Rio Tinto

Rössing Uranium Limited
Working for Namibia

Annual Environmental Report 2013

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Effective date	31 December 2013
Status	Final
Version No.	2.0
Document No.	JE85/RPT/001
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Acronyms and abbreviations

The following acronyms and abbreviations are used throughout the report:

µm	micro-metre, 10^{-6} m
Bq/L	Becquerel per litre
CO_2-e	carbon dioxide equivalent
dB(A)	A-weighted decibels
GHG	greenhouse gas
GJ/t	gigajoule per tonne
HSE MS	Health, Safety and Environment Management System
ISO	International Organization for Standardization
Leq	equivalent sound pressure level
m/s	metres per second
m^3/t	cubic metres per tonne
mg/L	milligrams per litre
mg/m^3	milligrams per cubic metre
ML 28	Rössing Uranium Limited's Mining Licence 28
mm/s	millimetres per second
OHSAS	Occupational Health and Safety Advisory Services
PM10	particulate matter smaller than 10 microns in diameter

1. Introduction

1.1 Location

Rössing Uranium Limited (Rössing Uranium) mines a large-scale low-grade uranium ore body in the Namib Desert, in the sparsely populated Erongo Region of Namibia (Figure 1.1).

The town of Arandis is situated less than 10 km from the mine's main entrance gate. The coastal town of Swakopmund is about 70 km away and Walvis Bay is located 30 km south of Swakopmund. To the east, the nearest town to Arandis is Usakos, about 80 km away. The Rössing Uranium mine is situated about 25 km upstream of the confluence of the Khan River and Swakop River.

1.2 Shareholding

Rio Tinto is the majority shareholder in Rössing Uranium Limited, holding 69 per cent of the shares; the Namibian Government has a 3 per cent shareholding, with a majority (51 per cent) when it comes to voting on issues of national interest. The Industrial Development Corporation of South Africa owns 10 per cent, while local individual shareholders own a combined 3 per cent shareholding. The Iranian Foreign Investment Company owns 15 per cent, a stake that was acquired during the establishment of the company in the early 1970s.

The shareholders have no uranium product off-take rights.

1.3 Scale of operation

At present, Namibia has two significant uranium mines and provides 6.9 per cent of world uranium oxide mining output. Producing 3.9 per cent of the world's primary uranium supply, Rössing Uranium is the third largest supplier globally and is also the world's longest-running open pit uranium mine. It is a 24-hour operation, in production 365 days a year. Rössing Uranium has a nameplate capacity of 4,500 tonnes of uranium per year and by the end of 2013, had supplied a total of 125,862 tonnes of uranium oxide to the world.

Some 2,407 tonnes of drummed uranium oxide was produced in 2013, compared with 2,700 in tonnes 2012, 2,148 tonnes in 2011, 3,628 tonnes in 2010 and 4,150 tonnes in 2009.

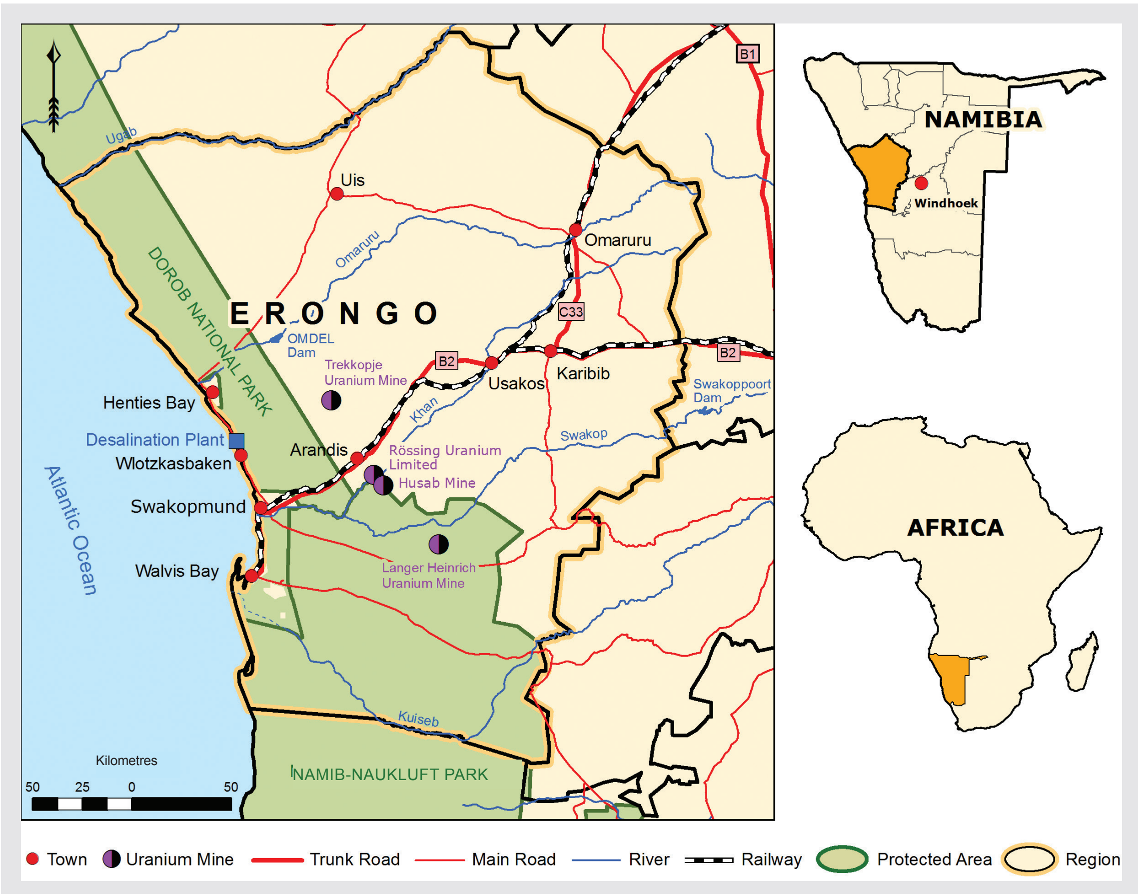
1.4 Current life of Rössing Uranium mine

The *Life of Mine Plan* developed in 2011 foresees the termination of mining activities in 2023 and mine closure in 2025.

The piloting of the expansion known as Phase 2 started in the northwestern part of the pit in 2006. The Phase 3 pushback on the southern side of the pit commenced in 2007 in material that is mainly waste rock and according to the plan will start to expose ore from 2014. A great deal of waste stripping has been done since 2009.

At the end of mining activities in 2023, the final depth of the SJ Pit will be reached at Bench 36, about 30 metres above sea level. Processing of remaining ore stockpiles will continue for another two years, with the final uranium oxide production completed at the end of 2025.

Figure 1.1: Location of Rössing Uranium mine



2. 2 Brief description of the environment

2.1 Geology

The Rössing uranium deposit lies within the central part of the late-Precambrian Damara orogenic belt that occupies an area approximately 50 km wide and that extends north east for over 100 km in west-central Namibia. The Damara lithology consists mainly of folded, steeply-dipping meta-sediments (gneiss, schist, quartzite and marble) arranged in a northeast-southwest striking belt.

The geology of the mining area at Rössing Uranium is associated with a dome structure and occurs in pegmatitic granite known as alaskite, which intrudes into meta-sediments. The Rössing ore body is unique in that it is the largest known deposit of uranium occurring in granite. The nature and grade of uranium ore is extremely variable and can be present as large masses or narrow inter-bands within the barren meta-sediments. All of the primary uranium mineralisation, and the majority of the secondary uranium mineralisation, occurs within the alaskite. However, the alaskite is not uniformly uraniferous and much of it is un-mineralised or of sub-economic grade.

Uraninite is the dominant ore mineral (55 per cent); secondary uranium minerals constitute 40 per cent; while the refractory mineral betafite makes up the remaining 5 per cent. Ore grades at the mine are very low, averaging 0.035 per cent. The uranium ore consists of 70 to 90 per cent alaskite and is subdivided into four ore types according to the composition of the host rock.

2.2 Climate

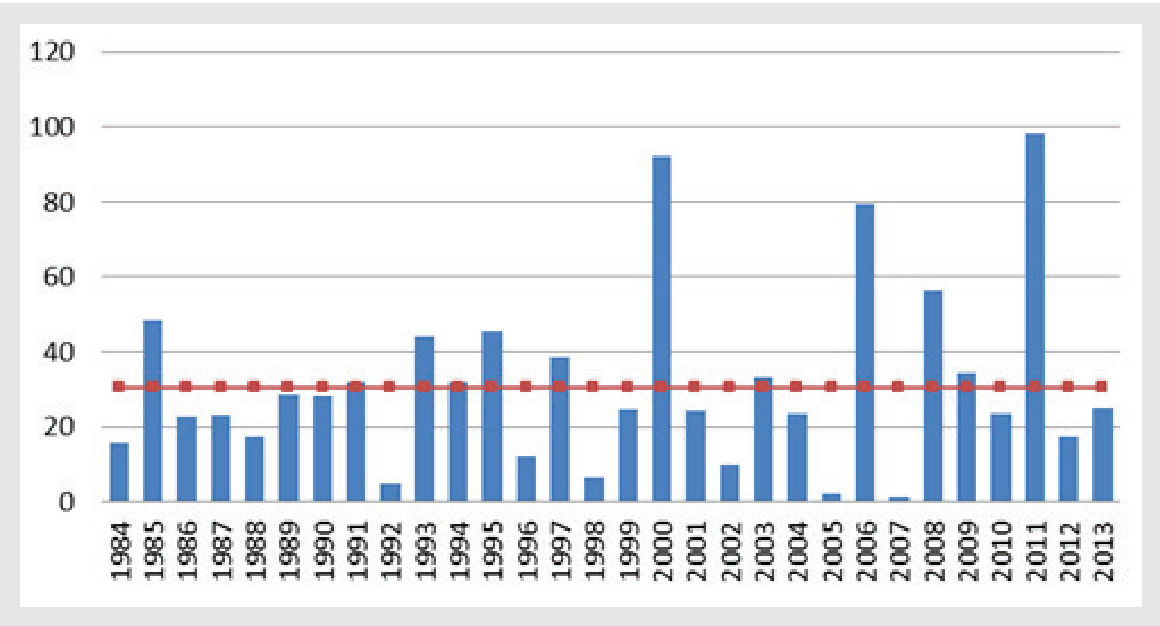
In the Rössing mining area, rainfall measurements indicate an average annual rainfall of about 30 mm but this figure is misleading because the totals vary widely below and above the mean (Figure 2.1). Much of the rainfall occurs as episodic late summer thunderstorms of high intensity and short duration, with virtually no rainfall recorded in the winter months.

