarna word aanbevelings gemaak oor hoe die negatiewe teëgewerk en die positiewe bevorder kan word.

Vir die navorsers is dit 'n vooruitskouing oor wat tot 2020 van die uraanstormloop verwag kan word. Dr. Tarr het gesê die opname geniet die ondersteuning van die Kamer van Mynwese.

Dr. Tarr het gesê die universele vraag na uraan word nog nie deur bestaande myne bereik nie. Die tekort word nou deur sekondêre uraanbronne aangevul. 'n Namibiese probleem is dat 'n uraanplan nie bestaan nie en ook nie hoe die uraannywerheid gaan eindig nie.

Namibië is verbind tot internasionale ooreenkomste oor uraan. Dit moet egter vasgestel word of daar nie in bestaande wette skuiwergate is nie en of die inheemse bevolking met die uraanstormloop sal kan handel.

"Ons moet bepaal hoe ons die Namib oor dertig jaar wil sien. Aanduidings moet gegee word van die mynleeftye en oor wanneer hulle gaan sluit. Gaan daar drie, vier tot ses, sewe tot tien uraanmyne wees wat vinnig gaan sluit. Bo verwagting is mynvorming van sewe tot tien tot 2020, maar wat gaan gebeur wanneer almal gelyktydig sou sluit? 'n Katastrofe sou wees as omstandighede buite beheer die myne feitlik oornag gaan sluit en die mynbase gaan wegtrek met die Namib wat in gebrokenheid gaan lê."

Die opnemers is bewus van mynleeftye wat normaalweg langer as die geprojekteerde leeftyd is. Die myne gaan 'n geweldige hoeveelheid water gebruik en teen 2015 kan dit 'n heenkome aan seweduisend werkers bied.

Van die mense op die vergaderings word verwag om insette te lewer oor onderwerpe soos bestraling, lugbesoedeling, water, die infrastruktuur, sosiale stres, maatskaplike dienste, eiendom en grondgebruik.

24 March 2010, Namibian Newspaper

to Africa that the region was already suffering a slowdown in key sectors, but countries that rely on exports of single commodities are the hardest-hit.

"Angola and Zambia recorded impressive growth over the past years, as a result of the rise in copper and oil prices," van der Merwe said.

"However with the sharp decrease in programmes.

Japan on Saturday announced additional foreign aid of US$500 million (N$4,8 billion), on top of an earlier pledge to double Tokyo's assistance to the continent.

Japan organised the conference to follow up on progress with its new aid scheme. – *Nampa-AFP*

NAMIBIAN 24 MARCH 2009

Public questions Govt on uranium rush

• **THORSTEN SCHIER**

THE public is questioning Government's ability to handle the uranium rush in Namibia.

This emerged from the seven public meetings held as part of a Strategic Environmental Assessment (SEA) of the industry.

Dr Peter Tarr of the Southern African Institute for Environmental Assessment (SAIEA), which is carrying out the SEA, said many participants at the meetings "do not think Government can handle this thing".

Tarr said people believe the existing mining of diamonds and granite, for example, is not being managed very well and so question Government's ability to regulate the uranium industry.

However, Tarr added that meeting participants were "not cynical about the will of Government" to handle the project but said it simply lacked the know-how.

The consensus at the meetings was that this problem could be solved by involving civil society.

Tarr quoted some examples given at the gatherings, for example the Gobabeb research station taking over some of the environmental monitoring of the industry while the Chamber of Commerce and Industry could look at the economic side.

As long as the authorities involve others, people believe the rush can be a success, Tarr said.

He said many participants mentioned the disastrous Ramatex project as an example of their fears for the uranium rush.

Tarr said Ramatex was an example of a project that was "politically oversold and not adequately monitored" and a case where Namibia had been "taken for a ride".

He said the scariest scenario for people was one where mining companies opened and then left before rehabilitating their sites due to unforeseen economic factors, as happened with Ramatex.

Participants therefore suggested that a fund be created which companies could not touch until they started cleaning up their sites.

In general the public expects a firm hand from Government in making foreign companies stick to local rules.

Other key concerns were about health risks caused by radiation and the contamination of water.

On the environmental front, people expressed fears of radioactive material being brought back into the country and dumped in the desert.

Tarr said there was no evidence to substantiate these rumours.

He pointed out that Article 95L of the Constitution specifically forbids any imports of toxic waste.

The main hope of people, especially in the Erongo Region, is that the uranium-mining industry would create jobs, either directly or in industries connected to mining.

The public can participate in the study until June.

Tarr invites any groups or individuals that feel they have a stake or interest in the uranium industry to contact the SAIEA through Morgan Hauptfleisch at (061) 220 579 or morgan.hauptfleisch@saiea.com.

be more accountable for their directors' pay packages.

These rulings are part of the new King III report, which is up for public comment.

The code, which South African companies are legally obliged to adhere to and which constitutes best practice in Namibia, has been rewritten to include much tougher stances on for example directors' remuneration and auditing practices.

Committee chairman Mervyn King is quoted as saying the revision of the report was necessary because of "a number of developments that had taken place since the publication of the second report in March 2002".

This hints at transgressions that have recently occurred in light of the financial crisis.

Companies' auditing practices and the habit of

31 March 2010, Republikein Newspaper:

31.03.2010

Kalm Namibië lok die uraanreuse

DIE beste geleenthede vir die ontwikkeling van die Afrika-vasteland se uraanvelde lê in Namibië. Beleggers in die uraannywerheid soek antwoorde op ses vrae alvorens eens aan mynwording in Afrika-lande gedink word.

