Volwaterbaai Desalination Plant and Associated Infrastructure, Northern Cape

Environmental Impact Assessment Report

Volume I

Report Prepared for

Sedex Desalination (Pty) Ltd

Report Number 451101/03

NCDENC Reference Numbers: NC/EIA/07/NAM/KAM/KOT1/2013

NCP/EIA/0000225/2013

DEA: O&C CWDP Reference Number: 2014/017/NC/Volwaterbaai Desalination Plant

Report Prepared by

srk consulting

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EXECUTIVE SUMMARY: ENVIRONMENTAL IMPACT ASSESSMENT REPORT VOLWATERBAAI DESALINATION PLANT AND ASSOCIATED INFRASTRUCTURE, NORTHERN CAPE

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1 INTRODUCTION

Sedex Minerals (Pty) Ltd (Sedex Minerals) proposes to develop the Zandkopsdrift Rare Earth Element mine on the remainder of Farm Zandkopsdrift 537, and portion 2 of Zandkopsdrift 537 in the Northern Cape Province. The development of the mine is subject to a separate Environmental Impact Assessment (EIA) process (NCDENC Ref: NC/EIA/NAM/KAM/ZAN/2012).

Due to the shortage of water resources in the area, Sedex Desalination (Pty) Ltd (Sedex Desalination), a subsidiary of Sedex Minerals, was established to develop a 8 million m^3/annum seawater desalination plant to provide water for the mine.

The desalination plant will be located at Volwaterbaai on Farm Strandfontein 559, on the west coast of the Northern Cape Province. From there, water will be pumped via pipeline to the mine, with a reservoir at Kotzesrus.

The pipeline as well as overhead power lines and an access road servicing the plant will follow a combination of 4 x 4 tracks and dirt roads between the desalination plant and the Zandkopsdrift Mine. Two alternative routes were identified for assessment: the *Kotzesrus Route* (passing though Kotzesrus) and the *Amended Bypass Route* (the preferred alternative, bypassing Kotzesrus to the north) (see Figure 1).

SRK Consulting (South Africa) Pty Ltd (SRK) was appointed by Sedex Desalination to undertake the Scoping and Environmental Impact Reporting (S&EIR, also referred to as EIA) process in terms of the National Environmental Management Act 107 of 1998, as amended (NEMA).

See page 10 for details on how you can participate in the process.

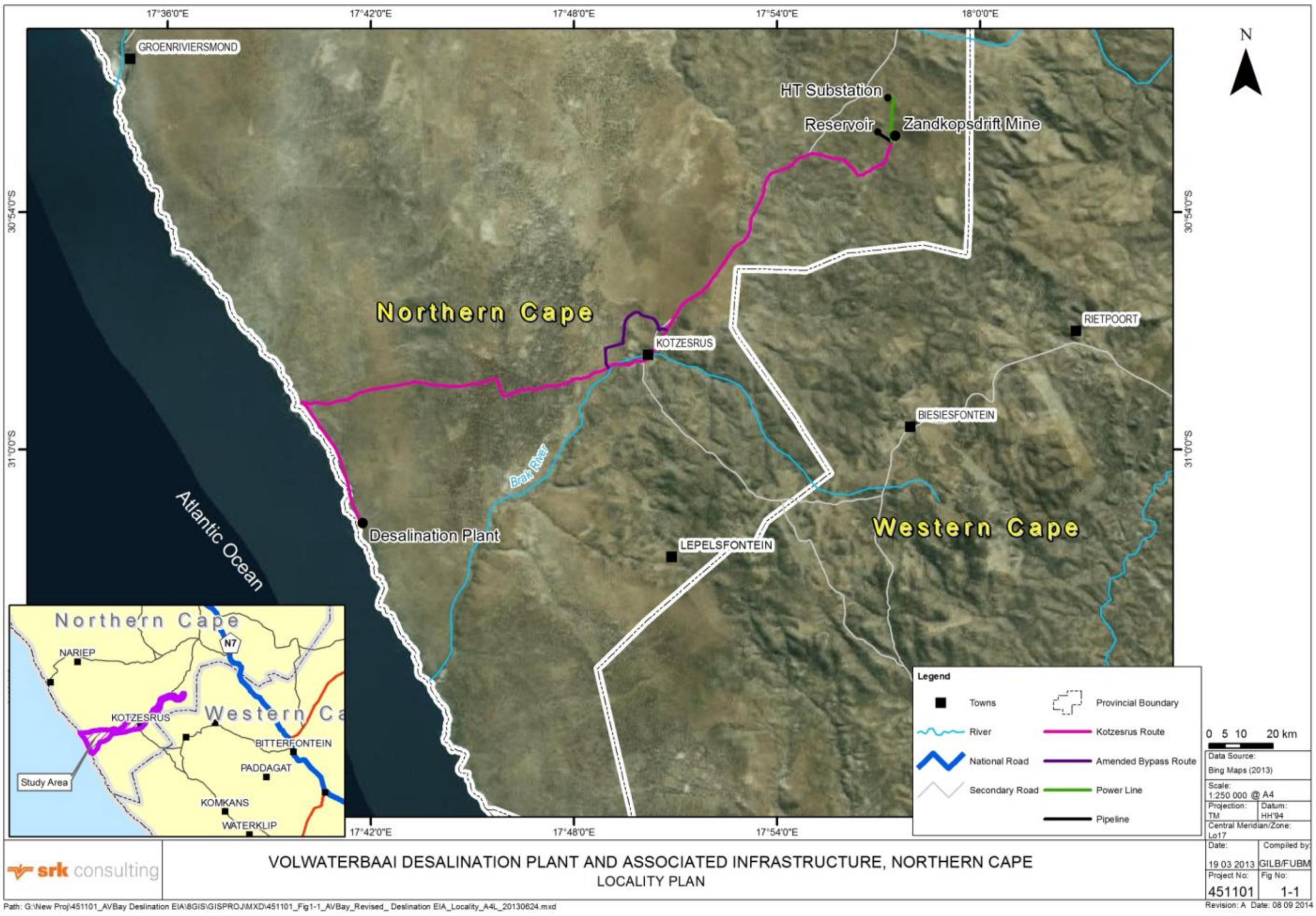

Figure 1: Locality Plan

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2 GOVERNANCE FRAMEWORK

Sections 24 and 44 of NEMA make provision for the identification of activities which may not commence without an Environmental Authorisation (EA), and stipulate the requirements for the assessment of such activities. The EIA Regulations, 2010 are contained in four Government Notices (GN) issued in terms of NEMA. GN R543 sets out two alternative procedures for authorisation processes: depending on the type of activity that is proposed, either a Basic Assessment (BA) process or a S&EIR process is required to apply for EA from the competent authority – in this case the Northern Cape Department of Environment and Nature Conservation (NCDENC).

SRK has determined that the proposed desalination plant and associated infrastructure trigger activities listed in terms of GN R544, GN R545 and GN R546 of the EIA Regulations, 2010 (Table 1).

Table 1: Listed activities triggered by the project

No	Description
GN R544 (requiring BA)	
9	The construction of infrastructure longer than 1 000 m for the bulk transportation of water.
11	The construction of 50 m^2 of infrastructure or structures within a watercourse or within 32 m of a watercourse.
14	The construction of structures bigger than 50 m^2 in the coastal public property.
15	The construction of facilities for the desalination of sea water with a design capacity to produce more than 100 m^3 of treated water per day.
16	Construction or earth moving activities in the sea, or within the littoral active zone or a distance of 100 m inland of the High Water Mark (HWM).
17	The planting of vegetation or placing of any material on dunes and exposed sand surfaces, within the littoral active zone for the purpose of preventing the free movement of sand, erosion or accretion.
18	The infilling or depositing of more than 5 m^3 of any material into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from a watercourse, the sea, the seashore, the littoral active zone, or 100 m inland of the HWM.
22	The construction of a road, outside urban areas, with a reserve wider than 13.5 m.
23	The transformation of undeveloped land to industrial use, outside an urban area and where the total area to be transformed is bigger than 1 ha but less than 20 ha.
37	The expansion of infrastructure for the bulk transportation of water.
39	The expansion of bridges, within a watercourse or within 32 metres of a watercourse.
47	The widening of a road by more than 6 m, or the lengthening of a road by more than 1 km where the existing reserve is wider than 13.5 m.
GN R545 (requiring S&EIR)	
5	The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent.
14	The construction of an island, anchored platform or any other permanent structure on or along the sea bed.
GN R546 (requiring BA in the sensitive areas)	
2	The construction of reservoirs for bulk water supply with a capacity of more than 250 m^3.
4	The construction of a road wider than 4 m.
12	The clearance of an area of 300 m^2 or more of vegetation where 75% or more constitutes indigenous vegetation within a Critical Biodiversity Area (CBA) or within 100m inland from the HWM.
13	The clearance of an area of 1 ha or more of vegetation where 75% or more constitutes indigenous vegetation within CBAs and within 1km of the HWM.
14	The clearance of an area of 5 ha or more of vegetation where 75% or more constitutes indigenous vegetation in all areas outside urban areas in the Northern Cape.
16	The construction of buildings with a footprint exceeding 10 m^2 in size; or infrastructure covering 10 m^2 or more, where such construction occurs within a watercourse or within 32 m of a watercourse.
19	The widening of a road by more than 4 m, or the lengthening of a road by more than 1 km.
24	The expansion of infrastructure by 10 m^2 or more within a watercourse or within 32 m of a watercourse.

Consequently, the proponent is obliged to apply for EA for the project. Since activities listed under Regulation GN R545 apply to the project, an S&EIR process is required.

A Water Use Authorisation in terms of Section 21 of the National Water Act 36 of 1998 (NWA) will be required from the Department of Water Affairs. Water use activities applicable to the project are listed in Table 2.

Table 2: Activities requiring a Water Use Licence

No	Description
c	Impeding or diverting the flow of water in a watercourse.
i	Altering the bed, banks, course or characteristics of a watercourse.

A Coastal Waters Discharge Permit is also required from the Department of Environmental Affairs in terms of the NEM: Integrated Coastal Management Act 24 of 2008 for the discharge of effluent to the sea. Additional permits may be required for the development of infrastructure in the coastal zone.

3 ENVIRONMENTAL PROCESS

The EIA Regulations, 2010 define the detailed approach to the S&EIR process, which consists of two phases: the Scoping Phase (completed in April 2014) and the Impact Assessment Phase (the current phase) (see Figure 2).

The Scoping Phase was completed in March 2014 and the Final Scoping Report was accepted by the NCDENC on 16 April 2014. The Impact Assessment Phase is being undertaken in accordance with the Plan of Study for EIA, included in the Scoping Report accepted by the NCDENC.

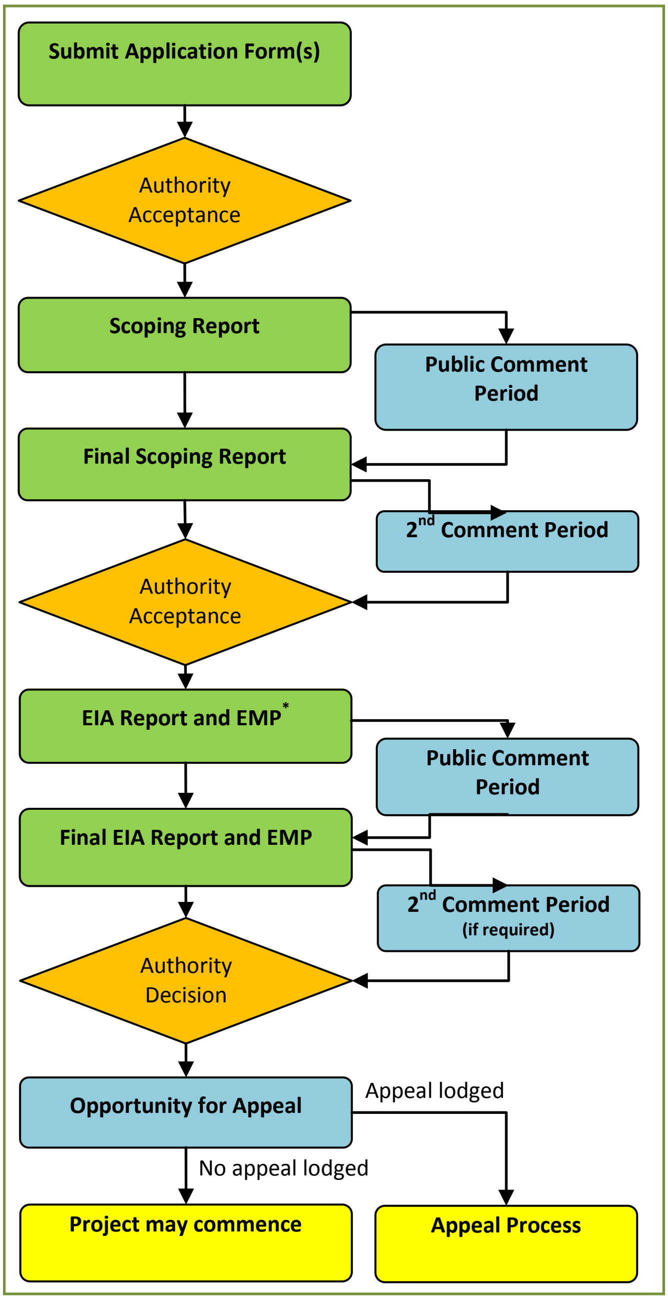

Figure 2: S&EIR Process

***Note:** EMP = Environmental Management Programme*

The key objectives of the EIA are to:

- Inform Interested and Affected Parties (IAPs) about the proposed Project and the EIA process followed;
- Obtain comments from IAPs (including the relevant authorities and the public) and ensure that all issues, concerns and queries raised are fully documented and addressed in the EIA Report;
- Identify and assess potential significant impacts associated with the proposed development;
- Formulate mitigation measures to avoid and/or minimise impacts and enhance benefits of the Project; and
- Produce a Final EIA Report which will provide all the necessary information for the NCDENC to decide whether (and under what conditions) to authorise the proposed Project.

4 DESCRIPTION OF THE SITE AND ENVIRONMENT

The site is located in Namaqualand, known for its unique, isolated arid environment. The desalination plant will be constructed at Volwaterbaai, approximately 15km west of the town of Kotzesrus and will be located on a typical stretch of the Namaqualand coastline, comprising rocky coastal outcrops interspersed with sandy beaches.

From the desalination plant, water supply pipelines, overhead power lines and an access road servicing the plant (linear infrastructure) will be routed along a combination of 4 x 4 tracks and dirt roads to the Zandkopsdrift Mine, a distance of approximately 42km. The route will pass through, or in close proximity to Kotzesrus (depending on the selected route alternative).

Figure 3: The Namaqua Coastline near Volwaterbaai

The surrounding area is mostly used for agricultural purposes (sheep grazing). A number of small settlements are located in the vicinity, including Kotzesrus, Lepelsfontein, Stofkraal, Rietpoort, Molsvlei and Garies.

According to the Namakwa Bioregional Plan, the project infrastructure traverses terrestrial and aquatic CBAs and Ecological Support Areas.

Although a water scarce semi-arid region, the Brak River, tributaries to the Brak and Groen Rivers and some wetland features (mostly considered to be in a *moderately modified condition)* occur in the project area.

The vegetation in the study area falls within the *Central Namaqualand Coast* region (which is listed as a *geographic priority area* by the Succulent Karoo Ecosystem Programme) and the *Succulent Karoo Region of Endemism (*which is listed as a *biodiversity priority area* according to the National Spatial Biodiversity Assessment). However, the study area does not fall within the remaining extent of any threatened ecosystem and the vegetation in the area is listed as *Least Threatened*.

Quartzite and clay exposure areas which are known to provide the habitat to support species of conservation concern (SCC) (and thus considered particularly sensitive) occur along 950m of the existing road, north east of Kotzesrus.

Figure 4: Natural Vegetation in the Vicinity of Kotzesrus

The Kamiesberg Local Municipality, in which the site is located had a population of 10 187 in 2011, having declined by approximately 5% between 2001 and 2011, due to out-migration associated with a lack of economic opportunities. The Municipality is characterised by high levels of unemployment, low education levels and a resultant high incidence of poverty.

5 PROJECT AND PROCESS DESCRIPTION

5.1 Project Infrastructure

The project will include the following:

- **Marine infrastructure**, comprising a seawater intake below the High Water Mark (HWM) of the sea and brine discharge works below the low water mark, both situated in existing gulleys. Underground pipelines to the desalination plant would traverse the intertidal zone;
- **Desalination plant**, situated close to the coast, with a footprint of 15 000 m^2. The plant building and surrounding infrastructure will be designed to reduce visual impacts;
- **Bulk water supply and storage infrastructure**, including pipelines, situated approximate 15cm above ground, along the road to the mine, pump stations at the desalination plant and along the pipeline and reservoirs at the desalination plant and at Kotzesrus;
- **Overhead power lines**, fed directly from Zandkopsdrift mine to supply the desalination plant with electricity. Power lines will follow the route of the roads; and
- **Roads** (approximately 42km in length) to provide access from the mine to the desalination plant, transfer pipeline and power lines. The gravel road would be 4m wide with a 15m servitude.

5.2 Desalination Process

Desalination refers to a water treatment process whereby salts are removed from saline water to produce fresh water. The proposed desalination process will make use of Reverse Osmosis (RO) technology to remove salt from sea water, thereby producing fresh product water as well as high salinity brine.

The main elements in the desalination process are:

- **Seawater intake** of approximately 55 000 m^3/day, over a time period of 24 hours;
- **Pre-treatment of feedwater**, which would include screening and filtration to remove suspended solids;
- **Desalination**, making use of RO technology, in which pressurised feedwater passes through a series of membranes which allow only water (low saline permeate) to pass through and salts and organic matter to accumulate in brine;
- **Post-treatment** (remineralisation and disinfection) of process water; and
- **Discharge of brine** (and sludge) from the desalination process into the sea.

The desalination plant will produce approximately 8 million m^3/annum of mineralised fresh water which requires approximately 55 000 m^3/day of seawater to be extracted. Of the approximately 55 000 m^3/day of the sea water passing through the desalination plant, on average 60% will be returned to the sea as brine from the plant. Brine has higher salinity and a slightly increased temperature compared to the incoming feedwater. Brine may also contain small amounts of chemicals used on cleaning of the plant and preservation of the membranes.

6 ALTERNATIVES

The EIA Regulations, 2010, require that all S&EIR processes must identify and describe feasible and reasonable alternatives. Numerous alternatives were identified and considered during the early feasibility and design phases of the project, including:

- **Alternative water sources** to meet the requirements of the Zandkopsdrift Mine, of which the desalination of seawater was considered the only feasible option;
- **Seawater intake technology alternatives**, of which an open water intake was considered the only feasible alternative;
- Twenty six (26) potential **seawater intake location alternatives** along a 28 km stretch of the coastline between Island Point and south of the Brak River mouth, of which the shallow narrow gully at Volwaterbaai was considered the only feasible alternative;
- **Brine disposal alternatives,** of which brine discharge to sea was considered the only feasible alternative;
- **Surf zone vs offshore disposal of brine**, of which surf zone discharge was considered to be the only feasible alternative;
- **Surf zone discharge location alternatives** at Volwaterbaai, of which the proposed site allowing for discharge within an existing gully, close to the gully inlet was identified as the only feasible alternative;
- **Alternative positions for the desalination plant** close to the selected seawater intake and brine discharge sites. The five potential positions (all within a single envelope) were assessment in the EIA;

- Approximately 10 **alternative routes for the linear infrastructure** were considered and evaluated in an extensive screening process. The Kotzesrus Route and two potential routes bypassing the town of Kotzesrus (Bypass Route and Alternative Bypass Route) were identified for assessment in the Scoping report. The two bypass alternatives were later amalgamated into the *Amended Bypass Route* (comprising portions of the Bypass Route and the Alternative Bypass Route) considered most feasible for bypassing Kotzesrus. The *Kotzesrus Route* and the *Amended Bypass Route* are therefore the two feasible and reasonable alternatives that are comparatively assessed in the EIA;
- **Power supply alternatives**, of which grid power supplied by overhead line from the mine was the strongly preferred alternative;
- **Alternatives for discharge/disposal of waste** (other than brine) from the desalination process, of which blending with brine for discharge to the sea is the only feasible alternative;
- **Alternative chemicals** used in the desalination process and plant; and
- **Pipeline alternatives**, including a single large pipeline or multiple smaller pipelines, and their installation above ground (either on the surface or elevated) or below ground.

6.1 The No-Go Alternative

The No Go alternative is considered in the EIA in accordance with the requirements of the EIA Regulations, 2010. The No Go alternative entails no change to the status *quo*, in other words the proposed desalination plant site will remain vacant and no linear infrastructure will be built. Due to the lack of water in Namaqualand it is unlikely that the Zandkopsdrift Mine would be developed in this case.

7 STAKEHOLDER ENGAGEMENT

Stakeholder engagement is a key component of the S&EIR process and is being undertaken in accordance with the requirements of the EIA Regulations, 2010. The key stakeholder engagement activities during the Impact Assessment Phase are summarised in Table 3 below.

Relevant local, provincial and national authorities, conservation bodies, local forums and surrounding landowners and occupants have been directly notified of the S&EIR process and the release of the EIA Report for comment.

Table 3: Stakeholder Engagement during Impact Assessment Phase.

Activity	Date
Release EIA Report to registered IAPs for comment	24 October 2014
Comment period	24 October – 4 December 2014
Finalise EIA Report and release for second comment period (if required)	January – February 2015
Collate comments and submit Final EIA Report to NCDENC	March 2015

Key comments and concerns raised by stakeholders predominantly relate to:

- **Economic benefits** to the surrounding communities;
- **Nuisance and security impacts** on affected landowners and residents of Kotzesrus;
- Potential **visual and aesthetic impacts** of infrastructure through Kotzesrus;
- Status of the **existing road**;
- **Increase in traffic** and further deterioration of roads;
- Impacts on the s**ense of place and historic buildings** in Kotzesrus; and
- **Improved access to the coast** and the informal camping and recreation in the coastal zone.

8 ASSESSMENT OF POTENTIAL IMPACTS

Specialist studies were undertaken to investigate key potential direct, indirect and cumulative impacts, as follows:

- Terrestrial and Aquatic Ecology;
- Marine Modelling;
- Marine and Coastal Ecology;
- Heritage;
- Palaeontology; and
- Air Quality.

For all potentially significant impacts, the significance of the anticipated impact was rated without and with recommended mitigation measures. These impacts are presented in Table 4.

The significance of potential impacts of the proposed Project was determined in order to assist decision-makers. Relevant observations with regard to the overall impact ratings, assuming mitigation measures are effectively implemented, are:

- The predicted *air quality* impacts, mainly associated with the creation of dust and resulting nuisance effects, notably on the community of Kotzesrus are rated as *insignificant*. Surfacing the road through Kotzesrus or making use of the *Amended Bypass Route* rather than the *Kotzesrus Route* would both further minimise this impact.
- The predicted *noise* impacts are rated as *very low* for the *Kotzesrus Route* and *insignificant* for the *Amended Bypass Route* during construction, and insignificant for either route during operations. Noise impacts associated with the desalination plant are insignificant due to the absence of sensitive receptors in the area.

- The predicted *traffic* impacts are rated as *insignificant* for either route alternative; however the impact on the Kotzesrus community will be marginally lower for the *Amended Bypass Route*.
- The predicted impacts on *aquatic ecology* are rated as *low* for either route alternative; however the *Kotzesrus Route* crosses the Brak River and will have higher impacts on wetland function than the *Amended Bypass Route*.
- The predicted *botanical* impacts associated with the *Kotzesrus Route* are rated as *low*, and for the *Amended Bypass Route, very low*. Within the extremely sensitive quartzite and clay exposure areas, it is assumed that the disturbance footprint will be minimised to prevent loss of individuals of *Bulbine bruynsii,* reducing the potentially very high significance impact to *low*. Botanical impacts at the desalination plant site are also rated as *low*. During operations, botanical impacts will be *insignificant*.
- The predicted impacts on *fauna* are generally rated as *low* to *very low*, with reduced impacts for the *Amended Bypass Route*, and construction of the desalination plant to the *east of the coastal road* (i.e. desalination plant positions A, C or D). Impacts for positions B and E are rated as *low*. The impact of the barrier to faunal migration created by the pipeline is however rated as *medium*.
- The predicted impacts on *marine ecology* are generally rated as *very low* during construction, and *low* during operation, since the position of the brine discharge outfall in a high energy surf zone, together with the design of the discharge infrastructure will expedite adequate mixing of the high salinity brine within a relatively short time and confined footprint.
- The predicted *socio-economic benefits* are rated as *very low* during construction and *low* during operation (although marginally lower for the *Amended Bypass Route* which would divert traffic around Kotzesrus, limiting benefits to businesses). Adverse socio-economic impacts are negligible.
- The predicted *heritage* impacts are rated as *very low*, but slightly elevated (to *low*) at the desalination plant.
- The predicted *visual* impact is rated as *low* for the *Kotzesrus Route* and coastal infrastructure, and is rated as *very low* for the *Amended Bypass Route*.

Cumulative impacts in the region may derive from existing agricultural activities and the proposed development of the Zandkopsdrift Mine and associated infrastructure. Cumulative biophysical impacts are of relatively low significance given the very limited scale of existing and planned development and associated anthropogenic activity in the area. Cumulative socio-economic benefits are considered more significant. The contribution of the Volwaterbaai Desalination Plant Project to cumulative impacts is relatively limited at a regional scale.

Table 4 below summarises:

- The impacts assessed in the EIA;
- Their significance before and following the implementation of essential mitigation measures; and
- The key mitigation measures on which the significance rating is based (where applicable).

Impact Significance Ratings Legend:

Rating	+ve	-ve
Insignificant	I	I
Very Low	VL	VL
Low	L	L
Medium	M	M
High	H	H
Very High	VH	VH

Where applicable, the preferred alternatives is indicated in bold text.

