PROPOSED 200/400/800 MW COAL-FIRED POWER STATION AND ADDITIONAL BLACK START GENERATION FACILITY AT WALVIS BAY, NAMIBIA

ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACT ASSESSMENT:

TERRESTRIAL ECOLOGY COMPONENT

SUB-CONSULTANT
John Pallett
Environmental Evaluation Associates of Namibia (Pty) Ltd
P.O. Box 20232
Windhoek
Namibia
Mobile: +264 (81) 240 25 28
Fax: +264 (61) 230172
Email: jpallett@mweb.com.na

PROPONENT
NamPower
15 Luther Street
Windhoek
Namibia

CONTENTS

1. Introduction

1.1 Context of the study

This assessment covers the terrestrial ecology component of the Environmental and Socio-Economic Impact Assessment (ESEIA) of the conceptual Walvis Bay Coal-Fired Power Station and potential Black Start / Emergency Generation Facility being proposed by NamPower. Two alternative sites for the power station are proposed, Site B close to the coast immediately north of Walvis Bay, and Site C in the proposed industrial area between Dune 7 and Rooikop Airport.

The study describes the impacts of a power station at the two sites, and identifies the limits within which the design should adhere to minimize negative impacts. Specifications of the power station that this assessment is based on, are as follows:

- Coal-fired power station with a capacity of 200 MW, 400 MW or 800 MW.
- The coal would be imported via the Port of Walvis Bay to a coal stockpile and handling area from where it would be transported overland, by conveyor belt, to the coal stockpile on the power station premises.
- The smoke stack/s associated with the power station would be 50 m, 100 m or 150 m tall, depending on the final plant design and location.
- Ash generated from the combustion of coal would be collected and transported overland to an ash disposal facility on Site C.
- A 100 MW multi-fuelled[1] black start generation facility will be constructed at the premises, in support of the coal-fired power station.
- Cooling technology – Site B: a single pass wet cooling system, with two pipelines carrying seawater from the ocean to the condenser in the power station and back to the ocean.
- Cooling technology – Site C: direct dry cooling technology, entailing the use of a structure comprised of radiator elements and large electrical fans to force air through the heat elements.
- The generated electricity would be evacuated from the plant via a high voltage (HV) and transmission substation yard, through a 220 kV line connecting to the existing 220 kV transmission lines in the vicinity of Walvis Bay.
- Associated with the power station are various ancillary components and infrastructure which include the following:
    - Perimeter fencing and gated access points;

[1] Multi-fuelled in this case refers to the use of Light Fuel Oil – LFO (diesel) and Heavy Fuel Oil - HFO. These are used in combination where the cleaner burning and more volatile LFO is used for the start-up and shut-down cycle and HFO is used for the operation cycle.

- Access (including parking), service and haul roads between the various facilities and connecting to the public roads;
- Offices and control rooms to house administrative and operational staff;
- General ablution, sanitary and staff amenities;
- Workshops and spare part storage facilities and lay-down areas;
- Storage tanks for process chemicals (e.g. acid and caustic substances), oil and fuel with associated bunding;
- Reservoirs for the storage of clean water, demineralised or neutral process water and effluents;
- Water demineralisation plant;
- Waste water treatment plant;
- Domestic water supply pipeline to service ablutions and potable water requirements;
- Electricity supply to offices, workshops and to run some ancillary equipment and processes;
- Various conveyor belts, hoppers and handling equipment used for the transportation of materials and waste (coal, ash etc) between the power station and the various stockpiles, handling or processing facilities and disposal sites; and
- Various pipelines, valves and pumps used to transport the various process liquids and gasses around the plant.

Impacts are considered during all phases of the proposed power station, namely construction, operation and decommissioning.

Recommendations for mitigation are presented, based on the significance of the identified impacts. Further work is also identified to get a clearer picture of the significance of certain impacts, where specific information has not yet been made available, and where specialist input is required. Environmental management plans will be presented once the mitigatory actions have been decided on.

1.2 Terms of reference

In addition to the broad terms of reference for the ESEIA as a whole, this component will provide a specialist study on the terrestrial ecological impacts that the power plant may generate in the Walvis Bay environment during construction, operation and decommissioning of the proposed plant.

Tasks will include:

- Literature review;

- Site visit;
- Biodiversity mapping of the terrestrial ecological component of the environmental description in the study area;
- Definition and evaluation of impacts (including power line component) and report compilation; and
- Identification of possible mitigation where appropriate.

1.3 Assessment methodology

A standardised and internationally recognised methodology is applied to assess the significance of the potential environmental impacts. The methodology is outlined as follows:

For each impact, the EXTENT (spatial scale), MAGNITUDE (size or degree scale) and DURATION (time scale) is described. These criteria are used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The mitigation described represents the full range of plausible and pragmatic measures but does not necessarily imply that they will all be implemented. The decision as to which combination of alternatives and mitigation measures to apply lies with NamPower as the proponent, and their acceptance and approval ultimately with MET:DEA. Tables 1 and 2 show the scales used to assess these variables and define each of the rating categories.