The total annual rainfall received on the mine was 25.2 mm in 2013, which is represents an approximate 18 per cent deviation from the long-term average of 30.6 mm. Furthermore, the total rainfall for 2013 was about 30% higher than the total rainfall for 2012, indicating the huge variation potential between years in the Rössing mining area. The variations in annual rainfall and the long-term rainfall average are displayed in Figure 2.1.

Insolation at the mining area is high, and as a result diurnal ranges of temperatures are wide, especially during late autumn and early spring when the temperature exceeds 20°C (see Figure 2.2). In September, the mean maximum and mean minimum temperatures vary the most, indicating the wide diurnal range. The lowest temperatures are recorded during August normally; frost is rare however. The highest temperatures are recorded in the late summer, particularly March.

The predominant winds are west-southwest to a south-southwest direction over the central Namib Desert. This is confirmed by the 2013 wind rose (Figure 2.3).

Figure 2.1: Variation in annual rainfall in the Rössing mining area



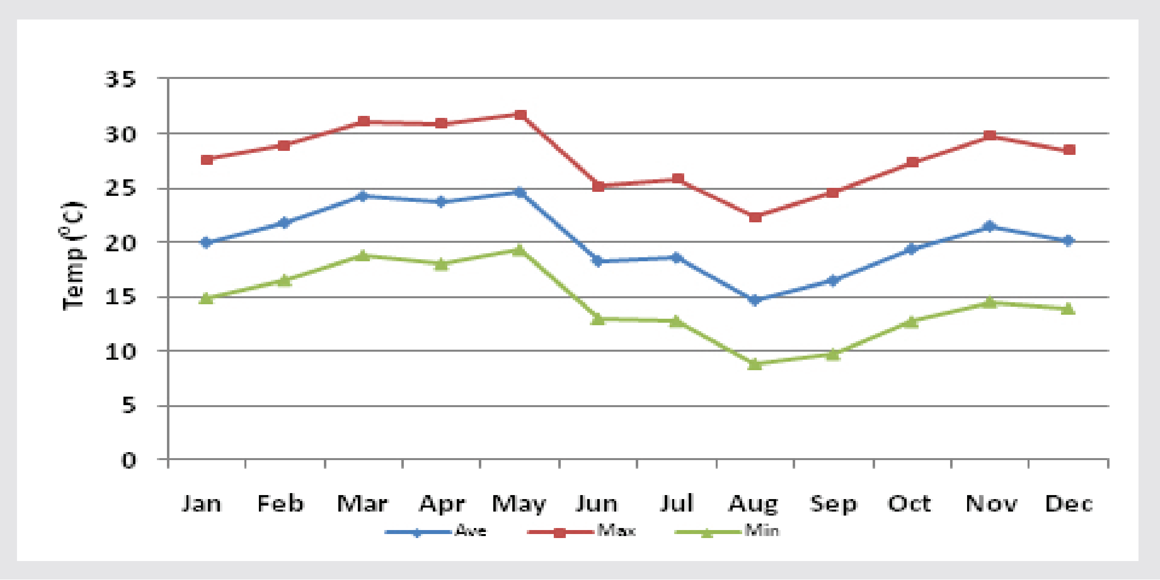


Figure 2.2: Temperature ranges at Rössing in 2013

Wind from these directions is more frequent and more prevalent. Wind from the northeast, although more occasional, is generally stronger.

The combination of the low rainfall, high temperatures, the wide temperature ranges and prevalent winds result in evaporation rates that vary between 6 and 15 mm per day. The potential evaporation is thus around 3,000 mm per annum.

2.3 Topography and soils

At a mean altitude of 575 m above sea level, most of the Rössing tenement in the west, north and north east consists of broad peneplains. The flat terrain is traversed by shallow drainage lines and stormwater gullies that feed into the Khan River. Close to the Khan River, the undulating plains change to an increasingly rugged terrain, which further increases towards the Swakop River (as illustrated in Figure 2.4).

Soils in the vicinity of the Rössing mining area could be described as shallow (<25 cm in depth), with a large proportion of coarse fragments and occasional concretions, characterised by high soil pH-values. Hard surface and near-surface crusts are common. The crusts reduce rainfall infiltration rates and enhance runoff.

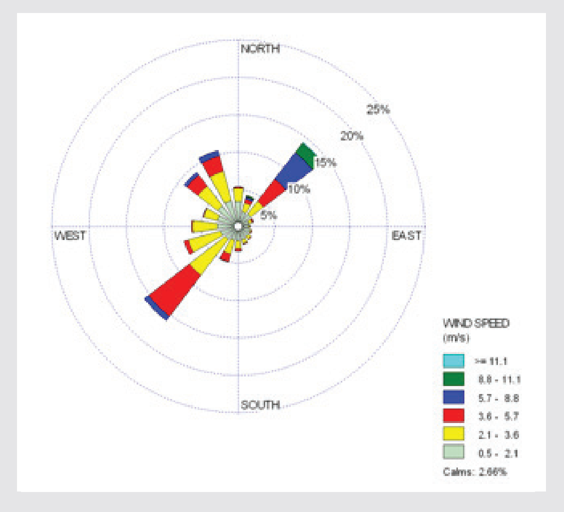


Figure 2.3: Wind speed and direction measured in the Rössing mining area during 2013

Sand deposits of varying depth are found in sheltered areas and are a mixture of dark to light brown grit, quartz, and feldspar fragments. Coarse material is present on the slopes of some hills; its thickness varies but may reach a depth of up to ± 1.5 m.

The deepest soil is confined to the drainage lines, comprising mainly infertile (almost sterile) alluvium that varies in thickness; topsoil is shallow, poorly developed, infertile and even absent over the largest part of the hill slopes and gravel plains of the mine tenement.

2.4 Biogeography

On the gravel plains of the Rössing mining area, vegetation is dominated by sparsely scattered dwarf shrubs and ephemeral grasslands. This is also the case for the undulating hills and mountains where grass is less evident. A total of 21 biotopes are discernible for the purpose of identifying landform boundaries in association with ecosystem functions and characteristic plant species. To date a total of 253 plants species have been identified at the mine site to date.

Sparse riparian vegetation marks the drainage lines, especially those associated with the Khan River; in general, vegetation relates strongly to the frequency, intensity and duration of flooding events. A few species dominate – the ana tree (*Faiderbia albida*), camel-thorn (*Acacia erioloba*), wild tamarisk (*Tamarix usneoides*) and thickets of mustard bush (*Salvadora persica*). The denser riparian vegetation provides food and shelter to many animal species and sustains important migration and dispersal routes as a result.

A total of 271 species of ground-living insects are recorded from the Rössing mining area excluding flying groups such as moths and lacewings. Of the 271 species, 20 are classified as threatened. The rocky hillsides, in particular those located along the Khan River, are regarded as the most important habitats of invertebrates.

The Namib Desert is known for its reptile diversity – particularly in regards to lizards and geckos – and 33 reptile species are recorded as occurring. Two species, *Meroles sp. Nov.* and the Husab sand lizard (*Pedioplanis husabensis*), are of special concern. Three species of frog are also known to occur at the mine site. From a local perspective, the Khan River has the highest bird species diversity, indicating the importance of water availability and consequent supported plant life as well as the diversity of habitats associated with cliffs. Two bird species are classified as threatened (Rüppell's Korhaan *Eupodotis rueppellii* and Gray's Lark *Ammomanes grayi*).

Mammal diversity in the Rössing mining area is not very high, as is typical in the central Namib Desert, and climatic variation is closely coupled with marked changes in the abundance of mammal species. Many of the mammal species that occur around the mine site use a wide range of habitats, or may cross a wide range of habitats in the course of migrating from one place to another. Common mammal species include: klipspringer (*Oreotragus oreotragus*), gemsbok (*Oryx gazelle*), springbok (*Antidorcas marsupialis*), greater kudu (*Tragelaphus strepsiceros*), Hartmann's mountain zebra (*Equus zebra hartmannae*), dassie or rock hyrax (*Procavia capensis*), black-backed jackal (*Canis mesomelas*), chacma baboon (*Papio ursinus*), and rodents (particularly gerbils).

2.5 Surface and groundwater

Open surface water in the Namib Desert is a rarity and may occur only ephemerally during the rainy season; flowing surface water in the Rössing Mining Licence Area (ML 28 Area) only occurs after heavy rainfall. Runoff in the drainage lines is an episodic, brief event and peaks and periods of runoff vary widely.

Due to their alluvium beds, the tributaries of the Khan River contain subsurface water flow for most of the year. Permeability of the alluvium is high and the alluvium also has a high storage capacity, with the water table being within 2 to 3 m of the surface.

Seasonal springs and small pools may occasionally form in the Khan River and in the gorges that drain into it. Only one natural perennial spring occurs in the Rössing mining area and is located in a side arm of Panner Gorge.

Groundwater flows and rainfall seepage at the mine site occur mainly along fractures and focus towards the gorges that drain into the Khan River.

Superimposed on the natural groundwater system are sources and sinks created by mining. The SJ Pit, more than 300 m deep, cross-cuts the hydrogeological connection between the existing Processing Plant and the nearby area that drains into the Khan River. It thus acts as a cut-off trench and enables the interception and subsequent evaporation of potentially contaminated water moving downstream from the Processing Plant area. The pit also creates a cone of groundwater table depression that cuts off groundwater flow through bedrock and alluvial channels. Hydrogeological parameters of storage and permeability are very low around the SJ Pit.