Table 4: Summary of Impacts

Impact	Significance rating Without	Significance rating With	Key mitigation/optimisation measures
CONSTRUCTION PHASE IMPACTS			
Changes in air quality due to project related emissions	I	I	• Maintain all vehicles and equipment in good working order; • Avoid clearing of vegetation until absolutely necessary; • Stabilise exposed surfaces as soon as practically possible; • Avoid excavation and handling and transport of materials which may generate dust; • Limit construction vehicle speeds to 40 km/hr on gravel roads, 30 km/h on the gravel road though Kotzesrus and 20 km/h on unconsolidated and non-vegetated areas; and • Apply dust suppression measures where required.
Increased noise and vibration	*Kotzesrus Route*: L ***Amended Bypass Route***: I	*Kotzesrus Route*: VL ***Amended Bypass Route***: I	• Limit noisy construction activities to daylight hours from Monday to Saturday; • Comply with the applicable municipal and / or industry noise regulations; • Notify adjacent residents or business premises before particularly noisy activities; • Maintain all vehicles and equipment in good working order; • Restrict the use of radios, televisions etc by workers; • Enclose diesel generators used on site for power supply; and • Investigate potential noise reduction measures if complaints are received.
Impact of project related traffic on existing road users	*Kotzesrus Route*: VL ***Amended Bypass Route***	*Kotzesrus Route*: I ***Amended Bypass Route***	• Use appropriate signage to warn other road users of construction activities on roads; • Maintain and repair roads damaged by construction vehicles; • Ensure that drivers of construction vehicles comply with the rules of the road; • Implement the necessary measures to maintain roads and road surface integrity; • Ensure that vehicle axle loads do not exceed the road design capacity of roads; and

Impact	Significance rating Without	Significance rating With	Key mitigation/optimisation measures
	VL	I	• Limit the speed of construction vehicles to 30 km/h through towns.
Loss of Wetland Habitat and Ecological Structure	*Kotzesrus Route*		• Demarcate all sensitive wetland zones as no-go areas; • Align pipelines and power lines to cross wetlands and drainage features, perpendicularly to limit the area of disturbance within the feature; • Install pipelines and power lines to span over drainage features and 32m buffer zone; • Permit only essential construction personnel within the wetland habitat; • Obtain the relevant approvals for activities within wetland areas; • Prevent potentially contaminated run-off from entering wetland habitats; • Incorporate adequate erosion and stormwater management measures in road design; • Upgrade inadequate bridges and culverts, where upgrades are required; • Rehabilitate all wetlands impacted by construction to re-instate wetland function.
	H	L	
	Amended Bypass Route		
	M	L	
Loss of Floral Habitat, Biodiversity and SCC	*Kotzesrus Route*		• Limit construction footprint and vegetation removal to what is absolutely essential; • Strictly control edge effects of construction activities; • Install pipelines and power lines above the ground on support structures (plinths); • Construct the pipeline in the road reserve, or as close as possible to the road edge; • Place all infrastructure outside of rocky outcrop areas as far as possible; • Compile and implement a detailed rescue and relocation plan for SCC; • Appoint a suitably experienced person to oversee the removal and relocation of SCC; • Obtain authorisation from NCDENC for plants to be disturbed, damaged or destroyed; • Remove alien species; ensure no additional impact due to the herbicide used; • Dispose of removed alien plant material at a registered waste disposal site; **In Quartzite and Clay Exposure Areas:** • Demarcate construction footprint and prevent disturbance outside the area; • Locate power lines and pipelines to the west of the existing road; • Install pipes by crane from the road edge, to minimise disturbance; • Cordon off individuals of Bulbine bruynsii in the construction footprint, with a 2 m buffer. Position support structures to avoid cordoned off areas; • Translocate affected individuals of Bulbine bruynsii if disturbance is likely; • Identify plinth positions in months when Bulbine bruynsii plants are visible; • Undertake excavations for power line and pipeline support structures manually; • Limit the number of construction personnel allowed into the sensitive habitat areas; • Submit method statements for review by a suitably qualified ecologist; • Appoint an Environmental Control Officer (ECO) to supervise construction activities; • Restrict footprint of material and equipment storage areas, which should be outside of quartzite and clay exposure areas; and • Do not store material removed during excavations within the road reserve adjacent to quartzite and clay exposure areas.
	H	L	
	Amended Bypass Route		
	L	VL	
	Quartzite and Clay Exposure Areas		
	VH	L	
	Desalination plant site		
	M	L	
Altered faunal habitat, diversity and RDL/protected species	*Kotzesrus Route*		• Strictly control edge effects of construction particularly in very high sensitivity areas; • Minimise removal of vegetation and associated faunal habitat from the road reserve; • Place infrastructure outside rocky outcrop areas as far as possible; • Reduce noise in close proximity to the Brak River crossing avoid the disturbance of the Aquila verreauxii (Verreaux Eagle) breeding pair; • Rescue and relocate fauna encountered within the construction footprint; • Strictly prohibit the trapping and hunting of fauna by construction personnel; • Enforce a speed limit for construction vehicles of 40 km/h; • Where possible, install seawater intake and discharge pipelines within road reserves; • Rescue and relocate fauna occurring within the construction footprint; and • Strictly prohibit the trapping and hunting of fauna by construction personnel.
	H	L	
	Amended Bypass Route		
	L	VL	
	Desalination plant: A,C and D		
	L	VL	
	Desalination plant: B and E		
	M	L	
Disturbance of coastal ecology	M	L	• Minimise disturbance of the intertidal and subtidal areas; • Lay pipeline in such a way that required rock blasting is minimised; • Minimise traffic on upper shore; and • Restrict traffic to clearly demarcated access routes and construction areas only.
Impacts of Contamination on Marine Biota	L	I	• Conduct an environmental awareness programme amongst construction personnel; • Ensure that oils and lubricants used in the field are correctly contained; • Maintain vehicles and equipment to prevent oils, diesel, fuel or hydraulic fluids spills; • Ensure that all construction vehicles in the coastal zone have a spill kit; • Prohibit mixing of concrete in the intertidal zone; • Regularly clean up concrete spilled during construction; • Prohibit dumping of excess concrete on the sea bed, or in the coastal zone; and • Ensure regular collection and removal of refuse and litter from intertidal areas.
Turbidity and smothering through redeposition of suspended sediment	VL	VL	• Prohibit dumping of construction materials in the intertidal and subtidal zones.

Impact	Significance rating Without	Significance rating With	Key mitigation/optimisation measures
Disturbance and injury of shore birds and marine biota through noise and blasting	L	VL	• Restrict blasting to the minimum required and a maximum of one blast per day; • Use blasting methods which minimise the environmental effects of shock waves through the use of smaller, quick succession blasts directed into the rock; • Avoid onshore blasting during the breeding season of shore-birds; and • Ensure no marine mammals and turtles are within 2 km before blasting.
Loss of benthic communities through loss of substratum	VL	VL	• No mitigation possible
Impacts of temporary desalination plant	I	I	• Minimise the footprint of the temporary desalination plant in the coastal zone; and • Discharge brine and co-pollutants into the surf-zone below the low water mark.
Increased employment, income and skills dev.	I	VL	• Survey local skills levels, and employ local people based on the availability of skills; and • Promote skills development as opposed to the importation of skills, where possible.
Increased business and tourism	VL	VL	• No optimisation possible.
Increased incidence of crime	I	I	• No mitigation required
Disturbance and loss of archaeological material	*Linear infrastructure* M	 VL	• Use existing tracks where possible and avoid encroachment into undisturbed areas; • Restrict construction activities to existing disturbance zone along the coastal route; • Design linear infrastructure to avoid sensitive archaeological sites; • Obtain permits from SAHRA if excavation of archaeological material is required; • Demarcate archaeological sites (including shell middens) as no-go areas; • Excavate sensitive archaeological sites in the construction footprint in consultation with a qualified archaeologist; • Inform employees that archaeological artefacts, including human skeletal remains, may be exposed during construction and implement a chance finds; • Do not remove, destroy or interfere with any artefacts on the site; and • Report the discovery of any shipwreck material to the SAHRA maritime unit.
	Desalination plant: A, B, D and E M	 L	
	Desalination plant: C VL	 VL	
Disturbance and loss of heritage structures	M	VL	• Avoid construction within 5 m of any heritage structures in Kotzesrus; • Clearly demarcate and protect buildings of heritage significance; • Reinforce heritage structures where required and ensure that blasting does not impact on the structural integrity of heritage structures; • Repair damage to heritage structures in consultation with a qualified architect; and • Negotiate the relocation of the Burden memorial the family, if required.
Disturbance and loss of palaeontological material	*Desalination plant: E* L	 L	• Instruct construction personnel to be alert for rare fossil bones and to follow "Fossil Finds Procedure"; • Appoint a palaeontologist should paleontological finds be uncovered by earthworks; • Cease construction on discovery of fossils and protect fossils from further damage; • Contact appointed palaeontologist and provide relevant information and images; and • Take actions for preservation, collection and record keeping as advised by palaeontologist.
	Desalination plant: A, B, C and D M	 M	
	Linear infrastructure M	 M	
Visual intrusion of construction equipment and activities	VL	I	• Limit outdoor security lighting and ensure that it is as unobtrusive as possible; • Attach signs to structures to avoid free standing signs during construction; • Control litter and keep construction site as clean and neat as possible; and • Use unobtrusive screening and avoid large expanses of bland security walls and unshielded delivery areas adjacent to or visible from scenic coastal road.
OPERATIONS PHASE IMPACTS			
Changes in Air Quality	*Kotzesrus Route* I	 I	• No mitigation required.
	Amended Bypass Route I	 I	
Noise Impacts during Operation	I	I	• No mitigation required.
Impacts of Operational Traffic	I	I	• No mitigation required.
Loss of Wetland Habitat and Ecological Structure	VL	I	• Permit only essential personnel in wetland habitats for unavoidable maintenance; • Disallow heavy machinery or vehicles in wetland areas; • Keep all demarcated wetland zones outside of the maintenance areas off limits; • Prevent run-off from work areas entering wetland habitats; • Incorporate adequate erosion and stormwater management measures; and • Monitor water pipelines for leaks and repair any leaks immediately.

Impact	Significance rating Without	 With	Key mitigation/optimisation measures
Loss of Floral Habitat, Biodiversity and SCC	*Linear infrastructure* VL *Desalination plant* VL	 I I	• Remove alien and weed species encountered within the study area; • Undertake maintenance activities within very high sensitivity habitats manually; • Do not permit heavy machinery into very high sensitivity habitat units; • Limit personnel entering very high sensitivity habitats during maintenance; • Restrict maintenance activities to the road reserve, with surrounding areas off-limits; • Strictly prohibit collection plant material from surrounding natural areas by staff; and • Monitor all project pipelines for leaks and repair any leaks immediately.
Impacts on faunal habitat, diversity and RDL/protected species	*Linear infrastructure* VL *Desalination plant* VL	 VL I	• Restrict maintenance activities to the road reserve, with surrounding areas off-limits; • Strictly prohibit the trapping and hunting of fauna by maintenance personnel; • Enforce a speed limit for operational and maintenance vehicles of 40 km/h; • Rescue and relocate faunal species encountered;
Disruption of faunal migratory corridors	M	M	• Design gravel roads to allow for either a gradual kerb or regular 'exits' from the road for faunal species. Regularly inspect gravel roads to ensure this.
Loss of marine species through impingement and entrainment	L	L	• Adjust seawater intake velocities to <0.15 m/s; and • Ensure installation of screens on the end of the intake pipes, or the use of a screen box or shroud.
Reduced physiological functioning due to elevated salinity	M	L	• Ensure engineering designs at the seaward end of the discharge pipe achieve the highest required dilution of brine (29x), thereby limiting increased salinities to the minimum achievable mixing zone only.
Reduced physiological functioning due to elevated temperature	VL	VL	• Ensure engineering designs at the seaward end of the discharge pipe achieve the highest required dilution of brine (29x), thereby limiting potential thermal footprints to the mixing zone only.
Chronic effects on marine organisms due to halogenated by-products	L	L	• No mitigation possible
Detrimental effects on marine organisms through discharge of co-pollutants in backwash water	M	L	• Use low-toxicity chemicals as far as practicable; • Limit the use of scale-control additives to minimum practicable quantities; • Avoid antiscalants that increase nutrient levels (e.g. polyphosphate antiscalants); • Select an antiscalant that has relevant eco-toxicological testing; • Conduct Whole Effluent Toxicity testing of the brine effluent; and • Collect residual cleaning solutions and membrane filter washes and neutralize and remove solids before discharge.
Detrimental effects due to residual biocides and chemicals in brine	M	I	• Implement shock dosing of biocide in preference to continual dosing; • Dechlorinate effluent prior to discharge with sodium metabisulphite (SMBS); • Undertake 'pigging' of intake and discharge pipelines to reduce the need for and costs of biocides.
Detrimental effects due to heavy metals from corrosion processes	M	VL	• Design the plant to reduce corrosion to a minimum by ensuring that dead spots and threaded connections are eliminated. Corrosion resistance is considered good when the corrosion rate is <0.1 mm/a (UNEP 2008).
Increased employment, income and skills dev.	L	L	• Award installation, customisation and maintenance contracts to South African companies where equipment or material is procured abroad; • Employ local people based on the availability of skill; and • Promote skills development.
Increased business and tourism	VL	VL	• No optimisation required
Improved service provision	VL	VL	• Investigate providing water to nearby villages.
Altered visual character and sense of place	*Kotzesrus Route* M ***Amended Bypass Route*** Low *Desalination plant and coastal linear infrastructure* M	 L VL L	• Make changes to existing road through Kotzesrus as conservatively as possible and respect the organic qualities of the village if re-alignment of the road through Kotzesrus is required, • Avoid formal concrete kerbs to ensure the visual integration with the landscape; • use non-reflective materials and rural construction techniques as far as possible; • Install the seawater intake and brine discharge pipelines below ground; • Appoint an architect to oversee design of the desalination plant and infrastructure; • Consult visual guidelines prepared by SRK in July 2013.
Visual impact of coastal waters discoloration	VL	VL	• Design the pre-treatment system to ensure that FeCl3 levels are kept to minimum to avoid discolouration of the brine; and • Monitor brine colour and implement appropriate measures to reduce discolouration.

9 CONCLUSIONS AND WAY FORWARD

This Draft EIA Report has identified and assessed the potential biophysical and socio-economic impacts associated with the proposed Volwaterbaai desalination plant and associated infrastructure in the Northern Cape.

SRK believes that sufficient information is available for NCDENC to take a decision regarding authorisation of the development.

The Volwaterbaai desalination plant and associated infrastructure will result in unavoidable adverse environmental impacts, although these are of relatively limited extent, given the limited footprint of the project. Consequently, none of these adverse impacts are considered unacceptably significant and all can be managed to tolerable levels through the effective implementation of the recommended mitigation measures. In addition, the project will indirectly benefit the local and regional economy by facilitating development of the Zandkopsdrift Mine.

Working on the assumption that Sedex Desalination is committed to ensuring that the desalination plant and associated infrastructure is operated and constructed to high standards, achieved through implementation of the recommended mitigation measures and ongoing monitoring of performance, SRK believes and the EIA Report demonstrates that through effective implementation of the stipulated mitigation measures, the adverse impacts can be reduced to levels compliant with national (and international) standards or guidelines.

SRK believes that the specialist studies have shown that the development of the Volwaterbaai desalination plant and associated infrastructure is generally acceptable. The EIA has also assisted in the identification of essential mitigation measures that will mitigate the impacts associated with these components to within tolerable limits.

In conclusion SRK is of the opinion that on purely ‘environmental’ grounds (i.e. the project’s potential socio-economic and biophysical implications) the application as it is currently articulated should **be approved**, provided the essential mitigation measures are implemented. Though the *Amended Bypass Route* is preferred, the *Kotzesrus Route* could also be approved, allowing the proponent to consider technical and financial factors when selecting the final route. Ultimately, however, the NCDENC will need to consider whether the project benefits outweigh the potential impacts.

HOW YOU CAN YOU PARTICIPATE IN THE EIA PROCESS

The Draft EIA Report is not a final report and can be amended based on comments received from stakeholders. Stakeholders’ comments on the EIA Report will assist the NCDENC in making a decision regarding the application. The public is therefore urged to submit comment. Once stakeholders have commented on the information presented in the EIA Report, the Final EIA Report will be prepared and submitted to the NCDENC for approval. Once a decision is taken by authorities, this decision will be communicated to all registered IAPs.

REVIEW THE REPORT

Copies of the complete report are available for public review at the following:

- Kotzesrus Cash Store;
- Municipal Service Point in Lepelsfontein;
- Municipal Service Point in Stofkraal;
- Municipal Service Point in Molsvlei;
- Municipal Service Point in Rietpoort;
- Garies Public Library;
- Security office at Zandkopsdrift Mine;
- SRK’s Cape Town office; and
- SRK’s website: www.srk.co.za – click on the ‘Recent Publications’ and then ‘Public Documents’ links.

Copies of the Water Use and Coastal Waters Discharge Permit Applications are also available on request.

IAPs are invited to comment, and/or to register on the project database. IAPs should refer to the NCDENC reference number, and must provide their comments together with their name, contact details (preferred method of notification, e.g. email), and an indication of any direct business, financial, personal or other interest which they have in the application, to the contact person below, by **4 December**.

REGISTER OR PROVIDE YOUR OPINION

Register or send written comment to:

Larissa Heyns

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Fax: +27 21 685 7105

Email: lheyns@srk.co.za

Profile and Expertise of EAPs

SRK Consulting (South Africa) Pty Ltd (SRK) has been appointed by Sedex Desalination (Pty) Ltd (Sedex Desalination) as the independent consultants to undertake the Environmental Impact Assessment (EIA) process required in terms of the National Environmental Management Act 107 of 1998 (NEMA).

SRK Consulting comprises over 1 600 professional staff worldwide, offering expertise in a wide range of environmental and engineering disciplines. SRK's Cape Town environmental department has a distinguished track record of managing large environmental and engineering projects and has been practisng in the Western Cape since 1979. SRK has rigorous quality assurance standards and is ISO 9001 accredited.

As required by NEMA, the qualifications and experience of the key individual practitioners responsible for this project are detailed below.

Project Director and Reviewer: Christopher Dalgliesh, BBusSc (Hons); MPhil (EnvSci)

Certified with the Interim Board for Environmental Assessment Practitioners South Africa (CEAPSA)

Chris Dalgliesh is a Partner at SRK and the Head of the Environmental Department in Cape Town. He has over 19 years of experience as an environmental consultant working on a broad range of EIA, auditing, environmental planning and management, stakeholder engagement and environmental management system projects. Chris's experience includes managing and co-ordinating major EIAs throughout Southern Africa and South America in the mining, energy, land-use planning and development, water and waste management, and industrial sectors.

Project Manager: Sharon Jones, BSc Hons (Env. Sci); MPhil (EnviroMan)

Certified with the Interim Board for Environmental Assessment Practitioners South Africa (CEAPSA)

Sharon Jones is a Principal Environmental Consultant with over 16 years of experience, primarily in South Africa, Southern Africa (Mozambique, Angola and Namibia) and South America (Suriname). Sharon has managed EIAs across a number of sectors, provided input into due diligence studies, compiled numerous construction and operation phase EMPs for a range of projects, and has audited compliance with EMPs on a number of sites. She is also involved with the development of Environmental Management Frameworks. Sharon is a registered Professional Natural Scientist (Environmental Science) with SACNASP and a Certified Environmental Practitioner of South Africa (CEAPSA).

Statement of SRK Independence

Neither SRK nor any of the authors of this Report have any material present or contingent interest in the outcome of this Report, nor do they have any pecuniary or other interest that could be reasonably regarded as being capable of affecting their independence or that of SRK.

SRK has no beneficial interest in the outcome of the assessment which is capable of affecting its independence.

Disclaimer

The opinions expressed in this report have been based on the information supplied to SRK by Sedex Desalination. SRK has exercised all due care in reviewing the supplied information, but conclusions from the review are reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

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Acronyms and Abbreviations

AGES	Africa Geo-Environmental Services
ANZECC	Australian and New Zealand Environment and Conservation Council
BA	Basic Assessment
Ca	Calcium
$CaCO_3$	Calcium Carbonate
CARA	Conservation of Agricultural Resources Act 43 of 1983
CBA	Critical Biodiversity Area
CH_3CO_3H	Peroxyacetic Acid
CIP	Cleaning in Place
Cl	Chlorine
CO_2	Carbon Dioxide
CWDP	Coastal Waters Discharge Permit
DAF	Dissolved Air Flotation (a solids separation process)
DBNPA	Dibromonitrilopropionamide
DEA	National Department of Environmental Affairs
DEA&DP	(Western Cape) Department of Environmental Affairs and Development Planning
DEA: O&C	Department of Environmental Affairs: Oceans and Coasts
DMF	Dual media filtration
DMR	Department of Mineral Resources
DWA	Department of Water Affairs (now DWS)
DWAF	Department of Water Affairs and Forestry (now DWS)
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMF	Environmental Management Framework
EMP	Environmental Management Programme
EMZ	Environmental Management Zone
ESA	Ecological Support Area
EStA	Early Stone Age
$FeCl_3$	Ferric Chloride
GGP	Gross Geographic Product
GN	Government Notice
H_2SO4	Sulphuric Acid
HAT	Highest Astronomical Tide
HCl	Hydrochloric Acid
HGM	Hydrogeomorphic

HIA	Heritage Impact Assessment
HWM	High Water Mark
IAP	Interested and Affected Party
IDP	Integrated Development Plan
IEM	Integrated Environmental Management
IUCN	International Union for Conservation of Nature and Natural Resources
KLM	Kamiesberg Local Municipality
LIG	Last Interglacial
LAT	Lowest Astronomical Tide
LM	Local Municipality
LSA	Late Stone Age
MHI	Major Hazardous Installation
MPA	Marine Protected Area
MLRA	Marine Living Resources Act: Act 18 of 1998
Mm^3	Million cubic metres
MSA	Middle Stone Age
MSL	Mean Seawater Level
Na_2CO_3	Sodium Carbonate
NaOH	Sodium Hydroxide
NCDENC	Northern Cape Department of Environment and Nature Conservation
NCNCA	Northern Cape Nature Conservation Act 9 of 2009
NCPG	Northern Cape Provincial Government
NDBSP	Namakwa District Biodiversity Sector Plan
NDM	Namakwa District Municipality
NEMA	National Environmental Management Act 107 of 1998 as amended
NEM:BA	National Environmental Management: Biodiversity Act 10 of 2004
NEM:ICMA	National Environmental Management: Integrated Coastal Management Act 24 of 2008
NEM:PAA	National Environmental Management: Protected Areas Act 57 of 2003
NFEPA	National Freshwater Ecosystem Priority Area
NH_3	Ammonium Hydroxide
NHRA	National Heritage Resources Act 25 of 1999
NSBA	National Spatial Biodiversity Assessment
NSDF	National Spatial Development Framework
NSSD	National Strategy for Sustainable Development and Action Plan
NTC	National Training Centre
NTU	Nephelometric Turbidity Units
NWA	National Water Act 36 of 1998
OHSA	Occupational Health and Safety Act 85 of 1993
PES	Present Ecological State
PGDS	Provincial Growth and Development Strategy

PRE	National Herbarium Pretoria
PRECIS	National Herbarium Pretoria Computerised Information System
PSDF	Provincial Spatial Development Framework
psu	Practical Salinity Unit
QDS	Quarter Degree Square
REC	Recommended Ecological Category
RDL	Red Data List
RDSIS	Red Data Sensitivity Index
RHDHV	Royal Haskoning DHV
RO	Reverse Osmosis
S&EIR	Scoping and Environmental Impact Reporting
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SANBI	South African National Biodiversity Institute
SANS	South African National Standards
SAS	Scientific Aquatic Services
SCC	Species of Conservation Concern
SDF	Spatial Development Framework
SEMP	Strategic Environmental Management Plan
SKEP	Succulent Karoo Ecosystem Programme
SLP	Social and Labour Plan
SMBS	Sodium Metabisulphite
SPC	Spatial Planning Categories
SRK	SRK Consulting (South Africa) (Pty) Ltd
StatsSA	Statistics South Africa
ToR	Terms of Reference
THM	Trihalomethanes
UDS	Urine Diversion Systems
VAC	Visual Absorption Capacity
VIP	Ventilated Improved Pit
VIS	Vegetation Index Score
WET	Whole Effluent Toxicity
WET-Health	Methodology Used to Determine Wetland Health
WMA	Water Management Area
WSP	WSP Africa Coastal Engineers
WUA	Water Use Authorisation

Glossary

Aquifer	An underground body of water.
Baseline	Information gathered at the beginning of a study which describes the environment prior to development of a project and against which predicted changes (impacts) are measured.
Biocide	Substance that is used to destroy all forms of life.
Biodiversity	The diversity, or variety, of plants, animals and other living things in a particular area or region. It encompasses habitat diversity, species diversity and genetic diversity
Brine	High salinity effluent discharged from the desalination plant. This may contain small amounts of chemicals used in the desalination plant.
Consultation	A process for the exchange of views, concerns and proposals about a proposed project through meaningful discussions and the open sharing of information.
Disclosure	The release of or provision of access to information, usually (but not exclusively) in the form of written reports.
Disinfectant	Substance applied to non-living objects to destroy microorganisms.
Ecology	The study of the interrelationships of organisms with and within their environment.
Ecosystem	The interconnected assemblage of all species' populations that occupy a given area and the physical environment with which they interact.
Endemic / Endemism	Found only within the study area.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group. These circumstances include biophysical, social, economic, historical and cultural aspects.
Environmental Impact Assessment	A process of evaluating the environmental and socio-economic consequences of a proposed course of action or project.
Environmental Impact Assessment Report	The report produced to relay the information gathered and assessments undertaken during the EIA.
Environmental Management Programme	A description of the means for achieving environmental objectives and targets during all stages of a specific proposed activity.
Fauna	The collective animals of a given region.
Feasibility study	The determination of the technical and financial viability of a proposed project.
Feedwater	Raw, untreated water feeding into the desalination process.
Flora	The collective plants growing in a geographic area.
Geohydrology	The study of groundwater.

Heritage Resources	Refers to something, e.g. a building, an area, a ritual, etc. that forms part of a community's cultural legacy or tradition and is passed down from preceding generations.
Integrated Environmental Management	The practice of incorporating environmental management into all stages of a project's life cycle, namely planning, design, implementation, management and review.
Mitigation measures	Design or management measures that are intended to minimise or enhance an impact, depending on the desired effect. These measures are ideally incorporated into a design at an early stage.
Process Water	Also referred to as permeate. This is water from the desalination process which has not yet been disinfected to meet the standards required to be considered Product Water.
Product Water	Water from the desalination process which has undergone all final treatments to meet the required water quality standards for the end use.
Red Data List	Species of plants and animals that, because of their rarity and/or level of endemism, are included on a Red Data List (usually compiled by the IUCN) which provides an indication of their threat of extinction and recommendations for their protection.
Reverse Osmosis Desalination	The process whereby water is forced through semi-permeable membranes at very high pressure, thereby producing permeate of low (or zero) salinity and brine in which all solutes have been concentrated.
Scoping	A procedure to consult with stakeholders to determine issues and concerns and for determining the extent of and approach to an EIA. This process results in the development of a scope of work for the EIA and specialist studies.
Specialist study	A study into a particular aspect of the environment, undertaken by an expert in that discipline.
Stakeholders	All parties affected by and/or able to influence a project, often those in a position of authority and/or representing others. Also referred to as Interested and/or Affected Parties.
Stakeholder engagement	The process of notifying and consulting stakeholders about a proposed project, and providing opportunities for input into the EIA process and project design. Also referred to as Public Participation.
Surfzone	The area in which waves from the ocean start to break onto the shore.
Sustainable development	Sustainable development is generally defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. NEMA defines sustainable development as the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations.

1 Introduction

1.1 Background and Introduction

Sedex Minerals (Pty) Ltd (Sedex Minerals) intends to mine a Rare Earth Element deposit and beneficiate the ore to produce a mixed rare earth salt at the Zandkopsdrift Mine, 30 km south of the town of Garies in the Northern Cape Province. Sedex Desalination (Pty) Ltd (Sedex Desalination), a subsidiary of Sedex Minerals proposes to construct a 8 million m^3/annum (Mm^3/a) seawater desalination plant, including associated infrastructure and services at Volwaterbaai, on the Farm Strandfontein 559 in the Northern Cape, (see Figure 1-1) to supply mineralised water via a transfer pipe to the Zandkopsdrift Mine.

The National Environmental Management Act 107 of 1998, as amended (NEMA), and the Environmental Impact Assessment (EIA) Regulations, 2010 (promulgated in terms of NEMA) warrant that listed activities require Environmental Authorisation (EA) from the National Department of Environmental Affairs (DEA) or provincial equivalent, in this case the Northern Cape Department of Environment and Nature Conservation (NCDENC). A Scoping and Environmental Impact Reporting (S&EIR) process is required to support an application for EA.

SRK Consulting (South Africa) (Pty) Ltd (SRK) has been appointed by Sedex Desalination to undertake the S&EIR process required in terms of the NEMA, the EIA Regulations, 2010.

1.2 Purpose of the Report

In terms of relevant legislation, the construction of the proposed seawater desalination plant and associated pipelines, power lines and road upgrades (the project) may not commence prior to obtaining a suite of authorisations (see Section 2). This report has been compiled in support of these applications. The EIA Report documents the steps undertaken during the Impact Assessment Phase to assess the significance of potential impacts and determine measures to mitigate the negative impacts and enhance the benefits (or positive impacts) of the proposed project. The report presents the findings of the Impact Assessment Phase and the public participation that forms part of the process.

The EIA Report is accompanied by an Environmental Management Programme (EMP) in Appendix 1A, which documents the management and monitoring measures that need to be implemented during the design, construction and operation phases of the project to ensure that impacts are appropriately mitigated and benefits enhanced.