Table 1: Assessment criteria for the evaluation of impacts

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**National**	Within Namibia
	Regional	Within the Erongo Region
	Local	On site or within 1000 m of the impact site
Magnitude of impact (at the indicated spatial scale)	**High**	Social and/or natural functions and/ or processes are *severely* altered
	Medium	Social and/or natural functions and/ or processes are *notably* altered
	Low	Social and/or natural functions and/ or processes are *slightly* altered
	Very Low	Social and/or natural functions and/ or processes are *negligibly* altered
	Zero	Social and/or natural functions and/ or processes remain *unaltered*
Duration of impact	**Short term** (construction period)	Up to 7 years
	Medium Term	Up to 10 years after construction
	Long Term	More than 10 years after construction

The SIGNIFICANCE of an impact is derived by taking into account the temporal and spatial scales and magnitude. The means of arriving at the different significance ratings is explained in the following table, developed by Ninham Shand in 1995 as a means of minimising subjectivity in such evaluations, i.e. to allow for standardisation in the determination of significance.

Table 2: Definition of significance ratings

SIGNIFICANCE RATINGS	LEVEL OF CRITERIA REQUIRED
High	• High magnitude with a regional extent and long term duration • High magnitude with either a regional extent and medium term duration or a local extent and long term duration • Medium magnitude with a regional extent and long term duration
Medium	• High magnitude with a local extent and medium term duration • High magnitude with a regional extent and construction period or a site specific extent and long term duration • High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration • Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Low magnitude with a regional extent and long term duration

Low	• High magnitude with a site specific extent and construction period duration • Medium magnitude with a site specific extent and construction period duration • Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Very low magnitude with a regional extent and long term duration
Very low	• Low magnitude with a site specific extent and construction period duration • Very low magnitude with any combination of extent and duration except regional and long term
Neutral	• Zero magnitude with any combination of extent and duration

Once the significance of an impact has been determined, the PROBABILITY of this impact occurring as well as the CONFIDENCE in the assessment of the impact is determined using the rating systems outlined in Tables 3 and 4. It is important to note that the significance of an impact is always considered in concert with the probability of that impact occurring.

Table 3: Definition of probability ratings

PROBABILITY RATINGS	CRITERIA
Definite	Estimated greater than 95% chance of the impact occurring.
Probable	Estimated 5 to 95% chance of the impact occurring.
Unlikely	Estimated less than 5% chance of the impact occurring.

Table 4: Definition of confidence ratings

CONFIDENCE RATINGS	CRITERIA
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

Lastly, the REVERSIBILITY of the impact is estimated using the rating system outlined in the following table.

Table 5: Definition of reversibility ratings

REVERSIBILITY RATINGS	CRITERIA
Irreversible	The activity will lead to an impact that is permanent.
Reversible	The impact is reversible, within a period of 10 years.

2. Baseline conditions

This section describes the receiving environment for the proposed power station at Sites B and C.

2.1 Site B

The area between the main road and the shore slopes gradually downwards towards the beach on a flat plain partly covered in low sand dunes, and reaches the intertidal habitat at the shore. The substrate comprises fine sand which is fairly homogeneous and rather unconsolidated. Flat plain areas are largely unvegetated, but do host scattered large hummocks of *Salsola* (ganna) plants. The small dunes carry no vegetation, or near their base only scattered clumps of the dune succulent, *Trianthema hereroensis*, and make low undulating topography. Plant life in this habitat is characteristic of sandy dune areas that are widespread along the central Namib coast, and no species are protected or have restricted ranges.

Reed patches immediately east and west of the main road close to Site B show as dark patches on the aerial photo. They very rarely hold surface water, usually only after good rains such as the falls of more than 50mm in 2006 and 2008. These wetlands originate from underground seepage from the ephemeral Tumas River which is blocked from reaching the sea by the main dune field on the east side of the road. The vegetation is typical of wetlands of this type – *Phragmites* reeds and sedges (widespread in southern Africa, not protected) that flourish with surface or underground flushes of water, and that appear rather dry and wind-battered in dry times. Despite this rather battered appearance, the reeds provide some shelter and food to local common birds (eg waxbills, warblers) and small mammals (eg gerbils) and present a variation from the surrounding barrenness.

Invertebrate life in this habitat is characterized by typical Namib sand-sea species such as sand-living fishmoths and beetles, and predatory spiders and other arachnids. They survive the harsh conditions by burrowing beneath the surface for protection from wind and temperature extremes. Within about 200m of the shore, kelp flies that live around organic beach detritus are found, and are sporadically abundant depending on the amount of stranded kelp and marine detritus on the shore. Further upshore, away from the marine influence, herbivorous species forage on the sparse plant hummocks and on wind-blown plant detritus. No species are known to have ranges restricted to this particular near-shore area. They are all understood to be widely distributed either further north and south on the coast, or in the main central Namib sand-sea.

Small vertebrates in the reptile and mammal classes living in this area include species such as palmato gecko (*Palmatogecko rangei*), barking gecko (*Ptenopus garrulus*), sand lizard (*Meroles cuneirostris*) and pygmy and Setzer's gerbils (*Gerbillurus paeba* and *Gerbillurus setzerii*). As with the invertebrates, these species are typical inhabitants of Namib dune and interdune plain habitats, and have widespread distributions in the central Namib sand sea. None are threatened (Griffin, 2005).

Important components of the fauna are the birds, described below.

2.1.1 Bird Island

Bird Island is situated about 4km north of the proposed site. This is a large flat platform constructed to encourage birds to roost and breed on it and deposit their guano. An alternative name, Guano Platform, describes it aptly. The island hosts mainly Cape cormorants, as well as lesser numbers of great white pelican and crowned cormorant, both classified as Threatened (Simmonds & Brown, 2006). All these marine birds use predominantly the platform, but they also swim, clean themselves and fish in the water immediately surrounding the platform, and often congregate on the adjacent beach to rest or dry off. Birds that are slightly weakened (for any number of reasons) preferentially choose to rest in uncrowded areas such as the beach, where they are away from the competition for roosting and nesting sites. Other species such as common, swift and sandwich terns also preferentially use the beach area for roosting.