Die vrae handel oor politieke stabiliteit, die beskikbaarheid van 'n basiese infrastruktuur, die beskikbaarheid van water, die beskikbaarheid van krag, duidelike riglyne oor grondbesit en die bestaan van 'n duidelike mynboukode.

Die vier lande wat naas Namibië die meeste belangstelling in die uraannywerheid wek, is die Demokratiese Republiek van Kongo, Angola, Tanzanië en Angola. Die ses vereistes is deur Graham Greenway van Johannesburg saamgevat na aanleiding van ‘n tegniese verslag wat hy oor die uraanstormloop op die vasteland opgestel het.

Uittreksels uit die verslag is reeds in vooruitskouinge vir Forsys Metals se Valencia-aanleg in die Namib gebruik. Greenway sê dit sal hom nie verbaas as Namibië voor die einde van die dekade oor vier produserende uraanmyne beskik nie. Die vereistes word nie net gestel nie, maar aanduidinge word ook gegee van in hoe ‘n mate Afrika-lande daaraan voldoen.

Politieke stabiliteit.

Is daar politieke risiko’s verbonde aan die ontwikkeling van uraanmyne in Afrika? Zimbabwe is die een Afrika- land waar politieke onsekerheid nou bestaan. In Niger is die beskikbaarheid van water ’n probleem en heers politieke onserkerheid. Hierteenoor heers politieke stabiliteit in Namibië.

Infrastruktuur.

As ‘n behoorlike infrastruktuur nie bestaan nie, sal ‘n uraanbron net ontgin kan word as dit van wêreldgehalte is. Daarmee word die beskikbaarheid van 'n paaienetwerk, pypleidings en enige vervoerstelsel bedoel. Infrastruktuur kan net geskep word, sou die omvang van die bron dit regverdig. In Namibië is die ontluikende myne nie ver van die produserende Rössing nie. Sou bykomende infrastruktuur benodig word, hoef dit net oor kort afstande geskep te word, nie honderde kilometers nie.

Water.

Baie dele van Afrika is droog. Namibië se uraanneerslae is in 'n woestyn. Vir die ontginning van die bron is water nodig. Niger het 'n waterstruktuur geskep, maar ondervind nou 'n droogte. In Namibië word na die ontsouting van seewater omgeskakel.

Krag.

Namibië is vir kragverskaffing hoofsaaklik op Suid- Afrika aangewese. Oorweging word egter aan die Kudugasvelde geskep. Die prys van ruolie kan ‘n duur oorweging vir kragverskaffing in Afrikalande word.

Grondeienaarskap.

In Angola en Kongo was daar in die verlede probleme met grondeienaarskap. Twee eienaars kon op die dieselfde stuk grond aanspraak maak, afhangende van wie bereid was om die meeste omkoopgeld te betaal. In Namibië word grondeienaarskap duidelik omskryf.

‘n Mynkode.

Dit behels basies die inkomste vir die staat uit myne. Die meeste van die lande hef basiese belastings op myne en vergun die eienaars dan die reg om die res van die winste uit die land te neem. Burkina Faso beskik oor ‘n goeie mynkode. In Namibië behoort dit nie probleme te skep nie.

11 May 2010, Namibian Newspaper

Uranium 'rush' or 'crush' for Erongo?

• ADAM HARTMAN

IT'S not hard to identify the positive spin-offs of a uranium 'rush' for Namibia's Uranium 'province' (Erongo), but there are also elements that could turn this positive outlook into a uranium 'crush', with serious social, economic and environmental implications.

One element is government's non consideration to re-invest uranium revenue back into the environment and communities effected by the rush. Another element is an unforeseen event that destabilises uranium prices and the global uranium market, resulting in mines 'turning off the lights and walking away'.

These were some of the points discussed at a recent public meeting in Swakopmund where the 'Uranium Rush' Strategic Environmental Assessment (SEA) was presented. The SEA is being done by the Southern African Institute for Environmental Assessment (SAIEA) on behalf of the Ministry of Mines and Energy and the final report is expected to be out soon.

Due a global trend to reduce greenhouse gasses and develop 'clean energy' many countries have turned over decades-old moratoriums to build reactors, leading to a massive demand for uranium. There are currently 436 operative nuclear reactors globally and another 45 under construction. Another 112 are being planned. These reactors need uranium and there is a shortage in supply.

Erongo has become a lucrative source of primary uranium due to its easily mined landscape and its transport infrastructure that is nearby, which simplifies mining, processing and export of uranium to foreign markets.

According to SAIEA representative, Bryony Walmsley a 'best-case' scenario on the 'cumulative impact' of the uranium rush in Erongo, to ensure the sustainability of the industry, economy, society and especially the environment, would mean serious management measures have to be in place – including government's cognizance to re-invest it uranium dollars into the effected communities and environment.

Photos: Adam Hartman

Uranium mining activities at Areva's Trekkopje plant.

There are four existing and immediate terms projects, which include Rössing Uranium, Langer Heinrich, Valencia, and Trekkopje.

Besides the mining sites, there is also important infrastructure required by each, which include pipe-, power- and railway-lines.

By 2016, 24 million pounds of uranium per year is expected be extracted, compared to the 11 million pounds currently. Employment will increase from the current 2 000 people to 4 000 in 2016. Water demand is now 13 million cubic metres, in 2016 is will be over 20 million cubic metres, while power supply will need to meet 120 megaWatts by 2016. There will also be a 58 percent increase in road traffic.