More specifically, the objectives of this EIA Report are to:

- Inform the stakeholders about the proposed project and the S&EIR (also referred to as EIA) process followed;
- Obtain contributions from stakeholders (including the applicant, consultants, relevant authorities and the public) and ensure that all issues, concerns and queries raised are fully documented and addressed;
- Assess in detail the potential environmental and socio-economic impacts of the project;
- Identify environmental and social mitigation measures to address the impacts assessed; and
- Produce an EIA Report that will assist NCDENC to decide whether (and under what conditions) to authorise the proposed development.

Figure 1-1: Locality Plan

1.3 Structure of this Report

This report discusses relevant environmental legislation and its application to this project, outlines the S&EIR process, presents a detailed project description and environmental baseline, details the stakeholder engagement process followed and assesses the potential impacts of the project before concluding the report with a set of pertinent findings and key recommendations. The report consists of the following sections:

Section 1: Introduction

Provides an introduction and background to the proposed project and outlines the purpose of this document and the assumptions and limitation applicable to the study.

Section 2: Governance Framework and Environmental Process

Provides a brief summary and interpretation of the relevant legislation as well as pertinent strategic planning documents, and outlines the approach to the environmental process.

Section 3: Project Description

Describes the location and current status of the site and provides a brief summary of the surrounding land uses as well as background to, motivation, desirability and need for, and description of, the proposed project.

Section 4: Description of the Affected Environment

Describes the biophysical and socio-economic characteristics of the affected environment against which potential project impacts are assessed.

Section 5: Stakeholder Engagement

Details the stakeholder engagement approach and summarises stakeholder comments that informed the impact assessment.

Section 6: Environmental Impact Assessment

Describes the specialist studies undertaken and assesses the potential impacts of the project utilising SRK's proven impact assessment methodology.

Section 7: Conclusions and Recommendations

Provides an Environmental Impact Statement (EIS), summarises the key findings and recommendations in the EIA Report and outlines further opportunities for stakeholder engagement.

1.4 Content of Report

The EIA Regulations, 2010 (Government Notice (GN) 543, Chapter 3, Part 3, Section 31) prescribe the required content in an EIA Report. These requirements and the sections of this EIA Report in which they are addressed, are summarised in Table 1-1.

Table 1-1: Content of EIA Report as per EIA Regulations, 2010

GN 543, S31 Ref.:	Item	Section Ref.:
(2) (a) (i)	Details of the EAP who prepared the report	p. ii
(2) (a) (ii)	The expertise of the EAP to carry out an environmental impact assessment	p. ii
(2) (b)	A detailed description of the proposed activity	3
(2) (c)	A description of the property on which the activity is to be undertaken and the location of the activity on the property	3.3
(2) (d)	A description of the environment that may be affected by the activity and how the physical, biological, social, economic and cultural environment may affected	4
(2) (e)	Details of the public participation process conducted, including:	5
(2) (e) (i)	Steps undertaken in accordance with the plan of study	5.3
(2) (e) (ii)	A list of registered IAPs	App 5A
(2) (e) (iii)	Summary of received comments and response by EAP	5.2.5, App 5C
(2) (e) (iv)	Copies of received comments	App 5B
(2) (f)	A description of the need and desirability of the proposed activity	3.9
(2) (g)	A description of identified alternatives (including advantages and disadvantages of each alternative)	3.5
(2) (h)	Methodology used in determining impact significance	6.1.5
(2) (i)	A description and comparative assessment of all identified alternatives	6.2 – 6.10
(2) (j)	A summary of the specialist findings and recommendations	6.2 – 6.10, 7.1.2
(2) (k)	A description of environmental issues, assessment of the significance of each issue and indication of the extent to which this could be mitigated	6.2 – 6.01
(2) (l)	An assessment of each identified potentially significant impact, including:	6.2 – 6.10
(2) (l) (i)	Cumulative impacts	6.10
(2) (l) (ii)	Nature of the impact	6.2 – 6.10
(2) (l) (iii)	Extent and duration of the impact	6.2 – 6.10
(2) (l) (iv)	Probability of the impact occurring	6.2 – 6.10
(2) (l) (v)	Degree to which the impact can be reversed	6.2 – 6.10
(2) (l) (vi)	Degree to which the impact may cause irreplaceable loss of resources	6.2 – 6.10
(2) (l) (vii)	Degree to which the impact can be mitigated	6.2 – 6.10
(2) (m)	Description of assumptions, uncertainties and gaps in knowledge	1.5
(2) (n)	Reasoned opinion as to whether the activity should or should not be authorised, and any conditions that should be made in respect of that authorisation	7.3
(2) (o)	Environmental impact statement which contains:	7.1
(2) (o) (i)	A summary of the key findings of the EIA	7.1
(2) (o) (ii)	A comparative assessment of the positive and negative implications of the proposed activity and alternatives	7.1
(2) (p)	A draft environmental management programme	App 1A
(2) (q)	Copies of any specialist reports	App 4A – 4E
(2) (r)	Any specific information that may be required by the competent authority	-
(2) (s)	Any other matters required in terms of sections 24(4)(a) and (b) of NEMA	-
	Detailed written proof of an investigation of feasible alternatives, or motivation if no reasonable or feasible alternatives exist.	3.5, 6.2 – 6.10

1.5 Assumptions and Limitations

As is standard practice, the report is based on a number of assumptions and is subject to certain limitations. These are as follows:

- Information provided by Sedex Desalination, other consultants and specialists is assumed to be accurate and correct;
- SRK's assessment of the significance of impacts of the proposed development on the affected environment has been based on the assumption that the activities will be confined to those described in Section 3. If there are any substantial changes to the project description, impacts may need to be reassessed;
- As noted by the marine ecologists, some important conclusions, assessments and recommendations made in the marine ecology study (Appendix 4B) are based on results from the detailed three-dimensional physical marine modelling study (Appendix 4C). The predictions of these models, whilst considered to be robust, need to be validated by field observations and subsequent monitoring. If field observations and monitoring, however, fail to mirror predicted results, the forecasted impacts will need to be re-assessed;
- Where detailed design information is not available, the precautionary principle, i.e. a conservative approach that overstates negative impacts and understates benefits, has been adopted;
- It is assumed that the stakeholder engagement process undertaken during the S&EIR process has identified all relevant concerns of stakeholders; and
- Sedex Desalination will in good faith implement the agreed mitigation measures identified in this report. To this end it is assumed that Sedex Desalination will commit sufficient resources and employ suitably qualified personnel.

Notwithstanding the above, SRK is confident that these assumptions and limitations do not compromise the overall findings of the report.

2 Governance Framework and Environmental Process

2.1 Legal Requirements

There are a number of regulatory requirements at local, provincial and national level with which the proposed project must conform. Some of the key environmental legal requirements include the following:

- National Environmental Management Act 107 of 1998, as amended (NEMA);
- EIA Regulations 2010, promulgated in terms of NEMA;
- Conservation of Agricultural Resources Act 43 of 1983 (CARA);
- The Northern Cape Nature Conservation Act 9 of 2009 (NCNCA);
- National Water Act 36 of 1998 (NWA);
- Water Services Act 108 of 97;
- National Heritage Resources Act 25 of 1999 (NHRA);
- National Environmental Management: Biodiversity Act 10 of 2004 (NEM:BA);
- National Environmental Management: Integrated Coastal Management Act 24 of 2008 (NEM:ICMA);
- Marine Living Resources Act: Act 18 of 1998 (MLRA);
- National Environmental Management: Off-road Vehicle Regulations 496; and
- Occupational Health and Safety Act 85 of 1993 (OHSA) and the Major Hazard Installation (MHI) Regulations.

A brief summary of SRK's understanding of the relevant Acts and Regulations that are applicable to this study is provided below. Note that other legislative requirements may also pertain to the proposed project. As such, the summary provided below is not intended to be definitive or exhaustive, and serves only to highlight key environmental legislation and obligations.

2.1.1 National Environmental Management Act 107 of 1998, as Amended

NEMA establishes a set of principles which all authorities have to consider when exercising their powers. These include the following:

- Development must be sustainable;
- Pollution must be avoided or minimised and remedied;
- Waste must be avoided or minimised, reused or recycled;
- Negative impacts must be minimised; and
- Responsibility for the environmental consequences of a policy, project, product or service applies throughout its life cycle.

Section 28(1) states that "every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring". If such degradation/pollution cannot be prevented, then appropriate measures must be taken to minimise or rectify such pollution. These measures may include:

- Assessing the impact on the environment;

- Informing and educating employees about the environmental risks of their work and ways of minimising these risks;
- Ceasing, modifying or controlling actions which cause pollution/degradation;
- Containing pollutants or preventing movement of pollutants;
- Eliminating the source of pollution; and
- Remedying the effects of the pollution.

Section 30 deals with control of emergency incidents, including unexpected major emissions which could lead to serious danger to the public or potentially serious pollution of or detriment to the environment, whether immediate or delayed. In the case of such an incident occurring, the responsible person must take all reasonable measures to contain and minimise the effects of the incident; undertake clean up procedures, remedy the effects of the incident and assess the immediate and long-term effects on the environmental and public health.

Legal requirements for this project:

Sedex Desalination (the proponent) has a responsibility to ensure that the proposed activities and the S&EIR process conform to the principles of NEMA. The proponent is obliged to take actions to prevent pollution or degradation of the environment in terms of Section 28 of NEMA, and to ensure that the environmental impacts associated with the project are considered, and mitigated where possible. Measures should also be in place to deal with emergency incidents in terms of Section 30.

2.1.2 EIA Regulations, 2010

Sections 24 and 44 of NEMA make provision for the promulgation of regulations that identify activities which may not commence without an EA issued by the competent authority, which in the Northern Cape is the NCDENC. In this context, the EIA Regulations, 2010[1] (which came into effect on 2 August 2010), promulgated in terms of NEMA, list activities that require EA (“NEMA listed activities”) and govern the process, methodologies and requirements for undertaking EIAs in support of EA applications.

GN R543 lays out two alternative authorisation processes. Depending on the type of activity that is proposed, either a Basic Assessment (BA) process or a S&EIR process is required to obtain EA. GN R544 lists activities that require a BA process, while GN R545 lists activities that require S&EIR. GN R546 lists activities in certain sensitive geographic areas that require a BA process. The regulations for both processes – BA and S&EIR – stipulate that:

- Public participation must be undertaken at various stages of the assessment process;
- The assessment must conducted by an independent EAP;
- The relevant authorities must respond to applications and submissions within stipulated time frames;

[1] GN R543 –EIA Regulations

GN R544 – Regulations Listing Notice 1 of 2010

GN R545 – Regulations Listing Notice 2 of 2010

GN R546 – Regulations Listing Notice 3 of 2010

GN R660 – Amendments to the EIA Regulations and Listing Notices

- Decisions taken by the authorities can be appealed by the proponent or any other Interested and Affected Party (IAP); and
- A draft Environmental Management Programme (EMP) must be compiled and released for public comment.

GN R543 sets out the procedures to be followed and content of reports compiled during the BA and S&EIR processes.

GN R543 also makes provision for appeal against any decision issued by the relevant authorities[2]. In terms of the Regulations, a 'notice of intention to appeal' has to be lodged with the relevant authority in writing within twenty days of the date of the decision (EA). The appeal must be lodged within 30 days of the lapsing of the 20 days allowed for lodging the notice of intention to appeal.

The proposed project includes activities that are listed in terms of the EIA Regulations (see Table 2-1). Note that the relevance of some of these listed activities will only be finalised following more detailed design and screening of alternatives.

Table 2-1: NEMA Listed Activities Applicable to the Proposed Project

No.	Listed activity
GN R544	
9	The construction of facilities or infrastructure exceeding 1 000 metres in length for the bulk transportation of water, sewage or stormwater - (i) with an internal diameter of 0,36 metres or more; or (ii) with a peak throughput of 120 litres per second or more.
11	The construction of: (iii) bridges; (x) buildings exceeding 50 square metres or more; or (xi) infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse.
14	The construction of structures in the coastal public property where the development footprint is bigger than 50 square metres.
15	The construction of facilities for the desalination of sea water with a design capacity to produce more than 100 cubic metres of treated water per day.
16	Construction or earth moving activities in the sea, or within the littoral active zone or a distance of 100 metres inland of the high water mark (HWM) of the sea, whichever is the greater, in respect of – (iii) embankments; (iv) rock revetments or stabilising structures including stabilising walls; (v) buildings of 50 square metres or more; or (vi) infrastructure covering 50 square metres or more.
17	The planting of vegetation or placing of any material on dunes and exposed sand surfaces, within the littoral active zone for the purpose of preventing the free movement of sand, erosion or accretion, excluding where the planting of vegetation or placement of material relates to restoration and maintenance of indigenous coastal vegetation or where such planting of vegetation or placing of material will occur behind a development setback line.
18	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock or more than 5 cubic metres from: (i) a watercourse; (ii) the sea; (iii) the seashore; (iv) the littoral active zone, or a distance of 100 metres inland of the high- water mark of the, whichever distance

[2] Sections 60 - 68

No.	Listed activity
	is the greater.
22	The construction of a road, outside urban areas, (i) with a reserve wider than 13,5 meters; or (ii) where no reserve exists where the road is wider than 8 metres.
23	The transformation of undeveloped, vacant or derelict land to – (iii) residential, retail, commercial, recreational, industrial or institutional use, outside an urban area and where the total area to be transformed is bigger than 1 hectare but less than 20 hectares.
37	The expansion of facilities or infrastructure for the bulk transportation of water or stormwater where: a. the facility or infrastructure is expanded by more than 1 000 metres in length; or b. where the throughput capacity of the facility or infrastructure will be increased by 10% or more– excluding where such expansion: (i) relates to transportation of water, sewage or stormwater within a road reserve.
39	The expansion of (ii) bridges; within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, where such expansion will result in an increased development footprint.
47	The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre - (i) where the existing reserve is wider than 13,5 meters; or (ii) where no reserve exists, where the existing road is wider than 8 metres.
GN R545	
5	The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent and which is not identified in Notice No. 544 of 2010 or included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case that Act will apply.
14	The construction of an island, anchored platform or any other permanent structure on or along the sea bed excluding construction of facilities, infrastructure or structures for aquaculture purposes.
GN R546	
2	The construction of reservoirs for bulk water supply with a capacity of more than 250 cubic metres. a. In **Northern Cape**: (i) Outside urban areas, in: bb. Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; dd. Critical Biodiversity Areas (CBAs) as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; ff. Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined.
4	The construction of a road wider than 4 metres with a reserve less than 13.5 metres. a. In **Northern Cape**: (ii) Outside urban areas, in: aa. A protected area identified in terms of National Environmental Management: protected Areas Act (NEM:PAA), excluding conservancies; cc. Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; ee. CBAs as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; gg. Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEM:PAA or from the core areas of a biosphere reserve; hh. Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined.
12	The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation. b. Within CBAs identified in bioregional plans; c. Within the littoral active zone or 100 metres inland from the high-water mark of the sea, whichever distance

No.	Listed activity
	is the greater.
13	The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, a. CBAs and Ecological Support Areas (ESAs) as identified in systematic biodiversity plans adopted by the competent authority. c. In the **Northern Cape**: (ii) Outside urban areas, in: cc. Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; gg. Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined.
14	The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, a. In the **Northern Cape**: (i) All areas outside urban areas.
16	The construction of: (iii) buildings with a footprint exceeding 10 square metres in size; or (iv) infrastructure covering 10 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse. a. In the **Northern Cape**: (ii) Outside urban areas, in: dd. Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; ff. CBAs or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; ii. Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined.
19	The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre. a. In the **Northern Cape**: (ii) Outside urban areas, in: cc. Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; ee. CBAs as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; gg. Areas seawards of the development setback line or within 1 kilometre from the HWM of the sea if no such development setback line is determined; hh. Areas on the watercourse side of the development setback line or within 100 metres from the edge of a watercourse where no such setback line has been determined.
24	The expansion of d. infrastructure where the infrastructure will be expanded by 10 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. a. In the **Northern Cape** (ii) Outside urban areas, in: cc. Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; ee. CBAs as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; gg. Areas seawards of the development setback line or within 1 kilometre from the HWM of the sea if no such development setback line is determined.

Legal requirements for this project:

As such, the proponent is obliged to apply for EA for these listed activities and to undertake an S&EIR process in support of the application, in accordance with the procedure stipulated in GN R543 under NEMA.

2.1.3 Conservation of Agricultural Resources Act 43 of 1983

The objectives of the CARA are to provide for the conservation of the natural agricultural resources by maintaining the production potential of land, combating and preventing erosion and the weakening or destruction of water sources, protecting vegetation and combating weeds and invader plants. The Act also makes provision of the declaration of listed weeds and invader plants.

In terms of GN 1048 of 1984, as amended, weeds and invader plants are divided into three Categories. Plants listed in terms of Category 1 are considered weeds, while plants listed in terms of Categories 2 and 3 are considered invader plants. Category 1 plants are not permitted to occur on any land or inland water surface other than in a biological control reserve, while Category 2 and 3 plants are not permitted to occur on any land or inland water surface other than a demarcated area or a biological control reserve.

The Act defines a land user as any person who has a personal or real right in respect of any land in his capacity as servitude holder, possessor, lessee or occupier. In terms of the GN 1048, land users must control (i.e. combat and remove) Category 1 and 2 plants that occur on any land or inland water surface on their property and may not allow Category 3 plants to occur within 30 metres (m) of the 1:50 year flood line of a watercourse.

Legal requirements for this project:

Invasive species (listed in terms of CARA), must be controlled by the proponent on any land that is leased, possessed, occupied or on which a servitude has been registered by the proponent.

2.1.4 The Northern Cape Nature Conservation Act 9 of 2009

The NCNCA aims to provide, inter alia, for the sustainable utilisation of wild animals, aquatic biota and plants, the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, offences and penalties for contravention of the Act and the issuing of permits and other authorisations.

The Act lists a number of restricted activities related to the sustainable utilisation of plants, which is not permitted without a permit, and in terms of which one may not:

- Pick, import, export, transport, possess, cultivate or trade in a specimen of a specially protected plant in terms of section 49 (1) of the Act; and
- Pick, import, export, transport, cultivate or trade in a specimen of a protected plant in terms of section 50 (1) of the Act.

Legal requirements for this project:

As such, the proponent would need to apply for a permit in terms of NCNCA, should the removal, transportation and relocation of any specially protected or protected species be required.

2.1.5 National Water Act 36 of 1998

Water use in South Africa is controlled by the NWA. The executive authority is the Department of Water and Sanitation (DWS), formerly the Department of Water Affairs (DWA). The NWA recognises that water is a scarce and unevenly distributed national resource in South Africa. Its provisions are aimed at achieving sustainable and equitable use of water to the benefit of all users and to ensure protection of the aquatic ecosystems associated with South Africa's water resources. The provisions of the Act are aimed at discouraging pollution and wastage of water resources.

In terms of the Act, a land user, occupier or owner of land where an activity that causes or has the potential to cause pollution of a water resource has a duty to take measures to prevent pollution from occurring. If these measures are not taken, the responsible authority may do whatever is necessary to prevent the pollution or remedy its effects, and to recover all reasonable costs from the responsible party.

Section 21 of the NWA specifies a number of water uses, including:

(a) *taking water from a water resource;*

(b) *storing water;*

(c) *impeding or diverting the flow of water in a watercourse;*

(f) *discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit; and*

(i) *altering the bed, banks, course or characteristics of a watercourse.*

These water uses require authorisation in terms of Section 22 (1) of the Act, unless they are listed in Schedule 1 of the NWA, are an existing lawful use, fall under a General Authorisation issued under section 39 or if the responsible authority waives the need for a licence.

In terms of GN 1199 of 2009, wetlands are considered sensitive environments and as such, Section 21 (c) and (i) water uses cannot be generally authorised where these water uses occur within a distance of 500 m of a wetland.

Legal requirements for this project:

The proposed project infrastructure triggers water use activities in terms of Section 21 (c) and (i) of the NWA and an application for Water Use Authorisation (WUA) application will be required from the competent authority, in this case DWS. A WUA application will be submitted to the DWS for Section 21 (c) and (i) water uses. Section 21 (a) will not be triggered by the project, since the project will not require the storage of water from surface runoff, groundwater or fountain flow or the construction of a dam which can store more than 50 000 m^3 *and has a dam wall more than 5 m high. Activities (a) and (f) relate to the marine environment and application will be made in terms of NEM:ICMA*[3]*.*

2.1.6 Water Services Act 108 of 1997

In terms of Section 7 of the Water Services Act 108 of 1997, no person may "*obtain water for industrial use from any other source other than the distribution of Water Services Provider nominated by a Water Services Authority having jurisdiction over the area in question, without the approval of that Water Services Authority*" (Industrial use is defined as the use of water for mining, manufacturing, construction or any related purpose).

In terms of Section 22 of the Act, "*no person may operate as a Water Services Provider without the approval of the Water Services Authority having jurisdiction in the area in question*". The Kamiesberg Local Municipality is the Water Services Authority in the area.

Legal requirements for this project:

The proposed desalination plant will provide water to the Zandkopsdrift Mine (for industrial use). Sedex will need to obtain approval from the Kamiesberg Local Municipality to operate as a water Services Providers and/or to secure water services from a source other than a Water Services Provider nominated by the Water Services Authority.

[3] The abstraction of water and discharge of brine to the marine environment will be dealt with in terms of NEM: ICMA, however suitable processes to administer NEM: ICMA with respect to the abstraction of seawater are not currently in place. DWS has also confirmed that these applications cannot be dealt with in terms of the NWA.

2.1.7 National Heritage Resources Act 25 of 1999

The protection and management of South Africa's heritage resources are controlled by the NHRA. The enforcing authority for this act is the South African National Heritage Resources Agency (SAHRA). In terms of the Act, historically important features such as graves, trees, archaeological artefacts/sites and fossil beds are protected. Similarly, culturally significant symbols, spaces and landscapes are also afforded protection.

Section 38 of the NHRA requires that any person who intends to undertake certain categories of development must notify SAHRA at the very earliest stage of initiating such a development and must furnish details of the location, nature and extent of the proposed development. SAHRA has designed the South African Heritage Resources Information System (SAHRIS) database to assist the developer in providing the necessary information to enable SAHRA to decide whether a Heritage Impact Assessment (HIA) will be required.

Section 38 also makes provision for the assessment of heritage impacts as part of an EIA process and indicates that, if such an assessment is deemed adequate, a separate HIA is not required. There is however the requirement in terms of Section 38 (8) for the consenting authority (in this case the NCDENC) to ensure that the evaluation of impacts on the heritage resources fulfils the requirements of the relevant heritage resources authority (SAHRA), and that the comments and recommendations of the heritage resources authority are taken into account prior to the granting of the consent.

Section 38(1) of the NHRA specifies activities that trigger the need for the proponent to notify SAHRA of the proposed development, in order for SAHRA to determine the need for further Heritage Assessment. The proposed Volwaterbaai and associated infrastructure triggers a number of these activities, including:

(a) *Construction of a road, wall, power line, canal or other similar form of linear development or barrier over 300 m in length;*

(c) *Any development or activity that will change the character of a site (i) exceeding 5 000 m^2 in extent, (ii) involving three or more existing erven or subdivisions thereof; and*

(d) *Rezoning of a site exceeding 10 000 m^2 in extent.*

Legal requirements for this project:

The proponent is required to notify SAHRA via the SAHRIS database of the proposed activities and then undertake any assessments deemed necessary by SAHRA. The assessment of heritage, archaeological and paleontological impacts was undertaken as part of the EIA process in terms of NEMA.

2.1.8 National Environmental Management: Biodiversity Act 10 of 2004

The purpose of the NEM:BA is to provide for the management and conservation of South Africa's biodiversity and the protection of species and ecosystems that warrant national protection. The NEM:BA makes provision for the publication of bioregional plans and the listing of ecosystems and species that are threatened or in need of protection. Threatened or Protected Species Regulations (2007), Guidelines for the determination of bioregions and the preparation and publication of bioregional plans (2009) and a National List of Ecosystems that are Threatened and in Need of Protection (2011) have been promulgated in terms of NEM:BA.

A published bioregional plan is a spatial plan indicating terrestrial and aquatic features in the landscape that are critical for conserving biodiversity and maintaining ecosystem functioning. These areas are referred to as CBAs in terms of NEM:BA. Bioregional plans provide guidelines for avoiding the loss or degradation of natural habitat in CBAs with the aim of informing EIAs and land-use planning (including Environmental Management Frameworks [EMFs], Spatial Development Frameworks [SDFs] and Integrated Development Plans [IDPs]).

Legal requirements for this project:

A number of aquatic CBAs, a terrestrial CBA and an ESA are located in the proposed project area and the impacts of the project on the biodiversity of the area and, in particular, the CBAs and ESAs will need to be assessed. The presence of CBAs and ESAs trigger certain activities listed in GN R546 of the EIA Regulations requiring authorisation.

2.1.9 National Environmental Management: Integrated Coastal Management Act 24 of 2008

NEM: ICMA provides for the integrated management of the coastal zone, including the promotion of social equity and best economic use, while protecting the coastal environment.

Chapter 7 of the Act establishes integrated permitting procedures and other measures to ensure the protection and sustainable use of the coastal zone and its resources. This includes the requirement that adequate consideration be given to the objectives of this Act when considering applications for EA (and planning authorisation) for any development within the coastal zone, and the consideration of impacts on coastal public property, the coastal protection zone and coastal access land.

Chapter 8 of the Act establishes an integrated system for regulating the disposal of effluent and waste into the sea. In terms of Section 69, a coastal waters discharge permit (CWDP) is required from the DEA for the discharge of effluent into coastal waters.

In terms of Section 65, no person may occupy any part of, or site on, or construct or erect any building, road, barrier or structure on or in coastal public property, except under and in accordance with a coastal lease awarded by the Minister. However, the relevant legislation that would regulate procedures for obtaining a coastal lease in terms of NEM: ICMA has not yet come into force.

Legal requirements for this project:

The project will include the development of infrastructure in the coastal zone as well as coastal protection zone (defined as being within 1 km of the shoreline in rural areas) as well as the discharge of brine from the desalination plant into coastal water. Assessment of impacts on the coastal environment as well as a CWDP from the DEA: (Oceans and Coasts [O&C]) is thus required. It is likely that coastal use permits may be required in terms of Section 65 of NEM: ICMA for the construction of infrastructure in the coastal zone and for the abstraction of sea water, once relevant legislation promulgated in terms of NEM: ICMA comes into force.

2.1.10 Marine Living Resources Act 18 of 1998

The MLRA governs Marine Protected Areas (MPAs) and states that no person shall in any MPA, without permission, take or destroy any fauna and flora other than fish; dredge, extract sand or gravel, discharge or deposit waste or any other polluting matter; or in any way disturb, alter or destroy the natural environment; carry on any activity which may adversely impact on the ecosystems of that area.

Legal requirements for this project:

A number of MPAs have been declared under the MLRA and care must be taken to avoid any possible impact on these areas. The nearest MPA is at Saldanha Bay, approximately 250km south of the desalination plant. However, it is likely that a MPA associated with the Namaqua National Park *will be proclaimed in future. This MPA would be located approximately 20km northwest of the desalination plant (see Figure 4-9). As such the assessment of impacts on the marine environment must include the consideration of possible impacts on the future MPA.*

2.1.11 National Environmental Management: Control of Use of Vehicles in the Coastal Zone GN Regulations 496 of 27 June 2014

In terms of Section 3 of the NEM: Control of Use of Vehicles in the Coastal Zone Regulation, the use of vehicles within the coastal area is permissible without a permit on (inter alia):

- A public road; and
- Private land, by the owner, or with the written permission of the owner or lawful occupier of that land.

In terms of Section 4 of the Regulations, a permit is required for the use of a vehicle in a coastal area for the purposes of the construction or maintenance of infrastructure authorised by any law. The competent authority is the DEA: O&C and the vehicle access permit for the construction or maintenance of infrastructure must be granted by the Minister.