2.1.2 Important Bird Area

The coastal strip between Walvis Bay and Swakopmund is classified as an Important Bird Area (SAIEA, 2008), based on regular bird surveys undertaken by Coastal Environmental Trust of Namibia (CETN) over the past approximately four years (Wearne, email communications 2005-2008). These surveys have reported high densities of foraging waterbirds such as sanderling, turnstone, white-fronted plover and kelp gull, including resident and long-distance migratory species such as Hartlaub's gull, red knot, other gulls and terns. In peak season (November – February), about 4,000 birds may occur in an area of about 4 ha (Hockey, 2005). By global standards, these densities are extremely high for any intertidal habitat (including estuaries and mudflats), as a result of nearby mussel beds that provide food such as polychaete worms, amphipods, isopods and other crustacean (Hockey, 2005). The birds also roost up to 200m upshore of the high-water mark in the low dunes and use the scattered *Salsola* hummocks for shelter during strong winds.

The value of this area for birds lies in the close proximity of feeding and roosting sites, which makes it a favoured area for them, and in the energy they gain from fattening up before migration. Compromised energy budgets may a) prevent birds from continuing their journeys, or b) reduce their subsequent breeding performance (Hockey, 2005).

Site B is situated on and immediately south of a Damara tern breeding area. The Damara tern, a near-endemic species to Namibia that is limited to the coastal strip from southern Namibia to southern Angola, is classified as Near-Threatened (Brown & Simmonds, 2007). It breeds within a few kilometers of the shore on bare or very sparsely vegetated gravel plains. Specific areas within the stretch of coast between Walvis Bay and Swakopmund are recognized as favoured breeding areas for this bird, and this is one of them (Figure 1). However, Site B and the surrounding area immediately north of the present extent of Walvis Bay, is earmarked for future growth of the town's residential area, of which the Afrodite Beach residential development (in initial stages of construction in October 2008) is part. The Damara tern breeding area will be sacrificed to this land use. By the same argument, this breeding area could be sacrificed for the proposed power station.

Flight paths of birds are a potential issue for the routing of power lines. Flight paths of birds found in and close to Site B are mostly parallel to the coast, as the birds move north and south between various foraging and roosting sites. Cape cormorants, the predominant species on Bird Island, do not fly over land in this area. Shorebirds such as sanderling and red knot tend to fly close to the beach or over water. Gulls may wander further inland, up to about 5 km from the shore, but there are no particular flight paths of these species in this area. Damara terns fly between sea and nesting areas inland, but as the area around Site B becomes more built up, numbers of Damara terns in this area will fall to insignificance.