With more mines coming, like Bannermann, Rossing South, Reptile Uranium, Marencia Energy, plus the need for a coal-fire power station, another desalination plant and chemical factories, these figures will more than triple.

Barry Dalal-Clayton, an international SEA-expert said prospective environmental and social indicators due to the rush are suggesting that the process is "excelling into their own directions", which will become unsustainable, unless the Namibian government invests its "uranium dollars" to swing the pendulum back to ensure a sustainable future. According to him, it was necessary to make a broader sustainability assessment to address the issue of Namibia's uranium revenue, and how that can be best invested for sustainable development.

"The government must have a legacy of not squandering away this money but to re-invest it in the

B.5 Questionnaires

Questionnaire on the state and dynamics in the housing market of Central Namib towns:

QUESTIONNAIRE ON HOUSING MARKET

URANIUM RUSH SEA

1. How many houses are currently in the market in this town?

In the following price ranges:

Luxury market……………………………………………………

Middle market…………………………………………....

Budget market…………………………………………………

Flats………………………………………………………….

2. How many erven are for sale:

High income areas:…………………………

Middle income areas:…………………….

Low income areas:…………………………

3. What is the current average price of a:

High income house (4 bedroom – sea view) :…………………………

Middle income house (2-3 bedroom) :………………………,,

Low income house (Mondesa) :…………………………

Flat in town (2 bedroom) :…………………………

Erf :…………………………

4. What was the price 3 years ago for:

High income house (4 bedroom – sea view) :…………………………

Middle income house (2-3 bedroom) :………………………,,,,

Low income house (Mondesa) :…………………………

Flat in town (2 bedroom) :…………………………

Erf :…………………………

4. What is the average waiting time to sell a:

High income house (4 bedroom – sea view) :…………………………

Middle income house (2-3 bedroom) :……………………,,,,

Low income house (Mondesa) :…………………………

Flat in town (2 bedroom) :…………………………

Erf :…………………………

5. What trends are you seeing in the market? (What do you expect in the next 5 years)

………

6. What is the profile of buyers of:

High income house (4 bedroom – sea view) :…………………………

Middle income house (2-3 bedroom) :……………………,,,,

Low income house (Mondesa) :…………………………

Flat in town (2 bedroom) :…………………………

Erf :…………………………

How has this changed over time (last 3 years)?

……

7. How is the Uranium Rush Impacting on the property market in your view?

……

Questionnaire for tourism operators as part of the tourism thematic report:

Uranium Rush Tourism Operators Survey

Survey number:

1 **Where are you or your tourist business based?**

Swakopmund

Walvis Bay

Other

Specify

2 **What type of tourist activities do you offer?**

Day tours

Sleepover tours

Adventure tours

Environmental tours

Scenic flights

Accommodation

Other

Specify

3 **Are the tours that you or your company offer related to a unique Namibian desert sense of place?**

Yes

No

4 **Which of the desert areas in the Erongo Region do you make use of in your tours?**

Goanikontes Moon landscape

Spitzkoppe

Welwitschia flats

Other

Specify

5 **What are the characteristics that make a unique desert destination attractive to tourists?**

The lack of noise and sense of silence

Views of unmodified natural landscapes

The interesting landforms in the area

The wildlife in the area

The unique vegetation of the area

Other

Specify

6 **Do you think that the existing mining activities in the desert areas are affecting the tourist industry in the Erongo Region?**

Yes

No

7 **If mining increases, what mining activity will cause the most change to the desert sense of place in the Erongo Region?**

Mineral exploration
More heavy vehicles and trucks on the road
Pollution
Poaching
Landscape modifications from mining structures and dumps
Noise
Dust
Blasting
Lights at night
Other
Specify

8 Which of the tourist related areas would be most impacted by increased mining in the vicinity
Goanikontes Moon landscape
Spitzkoppe
Welwitschia flats
Other
Specify

9 Do you think that mine tourism will replace eco-tourism in the Erongo Region?
Yes
No

10 Do you think that tourist perception of exposure to radiation from multiple uranium mines could impact the tourism industry in Namibia
Yes
No

B.6 Youth Forum – Program, minutes and attendance list

PROGRAM Friday 6 November 2009

🕒	Session detail	Method
8:00 (+20 min)	**Registration & Opening**	◆Reception desk ◆Speaker officiates
8:20 (+20 min)	**1. Background & Context** a. Present PPT of the SEA Abstract: - cover the 8 issues, - the 4 scenarios and - the Steering Committee b. Allow Q&A for broad clarification	◆PPT presenter ◆Set of PPT-notes for participants
8:45 (+30 min)	**2. SEA Case Study** a. View DVD of a relevant, illustrative SEA [<u>Purpose</u>: stimulate fundamental understanding of how critical an SEA is to affected people & environment]	◆DVD from Peter Tarr (available) ◆Viewing equipment by Confer. Centre
9:15 (45 min)	**3. Program Guidelines (workshop approach)** a. Explain two sets of critical SEA **Issues** grouped into A: Concrete and B: Softer/Fuzzy issues b. Explain Phase 1 <u>two</u> questions and Phase 2 <u>two</u> questions, with facilitation support c. Explain desired outcomes: Youth input to SEA ...*"to maximise on opportunities & synergies, minimise on negative impacts"* d. Organise/allow selection of Set A-Issues	◆Lead-Facilitator ◆PPT of Set A and Set B issues, x4Q's and main tasks of groups, locations in conference hall
10:00-10:30	T-break	
10:30 (1hr 30min) 45 min 45 min	**4. Phase 1: Questions 1 & 2** a. Facilitators guide participants through **Set A-Issues** on 2 Questions: **Q1 What excites you?** {... about the prospects/ possibilities of this issue..} **Q2 What frightens you?** {... about the prospects/ possibilities of this issue..} b. Facilitators and participants *<u>switch</u>* to **Set B-Issues** with same 2 Questions.	◆8 Issue-stations ◆8x 'fact sheets' in A1 (posted at each station – e.g., printed by Archit. Outlet)
12:00 (+45 min)	**5. Plenary Re-direction** a. Check on experiences of the Phase 1 process b. Re-direct participants towards Phase 2 approach	◆Lead Facilitator ◆PPT of Q's 3 & 4 ◆Bullets of main steps