Legal requirements for this project:

The construction or maintenance of infrastructure in the coastal zone which requires the use of vehicles in the coastal zone would require a permit for the use of vehicles in this zone (or exemption from the requirements of these regulations).

2.1.12 Occupational Health and Safety Act 85 of 1993 and Major Hazard Installation Regulations

The OHSA and the MHI Regulations as amended in GN R. 692 of 30 July 2001 require a risk assessment of any MHI for the (permanent or temporary) storage of a quantity of a substance which may pose a risk to the health and safety of employees and the public. The risk assessment must be conducted prior to construction by an inspection authority approved by the Department of Labour.

Legal requirements for this project:

The project does not qualify as a MHI as the maximum volume of chlorine gas stored at the plant will be 3 tons or less[4]. However, due to the proposed use and storage of chlorine gas at the desalination plant, a risk assessment by an approved inspection authority, and compliance with relevant South African National Standards (SANS) standards is required. If alternatives to chlorine are found to be feasible, a risk assessment may not be required.

2.2 Planning Policy Framework

This section discusses a number of key formal planning policies relevant to the project. The policies and plans briefly discussed below include regional and local development and spatial plans, including the:

- The Northern Cape Provincial Growth and Development Strategy (PGDS) (2011);
- Northern Cape Provincial Spatial Development Framework (SDF) (2012);
- Northern Cape Province Coastal Management Plan (2005);

[4] If 10 tons of chlorine is stored in a single vessel, the plant would be considered an MHI.

- Namakwa District Biodiversity Sector Plan (NDBSP) (2008);
- Environmental Management Framework (EMF) and Strategic Environmental Management Plan (SEMP) for the Namakwa District Municipality (NDM);
- Integrated Development Plans (IDPs) for District and Local Municipalities, which formulate the specific needs in, and desirable developments for, municipalities; and
- SDFs for the District and Local Municipalities, which translate the aims of the IDP into a spatial dimension and, together with the IDP, aim to give effect to the national imperative to increase economic growth and promote social inclusion whilst ensuring that such growth is environmentally sustainable (DEA&DP, 2009).

This section implicitly examines the extent to which the proposed project is consistent with relevant plans, supported by an explicit analysis of need and desirability in Section 3.8.

2.2.1 Northern Cape Provincial Growth and Development Strategy (2011)

The PGDS is a guiding tool for future development in the Northern Cape and identifies poverty as the most significant challenge facing the province. Long- term sustainable economic growth and development is recognised as a priority in order to ensure that challenges associated with poverty are addressed. The PGDS aims to guide and coordinate the allocation of government resources and private sector investment in order to facilitate sustainable development.

The PGDS defines a vision for the Northern Cape: *'building a prosperous, sustainable growing provincial economy to eradicate poverty and improve development for a caring society'*. The overarching objective of the PGDS is to ensure the integration of development processes and, in particular, to facilitate sustainable development throughout the province.

2.2.2 Northern Cape Provincial Spatial Development Framework (2012)

The Northern Cape Provincial Spatial Development Framework (PSDF) is a spatial planning document that guides district and local spatial initiatives such as IDPs and SDFs. The PSDF is based on the principles of the PGDS and one of its overarching functions is to serve as a spatial land-use directive which aims to promote environmental, economic, and social sustainability through sustainable development.

The PSDF identifies a number of objectives including the following:

- Provide a spatial rationale and directive for future development in terms of the principles of sustainability as advocated by the National Strategy for Sustainable Development;
- Give spatial effect to the provisions of the PGDS and guide the implementation of key projects;
- Provide guidance to public and private infrastructure investment in the province, taking cognisance of the growth and development potential of the various regions and settlements in the province; and
- Spatially co-ordinate and direct the activities and resources of provincial government departments.

The PSDF identifies a number of Spatial Planning Categories (SPCs). These SPCs were formulated in terms of bioregional planning principles and collectively illustrate the desired matrix of land- use throughout the province. The SPCs are used to define a spatial vision for the province and are illustrated in the composite spatial vision of the Northern Cape Province (Figure 2-1). The SPCs also provide a framework to guide decision- making regarding land- use at all levels of planning.

The SPCs identified for the area surrounding the proposed development area include core, buffer and agricultural areas. Core areas are defined as statutory protected areas, while buffer areas include ecological corridors. The agricultural areas in the vicinity of the project area are considered to be suitable for grazing. According to the composite spatial vision for the Province, the N7 is identified as an important development corridor and the western coastline is highlighted as an important fishing and mariculture corridor.

The PSDF identifies a general approach to the investment of public and private funds. This is based on the business principle that investment should be directed where the best return on such investment can be generated. Garies and Kamieskroon are identified as having a high level of development potential and a low level of human need. They are therefore considered as being high priority areas for public and private investment and infrastructural development. Investment into social capital is not deemed essential in these areas and investment can be directed toward infrastructural development and large scale capital investment, producing secondary economic and social benefits.

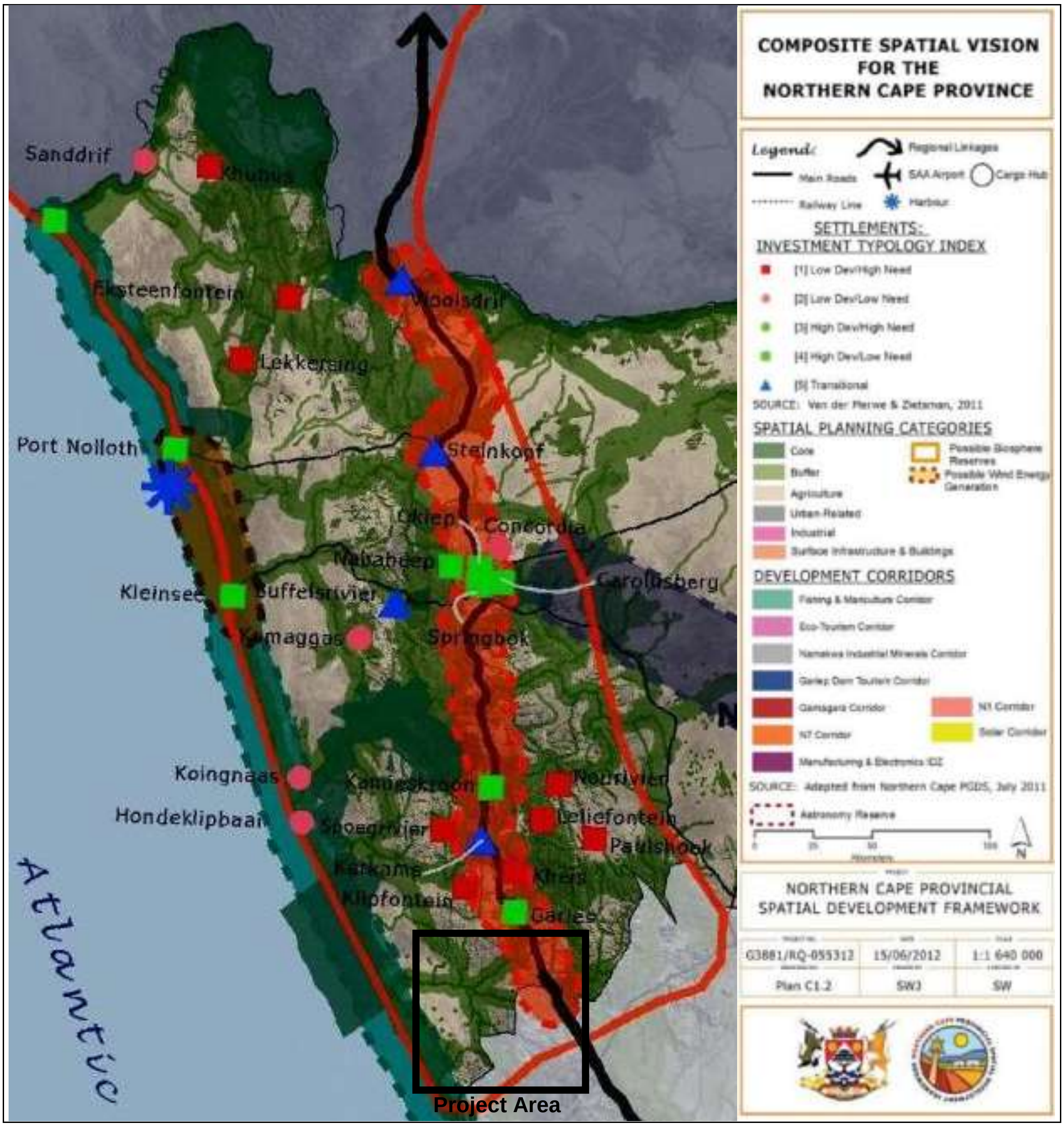


Figure 2-1: PSDF: Composite Spatial Plan

Source*:* Northern Cape Provincial Government (*NCPG) (2012)*

2.2.3 Northern Cape Province Coastal Management Plan (2005)

The Northern Cape Province Coastal Management Plan (2005) has adopted a vision: '*to promote sustainable coastal development and the realization of livelihoods that reflects the true range of ecological and socio-economic opportunities in Namaqualand coastal zone*'. The aim is to achieve this by creating co-operative governance institutions and capacity in order to promote integrated coastal management. A number of goals and strategies are identified in terms of the Plan. These aim to:

- Preserve, protect or promote historical and cultural resources and activities of the coast;
- Promote the diversity, vitality and long-term viability of coastal economies and activities;
- Maintain an appropriate balance between built, rural and wilderness coastal areas;
- Appropriately manage and ensure that the public has the right to physical access to the sea and the opportunities and benefits of the coast;
- Alleviate coastal poverty through proactive coastal development initiatives;
- Manage coastal settlements to be in harmony with local and regional aesthetic, amenity, biophysical and cultural opportunities and constraints;
- Maintain the diversity, health and productivity of coastal processes and ecosystems;
- Establish coastal protected areas;
- Use non-renewable coastal resources in a manner that optimises public interest and retains options for alternative and future uses;
- Plan and manage coastal developments with regard to natural hazards to minimise the risk of damage caused by coastal processes (climate change, sea- level rise, etc.);
- Implement pollution control and waste management measures in order to prevent, minimise and strictly control harmful discharges into coastal ecosystems; and
- Manage polluting activities to ensure that they have minimal adverse impacts on the health of coastal communities, and on coastal ecosystems and their ability to support beneficial human uses; and
- Rehabilitate damaged or degraded coastal ecosystems and habitats.

2.2.4 Namakwa District Biodiversity Sector Plan (2008)

The NDBSP served as a guideline to inform the Namakwa Bioregional Plan that was published in terms of NEM: BA in 2010. It aims to help guide land-use planning, environmental assessments and natural resource management in order to promote sustainable development in the NDM through the identification of potentially sensitive environmental areas, including CBAs.

The NDBSP identifies terrestrial and aquatic CBAs (Type 2), and terrestrial and aquatic ESAs within the study area (Figure 2-2). Type 2 terrestrial and aquatic CBAs are listed as important areas known to be of high biodiversity value and should be maintained as near-natural landscapes with no or limited loss of biodiversity patterns and a limited loss of ecosystem processes.

Terrestrial and aquatic ESAs are listed as areas that support key biodiversity resources (e.g. water) or ecological processes (e.g. movement corridors) in the landscape and should be maintained as near-natural landscapes. Some loss of biodiversity and a limited loss of ecosystem processes are permissible in these areas.

Linear engineering structures as well as *water projects and transfers* are listed as restricted activities within both terrestrial and aquatic CBAs (Type 2) and ESAs, but are not considered to be unsuitable activities in terms of the NDBSP and are not actively discouraged.

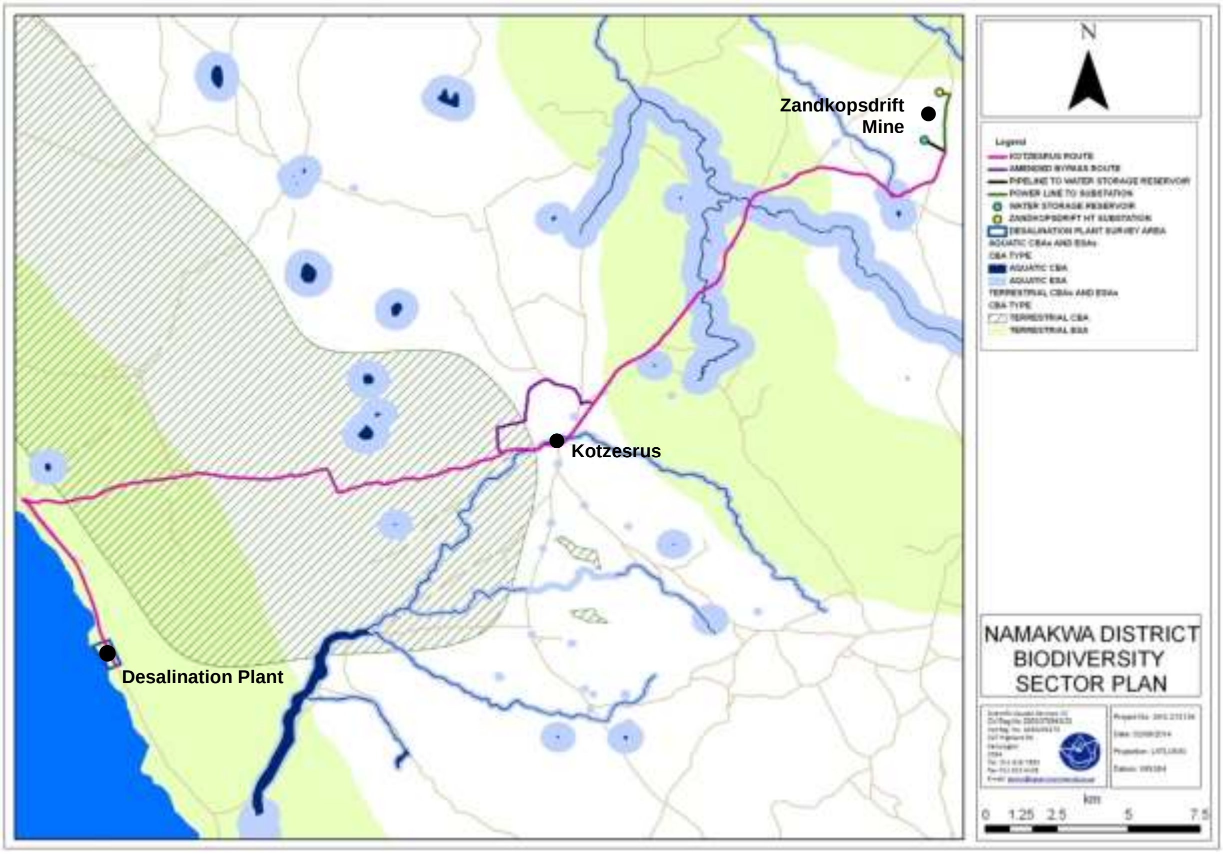


Figure 2-2: Critical Biodiversity Areas (Namaqua District Biodiversity Sector Plan)

Source: Zdanow et al. (2014)

2.2.5 Environmental Management Framework and Strategic Environmental Management Plan for the Namakwa District Municipality

The EMF and SEMP for the NDM provides a high level implementation plan for sustainable development. The document defines the state of the environment, describes the inherent environmental opportunities and constraints in the area and provides monitoring and management measures that can be used to achieve the environmental vision that is outlined for the NDM and the desired state of the environment (Chidley et al., 2011).

The vision for the NDM in terms of the EMF and SEMP is: 'to ensure that economic and social development in the NDM advances to meet inhabitants' needs whilst ensuring that environmental goods and services are protected where stressed and used where sustainable'.

The EMF and SEMP identifies a number of environmental opportunities and constraints, including:

- Water scarcity and the poor and unreliable overall quality of groundwater resources (particularly in the vicinity of Garies);
- The effect of climate change in the Namaqua District which will likely include more variable and severe climatic conditions, an increase in water demand, less reliable water supply, reduced recharge and increased salinization of groundwater resources.
- The unique biodiversity of the NDM is important for economic, cultural, aesthetic, scientific and educational purposes. Major threats to biodiversity in the area include invasive species, habitat

loss due to agriculture, mining and urbanisation, exploitation of species of interest; and climate change;

- Wetlands are an important biodiversity resource and are of provide important functions in terms of groundwater recharge, water treatment, habitat provision and tourism;
- The coastal area has an abundance of marine and coastal resources, however, coastal infrastructure is not well developed and this has hampered the fishing and mariculture industry;
- Mining has played an important economic role in the District; and
- Large portions of the coastal area have been transformed through diamond mining (especially on the northern coastline of the NDM near Alexander Bay and Hondeklipbaai).

The EMF and SEMP identifies a number of strategic management measures to ensure that environmental resources in the NDM are managed sustainably. Relevant measures applicable to the project include:

- Discourage new human settlements and development where water supplies cannot be secured;
- Seek alternative water sources to ensure security of water supplies and investigate interim solutions such as the provision of potable water from desalination;
- Ensure storage reservoirs have a very low surface area to storage volume ratio to reduce water loss;
- Encourage current industries and proposed developments to make use of water and energy conservation measures and encourage effective water re- use and recycling;
- Encourage mining where environmental impacts are deemed to be acceptable, the appropriate environmental controls are in place and economic benefits will exceed potential environmental impacts;
- Secure access to the coastline in the less disturbed southern parts of the NDM in order to encourage tourism;
- Ensure that longitudinal developments that traverse biodiversity corridors incorporate mitigation measures to ensure that the biodiversity corridors are not severed; and
- Protect visually and ecologically sensitive areas in order to promote conservation and tourism.

The EMF and SEMP divides the NDM into a number of Environmental Management Zones (EMZs). These zones provide an indication of sensitivity and the resilience of the receiving environment to various types of development. EMZs identified in the project area include EMZ B (the NDM coastal area) and EMZ C (the area surrounding Kotzesrus). Areas in EMZ B are considered to have *very high* sensitivity while areas in EMZ C are considered to have *high* sensitivity. No critically sensitive areas (EMZ A) are identified in the project area.

The following management measures are suggested for the EMZ B and EMZ C areas respectively:

- EMZ B: Restrict development in terms of type and magnitude of impact. Do not exclude development where compelling economic and social benefits will be derived for the local and regional population; and
- EMZ C: Ensure that development serves to complement the area and limit development, where relevant.

2.2.6 Namakwa District Municipality Integrated Development Plan (2012 -2016)

The NDM's IDP (NDM, 2012) is a strategic plan that is used to guide the development of the District for a specific period. It guides the planning, budgeting, implementation, management and future decision making processes of the District Municipality. The IDP identifies the high level of unemployment and low education level in the District as an indication of the urgent need to develop human capital in the District in order to reduce poverty.

The key outcomes of the District Municipality's implementation plan identified in the IDP and the projects identified to achieve each of the following desired outcomes are as follows:

Outcomes identified in the IDP:	**Associated projects identified in the IDP**:
• Improved quality of basic services;	• The transformation and development of the mining sector: implementation of the Social and Labour Plans (SLPs);
• Decent employment through inclusive economic growth;	• Job creation through infrastructure development;
• A skilled and capable workforce to support an inclusive growth path; and	• The transformation and development of the mining sector: data capturing and information management to determine the impact of all SLPs in the District;
• An efficient, competitive and responsive economic infrastructure network.	• Infrastructure development; • Socio- economic development; and • Trade and investment.

2.2.7 Namakwa District Municipality Spatial Development Framework

The NDM's SDF (CNdV, 2012) aims to provide a framework for the spatial management of growth in urban and rural environments in order to ensure that urbanisation and the associated impact on resources can be accommodated. The SDF intends to show desired patterns of land use, directions for future growth, indicate the alignment of urban edges, and depict other special development areas in the NDM.

The SDF defines the spatial vision for the NDM as: 'an exciting mix of cultural wilderness, floristic, river and coastal tourism; mining and mining beneficiation; agriculture including intensive irrigation and dry land farming, livestock grazing and game; and mariculture and coastal opportunities that includes fishing and abalone ranching'.

According to the SDF, the following actions should be taken to achieve this vision:

- Ensure adequate and appropriate infrastructure;
- Maximise the amount of beneficiation that occurs from mining and agriculture through providing necessary facilities, training, education, environmental development and business support with a focus on economic empowerment; and
- Eradicate poverty and improve social development by strengthening the economy and thriving sectors.

The SPCs that were identified in the PSDF are included in the NDM's SDF. The SDF identifies five broad SPCs including: core areas, buffer areas, agricultural areas, urban settlements and industrial areas (Figure 2-3). The SPCs that were identified in the project area include: buffer areas (ecological corridors and river corridors) and agricultural areas (mostly extensive agriculture/ grazing).

The SDF provides policies for development within each of the SPCs. Policies for buffer areas and agricultural areas include low density development (1 building per 10 hectares), clustered development, and no further subdivisions of agricultural land below a minimum farm size. The SDF also identifies Garies and Kamieskroon as economic growth points as both these settlements have high development potential.

The SDF identifies a number of opportunities associated with the coastal areas within the District Municipality including tourism, fishing, mining, coastal wind farms and desalination plants. The SDF advises that gravel roads between settlements should be upgraded and maintained so that they can provide access for tourism and the transportation of agricultural produce. The SDF also states that the Kamiesberg area (within which the project falls) is considered to be a major agricultural area and that good roads are necessary in order to stimulate economic activity and tourism.

According to the SDF, two existing mines are identified to the southwest of Garies and a potential mine is identified to the northeast of the town. A nuclear disposal site is located to the northwest of Garies and the SDF iterates that no development should be allowed in this area. The SDF also highlights the development of a proposed gas pipeline from Hondeklipbaai south towards Saldanha Bay harbour. This pipeline falls within the project area.

2.2.8 Kamiesberg Local Municipality Integrated Development Plan

The Kamiesberg Local Municipality (KLM)'s IDP identifies certain areas of concern in the Municipality that must be addressed, and aims to provide for the implementation of strategies to address these. These strategies incorporate the vision, mission, values and objectives of the Municipality. The IDP defines the vision for the Municipality: '*to better the guiding of life for all its inhabitants*'. The objectives of the IDP include:

- Meeting Basic Needs;
- Stimulating the Economy;
- Improving Service Delivery; and
- Capacitating Local Government.

The KLM IDP identifies a number of sectors with economic growth and development potential. These include: livestock grazing, mining and tourism. The IDP also identifies two emerging sectors, *viz*. aquaculture and conservation and ecological restoration. However, according to the IDP, these sectors cannot provide sufficient employment to address high unemployment levels in the area and it is considered unlikely that the Municipality will become an economic driving force in the region. Major challenges faced by the Municipality include:

- Water scarcity, which is one of the biggest concerns in the area;
- Poor roads and accessibility;
- The lack of railways, harbours and airports;
- Low education levels resulting in the lack of skills and qualifications;
- Dispersed nature of settlement. (Large portions of the population live in dispersed settlements that are approximately 80 km from each other and connected with gravel roads); and
- The downscaling of the mining industry, which this is the core employment source in the area.

Figure 2-3: Namakwa District Municipality Draft Municipal SDF: Kamiesberg Area

Source: CNdV (2012)

However, due to its location and physiographic characteristics, there are a number of opportunities which could be utilised to the benefit of the people of the Kamiesberg area. These include opportunities for investment in mariculture, alternative energy, tourism, mining, livestock farming and a conservation based economy.

2.2.9 Kamiesberg Local Municipality Spatial Development Framework (2010- 2015)

The KLM's SDF is a component of the Municipality's IDP. It essentially illustrates the form and extent of development that the KLM wants to promote, taking the strategic approach adopted by the IDP into consideration (Figure 2-4). The SDF aims to guide and inform all decisions on spatial development and land use management within the Kamiesberg Municipal area.

The SDF iterates that effective linkages and good accessibility are considered to be of prime importance to achieve the objectives of the IDP. This is considered necessary to ensure growth in the tourism industry, linkages to other regions, effective service delivery, access to internal and external markets for the agricultural industry and access to external markets for the mining industry.

The SDF identifies a number of small dysfunctional settlements spread throughout the Kamiesberg Municipal area. The majority of the settlements (with the exception of Kamieskroon and Garies) do not have the capacity to function as economic centres or create economically viable livelihoods. The SDF also iterates that the fragmented spatial pattern of the settlements in the Municipality is costly to maintain. Furthermore, these areas are known for high levels of unemployment and poverty. The SDF therefore defines a spatial hierarchy for the Municipality in order to rationalise the provision of services to areas within the Municipality. The town of Garies is identified as a Class B settlement type (administrative node) in terms of the SDF and Kotzesrus and Lepelsfontein are considered to be Class F settlements. The expansion of Class F settlements is not recommended by the SDF.

The area around Koingnaas and Hondeklipbaai is designated as an economic growth point. This area is situated adjacent to the Namaqua National Park, which provides opportunities for tourism development. The SDF supports a proposal that the Park is expanded to include areas to the north, west and east of the existing reserve. The establishment of a MPA adjacent to the reserve is also suggested. This provides an opportunity for the development of resorts and tourist accommodation.

The SDF proposes the development of a desalination plant at Hondeklipbaai in order to address water shortage concerns in the KLM. It is proposed that the plant have sufficient capacity to meet the needs of the Namaqua District Municipality. The Hondeklipbaai area is also highlighted as a potential development node for fishing and mariculture industries and is considered suitable for wind energy generation. A gas field is located approximately 70 to 105 km offshore of Hondeklipbaai and there is therefore the potential to benefit from infrastructure associated with the exploitation of oil and gas resources in the area.

The SDF further emphasises the importance of linkages and accessibility. The N7 is identified as an important mobility corridor, while arterial roads and local connector roads are also considered to be of importance. The route between Garies and Kotzesrus is identified as an access road in terms of the SDF. The west coast road along the Namaqua coastline is also highlighted in the SDF and a bulk water supply pipeline is envisaged between Garies and Lepelsfontein.