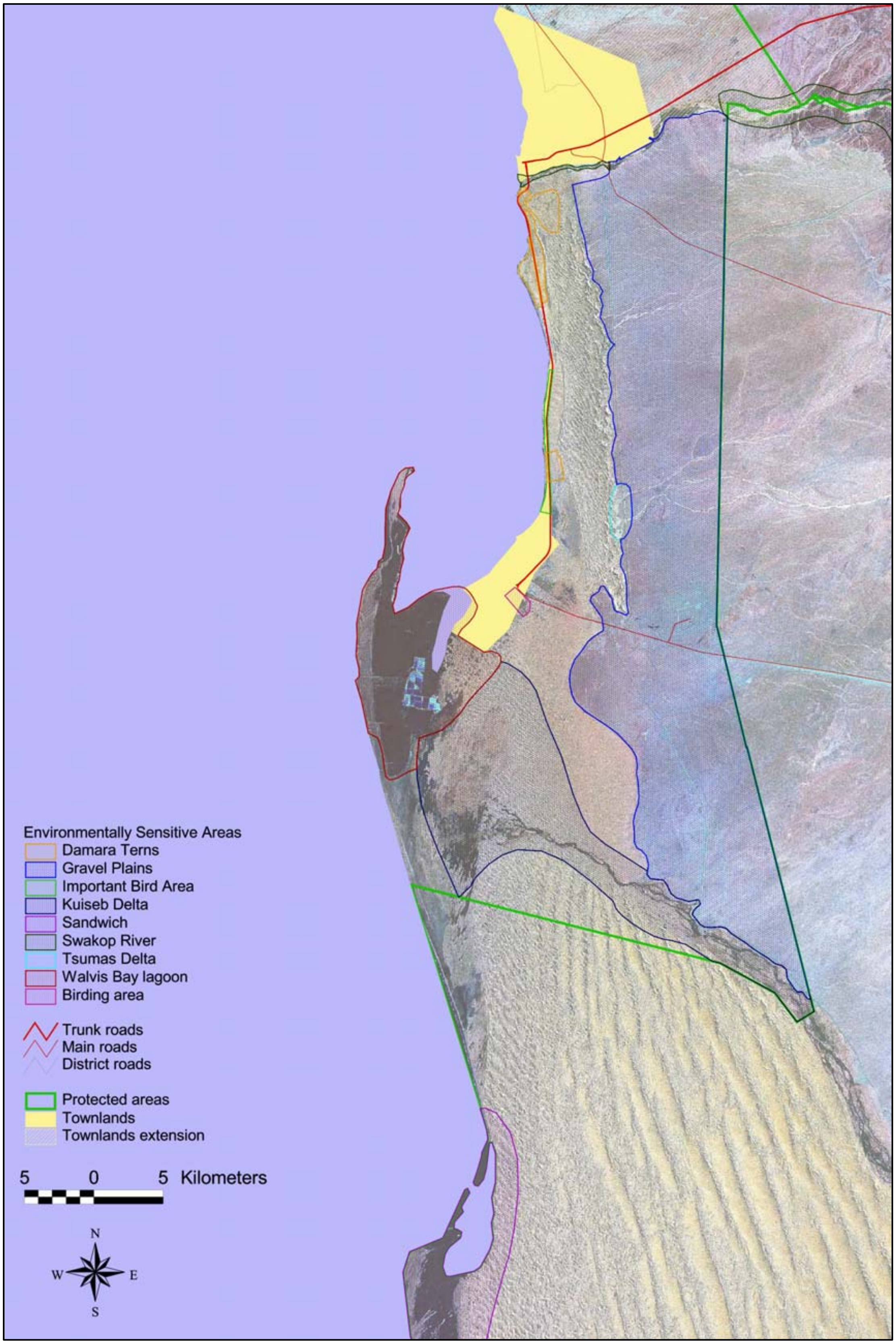


Figure 1: Environmentally sensitive areas around Walvis Bay and Swakopmund. From SAIEA (2008): Management and Development Plan for the Central Area of the Namib – Skeleton Coast National Park.

2.2 Site C

This site is on sandy gypsum plains adjacent to Dune 7, from which it is separated by a gravel road. Approximately 5 km to the SE lies Rooikop Airport. Coarse sand and grit form a lag on the surface, with finer-grained gypsum-rich fairly homogeneous soil underneath. No biological soil crust (BSC), or very poorly developed BSC, appears to be present, but the thin 'pavement' of coarse grains is fairly well developed. This may indicate that some form of BSC holds the surface mat together.

Scattered shrubs, mostly *Salsola* (ganna), *Zygophyllum stapfi* (dollar bush) and *Arthraerua leubnitzii* (pencil bush), grow on the plains, with small accumulations of wind-blown sand around them. Grass grows sparsely on the plain after falls of rain (>10mm), but soon dries out and is carried away by wind to contribute to the detritus which supports dune- and plains-living insects. The plains are therefore bare most of the time, except for the scattered hummocks.

A lichen field, comprising predominantly crustose lichens (hard, crusty lichens that cover the exposed surfaces of rocks), is known to exist to the east but its closest edge is about 5km away from the proposed site (Schultz, 2003).

Animal life is scarce and most predominant in the category of small inconspicuous invertebrates for which the Namib is well known (Seely & Pallett, 2008). Black-backed jackals, gerbils and probably a few other species of small mammals (eg sengis [elephant shrews], other rodents, hares) comprise the mammal fauna. No water birds are expected this distance from the coast and Walvis Bay sewage works, and the avifauna comprises typical Namib plains species such as Gray's lark, finchlarks and tractrac chat, with occasional occurrence of pied and black crows and rock kestrels. The area is probably home to small reptiles such as barking geckos (*Ptenopus*) and sand lizards (*Meroles* and *Pedioplanis* spp), and snakes such as horned adder (*Bitis caudalis*) and dwarf beaked snake (*Dipsina multimaculata*). None of these vertebrates are classified as Threatened (Griffin, 2005), and their populations will be insignificantly affected by the proposed development. Invertebrate fauna is poorly known and it is not useful to list the known diversity recorded from the area. Because the central Namib coastal plains are fairly homogeneous and widespread to the north and east of the proposed site, it is unlikely that there are any invertebrate species in the area that are restricted to the project area. None are known to be of high conservation status.

This area is zoned for future industrial development, and it has little of biodiversity value to dispute this arrangement. These gravel plains are rated as 'environmentally sensitive' in the Management Plan for the proposed Namib – Skeleton Coast National Park (SAIEA, 2008) due to their sensitivity to vehicle tracks, which easily scar the landscape as they remain visible for up to 30 years.

3. Constraints to development

3.1 Site B

Development at Site B should preferentially be as far south as possible ie close to the present northern limit of the Walvis Bay built up area. This will reduce any impacts on the shore and nearshore strip that is identified as an Important Bird Area, and reduce possible disturbance to the birds on and near Bird Island.

Power lines emanating from the power station must not interfere with areas of relatively high bird traffic. Bird flight paths to be avoided are the shore and near-shore strip along the Important Bird Area.

3.2 Site C

There are no constraints to development at Site C with regard to terrestrial ecology.