	Session detail	Method
	- All participants in same groupings for their individual 1st choice Set A-Issue, addressing Q3 and Q4; followed by a *switch* (as in Phase 1) - Highlight different group thinking process: brainstorm and consolidate short-list of solutions c. {*Facilitators appoint QA-Teams: four pairs, above avge. English and analytical writing ability*} d. Brief QA teams on assignment for Phase 2 e. Facilitators quick-sort & group cards @ each issue-station into similar themes	◆Facilitator- and QA-team meeting before lunch
12:45-13:55	Lunch	
13:55 (10 min)	**(repeat) 5. Plenary Re-direction** → Repeat instructions in short and direct into groups at "Issue Stations" (as per 4x Set A-Issues)	◆Lead Facilitator ◆PPT instructions
14:10 (45 min)	**6. Phase II: Questions 3 & 4** a. Facilitators guide participants through brainstorm & consolidation of solutions on **Set A-Issues,** Q3 & Q4: **Q3 What to do to <u>meet</u> your expectations for… Q1?** **Q4 How to <u>minimise</u> what you're afraid of …Q2?**	◆8 Issue-stations ◆8x posted cards at each issue-station ◆QA-Teams deployed
15:00-15:20	T-break	
15:20 (45min)	**6. Phase II: Questions 3 & 4** b. Facilitators and participants <u>*switch*</u> to **Set B-Issues** with same Questions 3 & 4. c. In parallel, QA-Team members observe and check, by questioning, the **CLARITY** of solution-card wording	◆8 Issue-stations ◆8x posted cards at each issue-station ◆QA-Teams deployed
16:05 (+25 min)	**7. QA-Teams Feedback** a. Allow QA Team members +/-3 min per pair to share impressions on "quality" (clarity) of solution cards	◆Plenary ◆Lead facilitator
16:30 (+15 min)	**8. Next steps & Closure** a. Explain how solution cards will be presented to SEA Steering Committee, after incorporation into report by SEA Consultants b. Hear "APPRECIATIONS" (off the floor) c. Close workshop	◆Plenary ◆Lead facilitator ◆MME Officiating representative

Set A Issues	**Set B Issues**
Water	Land use
Physical Infrastructure	Social infrastructure
Social economic	Health & Safety
Mine Closure	Environment

Republic of Namibia

MINISTRY OF MINES AND ENERGY

Workshop Report for the Youth Debate on the Strategic Environmental Assessment (SEA) for the Central Namib Uranium Rush

Contributing to the:

Strategic Environmental Assessment (SEA) Report

6th November 2009

Compiled by:

Consulting Synergies Africa cc

Ulfried Schwacke

TABLE OF CONTENTS

ABBREVIATIONS/ ACRONYMS

AA	Affirmative Action (Act)
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe (German Geological Survey)
DRFN	Desert Research Foundation of Namibia
EIA	Environmental Impact Assessment
GDP	Gross Domestic Product
GRN	Government of the Republic of Namibia
GSN	Directorate Geological Survey, Ministry of Mines & Energy
MET	Ministry of Environment & Tourism
MME	Ministry of Mines & Energy
PPR	Police Public Relations (…committees)
SEA	Strategic Environmental Assessment
SME	Small & Medium Enterprise

PART ONE: PURPOSE & APPROACH

1. BACKGROUND

The Ministry of Mines and Energy has taken the lead to conduct the worldwide first Strategic Environmental Assessment (SEA) for a mining area. Due to the rising global demand for uranium, exploration and mining have become increasingly active in Namibia leading to a "uranium rush" in the Erongo Region. A wide variety of significant cumulative environmental, social and economic issues need to be considered to guarantee an optimum contribution of the mining activities to the sustainable development of Namibia.

This SEA will provide a big picture overview and sound advice on how to avoid negative cumulative impacts as well as how to enhance synergies or positive cumulative impacts. It will provide practical tools for achieving best practice and will also propose ways that the operators in the industry can collaborate to achieve a common approach towards long term management and monitoring.

The key challenge of the SEA is to avoid or minimize negative impacts, while all opportunities are maximized.

2. YOUTH CONSULTATION

The Ministry of Mines and Energy, Directorate Geological Survey (GSN), invited young Namibians, aged between 16 to 29 years, to share their views and opinions on uranium mining in Namibia in general and their expectations on the booming uranium industry in the Erongo Region.

The format chosen for this consultation workshop enabled 49 youths to participate in intensive group discussions for one day. Each individual was given opportunity to address group members in two of eight "main issues", as highlighted by the first materials developed for the SEA process (cf. provided by the process steering committee in co-operation with the SEA consultants, the Southern African Institute for Environmental Assessment (SAIEA), which has assembled a team of experts in fields such as: Radiation and human health, biodiversity, tourism, economics, hydrology and social infrastructure).