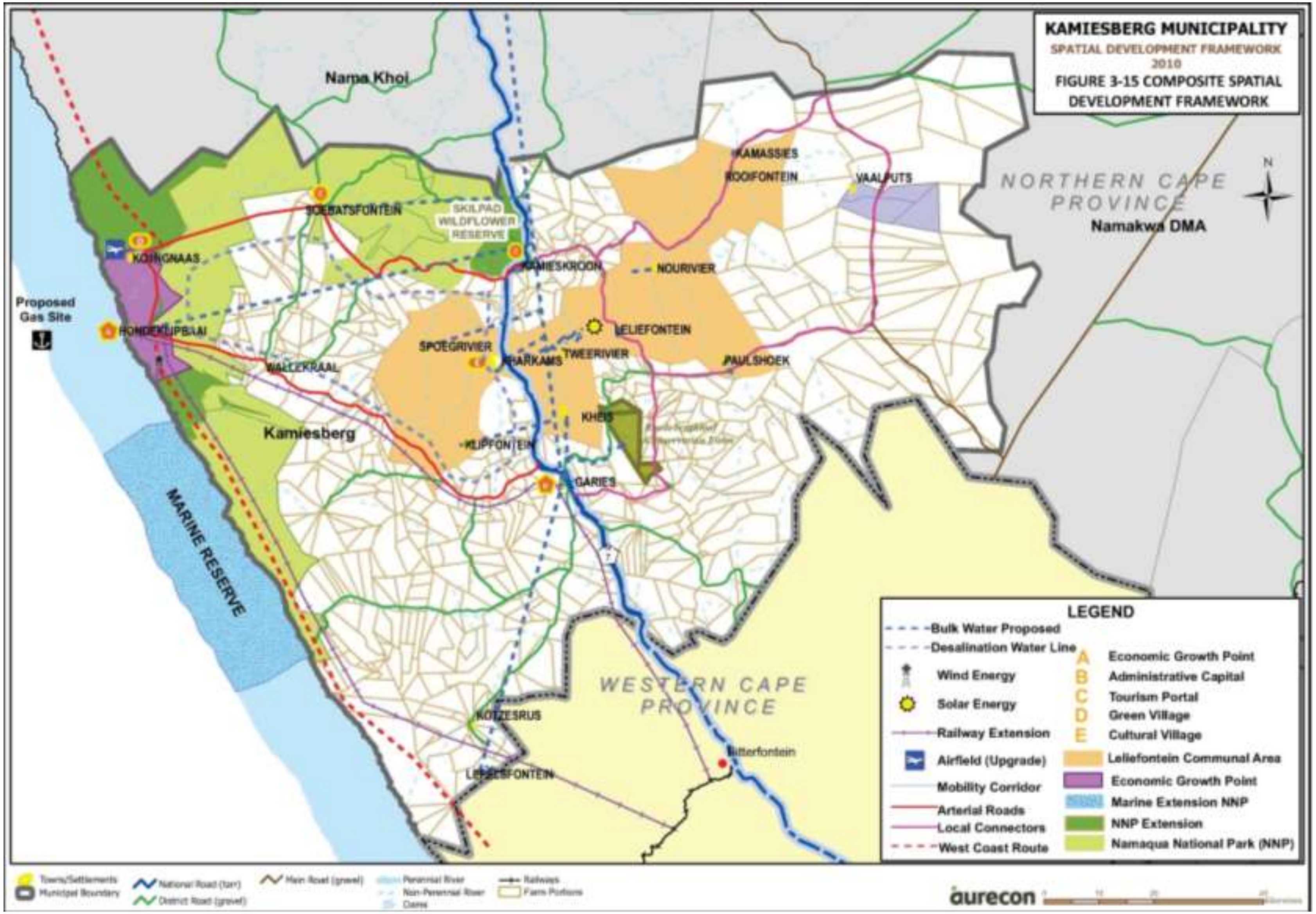


Figure 2-4: Kamiesberg Local Municipality SDF: Composite Plan

Source: Kamiesberg Local Municipality SDF (Higgs et al. 2010)

2.3 Environmental Process

The general approach to this study is guided by the principles contained in Section 2 of NEMA and those of Integrated Environmental Management (IEM).

NEMA lists a number of **principles** that apply to the actions of organs of state and that also serve as reference for the interpretation of environmental legislation and administration of environmental processes. The principles most relevant to environmental assessment processes and projects for which authorisation is required are summarised below.

Principles relevant to the EIA process:

- Adopt a risk-averse and cautious approach;
- Anticipate and prevent or minimise negative impacts;
- Pursue integrated environmental management;
- Involve stakeholders in the process; and
- Consider the social, economic and environmental impacts of activities.

Principles relevant to the project:

- Place people and their needs at the forefront of concern and serve their needs equitably;
- Ensure development is sustainable, minimises disturbance of ecosystems and landscapes, pollution and waste, achieves responsible use of non-renewable resources and sustainable exploitation of renewable resources;
- Assume responsibility for project impacts throughout its life cycle; and
- Polluter bears remediation costs.

This S&EIR process complies with these principles through its adherence to the EIA Regulations, 2010 and associated guidelines, which set out clear requirements for, *inter alia,* impact assessment and stakeholder involvement (see below), and through the assessment of impacts and identification of mitigation measures during the Impact Assessment Phase. An initial analysis of the project's compliance with the aims of sustainable development is provided in Section 3.8 as well as in the impact assessment.

In accordance with the **IEM** Information Series (DEAT, 2004), an open, transparent approach, which encourages accountable decision-making, has been adopted.

Although various environmental authorisations, permits or licences are required before the proposed project may proceed, the regulatory authorities are committed to the principle of cooperative governance and in order to give effect to this principle, a single S&EIR process is required to inform all applications. To this end, a single EIA Report (this report) has been compiled. The EIA Report will be submitted to the NCDENC in support of the application for environmental authorisation of NEMA listed activities.

Supplementary applications will be made as required for the remaining authorisations.

The underpinning principles of IEM require:

- Informed decision making;
- Accountability for information on which decisions are made;
- A broad interpretation of the term “environment”;
- An open participatory approach in the planning of proposals;
- Consultation with interested and affected parties;
- Due consideration of alternatives;
- An attempt to mitigate negative impacts and enhance positive impacts of proposals;
- An attempt to ensure that the social costs of development proposals are outweighed by the social benefits;
- Democratic regard for individual rights and obligations;
- Compliance with these principles during all stages of the planning, implementation and decommissioning of proposals; and
- The opportunity for public and specialist input in the decision-making process.

The study will also be guided by the requirements of the EIA Regulations, 2010 (see Section 2.1.2), which are more specific in their focus and define the detailed approach to the S&EIR process, as well as relevant guidelines published by the DEA and, in the absence of guidelines published by NCDENC, the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP)[5], including:

- DEA’s Draft Companion to Environmental Impact Assessment Regulations of 2010 (DEA, 2010); and
- DEA&DP’s EIA Guideline and Information Document Series (DEA&DP, 2013), which includes guidelines on Generic ToR for EAPs and Project Schedules, Public Participation, Alternatives, Need and Desirability, Exemption Applications and Appeals, an information; and
- DEA&DP’s Information Document on the Interpretation of the Listed Activities (DEA&DP, 2011).

2.3.1 Submission of Applications

Various environmental authorisations, permits or licences are required before the proposed project may proceed. Some application forms must be submitted at the outset of the S&EIR process (e.g. in terms of the EIA Regulations and NHRA) while licences and permits in terms of the NWA and NEM: ICMA are only issued after EA and are submitted towards the end of the EIA process. The required authorisations and their status are listed in Table 2-2.

[5] As no specific guidelines are available from NCDENC, reference is made to DEA and DEA&DP guidelines.

Table 2-2: Environmental Authorisations, Permits and Licences Required for the Project

Application	Authority	Status
EA	NCDENC	Application was submitted to the NCDENC on 22 April 2013 and accepted on 25 April 2013. Reference numbers **NC/EIA/07/NAM/KAM/KOT1/2013** and **NCP/EIA/0000225/2013** were issued for the application.
Heritage Application	SAHRA	Application was submitted via the SAHRIS on 29 April 2013. Acknowledgement of receipt was received from SAHRA on 2 May 2013 and **Case ID. 2130** was allocated to the project. SAHRA requested the completion of a Heritage Impact Assessment (HIA), inclusive of an Archaeological and Palaeontological Impact Assessment on 30 August 2013 in response to the release of the Scoping Report.
WUL	DWS	Application was submitted to DWS with the release of the draft EIA Report for public comment in October 2014.
CWDP[6]	DEA: O&C	Application was submitted to DEA: O&C on 10 September 2014. Acknowledgement of receipt was received on 25 September 2014. Reference number **2014/017/NC/Volwaterbaai Desalination Plant** was issued for the application.

2.3.2 S&EIR Process and Phasing

The S&EIR process consists of two phases, namely the Scoping Phase (which has been completed) and an Impact Assessment Phase *(*the current phase*)* (see Figure 2-5 below).

The objectives of the **Scoping Phase** were to:

- Identify stakeholders and inform them of the proposed activity, feasible alternatives and the S&EIR process;
- Describe the affected environment and present an analysis of the potential environmental issues and benefits arising from the proposed project that may require further investigation in the Impact Assessment Phase;
- Develop ToR for specialist studies to be undertaken in the Impact Assessment Phase;
- Provide stakeholders with the opportunity to participate effectively in the process and identify any issues and concerns associated with the proposed activity, review specialist study ToR and the Plan of Study for EIA; and
- Produce a Scoping Report for submission to the relevant authorities (in this case, DEA and DWS).

[6] Any other permits or licences required in terms of the NEM:ICMA will be determined in consultation with DEA.

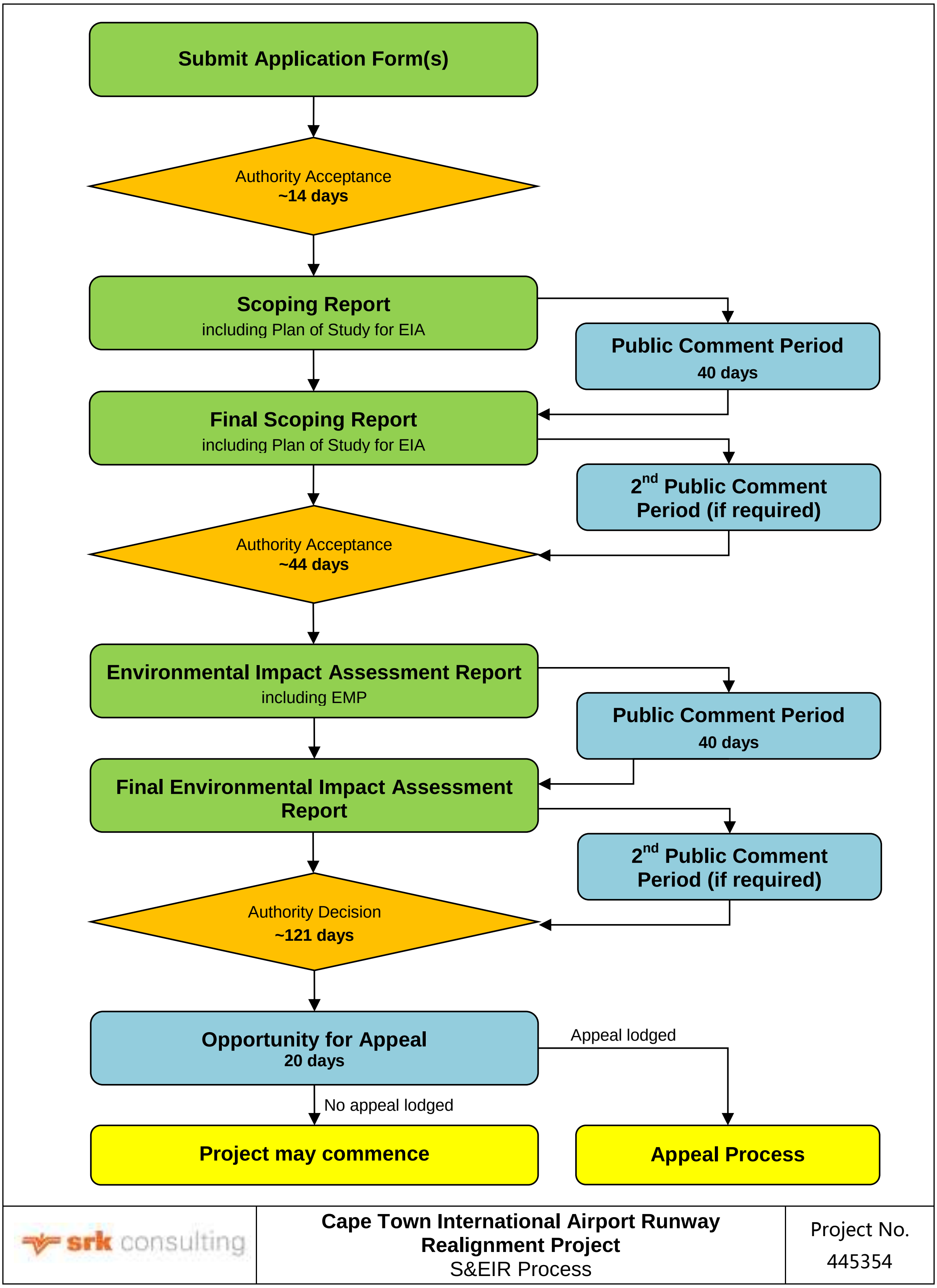


Figure 2-5: S&EIR Process

The aims of the **Impact Assessment Phase** are to:

- Inform and obtain contributions from stakeholders, including relevant authorities, the public and local communities and address their relevant issues and concerns;
- Build capacity amongst stakeholders during the S&EIR process so that they may actively and meaningfully participate;
- Document and contextualise the biophysical baseline conditions of the study area and the socio-economic conditions of affected communities;
- Assess in detail the potential environmental and socio-economic impacts of the project;
- Identify environmental and social mitigation measures to avoid and/or address the impacts assessed; and
- Develop and/or amend environmental and social management plans based on the mitigation measures developed in the EIA Report and EMP.

Further detail about activities undertaken or planned during the S&EIR process are presented in Section 5.

3 Project Description

3.1 Introduction

The project design information in this chapter reflects the information available at the time of the compilation of the EIA Report. The detailed design and EIA are being undertaken concurrently and the project description has evolved slightly from that which was presented in the Scoping Report.

3.2 Background to the Project

Sedex Minerals propose to develop the Zandkopsdrift Rare Earth Element mine on the remainder of the Farm Zandkopsdrift 537, and portion 2 of the Farm Zandkopsdrift 537, in the Northern Cape Province (See Figure 1-1). The development of the mine is subject to a separate EIA process, being conducted by Africa Geo-Environmental Services Gauteng (Pty) Ltd (AGES) (NCDENC Ref: NC/EIA/NAM/KAM/ZAN/2012).

Due to the shortage of water resources in the area, a seawater desalination plant is proposed at Volwaterbaai on the Farm Strandfontein 559, Namaqualand to supply water to the mine. Sedex Desalination, a subsidiary of Sedex Minerals, was established specifically to develop a desalination plant for this purpose. The water will be pumped via pipeline from the desalination plant to the mine, with a reservoir located at Kotzesrus. An access/maintenance road and power lines will also be established between the mine and the desalination plant.

The current design of the desalination plant and associated infrastructure is for the provision of a maximum of 8 Mm^3/a of product water.

3.3 Description of the Project Area

3.3.1 Site Description

The site for the desalination plant and associated infrastructure is located in Namaqualand, which stretches along the west coast of the Northern Cape and further inland. The area is known for its unique, isolated arid environment.

The proposed desalination plant will be constructed at Volwaterbaai on the Farm Strandfontein 559, located on the west coast of the Northern Cape Province approximately 55 km northwest of Bitterfontein (in the Western Cape Province); approximately 15 km west of the town of Kotzesrus and approximately 29 km southwest of Garies (both in the Northern Cape Province) (see Figure 3-1).

The Farm Strandfontein 559 is owned by Sedex Minerals and measures approximately 12 259 ha and is zoned for Agriculture. The property contains relatively pristine indigenous coastal vegetation that is used for grazing purposes on an intermittent basis by a farmer in the area. It is proposed that the small portion(s) of the property that will be required for the desalination plant will be rezoned and subdivided from the remainder of the Farm, with the possibility to sell the unutilised portions in future.

TransHex have been granted diamond prospecting rights on the property although no prospecting (or mining) activities are currently taking place. The previously proposed development by Forest Oil of gas supply infrastructure and a desalination plant on the northern portion of Farm Strandfontein 559 has been withdrawn.

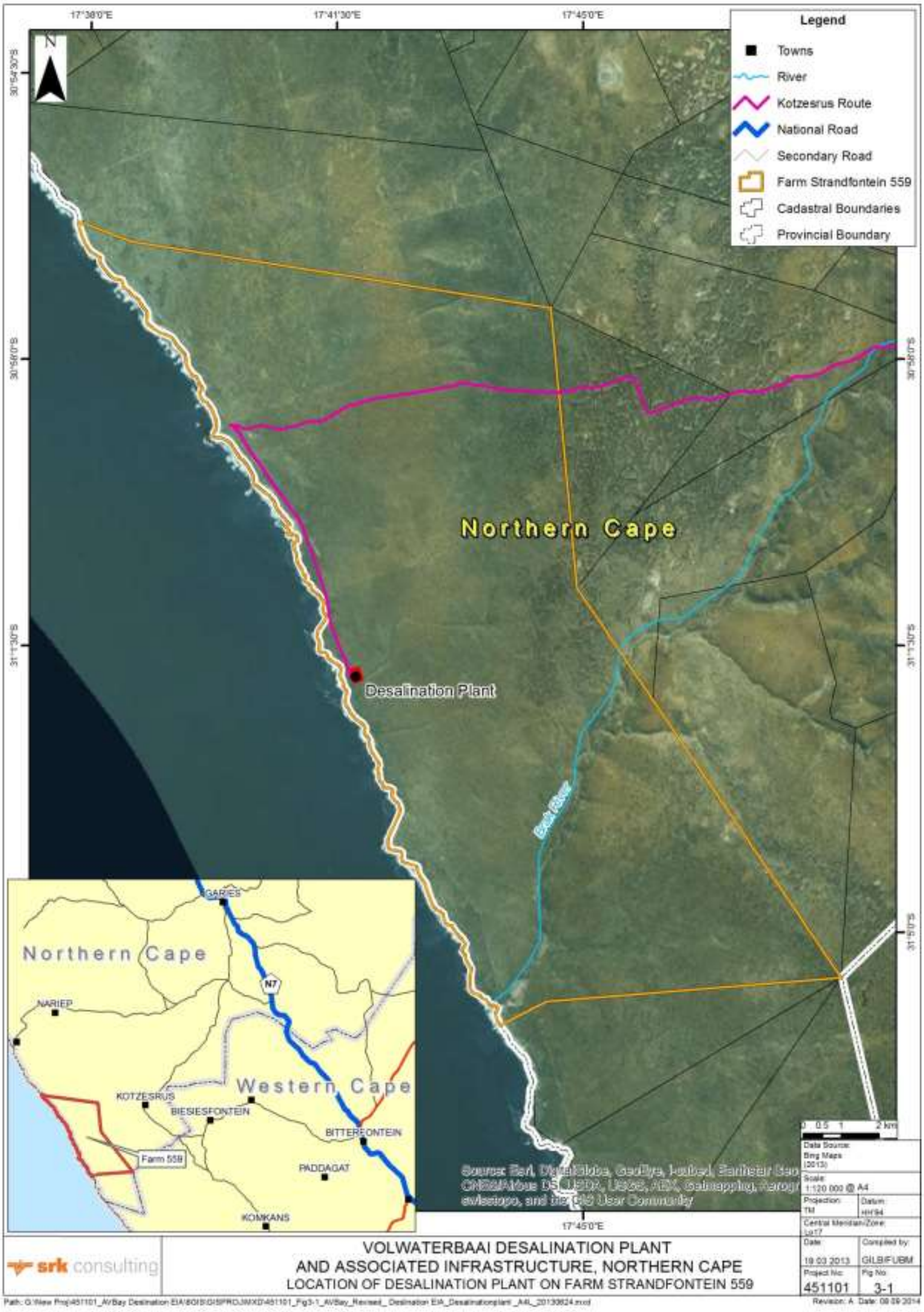


Figure 3-1: Location of Desalination Plant on Farm Strandfontein 559

The desalination plant will be located approximately 6 km north of the Brak River on a typical stretch of the Namaqualand coastline, comprising rocky coastal outcrops interspersed with sandy beaches. From the desalination plant, water supply pipelines, overhead power lines and an access road servicing the plant (hereafter linear infrastructure or linear routes) will be routed along what is currently a combination of 4 x 4 tracks and dirt roads to the Zandkopsdrift Mine, a distance of approximately 49 km.

The various sections of the proposed linear route between the desalination plant and the Zandkopsdrift Mine are illustrated in Figure 3-2 and Figure 3-3. The direct route between the desalination plant and the Zandkopsdrift Mine (the *Kotzesrus Route*) will:

- Follow (and be restricted to) an existing coastal dirt road in a north-westerly direction for approximately 6.5 km;
- Turn to the east on a 4 x 4 track traversing Farm Strandfontein 559 and follow mostly existing 4 x 4 tracks towards Kotzesrus for approximately 17.5 km through areas of natural vegetation (including sensitive Sand Fynbos vegetation) and farmland that is used mostly for grazing;
- Follow (and be restricted to) the existing gravel road between Kotzesrus and Garies, passing through agricultural (grazing) land for approximately 13 km;
- Turn to the east, following an existing route for approximately 5 km towards the Zandkopsdrift Mine;
- At the Zandkopsdrift Mine, a pipeline (approximately 700 m in length) will deviate from the route, extending towards the water storage reservoir to the northwest; and
- A power line (approximately 2 km in length) will extend in a northerly direction towards the Zandkopsdrift HT substation.

Two alternative routes (the *Bypass Route* and the *Alternative Bypass Route*) were identified during the Scoping phase to bypass the town of Kotzesrus (see Section 6.1.3). These routes follow existing tracks and previously undisturbed areas over privately owned farmlands, and were identified in consultation with relevant property owners. These routes have been amalgamated into a single bypass alternative, the *Amended Bypass Route,* which are assessed in the EIA.

The proposed infrastructure alignment routes may also cross existing services such as water and sewer mains, telecommunications and power cables, gas and oil pipelines, other existing roads and rail infrastructure. Eskom is currently planning a 400 kVA line which may cross portions of the potential route alignments in the vicinity of Kotzesrus.

3.3.2 Surrounding Land Use

The project area is typical of the sparsely inhabited Namaqualand region and the desalination plant is in a remote location. The area surrounding the desalination plant and the linear infrastructure is mostly used for agricultural purposes. Livestock (sheep) grazing is the dominant form of agricultural activity in the area. Dryland crop farming occurs closer to the Zandkopsdrift Mine.

The coastal area at Farm Strandfontein 559 falls within commercial rock lobster fishing zones that extends from Kleinzee to the mouth of the Brak River. Rock lobsters are mostly harvested from shallow waters (<30 m) along the coast and kelp, too, is also harvested commercially along the coast.

Coastal gravel road leading towards desalination plant

Namaqualand Coastal vegetation on Farm Strandfontein 559

Existing 4 x 4 tracks on Farm Strandfontein 559

Sensitive Sand Fynbos vegetation en route towards Kotzesrus

Approach to town of Kotzesrus from desalination plant

Existing gravel road between Kotzesrus and Zandkopsdrift Mine

srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** Project Area and Existing Roads	Project No. 451101

Figure 3-2: Views of the Project Area and Existing Roads

Source: SRK

Abalone ranching has been identified as a key economic development opportunity along the Namaqualand coast and areas have been identified that may be suitable for this purpose. The proposed desalination plant is located approximately 50-60 km south of the southern-most identified abalone ranching zone.

The coastal area is used for recreational purposes, particularly during the summer months. Recreational activities at the coast include camping, catching rock lobster and line fishing.

Although there are few commercial activities in the vicinity of Kotzesrus, a small shop (the Kotzesrus Cash Store) is located in the centre of the town, mainly serving the local residents, tourists and residents of Lepelsfontein.

The properties in the vicinity of the project area (particularly those around Kotzesrus) are largely privately owned and zoned for Agriculture. Properties that may be affected by the development are shown in Figure 3-3. Property owners in control of the land in which the project infrastructure will be located are listed in Table 3-1 and an indication of the potential elements of the project that affect individual properties is provided.

Table 3-1: Affected Properties and Property Owners

Erf / Farm Number	Property owner	Relevant project elements
Farm Strandfontein 559 (RE/559)	Sedex Minerals (Pty) Ltd	*Kotzesrus Route* and desalination plant
Riet Veldt 558 (RE/558)	de Beers Consolidated Mines Ltd	*Kotzesrus Route*
Remainder of Farm Nuwe Begin 641 (RE/641)	Mr Fanie Nel Mrs Tilma Nel	All routes
Portion 1 of Farm Nuwe Begin 641 (1/641)	Mr Tielman Nieuwoudt	*Kotzesrus Route*
Portion 1 of Brakfontein 555 (Nieuwefontein), Portion 5 of Farm Klipheuwel 538 (5/538), Portion 7 Farm Brakfontein 555 (7/555)	Mr Isak Abraham Nieuwoudt	*Amended Bypass Route* and reservoirs and associated infrastructure around Kotzesrus and *Kotzesrus Route*
Welgemeend Portion 2 of Farm Varsfontein 554 (Consolidated) (2/554)	Mr AJ Cornelissen	*Amended Bypass Route* and associated infrastructure around Kotzesrus
Portion of Hendriksvlei, Portion 1 and Remainder of Brakfontein 551 (RE/551), Portion 5 of Klipheuwel, Remainder of Varsfontein 554 (RE/554), Portion 1 Farm Brakfontein 553 (1/553).	Mr CA Louw	*Amended Bypass Route* and associated infrastructure around Kotzesrus
Portion 6 which is a Portion of Portion 5 Farm Hendriksvlei	Buchuberg Exploration and Farming (Mr An Cornelissen)	*Amended Bypass Route*
Portion 14 Farm Brakfontein 555 (14/555)	Mrs Betsie van Zyl	*Kotzesrus Route*
Portion 17 Farm Brakfontein 555 (17/555)	Andries Jacobus du Toit	*Kotzesrus Route*
Portion 3 Farm Brakfontein 553 (3/553)	Mr Theo Schutte	*Kotzesrus Route*
Portion 1 Farm 540	Langkloof Familie Trust	*Kotzesrus Route*
Portion 2 of Farm Zandkopsdrift 537 (2/537)	Sedex Minerals (Pty) Ltd	*Kotzesrus Route* and Zandkopsdrift Mine

A number of small settlements are located in the vicinity of the project area. These include:

- Kotzesrus (~15 km northwest of the proposed desalination plant);
- Lepelsfontein (~13 km southeast of the proposed desalination plant and ~10 km south of Kotzesrus);
- Stofkraal, Rietpoort and Molsvlei (in the vicinity of the Zandkopsdrift Mine); and
- Garies (~35 km northwest of the Zandkopsdrift Mine).

Kotzesrus lies approximately halfway between the Zandkopsdrift Mine and the proposed desalination plant on Farm Strandfontein 559 (see Figure 1-1) and would be most directly affected by the linear infrastructure. The major towns in the vicinity of the project area are briefly described below.

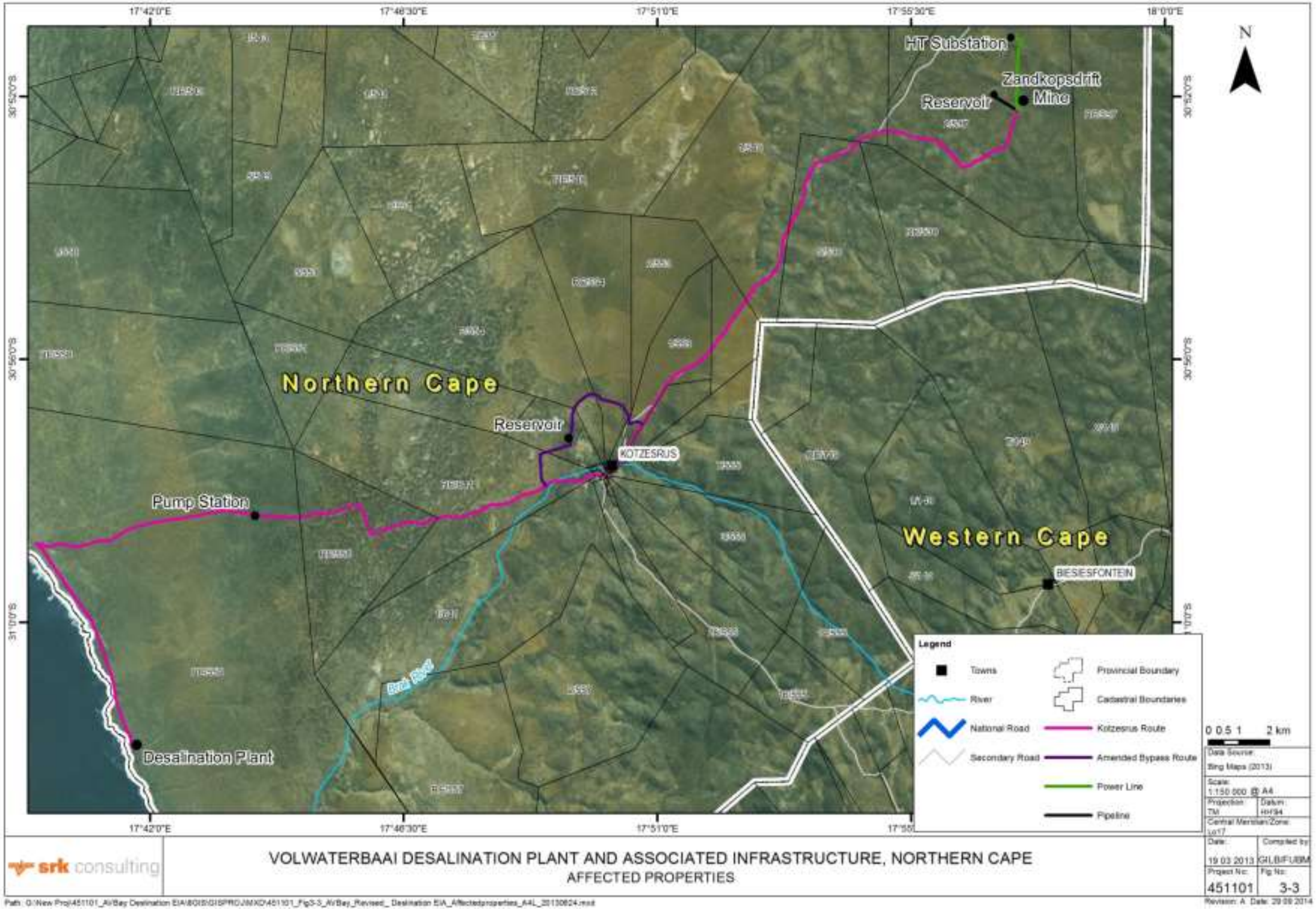


Figure 3-3: Affected Properties

Garies

Garies is the administrative centre of the KLM. The town is located along the N7 and offers essential services to the smaller towns in the surrounding area. It has a library, town hall, clinic, high school and a police station.