The current level at the bottom of the pit is substantially lower than that of the Khan River 3 km to the south, and the regional water table (about 20 m below ground). The Khan River is also separated from the pit by a low-permeability rock mass and the possibility of water from the Khan River entering the pit void is significantly reduced in this way.

The natural groundwater in the vicinity of the Rössing mining area is very saline, with total dissolved solids concentrations of 20,000 to 40,000 mg/L. The only groundwater potentially suitable for agricultural use near the mine site is found in the Khan River but this water is brackish and only suitable for livestock watering. As a result of the high salinity of the Khan River, the only beneficial uses of the water are in the industrial context, for example for dust suppression. Despite its salinity, the very hardy natural vegetation along the river depends on this water and abstraction takes place against the close monitoring of the water table.

2.6 Air quality

Atmospheric conditions at the mine site vary according to the presence of airborne dust and other impurities, a situation that is exacerbated by air movements. Average daily wind speed measured at the Rössing Uranium mine in 2013 was 2.87 m/s with the highest maximum wind speed over a one-hour period recorded at 7.89 m/s. Though the recorded maximum speed was much lower in 2013, higher occurrences have been recorded before. These velocities usually occur during the winter and gusts of up to 34.90 m/s have been known to occur. The mean maximum gust is 26.17 m/s

The potential for dust and other impurities to be transported via atmospheric pathways towards inhabited areas is dependent on the direction of receptor points relative to wind direction. Table 2.1 summarises localities relevant to wind direction in the Rössing mining area.

Deposited dust is not a health hazard generally; however because it is visible it is the cause of most local concerns relating to Rössing Uranium's operations. While dust is in suspension particulates with a diameter of less than 10μm might be inhaled; the degree of hazard is determined by concentrations of dust and the period of exposure. It is not only human health that can be adversely affected by dust: the fallout of heavy metals onto soil and the foliage of plants also results in an adverse impact on the environment. These factors, combined with the concern about nuisance dust that may end up on land around Rössing Uranium Limited's Mining Licence 28 (ML 28) Area, mean that potential environmental dust deposition is monitored at several stations around the mining operations.

Whilst most of the dust generated in the pit at the mine site is of a fugitive nature, blasting activities can be considered as a point source of particulates from where dust is dispersed into the surroundings of the mine. Large blasts occur approximately every week, with smaller blasts taking place two or three times a week. The size of the blasting dust plume is unlikely to increase in size in the future because as the pit deepens, the blast dust will become less dispersed into the surrounding area. The dust plumes from the smaller blasts tend to disperse along the length of the pit and the dust settles on the benches and roads within the pit, only to be remobilised again by wind action and vehicles.

Of the eight common air impurities identified, five (SO_2, CO, NO_x PM10 and dust deposition) are released in the Rössing mining area. However only two are recognized as significant, ie particulate matter smaller than 10 microns in diameter (PM10) and dust deposition, and these are regularly monitored. Rössing Uranium conducts annual monitoring of SO_2, CO and NO_x that could be emitted as a result of the yellowcake roasting during final product recovery. In addition, greenhouse gas (GHG) emissions are estimated as carbon dioxide equivalent (CO_2-e) on a monthly basis, deduced from fuel consumption, electricity usage, and explosives used for blasting.

Noise and vibration arising from exploration and operations – including mining, mineral processing, materials handling, infrastructure, and on-site transport – may have significant impacts on employees, communities, and the surrounding environment. Noise, ground vibrations and air blasts can have an adverse impact on the general living conditions of local species and/or the quality of life of human neighbours so these are monitored in order to mitigate adverse impacts. For this purpose, spot checks, specific surveys and investigations, and regular risk assessments are conducted. Air blasts and ground vibrations are also monitored to provide information for geo-technical purposes, to specifically assess the stability of man-made landforms.

2.7 Sites of archaeological and cultural interest

A total of 49 archaeological and historical sites are recorded in the Rössing mining area. Although there is some evidence of upper Pleistocene occupation, most of the archaeological sites date to within the last 5,000 years. A cluster of sites relates to grass seed-digging activities in well-drained soils derived from weathered granite, estimated to post-date AD 1000. The seed-digging sites are concentrated around a number of low-lying granite outcrops associated with shallow depressions in between that may contain water after rain, and show similarities with the seed-digging activities that still exist among Damara Namibians today.

Historical sites also relate to the narrow gauge railway that operated between the Khan Mine and the Arandis siding until about 1918.

The Rössing tenement is not an area of outstanding archaeological importance and does not have the dense site clusters that are characteristic of some parts of the escarpment and ephemeral river systems of the Namib Desert. The areas of highest heritage value lie outside the main focus of mining activity and the mining area and related high-disturbance locations have a rather low heritage value. In general, the archaeological and historical sites are mainly of a low individual significance and furthermore show a low vulnerability potential to disturbance.

2.8 Land use

Apart from the town of Arandis, there is no active land use in the proximity of Rössing's Mining Licence Area. Around the Rössing mine site, water is severely limited – meaning that agriculture is of marginal potential only, even along the ephemeral water sources of the Khan and Swakop rivers. The closest commercial farmland is about 15 km to the east, and the border of the communal land is about 15 km to the north. Along the lower Swakop River, close to the coast, commercial farming is undertaken on several smallholdings. Production aims to supply the needs of Swakopmund and Walvis Bay and includes asparagus, olives, mushrooms, and other vegetable farming, as well as tourism- and leisure-oriented activities.

The ML 28 Area is located within the #Gaingu Conservancy area but few people reside within the #Gaingu Conservancy area south of the main road. About 720 ha of the Mining Licence Area overlap with the Namib-Naukluft National Park on the southern bank of the Khan River. The Dorob National Park, about 10 km to the west of the ML 28 Area, is a near neighbour of the mine. Both parks fall within Category II (National Parks) of the International Union for Conservation of Nature (IUCN).

Table 2.1: Geographical position of localities relative to wind direction

Locality	Distance	Direction	Relative to wind direction
Arandis town	5 km	Northwest	Does not lie in the direction of E, NE, or SW winds
Arandis Airport	6 km	West	Lies in the direction of E wind
Swakopmund small-holdings	50 km	Southwest	Lies in the direction of NE wind at a distance
Swakopmund town	60 km	Southwest	Lies in the direction of NE wind at a distance
Walvis Bay	75 km	South-southwest	Lies in the direction of NE wind at a distance
Henties Bay	88 km	Northwest	Does not lie in the direction of E, NE, or SW winds

3 Environmental management at Rössing Uranium

Built on an early commitment, all operational activities at the Rössing Uranium mine are managed to ensure that its impacts on the biophysical and the socio-economic environments are reduced to acceptable limits. Operations are governed through applicable national legislative and regulatory frameworks and managed through an integrated Health, Safety and Environment Management System (HSE MS). The HSE MS conforms to the international standards ISO 14001, OHSAS 18001, and ISO 9001; Rössing Uranium itself has been certified to ISO 14001 since 2001. Based on an understanding of potential health, safety, and environment hazards/aspects, the HSE MS allows Rössing Uranium to:

- identify key aspects and impacts
- guide operating procedures, and
- aim for continual improvement in managing these.

All potential impacts are listed on a risk register, with related mitigating and operational controls.

The HSE MS is a tool designed to assist in achieving Rössing Uranium's goals, including its commitment to meet its legal obligations. This systematic approach to management performance promotes the efficient use of resources and offers the prospect of financial gains to the company – generating a win-win outcome in terms of environmental and business performance. An audit programme evaluates the HSE MS periodically. During 2013, audits were conducted against the Rio Tinto Performance Standards and the HSE MS Standard (ISO 14001 surveillance) and Rössing Uranium maintained certification for ISO 14001:2004.

In addition to the HSE MS, Rössing Uranium started to implement conformance to Rio Tinto Performance Standards in 2005. The objective of the standards is to gain the commitment of employees on an annual basis to improvement in impact management performance. Ultimately, environmental management at Rössing Uranium aims to achieve the following:

- Assess environmental impacts of mining activities throughout the design and planning, construction, operational, and decommissioning phases
- Develop, implement, and manage monitoring systems to ensure maximising of avoidance, mitigating and rehabilitation of adverse environmental impacts
- Comply with all environmental regulatory and legislative frameworks during all phases of the mine's operations through an approved Environmental Management Plan.
- Investigate and exploit measures to reduce usage of non-renewable resources.
- Maximise positive environmental impacts
- Avoid, mitigate, and rehabilitate adverse impacts
- Limit contamination through prevention measures (escapes into aquatic and atmospheric pathways), appropriate containment, recycling, and removal measures
- Protect, conserve, and enhance cultural, heritage, and archaeological resources
- Keep communities informed and involved in decision making about mining activities
- Ensure the health and safety of employees, contractors, and surrounding communities through agreed performance criteria, and
- Support and encourage awareness, training, and responsibility with regards to environmental management.

The use of a formalised, integrative HSE MS is essential in allowing Rössing Uranium to optimise, coordinate, and manage its various operations, personnel, plant and equipment and their interactions in a manner that demonstrates consistent application of best practice in environmental management. Matters of planning, implementation and operation; checking and corrective action; and management review, are embodied in the system. This approach assists in the identification of key environmental aspects and serves to guide Rössing Uranium in continued formulation of suitable standard operating procedures (SOPs) and in attaining continual improvement objectives.

Annual HSE MS reviews are conducted at Rössing Uranium by key management personnel. The annual review is a necessary part of the continual improvement process and helps senior management focus on the effectiveness of the management system and authorise actions and/or provide resources to improve HSE performance. The aim of the HSE management review is to ensure that the HSE MS is efficient and effective in managing HSE performance and meeting Rössing Uranium's legal and other requirements.

4 Environmental performance in 2013

The *Environmental Management Plan* for Rössing Uranium was updated at the end of 2012. This document contains a concise description of the management of environmental aspects and impacts at the Rössing mine site, from the designing phase through to the decommissioning phase.