4. Prediction of impacts for the construction, operational and decommissioning phases

4.1 Site B

4.1.1 Interference with roosting, feeding and breeding activity of birds on Bird Island and along the shore and nearshore area

The proposed development:

i) could possibly kill or affect the roosting and breeding of birds on Bird Island;

ii) will exacerbate existing interference with the Important Bird Area along the shoreline and immediate upshore environment;

iii) by reducing the amount of bird activity in the area, will reduce the aesthetic beauty of this natural area that is part of the main gateway to Walvis Bay.

i) The power station poses three threats to the birds on Bird Island. Firstly, birds that rest and roost on the beach adjacent to Bird Island are unlikely to continue to do so if there is greater human and industrial activity within a few kilometers of it. This is not a highly significant impact, but would be one incremental increase in the human pressure experienced by these birds.
Secondly, there is the small but very significant risk of a pollution accident with potentially major impacts on this large concentration of birds. The example of an incident of pollution from fish oil, that killed thousands of Cape cormorants in the bay, is relevant here (Berry, 1976). The close proximity of Bird Island to the proposed power station allows little margin for error, yet industrial accidents or emergencies cannot be entirely ruled out.
Thirdly, noise created by the power station is expected to not have any impact on the birds, so long as the noise is relatively constant. This impact becomes significant if the noise includes sporadic sudden loud bangs or sirens. These may cause alarm among nesting birds so that they fly off and leave their nests for a short period, exposing the eggs and/or chicks to predation by gulls, skuas and pelicans. This could reduce the breeding success rate of the birds. The magnitude of the drop in birds achieving maturity as a result of this impact is impossible to quantify. The impact is negative but probably small. Sound-proofing the power station to reduce overall noise level is necessary. Noise mitigation should include eliminating the possibility of sudden, loud sounds audible within 4km of the power station.

ii) The power station will cause loss of the roosting and feeding sites along the stretch of coast adjacent to it, where water intake pipes will be situated. This poses problems for the birds, which could suffer compromised feeding opportunities and may abandon the foraging and roosting sites. Because development is or has already taken place on much of the coast between Walvis Bay and Swakopmund, this impact is an additional loss on top of the existing cumulative impacts of developments at Afrodite Beach, Langstrand and Langstrand Extension, Dolfynstrand and others. The cumulative impacts of these developments could compromise the performance of migratory species. Sudden loud noises emanating from the power station are likely to disturb these birds too.

The situation with respect to Damara terns is actually not a factor in the argument against siting the power station at Site B. Site B and the surrounding area immediately north of the present extent of Walvis Bay, is earmarked for future growth of the town's residential area. The Damara tern breeding area will be sacrificed to this development. Thus, by the same argument, the breeding area can be sacrificed for the proposed power station.

iii) The area around Site B has value for its intrinsic beauty as fairly natural desert alongside the sea as one approaches Walvis Bay along the main road. The reed patches, large *Salsola* hummocks and small *Trianthema* shrubs on the dunes give the area some natural greenery, enhancing the idea of remarkable plant life surviving in this barren, wind-blown place. Bird Island adds to the sense of place as an island of bird activity in harsh surroundings.

The proximity of Bird Island, the significance of this coastal strip as an Important Bird Area, and the aesthetic considerations are significant reasons why a large industrial development is unsuitable in this area. The significance of the impact is rated as MEDIUM (Table 6), although the possibility of impacts spreading to international populations of migrant birds would suggest that the significance is actually HIGH.

It is assumed that powerlines that run from the power station to link up with the national grid will run directly inland, away from the coast. In this case they are unlikely to exacerbate the interference described above, since they will not cross any major bird flight paths.

Table 6: Assessment for the impact of interference with roosting, feeding and breeding activity of birds on Bird Island and along the shore and nearshore area

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**National and international**	Within Namibia and possibly extending to the areas that the migrant waders migrate to, namely northern Eurasia
Magnitude of impact (at the indicated spatial scale)	**Low**	Natural functions and/ or processes are *slightly* altered
Duration of impact	**Long Term**	More than 10 years after construction.
SIGNIFICANCE	**DESCRIPTION**	
Medium	Low magnitude with an international extent and long term duration	
PROBABILITY	**DESCRIPTION**	
Probable	Estimated 5 to 95% chance of the impact occurring.	
CONFIDENCE	**DESCRIPTION**	
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.	
REVERSIBILITY	**DESCRIPTION**	
Irreversible	The activity will lead to an impact that is permanent, since construction of the power station will likely lead to other developments of a similar nature in the vicinity, which will have a lifespan longer than the power station.	

4.1.1.a Possibilities for mitigation

There are various aspects of this impact, some of which can be mitigated.

- Greater levels of human activity at or near the beach adjacent to Bird Island can be prevented by marking the area as an Important Bird Area and specifically limiting access for people and vehicles.
- The chance of a pollution accident is small but cannot be entirely ruled out.
- It will not be possible to eliminate sudden noises during construction. In the operational phase, it should be possible to eliminate sudden noises and sirens occurring.
- The presence of the power station will reduce the extent of the Important Bird Area along the shore and nearshore strip. This cannot be mitigated.
- The incremental reduction of bird life in the area, as one component of the aesthetic beauty of this gateway to Walvis Bay, may be mitigated to a certain extent. This will depend on how conscientiously the commitment to reduce interference with birds is applied.

These mitigatory actions do not reduce the extent, magnitude or duration of the impact, and its significance remains medium. The probability and reversibility are also not changed by mitigation.

Table 7: Summary of impact of interference to birds, before and after mitigation.