3. ISSUES FOR CONSULTATION

Eight key issues were presented in summarised fact sheets, as outlined below.

1. **Water**: The operation of the 7 uranium mines (in the expected scenario) in the arid Central Namib will require approximately 50 million cubic meter of fresh water annually. This amount is equal to NamWater's current nation-wide supply and can't be extracted from the regional groundwater resources. Fresh water has to be produced by sea water desalination which is an energy intensive process. In addition, the scarce groundwater resources of the Swakop, Khan, Omaruru and Kuiseb Rivers have to be protected for any contamination from those mining operations. Therefore, the SEA team currently establishes a groundwater baseline data base for the region as well as a water balance and groundwater model.

2. **Power**: The uranium mines will require an additional 150 to 200 megawatts of installed capacity which is currently not available.
3. **Infrastructure**: Pipelines, electricity lines, roads and railways have to be constructed in an optimized balance between logistics, efficiency and minimised impact to the environment. Perhaps, development corridors have to be defined.
4. **Social infrastructure**: Under the expected scenario, an additional influx of approximately 50,000 people will double the number of residents in the towns of Swakopmund and Walvis Bay within a very short time. The SEA will advise on regional and local town planning including housing, health facilities, recreation facilities, schools etc.
5. **Health and safety**: Residents in the coastal area are highly concerned about eventual increasing radiation and its negative health effects. The SEA conducts a specialists study on air quality and radiation as baseline information and will develop a regional air quality monitoring program.
6. **Land use and regional economy**: Mining, tourism and agriculture are Namibia's economic pillars which are in most cases antagonistically related. The SEA studies the current situation and will advise on regional land use planning in relation to the new mines.
7. **Environment**: The landscape integrity and endemic species are part of Namibia's unique natural assets. Therefore, millions of tourists visit Namib Naukluft National Park and Erongo Region every year and significantly contribute to the country's economy. Environmental Impact Assessments (EIA) of the mines focus on the actual mining area. However, the cumulative impacts on the environment extend these boundaries and will be studied and assessed as a central part of the SEA.
8. **Mine closure**: Mineral resources are finite resources. Therefore, mine closure and rehabilitation have to be an integral part of any feasibility study for mining operations. Although we are talking about a "rush-like" opening phase of many new mines, it is essential to develop a post-mining land use plan by now.

4. WORKSHOP METHOD

The concept of an SEA was thoroughly introduced by means of a contextual and background presentation done by a member of the MME's Geological Survey of Namibia, Alina Haidula. Participants were encouraged to ask questions and this proved to be very worthwhile, as the youth representatives had incisive comments and queries. They were clearly stimulated by the topic of an SEA and its importance to the Uranium Rush, their careers and the future of the Central Namib and the Erongo Region.

Subsequently, facilitators in each of four group-locations engaged the participating youth members on the eight topics (above, section 3), in dealing with four questions, which are asked against the background of the prospects and possible impacts of the "Uranium Rush" in the Central Namib:

- What excites you?
- What frightens you?
- What is to be done to meet your expectations?
- How is the impact of what you fear, to be minimised?

Participants of all group-discussions also viewed one another's' contributions in order to give final comments and thus provide the workshop's sanction of all inputs.

Facilitators transcribed the discussion outcomes and the report presents these recommendations in a slightly summarised format in Part Two of the report.

5. WORKSHOP EFFECTIVENESS

5.1 Effective methods

The presentation on an SEA/EIA and the use of a DVD-based introduction of the relevant Act in Namibia was probably the best way to prepare and stimulate the youth participants for the workshop topic and purpose. Their response during the brief question and answer session showed that they quickly grasped the importance of the topic, and they personally identified with the need to be there to "speak their mind".

The preparation of fact-sheets as background for discussion proved to be essential as this created a platform of relevant reference information.

The facilitators were particularly impressed with the level of engagement of the youth. They readily came to grips with the technical content, making good use of the introductory presentation and the fact sheets (also included in Part Two of the report).

The use of several (total: four) facilitators in smaller discussion groups proved to be essential, since discussions in some instances needed to be re-focused, where participants strayed from the eight key issues. The preferred method of having participants write their contributions on cards and pin these up for all to see, also worked very well. Members of groups could build on one another's ideas and also debate more complex points before finalising the conclusions and recommendations on each concern.

PART TWO: OUTCOMES & RECOMMENDATIONS

1. SEA KEY ISSUE: ENVIRONMENT

		PROPOSED MITIGATION & PROVISIONS
Worry	◆ short-term **gain**: U-sales, BUT long-term **loss**: drop in eco-tourism income & international reputation, and loss of natural heritage ◆ Irreparable losses: i. desert's scenic value (visual pollution) ii. Sensitive ecologies, iii. habitat & biodiversity -- impacts whole Central Namib ◆ Greed becomes a threat to ecology ◆ Open pit mining may speed up erosion & desertification, high rehab-cost ◆ Rehabilitation of endemic lichens impossible – money cannot undo this ◆ Waste water contamination of ground water	1. PROTECT ECO-TOURISM - mines pay for environmental monitoring - mines to 'upgrade' national parks 2. RAISE TERTIARY FOCUS ON ENVIRO' - MET bursaries for Namibians (Environmental. Science) - Compulsory secondary & tertiary level module - raise taxes and royalties from mines 3. WASTE MANAGEMENT STANDARDS - mines to sponsor U-waste disposal research - set stringent waste-water recycling requirements - GRN (MET) inspectors to mines - rehabilitation projects to benefit communities/ leisure facilities (golf course, man-made lake) 4. CONTROL THE 'RUSH' - limit production: extends mine lifespan - limit number of concurrently operational mines (best: do not open any new mines at all) - set timed rehabilitation of one mine as condition for opening of next - make rehabilitation conditional to any expansions - place selected areas under permanent protection 5. YOUTH REPRESENTATION - each SEA Committee to include representatives of secondary, tertiary and 'young professionals' - establish a "junior" decision-making body of youth representatives for each stakeholder ministry
Hope	◆ Improved environmental monitoring & research	