No significant environmental incidents occurred during 2013 and no deviations from the *Environmental Management Plan* were therefore reported to the respective authorities. Work on the Social and Environmental Impact Assessment for the Z20 uranium occurance was completed in 2013.

As a resource-intensive industry, Rössing Uranium's operations have the potential to impact on natural resources and the environment. For this reason, Rössing Uranium focuses continuously on improving environmental management programmes to maximise benefits and to minimise negative impacts. Key environmental management programmes include:

- Energy efficiency and greenhouse gas emissions
- Air quality control
- Water usage
- Waste Management Programme
- Chemical substance management, and
- Land-use management.

Performance in 2013 with regard to the environmental management programmes is discussed below.

Table 4.1: Tier 1 targets

Year	Emissions	Product uranium emissions target	Energy intensity
	(tonnes CO_2-e)	(t CO_2-e/tonne)	GJ/t U_3O_8
2008	222,567.00	54.18	454.41
2009	243,243.00	58.63	522.71
2010	221,044.68	60.76	548.81
2011	232,585.27	76.84	675.14
2012	212,837.92	67.62	563.50
2013	212,722.25	65.20	543.20
2014	196,076.54	56.65	454.12
2015	196,123.77	54.57	437.57

4.1 Energy efficiency and greenhouse gas emissions

Efforts to stabilise global atmospheric concentrations of greenhouse gasses at reduced levels is a priority for Rio Tinto and as a result, Rössing Uranium measures these emissions too. Sources of greenhouse gas (GHG) emissions include:

- electricity and fuel consumption
- transport of reagents and uranium
- blasting (explosives)
- waste (sewage, rubbish disposal and landfill)
- extraction, and
- processing.

The intensity of emissions is reported per unit of product target and these 'Tier 1 targets' are reported to Rio Tinto monthly and annually. The Tier 1 targets were amended in 2011, based on the Life of Mine (LOM v10) plan (Table 4.1).

To set the Tier 2 targets, two processes – hauling and milling – are measured to calculate the total amount of energy use per work done. These two processes are the two most energy-intensive of the mine's operations. Two indicators are used to measure energy use during these two processes:

- haul metric: GJ/kilo tonne of material hauled, and
- plant metric: GJ/kilo tonne of ore milled.

The Tier 2 in-house targets are Rio Tinto requirements to drive internal energy efficiency and reduction in greenhouse gas emissions. Tier 2 targets are displayed in Table 4.2.

4.1.1 Performance in 2013: Tier 1 target — energy efficiency

In the year 2013 production of 2,406.77 tonnes of uranium oxide drummed, the total energy consumption was 1,007,659 GJ. This converts to an annual energy consumption of 683.27 GJ/t uranium oxide produced which is 22.68 per cent above the target of 556.95 GJ/t uranium oxide produced. See Figure 4.1.

Table 4.2: Tier 2 targets

ENERGY AND EMISSION INTENSITY REDUCTION		2011	2012	2013	2014	2015
		1.5%	2.5%	3.5%	4.5%	5.0%
Energy target	Target haul metrics (GJ/kt material hauled)	16.55	18.15	17.96	17.78	17.68
	Target plant metrics (GJ/kt ore milled)	46.71	46.20	45.76	45.37	45.17
Greenhouse gas equivalent target	Target haul metrics (kg CO_2-e per/t material hauled)	1.20	1.45	1.44	1.42	1.41
	Target plant metrics (kg CO_2-e/t material milled)	6.73	6.66	6.59	6.53	6.50

Overall, the Tier 1 targets for energy efficiency were not met due to the unfavorable waste-ore ratio during the current ramp-up mode at the mine and the dependency on low-grade ore at this stage. The situation was also worsened by the lower than expected production as a result of the difficulties experienced in the Processing Plant at the end of 2013. It is anticipated that the long-term targets will be achieved by 2016 as the outlook becomes more favorable after 2014.

As waste stripping remained high during 2013, and will continue to be high during 2014, it is not foreseen to meet the Tier 1 targets for energy efficiency.

4.1.2 Performance in 2013: Tier 1 target — greenhouse gas emissions

The actual performance achieved in 2013 amounted to 78.04 t CO_2-e/t U_3O_8, which is 17 per cent above the target of 66.85 t CO_2-e/t U_3O_8 for 2013 (Figure 4.2). In December 2013 emissions intensity amounted to 107.42 t CO_2-e/t U_3O_8, which relates to the low production as a result of the leach tank failure.

4.1.3 Performance in 2013: Tier 2 — in-house metrics

Rössing Uranium's performance against Tier 2 targets is displayed in Table 4.3. These targets were not met during 2013, mainly due to the unfavorable waste-ore ratio, the dependency on low-grade ore, and the lower than expected production.

4.1.4 Climate change

Rössing Uranium participates in – and influences – evolving conceptual discussions and thinking on climate change. As part of an internal networking and stakeholder engagement programme, Rössing Uranium has been present at different seminars and workshops on climate change policy and adaptive capacity held throughout the year, to give inputs and also to learn from best practice.

Figure 4.1: Total energy consumption intensity 2013

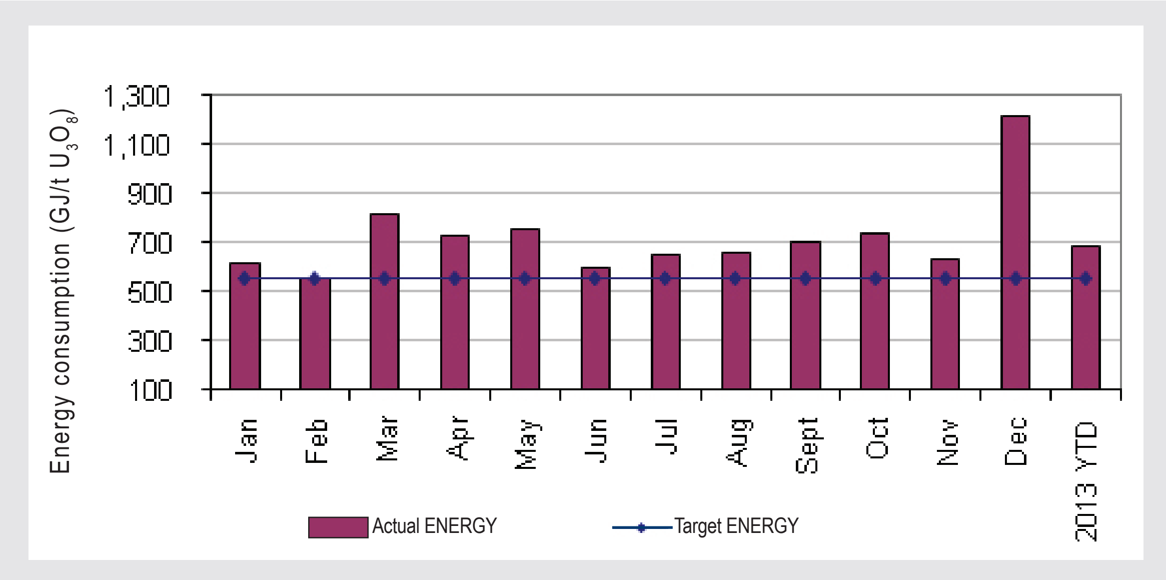


Figure 4.2: Total greenhouse gas emission intensity 2013

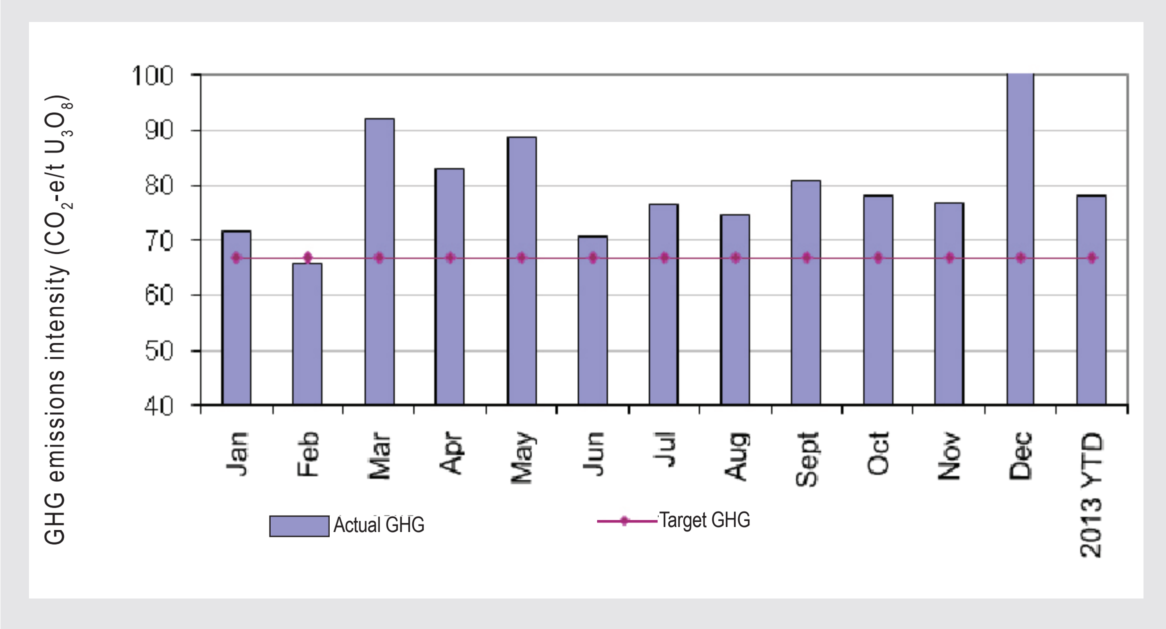


Table 4.3: Performance 2013: Tier 2 - Haul and plant metrics

Metrics	Target: 2013	Actual: 2013
Haul		
Haul metrics GJ/kt equivalent material hauled	18.15	17.75
GHG haul metrics kg CO_2-e/t material hauled	1.45	1.44
Plant		
Plant metrics GJ/kt equivalent ore milled	46.20	44.69
GHG Plant metrics kg CO_2-e/t ore milled	6.66	6.29

4.2 Air quality control

The *Air Quality Management Plan* (JE20/MMP/004) guides the management of environmental dust at the Rössing Uranium mine. Air emissions are listed in an inventory and all air quality standards applied at Rössing Uranium are documented. In short, improvements to air quality management practice at the mine site aim at:

- a refined understanding of Rössing Uranium's dust footprint, in correlation with the local wind regime
- a review of the existing sources of emissions from mining operations
- characterising ambient air quality
- a better understanding of the correlation between blasting and its impacts – dust, noise and vibration
- a better comprehension of atmospheric impacts on the biosphere, and
- a review of control measures to recommend additional measures if needed, and to manage air quality better.