Kotzesrus

Kotzesrus consists of a number of farms radiating from a water source on the Brak River, with farmsteads located at the apex of each property (near the Brak River) to form the small town (village) of Kotzesrus.

There are a limited number of structures in the village, including a shop and disused school and church buildings. The village has a very small number of permanent residents (no more than 20) and no water or electrical services are provided by the KLM.

Tourists are attracted to the town for its unique characteristics and secluded nature, especially during the Namaqualand flowering season (August–September) and the summer holiday period (December to February).

Lepelsfontein

Lepelsfontein is considerably larger than Kotzesrus (approximately 465 residents), and is also remotely located. The town has a community hall and primary school (from grades 1 to 6) and water and electrical services are provided by the KLM.

Stofkraal, Molsvlei and Rietpoort

These small settlements are located to the north and east of the Zandkopsdrift Mine and as such will not be directly affected by the project.

3.4 Proponent's Project Motivation

The proposed desalination plant is the key element in the water supply scheme for the Zandkopsdrift Mine. Namaqualand is a water stressed region, situated mostly in the Orange River sub-area of the Lower Orange River Water Management Area (WMA). The area has an arid to semi-arid climate and is drought prone. There are no surface water resources such as large dams or perennial rivers in the area, and the majority of the water is obtained from groundwater resources. The estimated available groundwater yield for the Namaqualand area is 3 Mm^3/a, while the current projected regional water demand is 8 Mm^3/a. The deficit is supplied by surface water resources from the Orange and Doorn Rivers (AGES, 2013).

The proposed Zandkopsdrift Mine in the Northern Cape would have an annual water demand of approximately 8 Mm^3/a. In this water scarce area, a water supply for the mine is not readily available, and Sedex Minerals has thus proposed the desalination of sea water to provide fresh water to the mine.

The design capacity of the desalination plant as well as the possible phasing and future increases in capacity (full capacity assessed in this EIA) will be determined by water demand at the mine, which is expected to increase as the mine develops.

The linear infrastructure including access roads, power supply, pipelines and water storage facilities are required to convey water from the desalination plant to the mine, and to facilitate access to and maintenance of the desalination plant and associated infrastructure.

3.5 Project Alternatives

The EIA Regulations, 2010, require that all S&EIR processes must identify and describe ‘alternatives to the proposed activity that are feasible and reasonable’. Different types or categories of alternatives can be identified, e.g. location alternatives, type of activity, design or layout alternatives, technology alternatives and operational alternatives. The ‘No-Go’ or ’No Project’ alternative must also be considered.

Not all categories of alternatives are applicable to all projects. However, the consideration of alternatives is inherent in the detailed design and the identification of mitigation measures, and therefore, although not specifically assessed, alternatives have been and will be taken into account in the design and S&EIR processes.

Numerous alternatives were identified and considered during the early feasibility and design phases of the project. These alternatives and their feasibility were described in detail in the Scoping Report (SRK Report 451101/02), which also identified alternatives considered suitable for further assessment in the Impact Assessment Phase. The types of alternatives considered during previous stages of the project included:

- **Alternative water sources** to meet the requirements of the Zandkopsdrift Mine, of which the desalination of seawater was considered the only feasible option;
- **Seawater intake technology alternatives**, including beach wells, of which an open water intake was considered the only feasible alternative;
- Twenty six (26) potential **seawater intake location alternatives** along a 28 km stretch of the coastline between Island Point and south of the Brak River mouth, of which the shallow narrow gully at **Volwaterbaai** was considered the only feasible alternative;
- **Brine disposal alternatives,** including disposal to an existing licensed waste water treatment works (located over 40 km away) and evaporation ponds to generate waste salt which would be disposed to a licensed waste disposal facility, of which brine discharge to sea was considered the only feasible alternative;
- **Surf zone vs offshore disposal of brine**, of which surf zone discharge is considered by Sedex Desalination to be the only feasible alternatives, due to the more significant construction impacts and increased construction costs associated with an offshore discharge along this stretch of the coast. Furthermore, the site lends itself to surf zone discharge due to the dynamic coastal conditions, and compliance with water quality guidelines and dilution rates are also achievable with surf zone discharge[7];
- **Surf zone discharge location alternatives** at Volwaterbaai, of which the proposed site allowing for discharge within an existing gully, close to the gully inlet was identified as the only feasible alternative;
- **Alternative positions for the desalination plant** close to the selected seawater intake and brine discharge sites. The five potential positions identified were all considered feasible for further assessment in the Impact Assessment phase, and are discussed further in Section 6.1.3;
- Approximately 10 **alternative routes for the linear infrastructure** (roads, pipelines and power lines between the desalination plant and the mine) were considered and evaluated in an extensive screening process, which included engineering and environmental considerations. A

[7] The project team however acknowledges that offshore discharge is usually preferred, especially where surf zone discharge may not allow for adequate dilution rates, and this project should thus not be considered to set a precedent.

preferred route was identified (**Kotzesrus Route**), along with two potential routes bypassing the town of Kotzesrus (**Bypass Route** and **Alternative Bypass Route**). The Scoping Phase identified these three routes for further assessment in the Impact Assessment Phase. At an early stage of the Impact Assessment Phase, the *Amended Bypass Route* was identified (comprising portions of the Bypass Route and the Alternative Bypass Route) as the most feasible alternative for bypassing the town of Kotzesrus. The *Kotzesrus Route* and the *Amended Bypass Route are* therefore the two feasible and reasonable alternatives that are comparatively assessed in the EIA;

- **Power supply alternatives**, of which grid power supplied by overhead line from the mine was the strongly preferred alternative;
- **Alternatives for discharge/disposal of waste** (other than brine) from the desalination process, of which blending with brine for discharge to the sea is the only feasible alternative (and assessed in the EIA). In principle, disposal to a licenced landfill is considered possible, but not reasonable due to the absence of suitable waste disposal facilities in the area[8];
- Alternative chemicals used in the desalination process and plant; and
- **Pipeline alternatives,** including a single large pipeline or multiple smaller pipelines, and their installation above ground (either on the surface or elevated) or below ground.

3.5.1 The No-Go Alternative

The No-Go alternative will be considered in the EIA in accordance with the requirements of the EIA Regulations, 2010. The No-Go alternative entails no change to the status *quo*, in other words the proposed desalination plant site will remain vacant and no linear infrastructure will be built. Due to the lack of water in Namaqualand it is unlikely that the Zandkopsdrift Mine would be developed.

3.6 Project Construction and Infrastructure

The project infrastructure described below is based on information provided by the project engineers during the conceptual design phase of the project and will be refined during the detailed design phase of the project. Key components of the project include:

- **Marine infrastructure**, comprising seawater intake and brine disposal outfall works;
- **Desalination plant**, installing a desalination plant including facilities for pre- and post-treatment of water;
- **Bulk water supply and storage infrastructure, pump stations and pipelines** to transfer product water to the mine with a take-off at Kotzesrus, as well as storage reservoirs at the plant and Kotzesrus;
- **Bulk power supply infrastructure** to supply the desalination plant and product water booster pumps with electricity;
- **Roads** to provide access to the desalination plant, transfer pipeline and power lines; and
- A **temporary desalination plant** to provide water for construction.

Project infrastructure is described in Sections 3.6.1 to 3.6.6 followed by a description of utilities and services and an overview of (environmental) management during construction.

[8] The waste would probably need to be transported to the Vissershok landfill (approximately 450 km away, near Cape Town) by road. Vissershok is also no longer able to accept high salinity waste.

3.6.1 Marine Infrastructure

3.6.1.1 Seawater Intake System

The seawater extraction system will be an open water intake placed inside an existing gully. The system will include:

- Modification to the existing gully, which will serve as the intake channel;
- Marine intake basin, which will be excavated into the underlying rock within the gully;
- Intake heads and screens;
- Intake pipes;
- Slurry type seawater extraction pumps;
- A pump station; and
- Pipeline(s) from the pump station to the desalination plant.

The seawater intake structure will be designed for a maximum feedwater abstraction capacity of ~20 Mm^3/annum (~1.66 Mm^3/month). The intake basin, with associated screens and grids and suction inlets will be installed below the high water mark (HWM) of the sea, with all other intake infrastructure above the HWM.

To avoid impingement and entrainment of marine organisms, water will be drawn into the intake heads at a velocity of <0.15 m/s, be screened through coarse (120 – 150 mm) and fine screens (40 mm) before being pumped to the desalination plant.

The installation of seawater intake infrastructure will require (limited) blasting, excavation and concrete work below the HWM and in the intertidal zone. The intake pipeline crossing the coastal zone will be positioned below ground.

Looking seaward along the intake gully

Looking shoreward from the gully, with propsoed position of intake pumpstation in upper right of image (below vehicles)

srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** Seawater Intake Site	Project No. 451101

Figure 3-4: Photographs of Proposed Seawater Intake Site at Volwaterbaai

Source: WSP

3.6.1.2 Brine Discharge System

The brine discharge system includes a brine discharge pipeline from the desalination plant to the sea and a diffuser system. The final design of the brine discharge pipeline and diffusers will ensure:

- Brine discharge within the (separate) discharge gully, with the brine outlet positioned below the low water mark (LWM) of the sea;
- Efficient dilution of brine; and
- Shielding of the diffuser from waves.

Design specifications of the diffuser and discharge rates will meet the requirements of the *South African Marine Water Quality Guidelines and the Operational Policy for the Disposal of Land-derived Water containing Waste to the Marine Environment of South Africa* insofar as they are applicable to this type of installation.

The system allows for the discharge of all solid waste material (sludge), wastewater and brine to the sea (see Section 3.7.1.5). Brine, along with the pre-treatment waste stream and other co-discharges, will be discharged into the sea either under gravity or pumped.

The brine discharge pipeline will be routed from the desalination plant across the intertidal zone and be installed, together with the outlet diffuser port and weight blocks, below the HWM. The discharge pipeline crossing the coastal zone will be positioned underground. The construction of the brine discharge system will require excavation and concrete work in the intertidal zone and below the HWM. The preferred position for the brine discharge site is approximately 500 m north of the seawater intake site, to prevent the intake of discharge water (see Figure 6-2).

At maximum plant capacity, ~12 Mm^3 of brine would be discharged into the sea annually (1 Mm^3/month). The brine would either be discharged under gravity feed, or be pumped. The brine will be discharged at a velocity of 4 - 6 m/s through a single 0.3 m diameter nozzle located directly above the seabed in approximately 1.2 m water depth, and directed horizontally offshore. The brine will be thus be dispersed into the ambient seawater as a fast moving current.

Looking seaward along the brine discharge site at high tide

Brine discharge location during rough sea conditions

srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** Brine Discharge Site	Project No. 451101

Figure 3-5: Photographs of Proposed Brine Discharge Site at Volwaterbaai

Source: WSP

3.6.2 Desalination Plant

The desalination plant will include all infrastructure associated with the desalination process as described in Section 3.7 (apart from the marine infrastructure) housed in or adjacent to a desalination plant building. Five alternative positions for the desalination plant (Sites A, B, C, D and E), all located in very close proximity to one another in a single site “envelope”, are comparatively assessed in the EIA (see Section 6.1.3 and Figure 6-2).

The desalination plant building will be constructed of concrete, brick and mortar, with a roof design informed by architectural considerations aimed at reducing the visual impact of the structure. A portion of the building will have a second storey, and as such the maximum height of the building will be approximately 8 m.

The plant building footprint will be approximately 3 000 m^2. Some process units and facilities at the plant will be placed outside of and adjacent to the main plant building. The total footprint of the facility, including entrance road, screening structures and fencing will be approximately 15 000 m^2.

No staff accommodation will be provided at the desalination plant.

A 6 m^3 septic tank will be installed at the desalination plant to deal with domestic wastewater and sewage generated at the plant. The exact position of the septic tank will be determined during detailed design.

3.6.3 Bulk Water Supply Infrastructure

3.6.3.1 Pipelines

There will be two product water pipelines between the desalination plant and the mine, following the same route as the roads, depending on the alternative that is authorised. At the mine, the pipelines leading to the on-site reservoir will deviate from the alignment of the road.

Pipelines will be positioned approximately 15 cm above ground on concrete plinths, at a spacing of approximately 6 m. The footprint of each plinth (carrying both pipelines) will not exceed 0.5 m^2. Pipelines will be positioned within the road reserve if acceptable to the roads authorities, failing which they will be placed in an 8 m wide servitude adjacent to the road reserve.

All pipelines will be protected against pressure surges and an adequate number of valves will be installed to facilitate maintenance (shut off and scour). Air release and drain valves will also be installed at appropriate points. All bulk water pipelines will be fitted with flow measurement devices at specific locations to allow for continuous water auditing/balancing and leak detection.

3.6.3.2 Pump stations

Product water will be pumped from the desalination plant to the mine, requiring a pump station at the desalination plant as well as an intermediate (booster) pump station along the pipeline route between the desalination plant and Kotzesrus, on Farm Strandfontein 559. The positions of the pump stations are indicated on Figure 3-3.

3.6.3.3 Reservoirs / Water Storage Tanks

Water storage tanks at Volwaterbaai are required in the pre-treatment, desalination, product water stages of the process (see Section 3.7.1). Retention times and tank storage capacities vary for different stages and processes. A 20 Mℓ concrete reservoir will be required at the desalination plant, providing 1 day’s buffer storage.

A 500 kl reservoir is proposed at the take-off at Kotzesrus.

The positions of the reservoirs at the desalination plant and at Kotzesrus are indicated on Figure 3-3. It should be noted that the reservoir at Kotzesrus will require an access road and power line that will deviate from the main access road between the mine and the desalination plant.

3.6.4 Bulk Power Supply Infrastructure

Electrical infrastructure to support the project includes bulk supply to the desalination plant (including transmission lines) as well as motor control and electrical services at the desalination plant.

Power will be articulated to the desalination plant by overhead power lines fed directly from the Zandkopsdrift Mine's 11kV intake medium voltage substation. Power line support structures (timber poles) will be spaced approximately 80 – 100 m apart, with a disturbance footprint of approximately 2 m in diameter. The optimal voltage of the transmission line (11kV, 22kV or 33kV) will be determined during detailed design. The overhead power lines will follow the route of the roads and pipelines once these have been finalised, and will be installed in an 8 m wide servitude adjacent to the road reserve.

It is anticipated that power during the construction phase will be provided by diesel generators

3.6.5 Roads

Access roads need to be provided from the desalination plant to the Zandkopsdrift Mine, situated approximately 49 km from the plant, as well as to all pipelines, power lines, reservoirs and any other associated infrastructure. Two route alternatives for the main access roads have been identified for assessment (see Section 3.5 and Figure 1-1).

It is anticipated that the proposed roads will be unpaved (gravel), subject to confirmation during the detailed design phase and the recommended mitigation measures. Roads will be 4 m wide, with a 2 m wide graded strip along one side where required, and a road reserve (total width) of 15 m. The pipelines and power lines will largely follow the road.

The portion route to the east of Kotzesrus (OG 155) is an existing, proclaimed gravel road (see Appendix 3C) and widening of the road will not be required. The existing tracks to the west of Kotzesrus (OG155, OG153 and OG299) will need to be widened to an approximate width of 4 m. The route may need to be realigned and widened through Kotzesrus to accommodate large construction vehicles.

Additional short, access roads may be required off the main route to access reservoirs, the desalination plant and associated infrastructure. The positions of these access roads have not yet been determined.

Some road construction materials may be obtained from borrow pits to be established in the area[9].

3.6.5.1 Road Drainage Structures

Suitable drainage structures will be provided along access roads, in accordance with relevant engineering guidelines. Depending on local conditions, these structures could include side drains, berms, mitre banks (to remove water from a drain and discharge to beyond the road reserve) and cross-drainage structures such as concrete pipes or box culverts where larger streams or water courses need to be crossed.

[9] Authorisation of any borrow pits will be undertaken as a separate study by RHDHV and falls outside the scope of this EIA process.

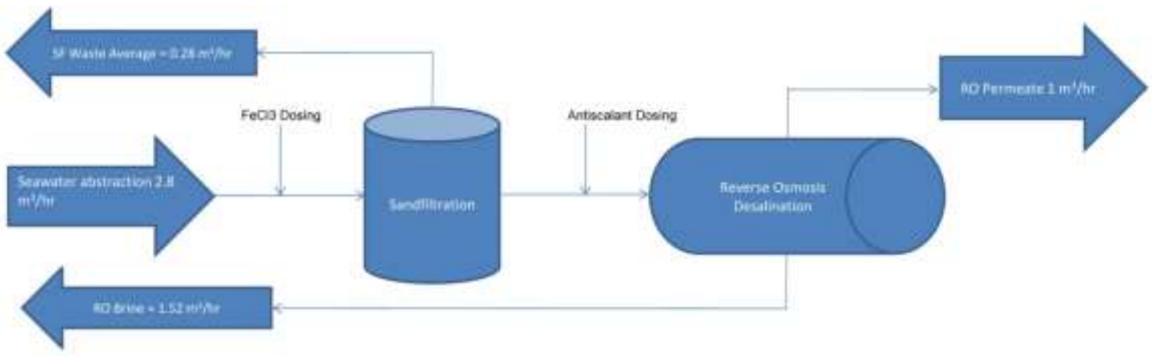
3.6.6 Water Supply and Use

Fresh water will be required for various construction activities, and no other viable sources are available for this purpose. It is thus proposed that a containerised RO plant be used temporarily, to supply fresh water during the construction phase of the project.

The temporary desalination plant will comprise a containerised plant approximately 15 m^2 in size, with external sand filters, feedwater and filtered water tanks. The plant will be powered by a diesel generator and enclosed in an 80 m^2 fenced area. Water will be abstracted from the sea via a submersible pump, positioned in a tidal pool close to the shore (to obtain the cleanest possible seawater). Water will be conveyed to the temporary desalination plant via a 50 mm pipe.

The desalination process used in this plant will differ slightly from the process described in Section 3.7 below, although it is based on the same principles. The temporary desalination process will include the following key steps, as depicted in Figure 3-6:

- Seawater abstraction;
- Ferric Chloride ($FeCl_3$) dosing for flocculation;
- Sand filtration;
- Antiscalant dosing;
- RO desalination; and
- Brine discharge.



srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** Temporary Desalination Process	Project No. 451101

Figure 3-6: Temporary Desalination Process

Source: Veolia Water

The intake and discharge flow rates for the temporary desalination plant are indicated in the figure above and summarised in Table 3-2. These flow rates are equal to 67 m^3/d (2 010 m^3/month) for sweater intake and 36.5 m^3/d (1 095 m^3/month) for brine discharge.

Table 3-2: Intake and Discharge Flow Rates for Temporary Desalination Plant

Flow	Flow rate (m^3/hr)
Intake	
Seawater abstraction	2.8
Discharge	
Waste from Sand Filters	0.28
Brine	1.52
Product Water	1

Wastewater from the temporary desalination plant will be discharged to the ocean as a single waste stream via a 50 mm pipe. The brine will also contain traces (<3 mg/ ℓ) of membrane antiscalant and suspended solids from the backwash waste. Anticipated characteristics of waste from the sand filter backwash, antiscalant and $FeCl_3$ used for flocculation in the brine stream are detailed in **Appendix 3A**.

Untreated seawater will be used for construction of the road between the desalination plant and Zandkopsdrift Mine, pumped from the sea at the closest accessible point on the coast.

3.6.7 Traffic

Construction traffic would include construction equipment, large vehicles / trucks delivering materials as well as smaller passenger vehicles used to transport construction staff. It is estimated that for the duration of the construction phase there would be 22 vehicles trips[10] per day by light passenger vehicles and 26 trips by heavy construction vehicles transporting workers and construction materials.

3.6.8 Waste Management

Waste management during the construction phase will be the responsibility of relevant contractors. All construction waste will be removed from the relevant work areas and disposed of at approved (municipal) waste disposal facilities, or waste facilities at the mine. Where possible, options for the reuse or recycling of waste materials will be favoured over disposal.

It is envisaged that material from cutting and blasting will be used as fill material and disposal will not be required.

3.6.9 Air Quality Management

Sources of emissions during the construction phase will include dust generated by the movement of construction vehicles on dirt roads, drilling and blasting (where required) and bulk earthworks (where required) as well as exhaust emissions from construction vehicles and diesel generators.

Emissions during the construction phase of the project will be limited as far as possible through stabilisation of any exposed areas and watering of dirt roads where dust becomes problematic to surrounding residents. Construction vehicles and generators will be maintained in good working order to minimise emissions.

3.6.10 Noise and Vibration Management

Sources of noise and vibration during construction include construction vehicles and generators, as well as drilling and blasting where required. Nuisance impacts of noise, particularly in residential areas such as Kotzesrus will need to be managed.

[10] In a single direction

3.6.11 Workforce

It is estimated that the construction of the desalination plant and associated infrastructure could create 40 direct temporary jobs during the first 18 months and an average of 60 over the following 12 months of the construction phase.

3.6.12 Construction Schedule

It is anticipated that the desalination plant and associated infrastructure will be constructed in 2016-2017, with production commencing in 2018. In this regard, construction of linear infrastructure would be completed in approximately 12 months, following which the desalination plant would be constructed (over a period of 18 months).

3.7 Project Operations and Process Description

3.7.1 Desalination Process

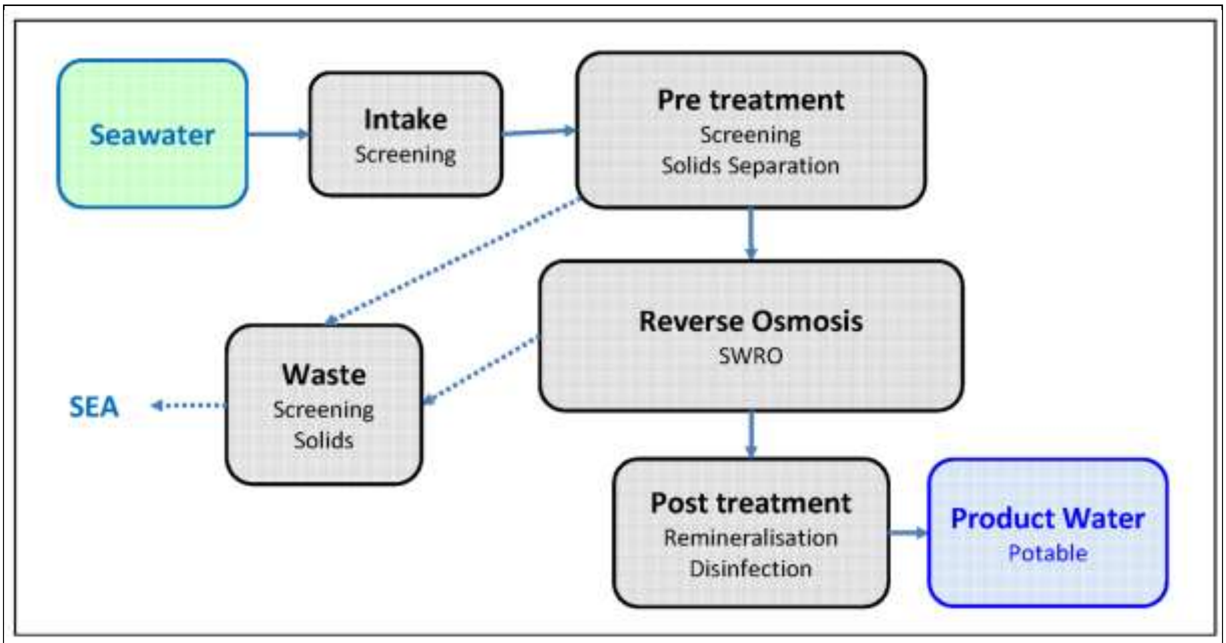
Desalination refers to a water treatment process whereby salts are removed from saline water to produce fresh water. The proposed desalination process will make use of Reverse Osmosis (RO) technology to remove salt from sea water, thereby producing fresh product water as well as high salinity brine. The recovery rate of product water through the process would be approximately 40%.

Reverse Osmosis: Osmosis is the natural movement of solvent from an area of low solute concentration through a membrane to an area of high solute concentration when no external pressure is applied. Reverse Osmosis is a separation process used to purify concentrated solutions of dissolved minerals and salts by forcing water through a semi-permeable membrane under high pressure, leaving the dissolved salts and other solutes behind on the surface of the membrane. Reverse osmosis allows for complete desalination of water i.e. retaining all solutes.

The main elements in the desalination process are:

- Seawater intake;
- Pre-treatment (screening, suspended solid removal and filtration);
- Media filtration (pre-treatment);
- RO (desalination);
- Post-treatment (remineralisation of process water);
- Disinfection and storage of product water; and
- Discharge of brine from the desalination process.

A desalination process flow diagram is presented in Figure 3-7.



srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** Desalination Flow Diagram	Project No. 451101

Figure 3-7: Desalination Flow Diagram

Source: RHDHV

3.7.1.1 Seawater Intake

The feedwater for the desalination plant is seawater from the Atlantic Ocean, abstracted at a marine intake located in a rock protected gully at Volwaterbaai (see Section 3.6.1.1). Seawater along the west coast of South Africa can be relatively cold and of variable quality. Common problems associated with desalination feedwater along the west coast include:

- Cold temperatures;
- Upwelling of cold, nutrient rich water (causing red tides); and
- Phytoplankton and algae.

Sampling and analysis of the quality of water at the proposed seawater intake commenced in November 2011, is on-going and will be used in the final process design, in particular the design of the pre-treatment system.

The seawater intake system will be fitted with coarse screens to prevent large solids (e.g. kelp) from entering the system. It is anticipated that seawater will be abstracted 24 hours per day, although this may be reduced depending on demand.

3.7.1.2 Pre-treatment

The aim of pre-treatment of feedwater is to minimise fouling of RO membranes by producing feedwater that complies with the following water quality requirements:

- Silt Density Index < 3
- Turbidity < 1 Nephelometric Turbidity Units (NTU)
- Dissolved Organic Carbon < 1 mg/l

Pre-treatment includes screening to remove plankton and algae and filtration to remove suspended solids and reduce turbidity. Dissolved Air Flotation (DAF) and Dual Media Filtration (DMF) are common pre-treatment processes.

DAF uses a combination of coagulation / flocculation and dissolved air to float suspended matter to the surface of the liquid for removal (rather than settling it). Flotation is an effective process, particularly in cases of algal bloom or hydrocarbon pollution and is commonly used for open sea water intakes. As seawater enters the DAF unit it passes through a coagulation and flocculation chamber where a coagulant like $FeCl_3$ and a polymer are dosed. Dissolved air then carries flocculants to the surface for removal with a scraper.