2. SEA KEY ISSUE: HEALTH & SAFETY

<table>
<tr><th></th><th></th><th>PROPOSED MITIGATION & PROVISIONS</th></tr>
<tr><td>Worry</td><td>
◆ Health after-effects could be worse than expected – mitigation measures could be ineffective
◆ health policies might not be enforced
◆ increased economic activity, leading to migration, hence prostitution & alcohol abuse, leading to higher HIV&AIDS prevalence rates
◆ pressure on the public health services & professionals due to the influx of people into the area
◆ access to health facilities might be restricted to mine employees & dependents
◆ shortage of Regional health facilities may not be addressed by GRN
</td><td rowspan="2">
1. COMMUNITY PROGRAMS & FACILITIES
- mines must run community awareness and treatment programmes on health risks (focus: HIV & AIDS, radiation)
- mines' annual reports to show assessment of increased community awareness achieved
- Steering Committee to give community feedback on SEA outcomes – then communities can undertake lobbying if necessary
2. LABOUR LEGISLATION PROVISIONS
- include compulsory health & safety training for all mining employees (as guaranteed condition of service)
- occupation health legislation to include national safety measures in line with international benchmarks
- strict enforcement of all legislation: radical penalties for non-compliance, e.g., withdrawal of mining licence
- include compulsory health insurance in conditions of service
- require long-term liability/risk cover to provide for health damages long after closure
3. ADVANCE TECHNOLOGY & KNOW-HOW
- Mine development plans to include a compulsory strategy to upgrade existing and constructed new health facilities & equipment (e.g., by partnering with GRN; or donating ambulances)
- apply a formula (GRN Min of Finance) to dedicate at a least a percentage of the Region's mining industry revenue to the development of health professionals of the Region
- mines to train and provide preferential bursaries to Namibians
</td></tr>
<tr><td>Hope</td><td>
◆ First Aid training for all employees
◆ mine staff raise health awareness in the area
◆ mines advance community education on safety issues, incl. HIV & AIDS, radiation
◆ mines provide programs & support on HIV&AIDS/ People Living With-HIV&AIDS
◆ mines train permanent medical staff
◆ capacity building growth in communities – technological advancement of employees
◆ better medical insurance/benefits for mine employees & dependents
◆ compensation for radiation effects, e.g.: proper health care
◆ better safety equipment available for mine employees
◆ mines could build more health facilities (benefit to nearby towns)
◆ permanent medical facilities could benefit all communities
</td></tr>
</table>

3. SEA KEY ISSUE: LAND USE

		PROPOSED MITIGATION & PROVISIONS
Worry	◆ Waste disposal dumping site/ pressure on land ◆ Road infrastructure wearing out due to heavy trucks ◆ Tourism threatened by mining ◆ Biodiversity is at risk ◆ Noise pollution ◆ Farming sector will not survive due to water contamination ◆ rapid and increased urbanisation ◆ Rise in property prices ◆ Pressure on municipal services	1. LAND USE PLANNING - ensure integrated land use plans – nationally - strongly position Namibia's uranium on world mrkt 2. TOURISM & RECREATION - ensure enforcement of Environmental Act 3. FARMING - timeous baseline studies to monitor groundwater condition changes (anti-contamination) 4. URBANISATION & 'RUSH' - engage local construction companies - adopt Scenario 2 to allow gradual development
Hope	◆ Boom in construction & estate sectors ◆ Higher uranium potential in the ground ◆ Land use planning guide to balance the competing interests of various sectors	

4. SEA KEY ISSUE: PHYSICAL INFRASTRUCTURE

		PROPOSED MITIGATION & PROVISIONS
Worry	◆ Sustainable management of infrastructure o possible shortage of expertise to deal with population growth consequences o Erongo suddenly over-developing o Hurried planning later impacts on other sectors because of high maintenance o visual impact of infrastructure corridors on landscape o can temporary structures be used, later to be removed ◆ Pollution impacts o CO^2 from coal power generation & increased traffic o noise pollution o water contamination ◆ Impact for public o road safety & maintenance o price increases (water & power) o Local contractors or foreign? ◆ Closure management o post-closure waste facilities/dumps o maintaining infrastructure after closure o unused infrastructure … an eye-saw? ◆ Information management o current data lacks info on future scenarios (impacts) o long-term town & resource planning must include all stakeholders	1. FOCUSED NATIONAL DEVELOPMENT - address national dependency mindset - focus youth expectations on sustainable development priorities - raise awareness of earth sciences (& mining) - improve professional competence in monitoring policy implementation (NB: in mining industry) - educate nation on consequences of corruption - ensure corporate re-investment in Namibia - promote value-adding industries - sensitise on productivity issues (for better ROI) - BUT, export U-oxide for less toxic waste in Nam - GRN financial priority = better education system (recruit for excellence in education) - also educate "elders" to build coping capacity on mine closure 2. RESPONSIBILITIES OF MINING CO'S - Enforce re-investment compliance in various forms: e.g. o sub-contracting local businesses o developing alternate energy sources o upgraded infrastructure for use of general public o educating employees to cope with closure impact o leisure infrastructure for employees – reduce stress & promote better life-style for youth - Enforce accountability for resources