4.2.1 Environmental dust

Measurements are taken in order to ensure that exposure levels to dust do not exceed prescribed occupational limits and to ensure that existing and newly-introduced controls efficiently detect differentiations as a result of process changes. Informed risk-based decisions, related to the level of control, have been introduced for the various exposure levels – with the objective of optimising performance in terms of emission reduction and control measures. Dust fallout is monitored and reported internally – monthly on site and annually to Rio Tinto – to reduce dust through innovative controls.

A PM10 monitoring point at the southwest mine boundary was established in February 2012 and was functional until the end of September 2013, after which components of this station were stolen. (The station is going to be re-established elsewhere on the ML 28 Area in 2014.) Despite several east wind events, dust concentrations recorded at this PM10 monitoring point remained below the standard of 0.12 mg per m^3 throughout the period January to September 2013 (see Figure 4.3).

The very low readings (average 0.012 mg/m^3) indicate that PM10 dust dispersal from potential sources in the operational areas is limited in distance and does not cross the boundary to the southwest of the ML 28 Area.

PM10 dust levels are continuously monitored at Arandis. Although the monitor station was malfunctioning during the winter months – and readings were therefore incorrect – readings for all the other months were much lower than the standard of 0.12 mg/m3 (as can be seen in Figure 4.4).

Figure 4.3: Ambient dust levels at the southwest boundary of the Rössing Uranium mine in 2013

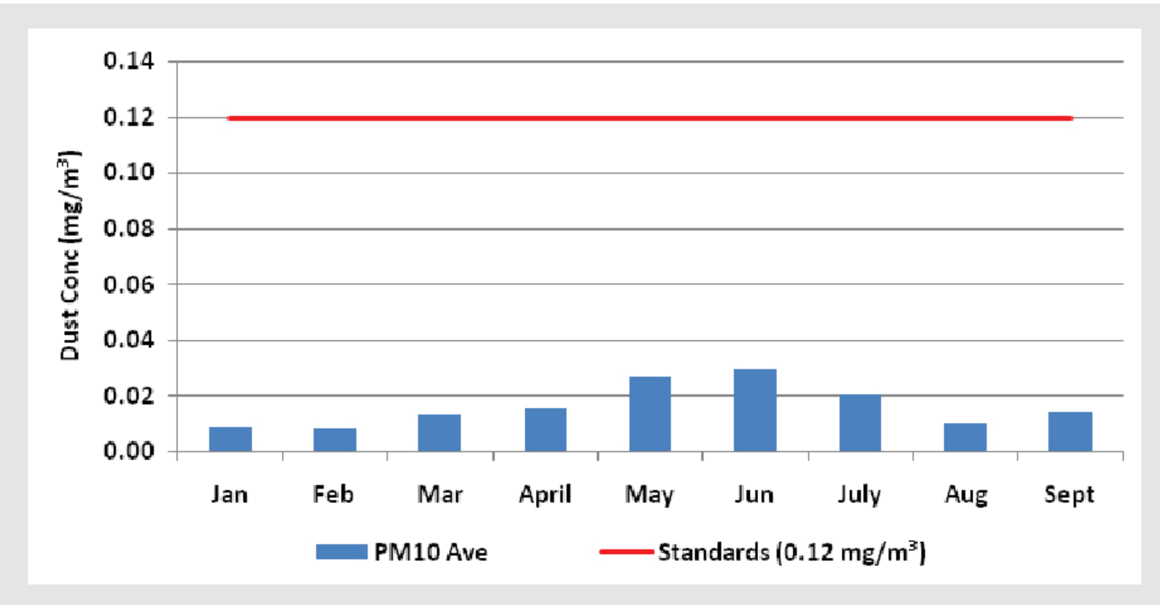
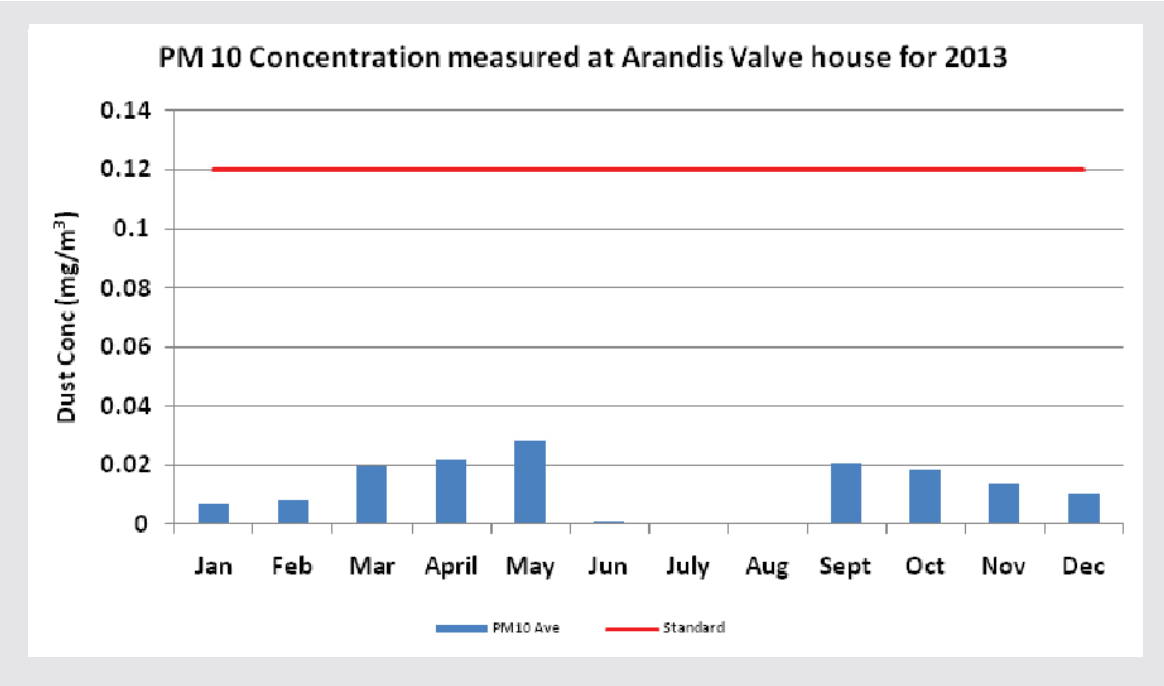


Figure 4.4: Dust concentrations measured in Arandis in 2013



Readings from the six monitoring stations that were added to the existing dust fallout network during August 2012 were taken monthly. This enabled a better understanding of dust emissions and the dynamics in terms of seasonal and spatial patterns.

4.2.2 Other air emissions

The annual assessment of stack emissions to evaluate the efficiency of filters, and to measure the emissions of impurities such as SO_x and NO_x, was conducted during December 2013.

Chlorine detectors with an alarm system (for safety purposes) are in place at the sewage plant.

Mercury emissions were monitored at the Final Product Recovery area, indicating insignificant gas emissions at the time of measurement.

4.2.3 Noise and vibration

Noise and vibration at the Rössing mine site are monitored through a network of various points and studies. Information is used to assess compliance and to address concerns, as well as to provide feedback to the Geotechnical Section, which utilises the information in investigating the impact of blast vibrations on the stability of the pit. The management of noise and vibration is guided by the Rio Tinto Performance Standard E6 (*Noise and Vibration Control*) on which the *Noise and Vibration Management Plan* (JE20/MMP/008) is based. Environmental noise is monitored according to international standards and reported monthly to minimise noise to threshold levels and to identify events when these are exceeded.

The highest air blast measured on the mine site during 2013 was 133 dB, in January. The lowest reading was 104 dB in November, as displayed in Figure 4.5. In short, the air blast levels have been consistently below the limit of 134 dB during 2013.

The highest resultant peak particle velocity (ground vibration) measured on the mine site for 2013, as displayed in Figure 4.6, was 6.16 mm/s in March and the lowest was 0.09 mm/s, in June. The ground vibration levels have been consistently below the limit of 12.5 mm/s throughout the year.

Environmental noise is measured over snapshots of ten minutes. Figure 4.7 provides a compilation of these snapshots, related to the months of the year.

There were six events during which the standard was exceeded, ie was above 45 dB(A), as recorded at the sampling points in 2013. Station 01, at the main access road to the mine, recorded three such events and this was mainly due to the frequent vehicle movement on the road. The highest Leq10 recorded in 2013 was 53.3 dB(A) recorded at Station 02, near the airport, and this can also be ascribed to light vehicle movement. The lowest Leq10 recorded in 2013 was 22.3 dB(A), recorded at Station 03 at the mine boundary.

In conclusion, the events during which noise levels exceeded the standard were not ascribed to the operational activities in the Rössing mining area, but can be explained as the result of natural sounds locally (such as birdsong or wind moving through foliage) and light vehicle movements in the vicinity of the sampling points.