DMF is then used to polish the product water from the DAF unit removing suspended matter. The DMF filter comprises multiple layers, in this case: a bottom layer of gravel, a middle layer of sand and a top layer of anthracite. In order to remove the suspended matter effectively it first needs to be chemically flocculated: thus a typical flocculant like $FeCl_3$ is dosed prior to filtration.

All filtration processes give rise to a waste streams containing the filtered solids and any coagulant (typically $FeCl_3$ and an anionic polymer) used. Sulphuric acid may also be used to lower the pH to the optimal flocculation pH of around 6.9. Flocculated water is then filtered from the top down through the media layers capturing the suspended matter. Once enough material is collected in the filter or after a pre-determined time the flow is reversed and the captured material is removed from the filter media through a backwash process.

Waste (backwash) from pre-treatment will be blended with other waste from the system and discharged to the sea via the brine discharge system (see Section 3.7.3).

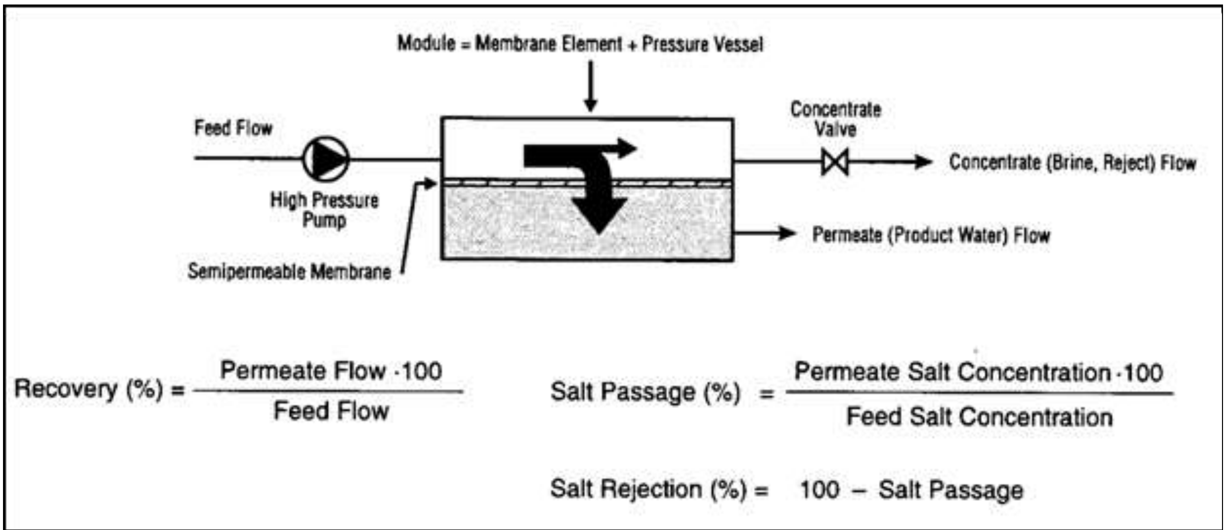
3.7.1.3 Desalination

The proposed desalination process will make use of RO technology.

Following pre-treatment, the feed-water is pumped to a seawater buffer storage tank. To overcome the natural osmotic pressure of seawater, it is then pumped at high pressure through the RO membranes. The series of membranes is housed in high pressure casings in tubular, spiral or hollow-fibre configurations. This process retains the brine (high salinity salts and organics) on one side of the membranes and allows the water (of very low salinity) to pass to the other side. The desalinated water is piped to the potable water tank, and the brine is released back into the ocean through discharge pipes. (See **Appendix 3B** for additional information regarding the RO desalination process).

A simplified diagram of the RO process is provided in Figure 3-8 below.

The proposed maximum output of treated water is 8 Mm^3/annum (~22,000 m^3/d or ~0,66 Mm^3/month). The plant will be capable of performing over a range of temperatures, with the RO feed pressure decreasing if the temperature is above 15 ºC and the required feed pressure increasing when the water temperature is below 15 ºC. The desalination plant will be designed, and the process equipment selected, for continuous operation 24 hours per day, for 350 days per year, with approximately 15 days per year allowed for maintenance. The actual operational time may vary, depending on the fresh water demands of the mine and maintenance requirements of the desalination plant. The anticipated life-span of the desalination plant is a minimum of 30 years, with provisions to expand and renew equipment as and where it is needed.



srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** RO Process	Project No. 451101

Figure 3-8: Simplified Diagram of RO Process

Source: Veolia Water

3.7.1.4 Product Water

Permeate from the desalination process will need post treatment i.e. remineralisation and disinfection to obtain the desired characteristics for the product water, based on the intended water use. Full remineralisation is proposed, which would include:

- Carbon dioxide (CO_2) injection;
- Calcium carbonate ($CaCO_3$) stabilisation; and
- pH correction.

The quality of the product water must comply with SANS 241:2011 (Drinking Water), must have a $CaCO_3$ precipitation potential index > 0; and a minimum calcium (Ca) level of 20 mg/l.

3.7.1.5 Brine Discharge

On average 60% of the sea water passing through the desalination plant will be discharged to the sea as brine from the plant. Brine is the portion of the feedwater which does not pass through the membranes in the high pressure RO vessels. Brine has higher salinity and a slightly increased temperature compared to the incoming feedwater.

The discharge system would allow for the discharge of solid waste material (sludge), the pre-treatment waste stream and other co-discharges with the brine. The brine may contain an organic scale inhibitor, which would be an approved chemical for potable water systems and will be bio-degradable. Other chemicals utilised in the pre-treatment and feed water conditioning process become disassociated[11], such as acid for pH conditioning and, possibly, Sodium Metabisulfite (SMBS) to scavenge available chlorine.

The predicted brine characteristics are presented in Table 3-3.

[11] The chemical or biochemical process in which molecules (or ionic compounds such as salts, or complexes) separate or split into smaller particles such as atoms, ions or radicals, usually in a reversible manner.

Table 3-3: Predicted Brine Discharge Characteristics

Description	Units	Quantity
Average brine discharge	m^3/d	32,876
Co-discharge (Pre-treatment Media Filtration Backwash – intermittent and discharged over 24 h)	m^3/d	2,147
Co-discharge (Cleaning in Place [CIP] rinse water – 6 x per year only and assumed to be discharged over 12 h at rate of 70 m^3/h)	m^3/d	841 (in 12 h)
Discharge velocity	m/s	4-6
Salinity	mg/ℓ psu	66,000 66
Change in temperature	°C	1 - 2
pH		7.3 – 8.2
Suspended Solids	mg/ℓ	11.67
Phosphonate antiscalant	mg/ℓ	4.7
Chlorine	mg/ℓ	0.002
Sodium bisulphate (SMS)	mg/ℓ	3.14
Spent CIP solution (quarterly and blended in over 12 hours) Peroxyacetic acid Low pH cleaner High pH cleaner	mg/ℓ	 0.006 0.015 0.015
Preservative (sodium metabisulfite) (on shutdown/start-up, and blended in over 12 h)	mg/ℓ	0.028
Coagulant: Ferric Chloride ($FeCl_3$) will precipitate into Ferric Hydroxide, which will be removed as a solid.	mg/ℓ	3.33*
Anionic polymer (alternative to $FeCl_3$) *	mg/ℓ	1.67

The brine is negatively buoyant and will tend to sink towards the seabed; however the brine temperature will increase slightly over the feed-water temperatures. The rate of brine discharge as well as the discharge infrastructure is intended to ensure that the concentrated brine mixes with the seawater and is diluted as quickly as possible, and that brine does not accumulate within the surf zone in the vicinity of the discharge outfall. Discharged brine at maximum plant capacity is anticipated to have a temperature of between 1 – 2 degree Celsius above ambient average seawater temperature, a salinity of 66 g/ℓ or practical salinity unit (psu) (based on the maximum feed-water salinity of 36.7 g/ℓ or psu) and a density of 1 050 kg/m^3 with a maximum discharge of ~12 Mm^3/yr or 1 $Mm^3/month$.

The discharge of brine is likely to create a sacrificial zone in the gully in which high salinity levels and co-discharges (any chemicals remaining in the brine) are likely to negatively affect marine life which has not already been disturbed by construction activities in the immediate area. The design of the discharge infrastructure would aim to minimise the size of this sacrificial zone. The rate of brine discharge as well as the discharge infrastructure (see Section 3.6.1.2) is intended to ensure that the concentrated brine mixes with the seawater and is diluted as quickly as possible, and that brine does not accumulate within the surf zone in the vicinity of the discharge outfall.

3.7.1.6 Use of Chemicals

Most of the chemicals used in the desalination process are to protect and prevent fouling of the RO membranes. Chemicals are also used to clean the plant and preserve membranes when not in operation. Remineralisation and disinfection chemicals are added to the product water to obtain the desired characteristics for the intended water use. The chemicals used during the normal operation of the plant are indicated in Table 3-4.

Table 3-4: Chemicals Used in Normal Plant Operation

Chemical	Application	Function
Feedwater and pre-treatment stream		
Chlorine (Cl)	Intermittently at seawater intake on shock basis	Biocide
$FeCl_3$	Seawater feed line before DAF and DMF	Flocculation
Anionic Polymer*	Seawater feed line before DAF	Flocculation
Sulphuric Acid* (H_2SO_4)	Seawater feed line before DAF	Flocculation
Pre-treated water		
Sodium Metabisulfite (SMBS)	In filtrate before RO membranes	Reduction of chlorine
Phosphonate	In filtrate before RO membranes	To control scale on membranes
In RO permeate		
Sodium Carbonate (Soda Ash) (Na_2CO_3)	Product water	pH correction
H_2SO_4 or CO_2	Prior to limestone columns	To lower pH for dissolution of $CaCO_3$
$CaCO_3$	Dissolved into permeate	Stabilisation
Final product water		
Cl	Dosed continuously to the product water stream	Disinfection

(* denotes alternative or additional chemicals which may not be required)

The use of a biocide (chlorine) will be required to inhibit biological growth in the intake pipeline and on the screens. An intermittent shock dosing treatment is proposed for this project. To avoid damage to the RO membranes, the chlorine needs to be neutralised with SMBS before it can pass through the membranes. Consequently, no residual biocide will be discharged with the brine. Antiscalants are added to control scaling and inorganic precipitation (including metals) on the RO membranes. The main representatives of antiscalants are organic, carboxylic-rich polymers such as polyacrylic acid and polymaleic acid. Phosphonate will be used as the antiscalant for the desalination plant.

Depending on the quality of the feed-water, the RO membranes will need to be cleaned at intervals of three to six months. The Cleaning in Place (CIP) process typically generates in the order of 134 m^3 of cleaning solution and rinse water per RO train. Therefore, for an 8 Mm^3/yr capacity plant, the maximum expected volume of cleaning solution and rinse water will be approximately 10 200 m^3/yr (850 m^3/month). The maximum expected volume of pre-treatment wastes is expected to average 1.18 Mm^3/yr (98 333 m^3/month) on a continuous basis, with a maximum of ~2 500 m^3 of CIP waste added in batches every two months. These residual streams will be mixed with the DAF sludge and blended into and co-discharged to sea with the brine effluent.

Chemicals used in the plant during cleaning and maintenance are indicated in Table 3-5 below.

Table 3-5: Chemicals Used Cleaning and Maintenance

Chemical	Function
Cleaning in place (CIP)	
Peroxyacetic acid (CH_3CO_3H)	Removal of biofouling from membranes
Low pH CIP solution or Hydrochloric acid (HCl)*	Removal of biofouling from membranes
High pH CIP solution containing Sodium Hydroxide (NaOH); or Ammonium Hydroxide (NH_3)*	Removal of biofouling from membranes
Membrane preservation	
SMBS	Preserving membrane when not in operation

(* denotes alternative or additional chemicals which may not be required)

Chemicals will be supplied in different forms (solid, liquid or gas) and are either ready for use, or may require make-up and dilution on site. All chemicals will be stored and handled in bunded areas and any spillages will be contained and handled in those areas. Spillages will not be directed to the waste sump, unless they have been neutralised and diluted to the same concentrations that are permitted for discharge.

3.7.2 Power Supply

The main power supply to the plant will be via overhead power lines from the mine (see Section 3.6.4). A back-up generator will be provided at the plant to provide for essential power and lighting, high lift pumps (to the mine) and membrane flushing and maintenance of the plant in case of emergencies. No backup power will be provided for the operation of the plant.

3.7.3 Waste Management

3.7.3.1 Waste/Discharges from Desalination Process

The desalination process will produce various waste streams as indicated in Table 3-6 below.

Table 3-6: Waste from Desalination Process

Waste type	Nature of waste	Origin	Proposed storage and disposal
Seawater Intake and screening			
Solid waste	Kelp, shells, sand, grit etc.	Washing into marine intake basin	Returned to the sea or alternatively sold/provided to kelp farmers in the area.
Screenings	Seawater containing suspended solids, organic matter, algae etc.	Drum filters	Discharge into the sea along with brine
Pre-treatment			
Pre-treatment waste	Continuous stream of seawater containing suspended solids, organics and trace coagulant during pre-treatment	DAF effluent	Discharge into the sea along with brine
Filter backwash	Intermittent flow of seawater containing suspended solids, organics and trace coagulant generated during backwashing and rinsing of filters in the pre-filtration system	Filters	Discharge into the sea along with brine
Desalination process			
Brine	Continuous flow of high salinity water containing concentrated constituents of seawater feed for the RO units	RO Units	Discharge into the sea via marine outfall

Cleaning and maintenance			
Spent CIP solution	Intermittent stream of used cleaning solution from cleaning of membranes and containing low concentrations of chemicals used for cleaning	Membrane CIP	Stored in CIP waste tank and drip fed into waste stream for discharge into the sea along with brine.
Spent SMBS	Used solution from membrane preservation (on shut down)	Membrane vessels	Discharge into the sea along with brine

It is estimated that once operating at capacity, approximately 1077 kg of solid waste[12] (100% dry weight) will be produced by the desalination process. The majority of the waste from the desalination process will be discharged at sea along with the brine. If this is shown not to be compliant with discharge standards, alternative waste disposal methods will be considered (see Section 3.5).

3.7.3.2 Solid Waste Management

A limited amount of domestic and general waste will be generated by staff at the desalination plant. Domestic and general wastes will include food waste, food packaging, drinking containers, metal cans, paper, cardboard, plastics, general packaging materials, light bulbs and fluorescent tubes, which will be disposed of at the mine's waste facilities.

The conventional hierarchy of waste reduction and management will be employed at the desalination plant:

- *Reduce* – e.g. modify processes to reduce the amount of waste going into the waste stream and/or identify alternative uses for waste such as removal of kelp by local kelp farmers;
- *Reuse* – e.g. cleanse and reuse bottles to eliminate them from the waste stream;
- *Recycle* – remove recyclable materials from the waste stream;
- *Treat (compost)* – compost organic material separated from the waste stream, preferably by source separation; and
- *Landfill* – final disposal of materials, which cannot be economically or technically removed from the waste stream.

The aim of this approach is to minimise the amount of waste generated by applying waste reduction strategies, and then to maximise alternative uses of waste so as to minimise the amount of waste requiring final disposal to landfill.

3.7.3.3 Waste Water and Sewage Management

Domestic wastewater is defined here as water that does not contain a human organic waste component. Sewage is defined as human organic waste, usually within a water suspension. Sources of domestic wastewater and sewage are the kitchen, toilets, washrooms and offices. Domestic wastewater and sewage will be captured in combined waste streams and directed to the septic tank.

3.7.4 Surface Water Management

Namaqualand is in an arid area with low rainfall and stormwater management is not considered to be a major challenge. Surface water management aims to capture and reuse water and prevent contamination of surrounding areas. To achieve this objective, the stormwater system at the desalination plant will be designed to allow for:

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[12] The volume of waste will depend on sea conditions, and average conditions have been assumed for this estimate. This volume translates to 5385kg/day at 20% dryness.

- Natural infiltration of uncontaminated stormwater from all (unpaved) hardened surfaces including dirt roads;
- The capture and reuse of uncontaminated rainwater from the roofs of buildings, for irrigation on site; and
- The capture of any potentially contaminated stormwater from hardened surfaces around the desalination plant will be directed to a bund from where it will be tested and removed via truck for suitable disposal off-site.

3.7.5 Air Quality Management

Potential sources of emission during the operation phase may include dust generated be vehicles moving on unpaved roads, as well as exhaust emissions from these vehicles and generators used during power outages.

Equipment which may generate emissions will comply with international emission standards. Exhaust emissions from diesel-powered equipment will be subject to periodic checks as part of regular maintenance programmes. This will allow Sedex to detect increased emissions and implement improvement measures where necessary.

3.7.6 Noise Management

Potential sources of noise during the operation phase include noise from vehicles the road between the desalination plant and Zandkopsdrift Mine, as well as generators and the desalination equipment at the plant.

Mobile equipment, vehicles and power generation equipment will be sourced from reputable manufacturers and all equipment will be subject to commissioning tests at handover by the supplier, and noise emissions will be measured against the manufacturer’s specifications to confirm compliance before the equipment is accepted.

Noise emissions from mobile and fixed equipment will be subject to periodic checks as part of regular maintenance programmes or through ambient noise measurements. This will allow Sedex to detect increases in noise and implement improvement measures where necessary.

The remoteness of the desalination plant will influence noise mitigation required in this area.

3.7.7 Workforce

Plant operators will be on site at all times, with full communication with the operations centre at the mine, and the control of certain aspects of the plant may be provided by the operations centre. It is estimated that five to seven plant operators and support staff will be permanently employed at the desalination plant.

3.7.8 Traffic

Traffic during the operation phase would be limited to the daily movement of staff to the desalination plant as well as traffic associated with infrastructure maintenance (when required) and monthly deliveries of chemicals and other supplies. It is estimated that traffic on the access route between the desalination plant and Zandkopsdrift Mine would be limited to approximately 6 light and 6 heavy vehicle trips per day. In addition, 20 trips by delivery vehicles (5 to 8 t) per month are anticipated.

3.7.9 Operational lifecycle

The operational life cycle of the plant is assumed to be 30 years, with a phased increase in capacity over the first five years of operation. Electrical and mechanical infrastructure may need refurbishment after 10 years.

3.8 Environmental Factors Influencing Project Design

In addition to the potential impact of the proposed project on the surrounding environment, there are a number of environmental factors which could affect the project, and have thus been taken into consideration during the planning and design of the project. Key environmental factors which could influence the project include:

- Extreme waves, water levels and storm surges at Volwaterbaai; and
- Climate change and associated sea-level rise.

These factors has been considered during the early feasibility and design stages of the project, particularly with respect to the marine structures i.e. the seawater intake and brine discharge structures, as well as the stormwater management system.

WSP Engineers (WSP) conducted a study to determine the lowest and highest water levels that may potentially affect (or threaten) marine infrastructure (including the seawater intake and brine discharge infrastructure) (WSP, 2010). The lowest and highest potential water levels were calculated based on tides, storm surge (elevated water levels due to barometric pressure and wind extremes), wave set-up, long waves, sea level rise (as a result of climate change) and incident waves (which affect the instantaneous water level). The desalination plant has been designed to operate during the lowest and highest water levels that are projected during the operational lifecycle of the plant (i.e. 30 years).

Climate change is expected to raise sea level by approximately 1 m over the next century. Over the 30 year operational life cycle of the plant, it is conservatively estimated that a 0,25 m rise above Mean Sea Level (MSL) will occur. Marine infrastructure at the desalination plant has been designed to accommodate a maximum expected water level of 3,297 m above MSL. The highest expected water level was based on calculations to accommodate Highest Astronomical Tide (HAT), wind setup, barometric pressure, wave set-up (see Section 4.1.9.13) and sea level rise (see Section 4.1.9.14). The overall lowest infrastructure for which marine infrastructure was designed is 1,226 below MSL (to accommodate Lowest Astronomical Tide (LAT), wind set-down and barometric pressure).

In addition, algal blooms, which typically develop during periods of unusually calm wind conditions when sea surface temperatures are high (February to April), can negatively impact source water quality and may result in elevated organics in the source water and accelerated biofouling of RO installations. Red tides may result in the release of algal toxins of small molecular weight, which may impact product water quality. These are, however, typically effectively removed during the RO process. Abstraction of the feed-water at depth and a reduced intake velocity can minimise the entrance of algal material in open water intakes. Feed-water will be abstracted from an open channel in the surf-zone. As the coastline is characterised by high wave energy, algal wrack often accumulates in large quantities in intertidal gullies and may thus similarly accumulate in the feed-water intake channel. Furthermore, the diver survey undertaken as part of the project also identified high concentrations of macerated macroalgae in the water column in the surf-zone. This algal material could likewise accumulate in the intake channel, clog the screens at the intake box and negatively impact source water quality through elevated organics, will need to be considered in the project design.

3.9 Analysis of Need and Desirability

Best practice requires that the need and desirability of a project (including viable alternatives) is considered and evaluated against the tenets of sustainability. It requires an analysis of the effect of the project on social, economic and ecological systems; and places emphasis on consideration of a project's *justification* not only in terms of financial viability, but also in terms of the specific needs and interests of the community and the opportunity cost of development. Proposed actions of individuals are therefore measured against the interests of the broader public, and project impacts are not allowed to be distributed in such a way that they unfairly discriminate against members of society (DEA&DP, 2013).

Regional planning documents such as SDFs, IDPs and EMFs enunciate the strategic needs and desires of communities, and project alignment with these documents must therefore be considered and reported on in the EIA Report. With the use of these documents or - where these planning documents are not available - using best judgment, the EAP (and specialists) must consider the project's strategic context, or justification, in terms of the needs and interests of the broader community (DEA&DP, 2013).

The compatibility of the proposed project (or the "desirability" thereof) with the objectives for planning and development for the area (or the "need") is considered in Table 3-7 below, based on the above analysis of the existing planning framework and proposed project activities.

Table 3-7: Need and desirability of the Project in the context of planning objectives

<table>
<tr><th colspan="2">Economic</th></tr>
<tr><th colspan="2">Objective ("Need")</th></tr>
<tr><td colspan="2">Provincial, District and Local Municipality level planning documents all reiterate the need for:
• Poverty alleviation;
• Socio- economic development;
• Encouraging trade and investment;
• Maximising the benefits of mining and agriculture through ensuring inclusive growth;
• The development of human capital and a skilled and capable workforce;
• The provision of adequate and appropriate infrastructure to stimulate economic growth;
• Addressing water scarcity as a limiting factor to economic growth; and
• Improving accessibility in order to stimulate growth in the tourism industry, provide linkages to other regions and support effective service delivery.</td></tr>
<tr><th>Compatible aspects</th><th>Potentially incompatible aspects</th></tr>
<tr><td>The project will create employment opportunities during the construction and operation phases.
Opportunities for skills development will arise (particularly for unskilled labourers during the construction phase).
The provision of service infrastructure (including roads and the possibility of water supply) to Kotzesrus and Lepelsfontein will likely stimulate economic growth and tourism potential in the area.
The desalination plant will supply water to the Zandkopsdrift Mine. Water scarcity would otherwise have been a limiting factor to the development of the mine. The mine is expected to stimulate economic growth in the area and provide a number of employment opportunities to local residents.
The expected project lifetime of the desalination plant is 30 years and employment opportunities at the desalination plant will thus be sustained over the long term (more than 15 years).
Improvement of the road network, and particularly access to the coast would promote tourism, with economic benefits.</td><td>The development of the desalination plant on Farm Strandfontein 559 may impact on scenic and tourism resources at the coast, and could potentially impact upon economic growth in the tourism sector.</td></tr>
</table>

<table>
<tr><th colspan="2">Environmental</th></tr>
<tr><th colspan="2">Objective ("Need")</th></tr>
<tr><td colspan="2">Provincial, District and Local Municipality level planning documents stipulate that:
The unique biodiversity of the Namaqua area is important for economic, cultural, aesthetic, scientific and educational purposes and has significant conservation importance;
The coastal area provides an abundance of marine and coastal resources;
Visually and ecologically sensitive areas should be protected in order to promote conservation and tourism;
Biodiversity in the Namaqua area is threatened by invasive species, habitat loss and climate change; and
Longitudinal developments that traverse biodiversity corridors should incorporate mitigation measures to ensure that corridors are not severed.</td></tr>
<tr><th>Compatible aspects</th><th>Potentially incompatible aspects</th></tr>
<tr><td>The development area (desalination plant and associated infrastructure) is not located in close proximity (less than 10km) to any National Park identified in NEM: PAA.

The development area does not fall within any threatened vegetation type, although some Species of Conservation Concern (SCC) may occur in the area.

The desalination plant on Farm Strandfontein 559 is not located in a CBA.

While traversing a terrestrial ESA and some aquatic CBAs and ESAs, the Kotzesrus Route follows an existing route.

The desalination plant and portion of the Kotzesrus Route along the coast is located within a terrestrial ESA. However, according to the Namaqua District Biodiversity Sector Plan, a limited loss of ecosystem services is permissible in ESAs.</td><td>The route leading from the coastal route on Farm Strandfontein 559, towards Kotzesrus follows existing 4 x 4 tracks, but is located within a terrestrial CBA.

A portion of the Amended Bypass Route also traverses a terrestrial CBA.

According to the NDBSP, linear engineering structures as well as water projects and transfers are listed as restricted activities within terrestrial and aquatic CBAs and ESAs, but are not considered to be unsuitable activities in these areas.</td></tr>
<tr><th colspan="2">Regional planning</th></tr>
<tr><th colspan="2">Objective ("Need")</th></tr>
<tr><td colspan="2">A number of regional planning documents have particular relevance to the project. According to the:
Northern Cape PSDF, Garies is identified as a high priority area for public and private investment and infrastructural development.
EMF and SEMP, development should be discouraged where water supplies cannot be secured and alternative sources of water supply should be investigated, including desalination; and
Mining should be encouraged where environmental impacts are deemed to be acceptable, the appropriate environmental controls are in place and economic benefits will exceed potential environmental impacts.</td></tr>
<tr><th>Compatible aspects</th><th>Potentially incompatible aspects</th></tr>
<tr><td>Garies will benefit from economic opportunities generated by the Zandkopsdrift Mine (which is reliant on the proposed desalination plant for development). The town is identified as a high priority area in terms of the Northern Cape PSDF and economic growth in the town is in line with regional planning principles.

The desalination plant provides an alternative water source that can be utilized to support development and mining in the arid Namaqua environment.

The coastal area on Farm Strandfontein 559 is identified as EMZ B in terms of the EMF and SEMP. The EMF and SEMP indicates that development should not be restricted in EMZ B areas where compelling economic and social benefits will be derived for the local and regional population.</td><td>Potential environmental impacts should be carefully weighed against economic benefits in order to ensure that the development is deemed to be acceptable from an environmental perspective and it should be ensured that the appropriate environmental controls are in place.</td></tr>
</table>

The relevant regional and local policies and planning guidelines support mining activities in the KLM as a means to achieve economic growth and poverty alleviation. The recent downscaling of the mining industry was identified as a concern in the KLM IDP. Limited infrastructure and accessibility is identified as a constraint to economic growth, while water scarcity is highlighted as a key concern.

Plans and guidelines also recognise the importance and sensitivity of Namaqualand's biodiversity, which presents significant potential in terms of tourism and conservation. The challenge would be to encourage economic growth in the area, while ensuring that environmental resources are maintained.

The proposed desalination plant and associated infrastructure will support economic growth in the area by facilitating development of the Zandkopsdrift Mine. The associated infrastructure will improve linkages and accessibility in the region, including accessibility to the coastal environment thus promoting tourism in the area. However, the development of the desalination plant may affect the tourism potential of the coastal area and may generate economic benefits. Economic benefits associated with the development should be carefully weighed against potential environmental impacts in order to ensure its sustainability.