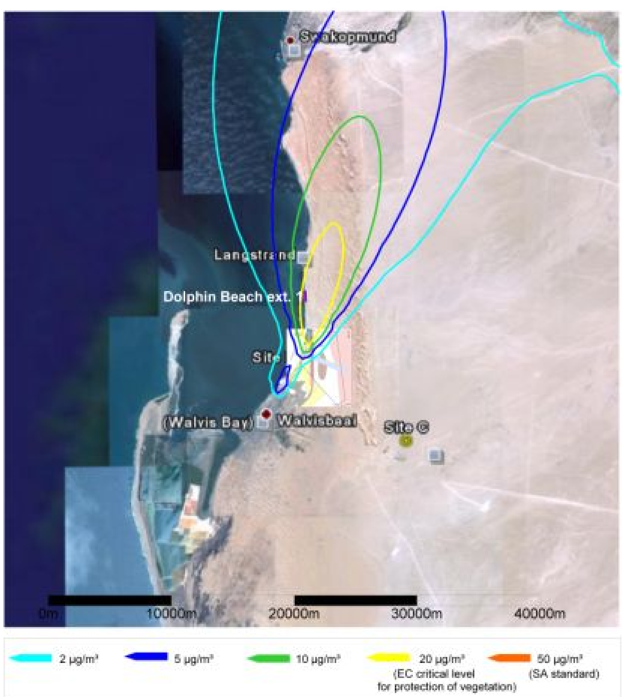
	Interference with roosting, feeding and breeding activity of birds on Bird Island and along the shore and nearshore area	
SITE B		
	Before mitigation	**After Mitigation**
Extent	National and international	National and international
Magnitude	Low	Low
Duration	Long term	Long term
SIGNIFICANCE	**Medium**	**Medium**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible

4.1.2 Impact of high SO_2 emissions on plants and animals

Emissions from the power station are expected to be relatively high in SO_2. The extent to which this gas will be dispersed by wind and in fog has been modeled in the Air Quality component of this ESEIA (eg Figure 2 this report). However, its potential to form 'acid fog' is very poorly known. No figures are available in the scientific literature to show the threshold levels of SO_2 that cause damage to fog-dependent invertebrates. Threshold SO_2 levels for human health are a prime determinant in the social component of this ESEIA. While the SO_2 level is therefore not expected to be dangerously high for human health, its impact on invertebrates may be considerably higher since these animals obtain all their moisture requirements from fog. Consequently, there may be a local impact on these animals' survival and reproduction. Similarly, certain Namib dune plants (found in this area) rely on fog water for growth and maintenance, and it is absorbed directly through leaves (as in *Trianthema* in the dunes, and *Arthraerua* on the plains) or more conventionally through roots, which are superficial so as to benefit from shallow wetting of the soil surface. The impacts on these organisms are not known. The impact of acid fog on lichens has been shown to be severe in other parts of the world (eg Sullivan 2006). Even if the impacts on fog-dependent plants and animals are equally severe, they can be expected to be fairly localized, depending on the plume of dispersion from the smoke stacks.

Figure 2. Modelled annual scenarios for SO_2 plumes arising from a power station at Site B South with a 200m high smoke stack, using coal with 1.9% Sulphur content. Fig 2a shows plumes from a 400MW power station, Figure 2b from a 800 MW one.

2a) Site B South
Annual average
200m
400MW
1.9% S



2b) Site B South
Annual average
200m
800MW
1.9% S

The extent of the 20 µg/m³ limit (Figure 2, yellow line, which marks the EC critical level for vegetation) is very limited for the 400MW power station, and much greater for the 800MW. In the latter case, it extends about 10km downwind of the predominant winds. For the sake of this assessment, we will assume a worst case scenario in which all plants and invertebrates within this 10km-long plume would be killed by ingestion of acid fog. The impact would be loss of plant and animal life, and of most ecological functioning, within the impacted area. None of the affected species are restricted in range or carry high conservation status. Additionally, the plants would look yellowed and unhealthy, detracting from the natural beauty of this dune landscape. The impact would be localized, and it would be in an area where ecological functioning is, in any case, very slow and low level. This worst case scenario is rated as MEDIUM significance (Table 8).

It is possible that the scenario will not be as severe as the worst case. In this case, plants and inverts might be only mildly affected, and their survival and reproduction not badly compromised. The true impact of acid fog on the fog-dependent fauna and flora requires further study. Monitoring of these aspects is strongly recommended, for the purpose of good environmental management of the power plant, and for improving scientific understanding of acid fog.

Table 8: Assessment of the impact of high SO_2 emissions, causing acid fog and possible death of plants and invertebrates.

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**Local**	Limited to a radius of 10km from the site, depending on the plume of dispersion.
Magnitude of impact (at the indicated spatial scale)	**High**	Natural functions and/ or processes are *severely* altered
Duration of impact	**Medium Term**	During the operational phase only
SIGNIFICANCE	**DESCRIPTION**	
Medium	High magnitude with a local extent and medium term duration	
PROBABILITY	**DESCRIPTION**	
Probable	Estimated 5 to 95% chance of the impact occurring.	
CONFIDENCE	**DESCRIPTION**	
Unsure	Limited amount of information on and relatively poor understanding of the environmental factors potentially influencing the impact.	
REVERSIBILITY	**DESCRIPTION**	

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**Local**	Limited to a radius of 10km from the site, depending on the plume of dispersion.
Magnitude of impact (at the indicated spatial scale)	**High**	Natural functions and/ or processes are *severely* altered
Duration of impact	**Medium Term**	During the operational phase only
Reversible	The impact will last only as long as acid fog is created. Repopulation of the areas will occur when the source of acid fog is removed.	

4.1.2.a Possibility of mitigation

Mitigation is expected to be possible through technologies that strip the SO_2 from the emissions The impact after mitigation depends on the efficiency with which reduction of SO_2 is achieved. Thus no prediction of the impacts after mitigation can be made until this is known.