Figure 4.5: Air blast levels measured during 2013

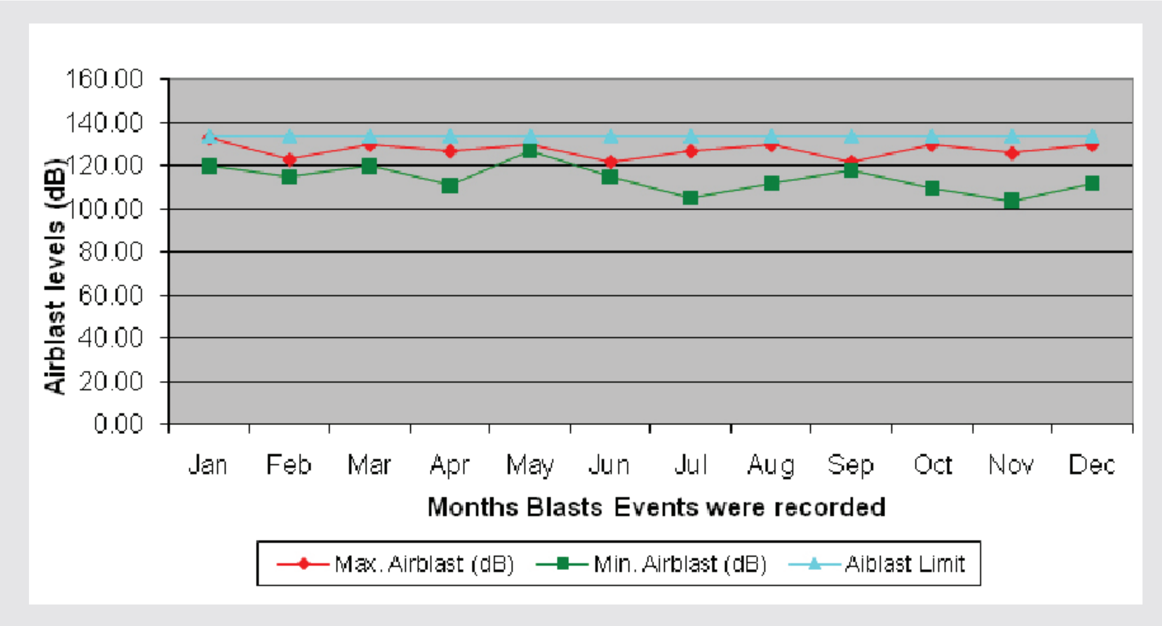


Figure 4.6: Ground vibration levels measured during 2013

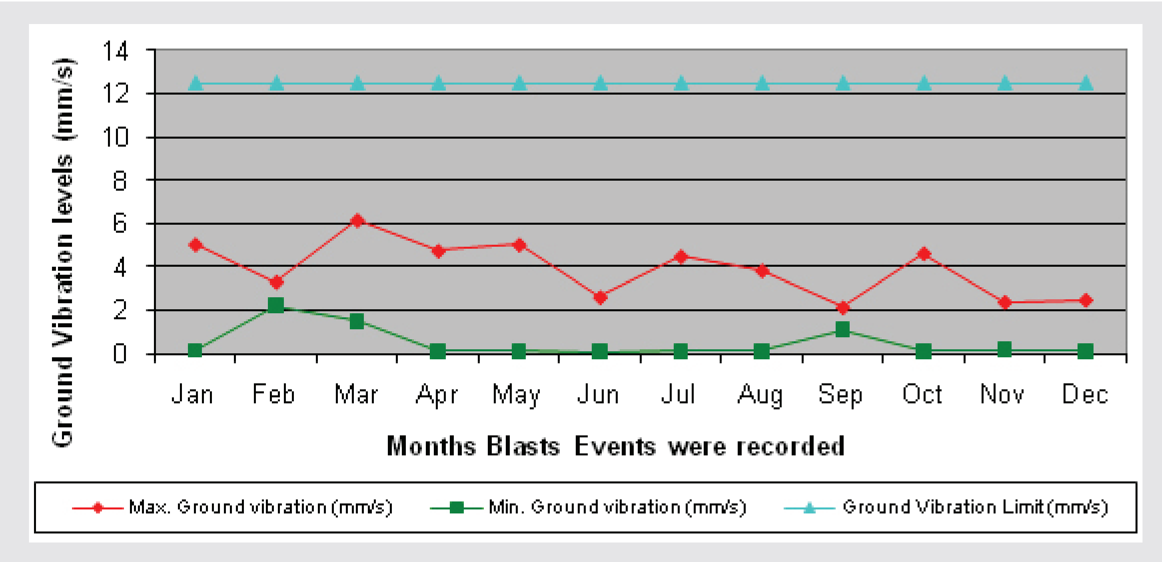
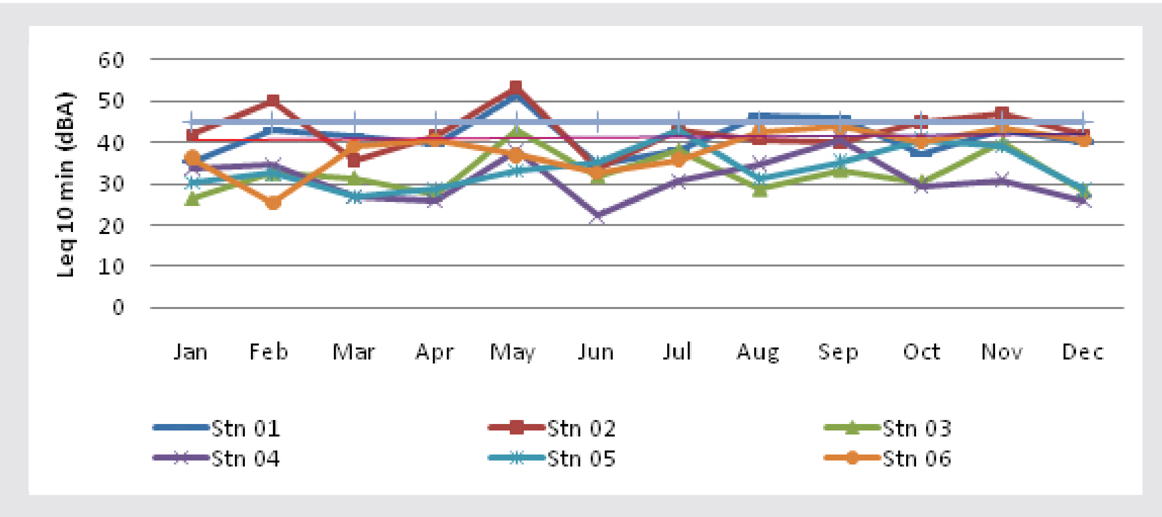


Figure 4.7: Environmental noise levels measured during 2013



4.3 Water usage

Water management in the Rössing mining area is guided by a formal water strategy (*Rössing Water Strategy* JE05/STR/001) and *Water Management Plan* (JA10/MMP/001), developed according to the Rio Tinto Performance Standard *Water Use and Quality Control* (E10) and supported by Rio Tinto's *Water Use and Quality Control Guidance Notes*. Water management covers all activities connected to water abstraction, dewatering, transport, storage, usage (potable and process), and direct/indirect discharge involving surface water (including runoff), impounded water, and groundwater. The aim of the standard is to ensure efficient, safe, and sustainable use and protection of water resources and ecosystems. Facing water-usage challenges head-on, water management activities aim at:

- recycling water
- the extracting and re-use of water from the Tailings Storage Facility
- minimising high evaporative water losses
- using alternative and lower-quality water sources, and
- creating awareness of the need to conserve water.

Water recycling and reuse is the foundation of the mine's Water Savings Programme. All spillages in the Processing Plant are captured and channelled to a large recycle sump for reuse. Effluents from the workshops are treated to remove oils, and sewage is treated in the on-site Sewage Plant. These effluents are used in the open pit for dust control purposes.

Most of the mine's water management takes place at the Tailings Storage Facility. Surface water from pools forming at tailings deposition areas is recycled and reused on a continuous basis in the plant, minimising evaporation and infiltration into the tailings pile.

Remaining water that has infiltrated is recovered by pumping boreholes and open trenches installed on the facility itself to reduce the volume of underground water within the tailings pile.

Seepage control systems are also employed outside the Tailings Storage Facility. They include a surface seepage collection dam to capture water from the engineered tailings toe drains, cut-off trenches in sand-filled river channels, dewatering boreholes situated on geological faults and fracture systems on the downstream western side of the facility. All systems lower the water table to such an extent that flow towards the Khan River is interrupted. The recovered water is reused in the Processing Plant.

A cornerstone of the mine's water and seepage management is a comprehensive monitoring programme. This starts at the Tailings Storage Facility to ensure sufficient capacity at deposition areas, to ensure low water levels in the tailings pools and to ensure the proper functioning of all seepage control systems. On the reuse side in the plant, frequent flow meter readings are taken at many areas to maintain an overview of the water balance at any time.

To ensure that all systems are functional and zero discharge to the Khan River is maintained, water level measurements are taken on a network of more than 100 monitoring points. A number of these points are also sampled to determine the quality of the groundwater, including the concentration of uranium and other radionuclides. As a condition of the permit issued by the Department of Water Affairs and Forestry, monitoring results are submitted to the Department at regular intervals for review.

Of the monitoring boreholes, 40 are monitored every year, on a rotating basis. Of these, results of 15 boreholes are reported to the Department of Water and Forestry. In 2013 a total of 22 boreholes were analysed for radio-nuclide concentrations and chemical analyses were conducted for 86 boreholes.

Table 4.4 shows water management performance against targets.

Table 4.4: Water targets and actual performance

PERFORMANCE DATA TABLE	Actual 2010	Actual 2011	Actual 2012	Target 2013	Actual 2013	Target 2014
Fresh water consumption (Mm^3)	2.965	3.06	3.103	3.194	2.914	2.377
Fresh water per tonne ore milled (m^3/t)	0.247	0.296	0.256	0.26	0.289	0.26
Ratio of fresh water : total water	0.33	0.39	0.38	0.33	0.4	0.35
Seepage water collected (Mm^3)	2.679	2.703	3.038	3.029	2.060	2.605

4.4 Waste management

In the absence of a clear legislative framework for waste management in Namibia, Rössing Uranium uses international standards such as ISO 14001:2004 as well as the Rio Tinto Environmental Performance Standard E7 (*Non-mineral Waste*) for conformance and compliance.