Hope	◆ Improved physical infrastructure o roads (improved traffic flow) o rail (safer alternative) o harbour (closer point of import) ◆ Employment creation o new local jobs to develop the infrastructure o careers for Nam engineers, environmentalists o local business expansion ◆ Economic growth o Opportunities for foreign investment o SME benefit from ‘mining boom’ o Development→ attracts tourists→ stimulates economy ◆ Improved living standards o Increased job opportunities→ improved living standards→ reduces govt. load re: social upliftment o Less crime due to improved living standards o Local Authorities: less informal settlement. ◆ Improved impact on nature o improved waste management o desalination plants reduce pressure on groundwater resources	

5. SEA KEY ISSUE: SOCIAL INFRASTRUCTURE

<table>
<tr><th></th><th></th><th>PROPOSED MITIGATION & PROVISIONS</th></tr>
<tr><td>Worry</td><td>
◆ skills shortages: education, health & Skilled jobs
◆ qualified specialists leave after closure or “bust”
◆ Expatriate influx, no tax revenue
◆ Loss of sense of place: locals vs “incoming”
◆ increased health risks (STDs & other)
◆ higher demand for/shortage of health services, education services, sewerage systems, recreation facilities
◆ capacity of local authorities to supply services
◆ shortage of low & middle income housing
◆ management of schools after mine closure
◆ inadequate landfill/recycling facilities
</td><td rowspan="2">
1. GRN PLANNING
- policies to ensure appropriate spending
- equal distribution of development and wealth by diffusing opportunities to other/more towns
- need effective (productive) feasibility studies on social factors
- bursaries for all fields of study: engineers, environmentalists, education, health, etc.
- offer employment guarantees as incentive to engage in relevant studies
- revise policies to ensure use of foreign professionals as value-adding persons (not ‘contract workers’)
- promote 80% Namibian workforce, incl. permanent residents
2. MINES’ RESPONSIBILITIES
- visible financial accountability
- partner with GRN for infrastructure development
- sustained assistance to manage schools, clinics, etc. in towns
- compulsory on-job education about sustainability, e.g. jobs, mine houses
- local & informal sector contracting
3. TOWN PLANNING
- preserve character & ‘sense of place’/identity
- green and child/family-friendly parks
- promote social work at recreation centres
- in-time planning to relocate landfill & sewerage
4. AWARENESS
- formal environmental awareness programs
- focus on prevention of contagious diseases
- SEA to have nation-wide publicity before finalisation – engage media
</td></tr>
<tr><td>Hope</td><td>
◆ qualified Namibian workforce
◆ improved education through bursaries, new subjects at schools & universities
◆ training people to start up businesses
◆ job creation in construction sector
◆ improved suburban infrastructure/appeal in coastal towns
◆ more & better schools and hospitals
◆ improved economy through good social infrastructure → competitive internationally
◆ upgrading of low income housing improves quality of life
</td></tr>
</table>

6. SEA KEY ISSUE: SOCIO-ECONOMICS

		PROPOSED MITIGATION & PROVISIONS
Worry	◆ Namibians may be deprived of opportunities: o Bursaries not for disadvantaged people o foreign expertise 'imported' o raw material exported without value addition o profits do not flow into sustainable development o inequitable income distribution maintained o only few elite benefit from increased GDP ◆ Down-side of urban migration: increased crime ◆ Workers being exploited in high risk jobs ◆ Rehabilitation funding - risk of corruption ◆ Creating dependence on ONE industry only ◆ trained Namibians migrate after mine closure ◆ corporate social responsibility may not create sustainable projects ◆ Encourage dependency on foreign funding	1. BURSARIES & STUDIES - mines to invest in all levels of education from primary to tertiary - transparent awarding of bursaries in all fields 2. MIGRATION & CRIME - mines to co-operate with police (PPR committees) - invest directly in community projects/upliftment (multi-purpose centres; partnerships with community; sponsorships for sport) - GRN to plan ahead for relevant services: town planning, police, community development 3. GDP GROWTH BENEFITS - strict enforcement of AA Act on Nam-understudies 4. RAW MATERIAL EXPORT - extend mine development period/restrict concurrent mine operations and simultaneously build Namibian U-enrichment capacity 5. REHABILITATION FUNDING - establish neutral body to monitor spending targets/ purposes against regulatory framework 6. SINGLE-INDUSTRY DEPENDENCY - GRN policy to balance urban and rural development spending: ex-employees must return to improved rural agricultural approaches - GRN-mine partnerships on these initiatives 7. FOREIGN INVESTMENT DEPENDENCY - legislate shareholding requirements that 'mix' GRN+local business+community+foreign - legislate for shareholding ratio to shift in favour of Namibians over lifespan of mine
Hope	◆ Bursaries for Namibian students ◆ Skills developed through on-site training ◆ job creation leads to increased GDP ◆ Increased foreign investment in Namibia	