Table 9: Summary of impact of SO_2 emissions on plants and animals at Site B.

	Impact of SO_2 emissions on plants ad animals	
SITE B		
	Before mitigation	**After Mitigation**
Extent	Local	
Magnitude	High	
Duration	Medium term	
SIGNIFICANCE	**Medium**	**Not possible to predict**
Probability	Probable	
Confidence	Unsure	
Reversibility	Reversible	Reversible

4.1.3 Impact of dispersal of fly ash en route to Site C

Fly ash will have to be transported from Site B to a 70 ha repository area at Site C. So long as the transport follows existing routes, and the material is covered to prevent loss and dispersal during transport, the conveyor / road / rail route for this material will not significantly add to the existing impacts of these routes.

Impact of disposal of fly ash at Site C is described in Section 4.2.1.

4.2 Site C

4.2.1 Impact of fly ash on vegetation and lichen fields

The quantity of fly ash that will be generated over the lifespan of the power station is significantly large, and dispersal of this dusty, toxic material by the strong winds that the coast experiences can be expected. This will be visually unattractive and possibly pose a health hazard if there is accumulation of the material in areas frequented by people or if there is seepage of water through these accumulations into groundwater. These problems will persist after decommissioning of the power plant. Fly ash concentrates inorganic non-combustible elements such as heavy- and trace-metals e.g. copper, lead, zinc, cadmium, arsenic and mercury (Carey et al, 2006; Dahl et al, 2008). Its impact on plants and lichen is unknown, but it could possibly be negative if it settles and partly smothers leaves or thalli (the leaf-like part of lichens) in the same manner as dust pollution, or if toxic constituents are mobilized when the material is saturated by fog.

It is important that the power plant does not leave a legacy of pollution after its closure, particularly one that could potentially contaminate groundwater sources.

Table 10: Assessment of the impact of fly ash on plants and lichens.

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**Local**	Estimate up to about 10 km when carried by wind
Magnitude of impact (at the indicated spatial scale)	**Medium**	Natural functions and/ or processes may be notably altered
Duration of impact	**Long Term**	For the duration of the plant's operation as the stockpile grows, and for as long as the stockpile remains.
SIGNIFICANCE	**DESCRIPTION**	
Medium	Medium magnitude with local extent and long term duration	
PROBABILITY	**DESCRIPTION**	
Probable	Dispersal by winds is certain; a negative effect on plants and lichens is probable; contamination of groundwater is probable.	
CONFIDENCE	**DESCRIPTION**	
Unsure	Need more information on the toxic constituents of the fly ash, their effects on plants and lichens, and their likelihood of being mobilized into the groundwater, to give a more confident prediction of the impacts.	
REVERSIBILITY	**DESCRIPTION**	
Irreversible	The impact will last as long as the stockpile remains, and may be irreversible if the dispersion of the ash makes it impossible to clear it up later, or if seepage into groundwater reserves occurs.	

4.2.1.a Possibility for mitigation

Transport of the fly ash to less windy locations will be costly and is unlikely to resolve the issue of contamination arising from its toxic constituents.

A method to compress or consolidate the material into solid blocks has been suggested. This option should be considered in greater depth. Full removal of the risk of dispersal and contamination is likely to be possible by this or other methods.

Table 11: Summary of impact of fly ash disposal before and after mitigation.

	Impact of SO_2 emissions on plants ad animals	
SITE B		
	Before mitigation	**After Mitigation**
Extent	Local	No impact if effectively sealed or removed
Magnitude	Medium	Zero
Duration	Long term	None
SIGNIFICANCE	**Medium**	**Neutral**
Probability	Probable	
Confidence	Unsure	
Reversibility	Irreversible	

4.2.2 Impact of high SO_2 emissions on lichens, plants and animals

Impacts of high SO_2 emissions at Site C are similar to those at Site B. The difference here is that Site C is closer to lichen fields on the gravel plains about 5km to the east. However the uncertainty over the level of emission of SO_2 and its potential to form acid fog still hinders this assessment, forcing a precautionary approach using the worst-case scenario as a guide (Table 12)

4.2.2.a Possibility of mitigation

As for this impact at Site B, mitigation by implementation of Flue Gas Desulphurisation is strongly recommended. No prediction of the impacts after mitigation can be made until the efficiency of removing SO_2 from the emissions is known.

Table 12: Summary of impact of SO_2 emissions on lichens, plants and animals at Site C.

	Impact of SO_2 emissions on lichens, plants ad animals	
SITE B		
	Before mitigation	**After Mitigation**
Extent	Local	
Magnitude	High	
Duration	Medium term	
SIGNIFICANCE	**Medium**	**Not possible to predict**
Probability	Probable	
Confidence	Unsure	
Reversibility	Reversible	Reversible

4.2.3 Additional impacts that are of little or no significance at Site C

Footprint impacts at Site C are of low significance, as the area is recognized as being suitable for industrial development.

Powerline bird-strike impacts are likely to happen infrequently as this area is away from areas of significant bird traffic. Assuming that the powerlines coming out of the power station go inland or parallel to the coast rather than towards it, bird-strike incidents are likely to be low. Standard mitigatory measures that are practiced to prevent bird strikes, such as making wires more visible and placing anti-perching obstacles on the pylons, are recommended.