4.4.1 Management of non-mineral waste

Non-mineral waste at the Rössing mine is characterised; for each area, an inventory and a risk register are maintained. An overarching *Non-mineral Waste Management Plan* (JE20/MMP/001) is in place to ensure sound non-mineral waste management through the minimisation of waste generation and the safe handling, treatment, and disposal of waste. The plan addresses all non-mineral wastes generated at the mine site during the operational phase and will be revised for the decommissioning phase. A database of historical waste dumps is also maintained and guidance on the remediation of these sites during operations exists.

Review of the *Non-mineral Waste Management Plan* is conducted at least every four years. In short the objectives of the plan are to:

- Avoid waste generation – the use of substitutes or alternative processes reduces the volume of total wastes and hence management requirements
- Reduce waste generation – waste reduction reduces costs of further treatment and decreases the risk of pollution associated with disposal facilities
- Segregate waste – allows for different waste streams to be recycled, reused, or disposed of correctly, and
- Re-use and recycle waste – reduces the volume of waste disposed of and has the potential to improve economic gain.

Specific targets for non-mineral waste management in the Rössing mining area are set annually and progress is monitored and reported monthly, six-monthly, and annually. Effectiveness is measured against the following performance indicators:

- number of non-conformances recorded
- increase in volumes of recycled/re-used waste
- reduction in waste generated, and
- incidents of pollution.

Non-mineral waste is weighed and a register is kept for reporting against targets. General waste is disposed of at a managed landfill site. The landfill and external recycle sites are frequently inspected and are audited on a two-yearly cycle. Records of waste generated, stored, and disposed of are filed and maintained. Groundwater in the vicinity of the landfill site is monitored according to operational procedure.

Redundant material and equipment that could potentially be contaminated are segregated according to criteria and disposed of in a designated site on the Tailings Storage Facility; the quantity and disposal location are recorded and access to the contaminated waste disposal site is controlled.

Although less steel was recycled, significant increases were made in the recycled volumes of wood and cardboard and paper in 2013. Moreover, the total volume of waste in 2013 is significantly less than the previous years. This is a result of the retrenchment during 2013 and the decision to classify waste from some areas in the Processing Plant as contaminated waste (which is disposed on the Tailings Storage Facility and not on the landfill).

The measureable target for the reduction of non-mineral waste destined for disposal was set at 80 per cent for 2013. This target was achieved with a final result of 88 per cent (see Table 4.5). Based on a 10-year average percentage, it is recommended that the target remains at 80 per cent to guide Rössing Uranium's current drive to increase the volume of waste recycled.

Paynes Metals was appointed as the company that handles and removes recyclable waste from the site. The contract includes agreement on the recycling of specified items and the terms for removal of waste from site against monetary targets. A new site for Paynes Metals was proposed from where waste management can be centralised and streamlined.

4.4.2 Management of mineral waste

At the Rössing mine site, mineral wastes are identified as waste rock and overburden, tailings and – possibly in future – ripios.

The Rössing Uranium *Mineral Waste Management Plan* (JE20/MMP/009) has been developed in accordance with the Rio Tinto *Mineral Waste Management Guidance Notes* and the Rio Tinto Performance *Standard Mineral Waste Management* (E8), as well as the relevant Namibian regulatory requirements. The aim of the plan is to ensure sound and effective mineral waste management by the minimisation of waste generation and by ensuring the safe handling, treatment, and disposal of these wastes. The *Mineral Waste Management Plan* for Rössing Uranium was revised at the end of 2011.

The purpose of the plan is to provide a documented record of issues related to mineral waste and to manage all mineral waste produced at the Rössing mine site in such a manner that disposal facilities and sites are physically, biologically, and chemically safe. Waste storage facilities are thus placed within permitted areas only. Considerations in the placement are:

- Preferably placing waste within inactive open pits, underground workings, or within existing disturbed areas
- Tying waste repositories into the surrounding topography to maintain regional drainage patterns and reduce visual impacts
- Avoiding placement on land with high biodiversity or ecosystem service values
- Avoiding placement in or near perennial surface water bodies or in large ephemeral drainage lines

Table 4.5: Non-mineral waste volumes (in tonnes), excluding hazardous waste

Year	Steel	Cardboard and paper	Wood	Plastic	e-waste	Conveyor	Tyres	Land filled	Total recycled	Total waste	% of total waste recycled
2002	1,597	10	17	-	-	-	-	433	1,624	2,057	78.9
2003	1,897	23	43	-	-	-	-	504	1,963	2,467	79.6
2004	1,734	36	57	-	-	-	47	785	1,874	2,659	70.5
2005	1,700	39	60	-	-	-	86	1,016	1,885	2,901	65.0
2006	1,411	37	42	-	-	-	10	548	1,500	2,048	73.2
2007	2,290	31	45	-	-	-	10	445	2,374	2,819	84.2
2008	2,254	21	39	-	-	24	-	410	2,339	2,750	85.1
2009	1,715	19	29	-	4	12	-	679	1,779	2,458	72.4
2010	3,128	13	45	6	3	85	101	672	3,380	4,052	83.4
2011	2,314	30	91	15			67	746	2,517	3,254	77.1
2012	2,930	8	45	7	-	63	2	415	3,055	3,470	88
2013	908	26	115	9	-	21	103	165	1,182	1,347	88

- Avoiding placement of chemically reactive waste over important groundwater aquifers or recharge zones
- Avoiding placement in areas with significant archaeological or social value.
- Avoiding placement in close proximity to local communities
- Preferably placing chemically reactive wastes in drainage basins that already contain reactive waste (thereby avoiding placement in pristine drainages)
- Avoiding placement in areas with poor foundation conditions due to topography, underlying geology, or hydrology, and
- Balancing economic considerations such as haul profiles, potential resource sterilisation, and pumping costs with environmental and social considerations, and the criteria for mine closure.

Waste rock dumps are typically comprised of coarse, angular fragments of very strong rock material that is resistant to mechanical disintegration and chemical decomposition. The exceptions are amphibole schist and biotite schist – both of these are minor rocks in terms of volumes, and furthermore are mostly processed as ore. Typically, the Rössing mine site dumps are therefore characterised by pervious, frictional material placed on competent, but steeply sloping, foundations.

Rössing Uranium keeps an inventory of mineral waste in its mining area that reflects the tonnage disposed per year; the cumulative tonnage; and the surface area, volume and location of the waste. Site maps are maintained; the spatial footprint of mineral waste is also recorded and reported annually.

At closure, the need for reshaping of the huge man-made landforms represented by the waste rock dumps and the Tailings Storage Facility needs to be minimised; to achieve this aim, dumping should progressively meet the final landform requirements. Additional work following closure (monitoring and maintenance) should also be limited and with this in mind, Rössing Uranium follows a Waste Rock Disposal Planning and Design Strategy; in the case of the Tailings Storage Facility an operating manual sets out the procedures to be followed in accordance with the engineering design. The following management objectives are emphasised:

- geotechnical stability and access
- radiation and radon emanation
- surface drainage and rainwater leaching
- rehabilitation and restoration requirements, and
- visual appearance and aesthetics.

Operational manuals regulate the management of the waste rock dumps as well as the Tailings Storage Facility and comply with the Rio Tinto *Safety Standard Management of Pit Slopes, Stockpiles, Spoils and Waste Dumps* (D3). The likelihood of injury to humans and wildlife in these areas is minimised through their design and construction and by means of access control, as well as through ensuring (geotechnical) stable conditions.

Table 4.6: Mineral waste disposed in 2010-2013

Tonnes deposited	2010	2011	2012	2013
Waste rock dumps	40,022,450	39,608,654	33,749,173	25,332,432
Tailings Storage Facility	11,594,430	10,370,362	12,152,173	11,261,619

In addition, the facilities are secured against temporary and long-term use or habitation.

Inspections of the Tailings Storage Facility are carried out at least annually. Consultants from Metago Environmental Engineers, SRK, and Aquaterra undertake annual reviews and report on the proceedings, findings, and recommendations for improvement. Metago conducts an inspection of the dam as a major waste storage facility every one or two years, as required by Rio Tinto.

The combined surface area of the waste rock dumps and the tailings facility is currently calculated at 1,368.84 ha. The surface area of the Tailings Storage Facility was expanded with 3.97 ha during 2013, and the surface area of the waste rock dumps increased by 2.08 ha.

The waste rock dumps and the Tailings Storage Facility will remain as man-made landforms at mine closure. The visual impacts of the final landforms are designed to be minimised in order to maintain the characteristics and aesthetic qualities of the surrounding landscape; mineral waste is thus scheduled to be deposited in such a way that it complements the contours of the surrounding landscape. An outcome that allows passive re-vegetation and integration into functioning ecosystems is the preferred option.

4.5 Chemical substance management

Rössing Uranium uses existing Namibian legislation, international standards such as ISO 14001:2004, as well as the Rio Tinto Environmental Performance Standard E5 (*Hazardous Materials and Contamination Control*) for the purpose of conformance and compliance.

The objective of the Rio Tinto standard is to ensure the safe and responsible use and control of all hazardous materials handled by the mine operations commensurate with risks to the environment, and to prevent spillage and environmental contamination from handling, storage, and processing. For this reason, monitoring programmes are in place to prevent spillages and environmental contamination from the transport, use, storage, and disposal of hazardous materials.

The *Hazardous Material and Contamination Control Management Plan* (JE20/MMP/002) is in place at Rössing Uranium. This programme contains several ongoing activities. The main objectives of the programme are to ensure that:

- The safety and responsibility for usage and control of all the hazardous materials handled by Rössing Uranium correspond with their risks to the environment.
- Control measures are in place to minimise the risks and the environmental impacts due to spill or other escapes, and
- In cases where site contamination has occurred, the contamination is properly characterised and managed.