7. SEA KEY ISSUE: WATER

		PROPOSED MITIGATION & PROVISIONS
Worry	◆ Changes to water table (low) - aquifer depletion ◆ Risk of influx of people – is it worth the consequences of fresh water scarcity ◆ Fossil fuel will be used ◆ Disposal of waste products from desalination process ◆ Contamination of water due to radioactive/dust/waste ◆ Increase in water costs for the public	1. GROUNDWATER RESOURCES - apply excess desalination production to meet town demands - regulate groundwater extraction (and enforce) - mine operation made conditional to having adequate water supply - enforce use of recycled water 2. ENERGY - enforcement/promote use of renewable energy 3. WASTE PRODUCTS - EIA to determine impact of desalination - legislate/ensure enforcement of contingency plans for hazardous waste leaks - proper construction of tailing dams 4. WATER PRICE - mines & Namwater to subsidise water price
Hope	◆ Less pressure on groundwater because of desalination plants ◆ Already looking at alternative sources ◆ Prospects for Aquaculture	

8. SEA KEY ISSUE: MINE CLOSURE

		PROPOSED MITIGATION & PROVISIONS
Worry	◆ sub-standard/non-compliant rehabilitation ◆ GRN inability to effectively enforce managed closure ◆ Capacity & management of rehabilitation fund ◆ 'Closure' of a town after mine closure ◆ Economic 'collapse' after boom – heavy price for communities to pay ◆ Groundwater contamination – leaching of heavy minerals/-metals way after mine closure	1. REHABILITATION/ RESTORATION - create a special unit, staffed with experts - balance regulatory standards with nation's competitiveness in uranium market 2. REHABILITATION FUNDING - establish mining trust fund - independent body to safeguard fund management 3. SOCIAL STRATEGIES - set up a social development fund - mines to invest in community projects that stimulate jobs after closure - establish community-mine partnerships to protect against closure impact 4. VALUE-ADDING OPTIONS - diversify economy by exporting electricity from enriched uranium
Hope	◆ Prospect of developing restoration strategy which would preserve biodiversity and ecosystem; can be used as a global model ◆ Possibilities of ensuring proper procedures are followed during closure ◆ Opportunity to conduct research into best methods of mine closure (restoration ecology) ◆ Derelict/abandoned and unrehabilitated mines could be a thing of the past	

9. ATTENDANCE REGISTER

The following three pages (jpeg-format documents) provide information on the attendance participants.

Attendance Register

Youth Debate/Information sharing on the SEA Central Namib Uranium Rush 6th November 2009

	Name	Organisation	E-mail address	Cell No.	Age	Residential Town	Signature
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11	Geingob Ervin	Community Activists	[illegible]	[illegible]	34	[illegible]	[illegible]
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28	Kiekebusch Elsita	Gobabeb Research Centre			23	Windhoek/Gobabeb	E.Kre
29	Mhopjeni Kombada	GSN	:-)	0812317919		WHK	[illegible]
30	Leonard Rosina	GSN				Windhoek	
31	Nghikungu Lineekela	Usakos Youth Bricks Project		0813715692	22 37	Usakos	[illegible]
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39	Ndalulilwa Kaarina	GSN					
40	Nikanor Desmond	UNDP					
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42	Mungunda Patience	UNAM		0813399455 ~~0813338447~~	22	WHK	PK
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45	Shaningwa Oscar	GSN					
46	Shapwa Martha	UNAM					
47	Shiimi Ndatila Karin	GTZ	ndatila.shiimi@gtz.de	0812800135	26	Windhoek	[illegible]
48	Shishiveni Patric	UNAM					
49	Uiras Sophy	Community Activists	sophyuiras@yahoo.com	0812844150	26	Walvis bay	[illegible]
50	Svenja Adrian	Gobabeb Research Centre	svenja@gobabeb.org		19	Gobabeb	[illegible]
51	Swartbooi Jeanette	Gobabeb Research Centre					
52	Simhopileni Taleni	UNAM	talenishimho@gmail.com	081 3797 234	19	WHK	[illegible]
53	Trampe-Kieslich Florian	GTZ	Florian.Trampe-Kieslich@gtz.de	0814464021	28	Windhoek	Trampe
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55	Varges David	Polytechnic					
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58	Fillipus Shivute	Polytechnic	Fnshivute@gmail.com	0812005313		Windhoek	[illegible]
59	Buckley Averyl	UNAM	buckley.averyl@gmail.com	0812027776	24	Windhoek	Buckl.
60	Mugiho ATAKA	Ministry of Youth GSN	mugi643@yahoo.co.jp	0813410915	26	Usakos	[illegible]
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62	Mutota Emily	Gobabeb Research	emily@gobabeb.org	064694199		Gobabeb	
63							
64							
65							

DETAILED LIST OF SPECIALIST STUDIES

Specialist Study	Specialist	Organization
Air quality	Ms Hanlie Liebenberg Mr Japie van Blerk	Airshed Planning Professionals Aquisim Consulting
Archaeological heritage	Dr John Kinahan	Quaternary Research Services
Biodiversity	Mr John Pallett Dr Mary Seely	SAIEA DRFN
Coastal town infrastructure and services	Mr Morgan Hauptfleisch	SAIEA
Community health	Dr David Snashall	St Thomas's Hospital, London
Economic assessment	Mr Klaus Schade Mr Beaven Walubita Mr Michael Humavindu	NEPRU
Forces and dynamics of the uranium rush	Dr Hartmut Krugmann	SSDC
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These reports will be made available as standalone documents by MME on receipt of a written request to Dr Gabi Schneider at email gschneider@mme.gov.na