5. Environmental Management Plan for mitigation of negative impacts

5.1 Site B

5.1.1 Reduce interference with sea- and shore-birds

Wherever possible, interference with sea- and shore-birds in the vicinity of Site B should be reduced. This can be done by the following:

- Prevent access to the beach close to Bird Island, to allow birds to use this area for roosting and resting without interference. A 2km strip adjacent to Bird Island should be declared out of bounds.
- For construction of the water inlet and outlet pipes into the ocean: reduce working time on the beach and near-shore environment as much as possible. This work should preferably be scheduled for the March – September period, when inter-contintental migrant birds are not present. Once installed, human activity around them should be kept to a minimum.
- Apply strict operational and safety measures to prevent occurrence of industrial accidents.
- Implement strict noise prevention and noise reduction measures in the operating plans for the power station. In particular, prevent sudden loud noises.
- Enforce a policy of strict hygiene and litter prevention on and around the power station site and its associated facilities, so that rodents, cats and dogs are not attracted to the area. When such animals are present, they prey on wild animals in the vicinity.

5.1.2 Reduce possibilities of acid fog

In view of the lack of knowledge on how acid fog will affect fog-dependant plants and animals, the precautionary approach suggests that all possibilities for reducing SO2 from the emissions should be applied.

5.1.3 Reduce dispersal of fly ash en route to Site C

Implement measures in the transport of fly ash to the repository area at Site C so that this material is not blown around and dispersed en route.

5.2 Site C

5.2.1 Find methods to permanently contain fly ash and prevent it contaminating the surroundings

While the threats posed by fly ash are not clear, the potential for pollution should be minimized by finding methods to permanently contain this waste and prevent it from threatening groundwater sources.

5.2.2 Reduce possibilities of acid fog

In view of the lack of knowledge on how acid fog will affect fog-dependant plants and animals, the precautionary approach suggests that all possibilities for reducing SO2 from the emissions should be applied.

6. Recommended additional information and specialist inputs

The expected level of SO_2 emission has not been specified, and the potential for this level of SO_2 to form acid fog in typical Walvis Bay conditions is not known. These aspects are vital for an understanding of the risk of acid fog from the power station.

Once the likely chemical situation is specified, the impact on lichens, plants and animals, particularly fog-dependent invertebrates, to this level of acid fog should be assessed and monitored on an ongoing basis This will require specialist input from a lichen expert and from experts on Namib plant and invertebrate life.

The levels of heavy- and trace-metals in the fly ash need to be specified.

Once the expected heavy- and trace-metals are known, their impact on lichens and plants should be assessed. Closely associated with this, the potential for heavy- and trace-metals to be mobilized when saturated by fog or rain should be investigated.

The work on heavy- and trace-metals could be avoided by finding an alterative method for disposal of the fly ash. It is possible that the information on levels of potential contaminants is irrelevant if a safe method of disposal, which carries no risk of contamination, is identified.

References

Anon. 1998. Integrated coastal zone management of Erongo Region.

Berry, H.H. 1976. Mass mortality of Cape Cormorants, caused by fish oil, in the Walvis Bay region of South West Africa. Madoqua 9: 57-62.

Braby, R. 2008. Director of the Namibian Coastal Management (Nacoma) Project. Personal communication regarding Damara terns.

Carey, A., Harrold, Z., Darrah, T. & Poreda, R. 2006. The effect of coal-fired power plant emissions and fly ash on a regional watershed. Geological Society of America Abstracts with Programs 38(7): 95.

Clayton, M. & Avafie, T. 2002. Management and monitoring plan for the dune belt between Swakopmund and Walvis Bay.

Dahl, O., Poykio, R. & Nurmesniemi, H. 2008. Concentrations of heavy metals in fly ash from a coal-fired power plant with respect to the new Finnish limit values. Journal of Material Cycles and Waste Management 10 (1): 87-92.

EnviroSolutions. 2005. Coastline strategic environmental assessment. Municipality of Walvis Bay.

Griffin, M. 2005. Checklist and provisional national conservation status of amphibians, reptiles and mammals known, reported or expected to occur in Namibia. Ministry of Environment and Tourism.

Harrison, J et al. 1994. Bird atlas of southern Africa.

Hockey, P. 2005. Assessment of the coast south of Dolphin Beach as a bird habitat, with reference to the proposed ‘Eco-village’ Development. Unpublished internal report held by Coastal Enviromental Trust of Namibia.

International Finance Corporation. 2008. Environmental, health and safety guidelines for thermal power plants. World Bank Group.

SAIEA. 2008. Draft Management and Development Plan for the Central Area of the Namib Skeleton Coast National Park. Unpublished internal report to Nacoma (Namibian Coastal Management) Project.

Schultz, C. 2003. Lichen communities of the Central Namib Desert. Unpublished M.Sc thesis.

Seely, M. & Pallett, J. 2008. Namib – secrets of a desert uncovered. Venture Publications, Windhoek.

Simmons, R.E. & Brown, C.J. 2006. Birds to watch in Namibia: red, rare and endemic species. Namibia Biodiversity Programme, Windhoek, Namibia

Sullivan, M. 2006. Recovery strategy for the boreal felt lichen (*Erioderma pedicellatum*) in New Brunswick. Internal report, Fish and Wildlife Branch, Department of Natural Resources, New Brunswick.

Walvis Bay Municipality. 2008. Biodiversity report for the Municipality of Walvis Bay.

Wearne, K. & Underhill, L.G. 2005. Walvis Bay, Namibia: a key wetland for waders and other coastal birds in southern Africa. Wader Study Group Bulletin 107: 24-30.