Current activities of the management programme focus on the following:

- Measuring controls that are in place to prevent/minimise spillages during the handling of chemical substances
- Carrying out routine inspections, monitoring procedures for leaks, and integrity testing for deterioration of storage tanks and pipelines
- Maintaining spill and leakage detection equipment and emergency response plans that are appropriate for the risk posed by the hazardous material to the environment and are linked to the appropriate operational control and emergency response unit
- Conducting regular internal and external audits, inspections, and monitoring activities
- Promoting awareness on the safe handling of chemical substances through training and special knowledge-building campaigns
- Engaging with stakeholders (suppliers, service providers and end-users) to ensure continuous improvement
- Identifying the needs for engineering controls to prevent spillages (by means of secondary bunds, for example)
- Providing support to approve and authorise the purchasing of chemicals, and
- Maintaining an inventory of hazardous substances on the company intranet, including the Material Safety Data Sheets.

4.6 Land-use management

The disturbance of land is an inevitable consequence of any mining activity. It is Rössing Uranium's objective to keep expansions of the 'footprints' of the SJ Pit, the waste rock dumps and the Tailings Storage Facility to a minimum. This is achieved by following a strategy of preventing area extensions and instead developing the facilities to higher elevations, thus avoiding impacts on plant and animal life and on archaeological finds.

From Table 4.7 it can be seen that the recent ramp-up mode in ore and waste rock mining has resulted in expansions since 2010, chiefly of the SJ Pit and waste rock dumps. The Processing Plant did not expand but the road network and Tailing Storage Facility did increase slightly in size. Due to non-infrastructure extensions, an area of 9.89 ha was reported as having been added to the total disturbed area at the Rössing mine site during 2013. [1]

The total area disturbed, ie the total footprint of the Rössing Uranium mining area, was 2,540.65 ha at the end of 2013. A combined surface area of 2,022 ha – 80 per cent of the total footprint – is made up of the SJ Pit (458 ha), waste rock dumps (635 ha), Tailings Storage Facility (734 ha) and Processing Plant (195 ha). The rest of the disturbed areas are related to roads, railways and other infrastructure. In comparison, the area of the town of Swakopmund covers about 1,000 ha.

It is noteworthy that the total footprint has increased by 174.12 ha since 2003, meaning that the mine's footprint has expanded at a rate of 19.35 ha per annum over nine years.

4.6.1 Management of biodiversity

The Central Namib Biodiversity Database, an initiative of Rössing Uranium, was launched in March 2012. The database enables all uranium mines in Erongo Region to share biodiversity information in order to access up-to-date data on species distribution that will underpin best management practices for important conservation species. The database also contains an extensive range of specialist reports and survey documents that are of relevance to the biodiversity of the central Namib Desert. This study provided important input to the *Biodiversity Action Plan* (JE20/MMP/006) of Rössing Uranium, which was completed during 2013.

Rössing Uranium hosted the 13th BirdWatch event at the Walvis Bay lagoon in September 2013, in conjunction with Part 2 of the Coastal Environmental Week organised by the Namibian Coast Conservation and Management project (NACOMA). A total of 54 pupils and eleven teachers from eleven high schools in Arandis, Swakopmund and Walvis Bay participated in the event. As a token of appreciation each participating school received science laboratory equipment.

Continuous biodiversity management activities at Rössing Uranium include:

- The monitoring, recording and reporting of biodiversity (including collection and identification of species) and making biodiversity information relating to the Rössing mining area and the central Namib Desert more accessible
- Building awareness through continuous stakeholder engagement, including the annual Rössing birdwatching day and the Coastal Environmental Week
- Continuous updating, refinement and re-alignment of ongoing work identified in the *Biodiversity Action Plan*, and
- In cooperation with land-use management and closure planning, investigating and planning rehabilitation at the Rössing Uranium mine.

During 2013 seven *Adenia pechuelii* (elephant's foot) plants, which occurred in an area earmarked for a small expansion of the Tailings Storage Facility, were relocated. Five of the plants were relocated to a similar ridge, where other plants of the same species already grow, near the Communication Management Centre (CMC). The other two plants were donated to the National Botanical Research Institute (NBRI) in Windhoek, the institution that assisted Rössing Uranium with this undertaking.

An event of note has been the repeated spotting of cheetahs around the mine site since 2012. The cheetahs have been seen hunting as well as resting after a kill, which indicates that their presence is not merely occasional.

Fauna and Flora International had been contracted by Rio Tinto to update Rössing Uranium's *Biodiversity Action Plan* and to identify the company's Net Positive Impact needs. The updated document (2012) will guide the required activities of 2014 and beyond in order for Rössing Uranium to plan for achieving Net Positive Impact by closure.

4.6.2 Management of rehabilitation

Since the mid-2000s, a number of areas on the mining site have been drilled in search of new uranium ore bodies. A contractor, Namib HydroSearch, was requested to rehabilitate these areas as the mine's Exploration Programme allowed it. Exploration is ongoing and rehabilitation of the disturbed areas as a result of exploration therefore continues. A minimal area of 4.3 ha was disturbed during the Z20 exploration drilling programme and financial provision has been made for complete rehabilitation in 2014 should the deposit not be developed further in the foreseeable future.

[1] The 9.89 ha is the figure reported at the end of 2013, of which 6.1 ha was physically disturbed in 2013 but the remaining area is a correction of an underreporting in 2012.

Table 4.7: Rössing Uranium mine's footprint since 2010

Totals in hectares (ha)		Total prior to 2010	Total in 2010	Total in 2011	Total in 2012	Total in 2013
Infrastructure	Plant	195.44	195.44	195.44	195.44	194.44
	Roads	19.62	19.67	22.93	24.22	24.22
	Water	6.45	6.45	6.45	6.45	6.45
	Infrastructure rehabilitated	39.87	39.87	39.87	39.91	39.91
Non-infrastructure	SJ Pit	431.25	449.46	453.66	453.66	457.5
	Waste Rock Dumps	728.25	726.23	739.72	745.18	747.25
	Tailings Storage Facility	730.17	730.17	730.17	730.17	734.14
	Explorations	4.31	5.65	7.34	7.34	7.34
	Other	275.54	275.54	275.54	275.54	275.54
	Non-infrastructure rehabilitated	51.4	52.1	52.1	52.86	52.86
Total		**2,482.31**	**2,500.62**	**2,523.26**	**2,530.76**	**2.540.65**

A progressive rehabilitation programme, which entails several mechanical activities – such as demolishing redundant infrastructure and facilities, remediation, and establishing geotechnical stability and protection against erosion – has been followed since 2010 and came to an end in 2013. Several rehabilitation tasks were completed. A total area of 93 ha has been rehabilitated since mining operations began. It is anticipated that the total area of rehabilitated land will expand in the future before mine closure as the focus on the importance of rehabilitation at Rössing Uranium increases.

Guidance from legislative and regulatory frameworks on biodiversity offsets and rehabilitation criteria in Namibia is limited. Rehabilitation is a long-term endeavour and is closely coupled to long-term monitoring requirements and research, especially in arid environments. The sustainability of rehabilitation interventions in arid environments is uncertain and clarity in terms of criteria and sign-off is needed. Therefore exit plans and clarity with regard to relinquishment of land are some important considerations for Rössing Uranium as it moves towards the end of the mine's life.

4.6.3 Closure planning

Mine closure is an integral part of Rössing Uranium's mine planning cycle, from exploration through mine development and production to decommissioning and after care. Therefore closure planning has been a continuous process at the mine and changes in operational circumstances, environmental conditions, legislative and regulatory frameworks, and stakeholder expectations have been considered every time plans have been updated over the past 20 years. The current *Life of Mine Plan* foresees cessation of mining activities in 2023 and processing activities in 2025.

(The current plans for closure stipulate that the SJ Pit will not be backfilled with rock and will remain a mining void in the future. The Tailings Storage Facility will be covered with waste rock, thus preventing dust and stormwater erosion. Tailings seepage will continue to be pumped but instead of being reused will be disposed of by evaporation. The Processing Plant and the mine's infrastructure will be broken down, decontaminated, and then sold or disposed of safely.)

Rössing Uranium's closure plans are guided by an aspirational vision for closure that is translated into objectives and targets. In order to achieve these, a closure strategy has been developed by analysing impact mitigation alternatives using sustainable development criteria and choosing a preferred alternative for each aspect or facility. Implementation plans for these preferred alternatives are then developed and the necessary closure costs calculated. Closure cost calculations are updated annually. A major technical update of the plan takes place every five years while closure cost calculations are updated annually (the present closure obligation for Rössing Uranium is calculated at N$1,225.8 million.). The next full technical update will take place in 2016. Five-year plans and annual updates provide a fully scoped and costed plan of closure that is documented and auditable to the company.

A Rössing Rehabilitation Trust Fund was established and makes provision for the closure expenditure that will be incurred by the mine in order that the company can comply with statutory obligations and the requirements of the Ministry of Mines and Energy and the Ministry of Environment and Tourism. Clause 15.2 of the Trust Fund Agreement stipulates: 'The mining company shall before the end of its financial year concerned, pay to the Fund a contribution towards the estimated cost of implementing the measures so approved.' The agreement also stipulates the formula to be used to calculate the annual contribution.

As at end October 2013, the Rössing Rehabilitation Trust Fund had a cash balance of N$331 million. The mine will make additional payments into the Fund on an annual basis in order to provide for the eventual total cost of closure by 2025.

A decision was taken in 2012 to integrate closure planning activities into business operations and to provide frequent feedback on progress to management. To drive and coordinate the various follow-up and scheduled activities the Closure Steering Committee was established in 2012.

The 2011 Closure Management Plan presents a defined closure strategy, an extensive knowledge base, and the costing and scheduling of activities that were developed for the 2023 closure scenario. Rössing Uranium intends to implement mine closure according to the discussions and conclusions detailed in this plan, and will provide adequate resources to achieve this goal. Should mine closure become inevitable unexpectedly due to force majeure, the Closure Management Plan might have to be modified in response to prevailing circumstances – it will nonetheless guide the closure process according to the concepts it contains.