4 Description of the Affected Environment

The following chapter presents an overview of the biophysical and socio-economic environment in which the proposed project is located, to:

- Understand the general sensitivity of and pressures on the affected environment;
- Inform the identification of potential issues and impacts associated with the proposed project, which were assessed during the Impact Assessment Phase;
- Identify gaps in available information to inform specialist study requirements; and
- Start conceptualising practical mitigation measures.

The region has previously been studied to some extent and is recorded in various sources. Consequently, some components of the baseline have been generated based on literature review. However, where appropriate, baseline information has been supplemented or generated by specialists appointed to undertake baseline and impact assessments for the proposed Project.

The specialist studies undertaken for the EIA process are listed in Table 4-1.

Table 4-1: Specialist studies undertaken for the EIA

Specialist Study	Specialists	Organisation
Terrestrial and Aquatic Ecology	Louise Zdanow Stephen van Staden Natasha van de Haar	Scientific Aquatic Services cc (SAS)
Marine Modelling	Stephen Luger	PRDW Consulting Port and Coastal Engineers (PRDW)
Marine and Coastal Ecology	Andrea Pulfrich Nina Steffani	PISCES Environmental Services (Pty) Ltd Steffani Marine Environmental Consultants
Heritage	Jayson Orton Tim Hart	ACO Associates cc (ACO)
Palaeontology	John Pether	Private Consultant

Final specialist baseline and impact assessment reports are attached as Appendices 4A to 4E.

4.1 Biophysical Environment

4.1.1 Topography

The topography of the NDM is characterised by mountainous areas, ridges, steep slopes, undulating hills and plateaus, floodplains and coastal dunes. The Kamiesberg mountain range forms an escarpment from Garies in the southeast to Springbok in the northeast and elevation above sea level ranges from about 250 m to 750 m in this area. The Kamiesberg mountain range is characterised by granite and gneiss rock formations and steep rocky slopes that are separated by sandy plains and lowland areas. The mountain range functions as an important rain catchment area (Chidley et al., 2011).

The lowest lying areas of the NDM are situated along the coastal plain belt to the west of the N7. The coastal areas in the District are relatively narrow with no natural harbours. The area surrounding Volwaterbaai is characterised by a rocky energetic coastline interspersed with sandy beach areas (CNdV, 2012).

4.1.2 Geology

There are five dominant geological formations in the NDM: tillite, sedimentary, shale, gneiss and granite. Of these, the sedimentary, gneiss and tillite formations occur in the project area (Figure 4-1) (Higgs et al, 2010).

Sedimentary formations are formed through a process of erosion and sedimentation. Sedimentary deposits are formed by the accumulation and settling of particles that have been formed by weathering and erosion and transported by wind, water or the mass movement of glaciers. Sedimentary formations generally coincide with river systems and contain the highest concentrations of fossils when compared to any other rock type. Sedimentary formations are often suitable for construction purposes.

Gneiss is a common and widely distributed type of rock that is formed by high-grade regional metamorphic processes from pre-existing formations that were originally either igneous or sedimentary rocks.

Tillite is a sedimentary rock that consists of consolidated masses of unweathered blocks that have formed as a result of glacial movement. Tillite may contain concentrations of gems or other valuable ore minerals such as diamonds. These concentrations form part of alluvial deposits that were transported by glaciers during their advance.

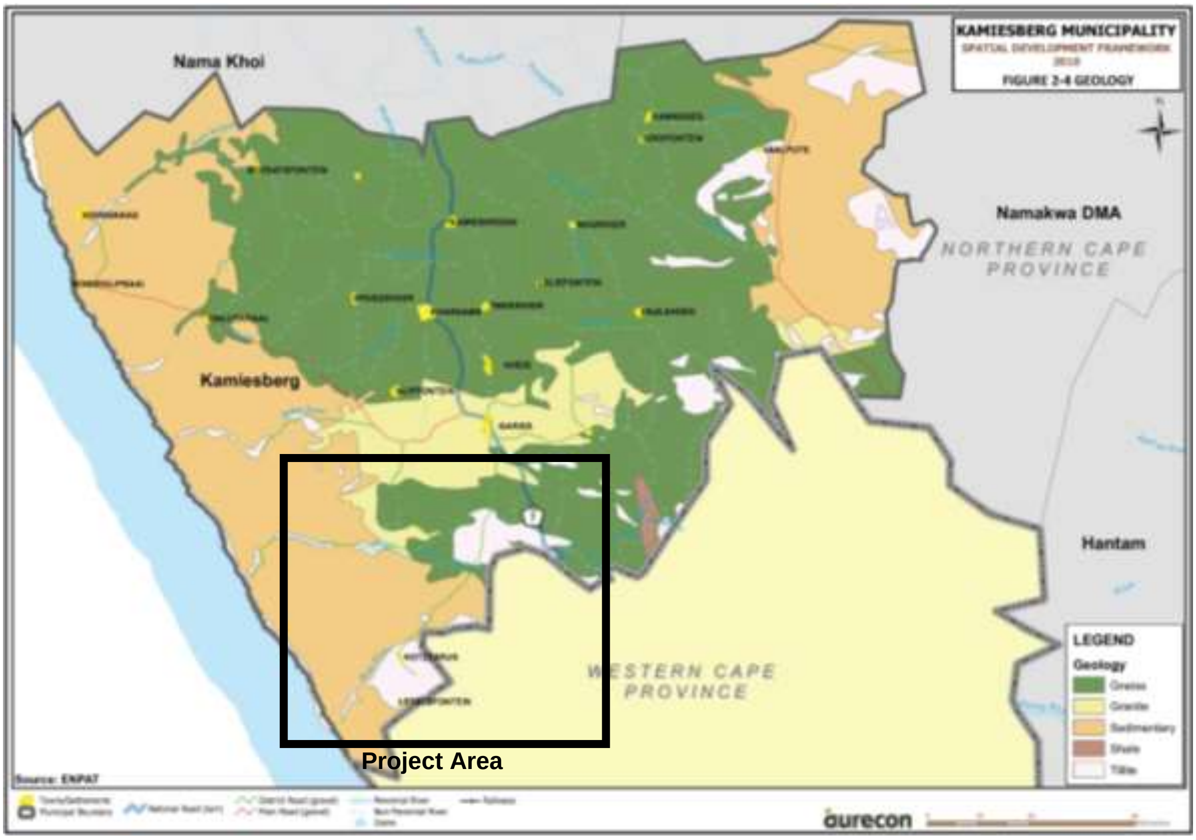


Figure 4-1: Geological Formations of the Kamiesberg Local Municipality

Source: Kamiesberg Local Municipality SDF (Higgs et al., 2010)

A light seismic tremor measuring 1.6 on the Richter scale occurred in the Springbok area in May 2009. However, the geology of the area is considered to be stable with a very low level of seismic activity. The closest known area of seismic activity is considered to be the Milnerton Fault which is located near Milnerton (in the Cape Town area), 340 km south of Kotzesrus (Higgs et al., 2010).

4.1.3 Climate

4.1.3.1 General Description of Regional Climate

The NDM has a typical arid to semi- arid climate. Rainfall is low and unreliable. Summers have characteristically high temperatures and winters have mild to cold temperatures. The northern areas of the District experience the highest mean annual temperatures, while the cooler areas have the highest level of rainfall. The cold Benguela Current influences the climatic conditions by producing coastal fog and dew during the winter months (Chidley et al, 2011).

4.1.3.2 Rainfall

Rainfall in the District is among the lowest in the country. The western parts of the NDM (the Succulent Karoo, including the Garies area) are characterised by winter rainfall while the Nama Karoo is characterised by late summer rainfall. The south eastern areas of the District, (a band along the escarpment from Sutherland to Nieuwoudtville) receive most rainfall (between 400 mm and 600 mm per annum). The area around Garies is situated on the west of the escarpment and falls under the same rainfall regime. The majority of the District receives rainfall less than 200 mm per annum.

Most rain is recorded between April and August, with the lowest rainfall occurring in September and the highest rainfall in May/ June. Highest monthly rainfall is recorded in Springbok (37.8 mm) followed by Fraserburg (31.5 mm) and the lowest monthly rainfall is recorded at Vioolsdrif (0.2 mm) followed by Alexander Bay (0.5 mm) (CNdV, 2012).

4.1.3.3 Ambient Temperature

The NDM can be divided into a number of climatic regions. The majority of the District has an average annual temperature of less than 18°C. The climatic region surrounding the Garies area is considered to be slightly warmer than the coastal climatic region near Volwaterbaai. The average annual temperature of the Garies area is more than 18°C, while the Volwaterbaai area is cooler with annual average temperatures of less than 18°C (Chidley et al, 2011).

Table 4-2 indicates the annual average minimum and maximum temperatures in the larger towns of the NDM.

Table 4-2: Average Annual Minimum and Maximum Temperatures in Larger Towns in Namakwa District Municipality

Name	Minimum Temperature	Maximum Temperature
Alexander Bay	9°C	19°C
Calvinia	8°C	20°C
Springbok	13°C	18°C
Sutherland	0°C	16°C

Source: Chidley et al., 2011

The average monthly minimum temperatures in the District are experienced between June and August and the lowest temperatures are recorded in July. The town that experiences the lowest temperatures is Fraserburg with temperatures reaching as low as -0.2°C in July.

Higher temperatures are experienced along the Orange River and northern border of the NDM. The highest average monthly maximum temperatures are experienced between December and March and the highest temperatures are recorded in February.

Vioolsdrift experiences the highest temperatures, with a monthly average maximum of 38.8°C in February. The highest average annual temperatures are also recorded at Vioolsdrift (24.7°C) and

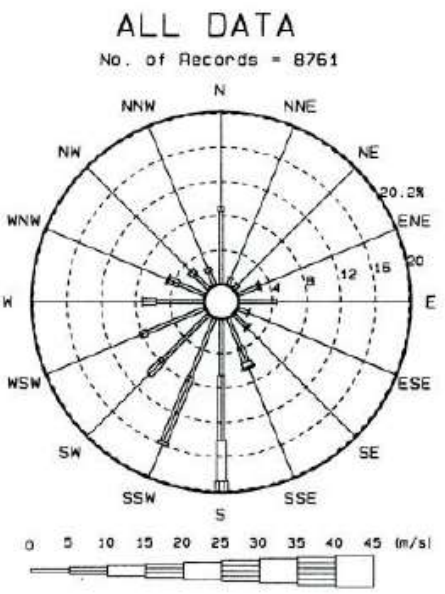
Pofadder (19.5°C) while the coldest average annual temperatures are recorded at Garies (15.0°C) and Port Nolloth (15.3°C). The colder areas (such as Garies) also experience the highest levels of rainfall (CNdV, 2012).

4.1.3.4 Wind

Wind in the District is strongly seasonal, which is typical of the west coast of Southern Africa. Summer and spring are dominated by southerly winds, while north-easterly winds are more common in autumn in winter.

Reliable wind measurements are taken from an automatic station situated at Alexander Bay. The wind rose derived from data collected at this station is shown in Figure 4-2. The wind rose indicates that the predominant wind direction is southerly and that maximum speeds of 20 m/s (approximately 39 knots) are experienced in the area.

The measurements at Alexander Bay are considered to be representative of coastal areas within the Namakwa area, but are not entirely representative of inland areas, which would generally experience lower wind speeds. The coastal wind climate is diurnal. Wind speeds are low in the morning, peak in the afternoon and slacken at night. Easterly berg winds that bring hot and dry conditions occasionally occur (Chidley et al., 2011).



srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** Alexander Bay Wind Rose	Project No. 451101

Figure 4-2: Wind Rose for Alexander Bay

Source: Namakwa District Municipality EMF (Chidley et al., 2011).

4.1.4 Air Quality

There are no significant sources of air pollution in the area. Farming activities generate limited emissions, mainly airborne particulates. It is therefore expected that air quality in the project area is good. The majority of the roads in the development area are dirt roads and small volumes of dust are generated by the movement of vehicles.

4.1.5 Noise

There are no significant sources of noise in the area, and very few noise receptors. Some noise may be propagated by vehicles travelling through Kotzesrus, although levels of traffic are extremely low in this area. Along the coast, noise generated by wave action is likely to result in higher than normal ambient noise levels, especially during rough sea conditions.

4.1.6 Hydrology and Surface Water

4.1.6.1 Catchment

The project is located in the Lower Orange Water Management Area (WMA). The Brak River and its tributaries and a number of tributaries of the Groen River flow through the project area. The Brak River runs to the southwest of Kotzesrus while tributaries to the Groen River run to the northeast (see Figure 4-3).

The South African National Biodiversity Institute (SANBI) National Wetland Classification system, classifies the Brak River and tributaries to the Groen River as Inland systems falling within the Western Coastal Belt Ecoregion. According to the National Freshwater Ecosystem Priority Areas (NFEPA) database (2011), the Brak River and tributaries of the Groen River are considered to be valley floor wetland features (see Figure 4-3). The Brak River is indicated as a channelled valley bottom wetland feature which is in a good condition (Class AB) and tributaries of the Groen River are indicated as floodplain wetland features in a good condition. Both river systems are non-perennial.

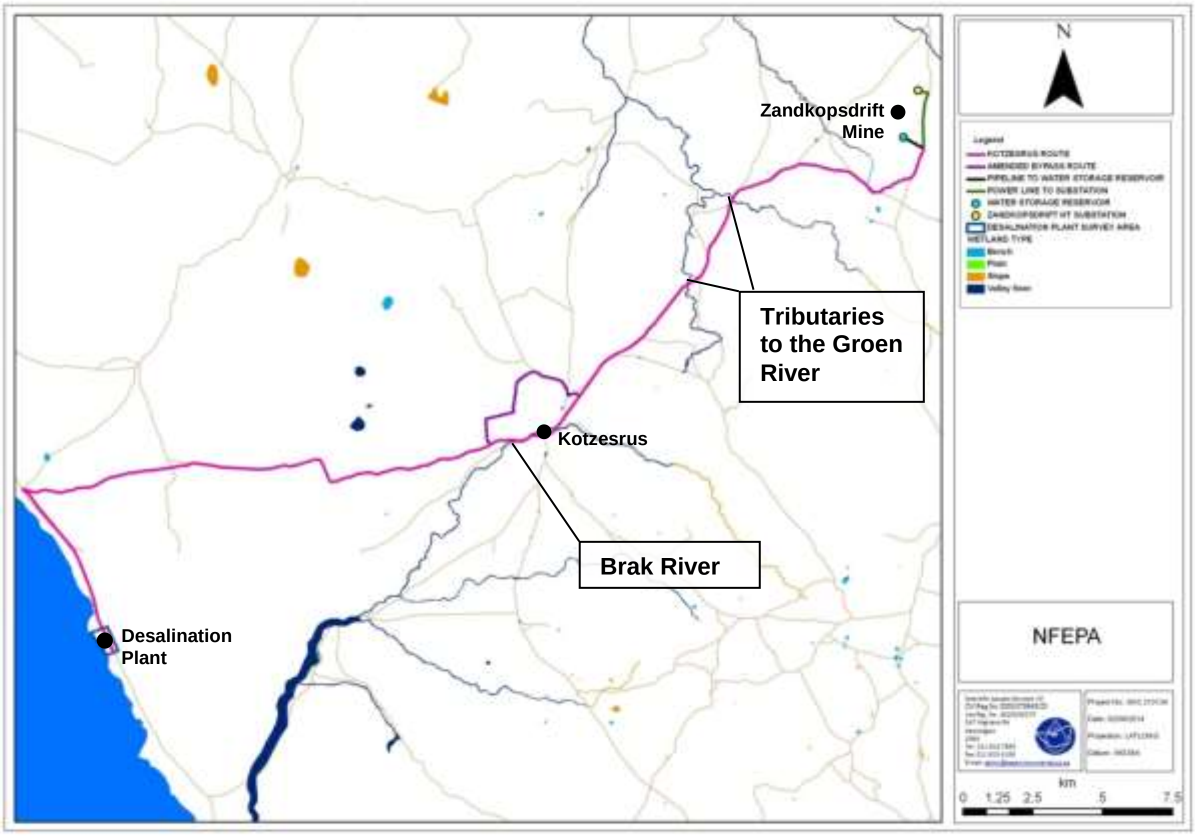


Figure 4-3: NFEPA Freshwater Information

Source: van Staden et al., 2014

4.1.6.2 Wetlands and Drainage Features

Ephemeral drainage features as well as natural and artificial wetland features fall within the project footprint (see Figure 4-4). Ephemeral drainage features are likely to convey water during and immediately after rainfall events. However, these drainage features do not retain water long enough for the formation of hydromorphic soils that would support facultative floral species. As a result these systems cannot be defined as wetlands.

The wetlands in the project area can be categorised as *the Brak River, tributaries to the Groen River*, *natural ephemeral pans* and *artificial depressions* (see Figure 4-4). These wetland features are situated in both valley floor and plain landscape settings and can be classified as *unchannelled valley bottom*, *floodplain* and *depression* Hydrogeomorphic (HGM) units on the basis of hydrology and geomorphology (see Table 4-3).

Table 4-3: Wetland Classification

Freshwater Habitat	Level 3: Landscape unit	Wetland Groups (HGM Type)
Brak River	Valley floor	Unchannelled valley bottom wetland
Tributaries of the Groen River	Valley floor	Floodplain wetland
Natural Ephemeral Pans	Plain	Depression - natural
Artificial Depressions	Plain	Depression - artificial

The Brak River is a non-perennial system with only intermittent surface flow, typically directly after isolated heavy rainfall events. It is characterised by alluvial soils and the presence of vegetation species such as *Sarcocornia natalensis* which is an indicator of saline conditions, as well as *Salsola aphylla, Crassula natans* and *Lycium cinereum*. The sensitivity of the portion of the Brak River to the west of Kotzesrus is elevated by the presence of numerous rocky outcrop and bed rock areas and by higher floral species diversity. Where the existing gravel road through the town of Kotzesrus traverses the Brak River, signs of erosion are evident.

The *Kotzesrus Route* follows an existing provincial gravel road to the north east of the town of Kotzesrus and traverses two non-perennial *tributaries of the Groen River* which are indicated as floodplain wetlands by the NFEPA database. These tributaries also only have intermittent surface flow directly after isolated heavy rainfall events, every few years. *Tributaries of the Groen River* are characterised by alluvial soils and the presence of species such as *Sarcocornia natalensis, Salsola aphylla, Crassula natans, Cotula coronopifolia* and *Moraea miniata*. The existing gravel road through these features has resulted in erosion of the features and inadequate culvert design has disrupted hydrological connectivity within the features.

Natural ephemeral pan features are found where the underlying clays are in close proximity to the soil surface which consequently enables the depressions to contain water for short periods during the wet winter months and spring. During these periods they may serve as a source of water for a variety of wetland and terrestrial faunal species. Furthermore, *ephemeral pans* may serve as breeding areas for invertebrate and amphibian species which in turn provide foraging habitat for avifaunal species.

Two *artificial depressions* occur within the *ephemeral drainage features* to the east of Kotzesrus most likely due to farmers excavating these areas to impound water for as long as possible (see Figure 4-4). These *artificial depressions* contain surface water during the rainy season and have remained inundated for long enough for the formation of hydromorphic soils and are therefore considered to be wetland habitat.

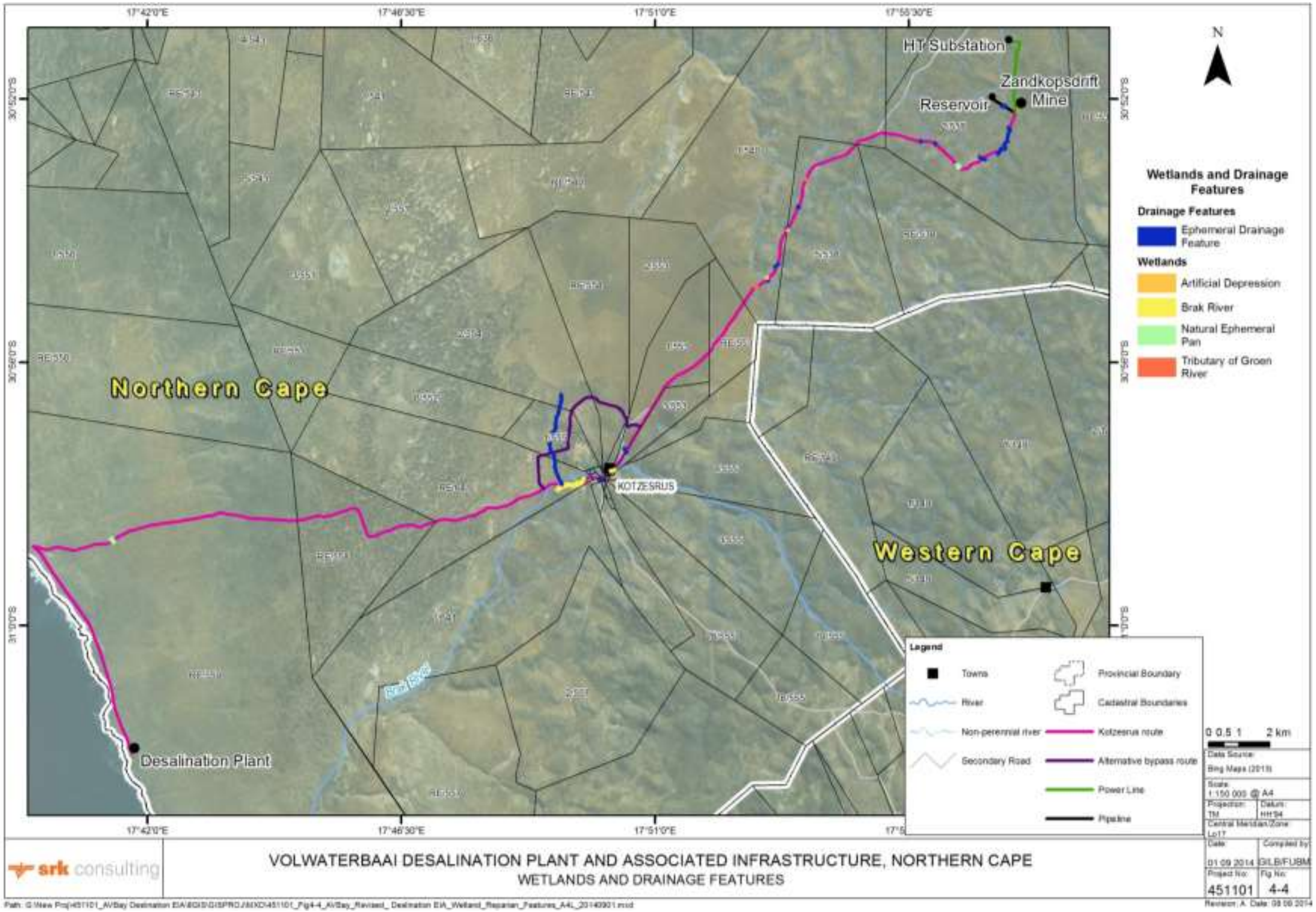


Figure 4-4: Wetlands and Drainage Features

4.1.6.3 Ecological Condition of Wetland Groups

Wetland function, Present Ecological State (PES) (using the WET-Health methodology[13]), Ecological Importance and Sensitivity (EIS) and Recommended Ecological Category (REC) were calculated for each of the wetland types. A summary of the findings is presented in Table 4-4.

Table 4-4: Summary of ecological condition of wetland groups

Wetland Group	Wetland Function and Service Provision (average score)	PES using WET-health methodology	EIS	REC
Brak River	1.2 – Moderately Low	Category A (unmodified/ natural)	Category A (very high sensitivity)	Category A (unmodified/ natural)
Tributaries of the Groen River	1.0 – Moderately Low	Category A (unmodified/ natural)	Category A (very high sensitivity)	Category A (unmodified/ natural)
Natural Ephemeral Pans	0.4 - Low	Category A (unmodified/ natural)	Category B (high sensitivity)	Category A (unmodified/ natural)
Artificial Depressions	0.4 - Low	Category F (critically modified)	Category C (moderately sensitive)	Category F (critically modified)

4.1.7 Hydrogeology

The hydrogeology of the Namakwa area consists of unconsolidated sub-structures that are host to intergranular aquifers. These aquifers have low yield due to the presence of fine and clayey materials and are dependent on rainfall for recharge. Major recharge events generally occur every 15 years and natural draw down occurs between periods of recharge.

Groundwater is one of the most important water sources in the NDM. It plays a major role in the provision of water to urban and rural areas. Groundwater extraction impacts on the natural rate of draw down. Indications are that boreholes at Garies, Kamieskroon, Hondeklipbaai and Koingnaas are at levels lower than observed in 1990. Where aquifers have been de-watered, this may lead to surface instability. The alteration of aquifer structure arising from de-watering could limit the possibility for future recharge.

Groundwater quality in the Lower Orange WMA ranges from good to unacceptable, the latter due to contamination by total dissolved solids, nitrates and fluorides caused by pollution from agriculture, lack of sanitation and algal blooms. Areas of high nitrate concentration have been measured at Garies and the surrounding areas.

Groundwater generally flows towards the coast and there is usually little connection between surface water flows and the groundwater aquifer, mainly due to low quantities of surface water. There are therefore not many aquifer dependent ecosystems in the District and it is likely that groundwater contamination does not pose a major risk to floral and faunal communities (Chidley et al., 2010, Higgs et al., 2010).

[13] Methodology used to determine wetland health: see Appendix 4A – Terrestrial and Aquatic Ecology Specialist Study.

4.1.8 Terrestrial Vegetation and Habitats

4.1.8.1 Regional Context

The study area is located within the *Central Namaqualand Coast* region and the *Succulent Karoo Region of Endemism* in the Northern Cape Province. The *Succulent Karoo Region of Endemism* is considered to be of high vulnerability in terms of biodiversity sensitivity and is listed as a *biodiversity priority area* according to the National Spatial Biodiversity Assessment (NSBA) (2004). The *Central Namaqualand Coast* region is listed as a *geographic priority area* by the Succulent Karoo Ecosystem Programme (SKEP) (2003). However, the study area does not fall within the remaining extent of any threatened terrestrial ecosystem and the vegetation in the area is listed as *Least Threatened*.

Much of the area surrounding the project area is used for agricultural purposes (mainly grazing) and remains largely natural. However, small portions along each of the alternative routes have been transformed for cultivation and urban development.

The vegetation in the study area falls within the *Fynbos* and *Succulent Karoo* biomes and the *North West Fynbos*, *Namaqualand Hardeveld* and *Namaqualand Sandveld* bioregions. The Succulent Karoo Biome is one of only three semi-arid biodiversity hotspots in the world and exhibits the highest plant diversity of any arid ecosystem. The following vegetation types have been identified in the study area: *Namaqualand Strandveld, Namaqualand Sand Fynbos, Namaqualand Klipkoppe Shrubland, Namaqualand Inland Duneveld*, *Namaqualand Coastal Duneveld* and *Namaqualand Heuweltjieveld* and *Namaqualand Seashore* (Figure 4-5). None of these vegetation types is considered to be of conservation concern. However, these vegetation types are not well conserved and are increasingly threatened by habitat loss due to mining, agricultural activities, road development, water extraction and other anthropogenic activities.

4.1.8.2 Vegetation Habitat Units

At a finer scale, five floral habitat units have been identified within the study area. These include: *Sand Fynbos, Succulent Karoo, wetland/riparian, rocky outcrop* and *transformed habitat* units. Due to its diversity, the *Succulent Karoo* habitat unit can be further divided into *Strandveld*, *Hardeveld* and *Coastal* habitat units (see Figure 4-6).

The *Sand Fynbos* habitat unit occurs primarily on slightly acidic, sandy, inland dune areas. It is not listed as a threatened vegetation type; however, species diversity within the vegetation type is considered high. Sandy dune areas characteristic of *Sand Fynbos* occur to the west of Kotzesrus, and may form part of a dune plume system which extends from the Groen River to the Brak River, that most likely acts as an ecological corridor and is considered to be sensitive. SCC identified within the *Sand Fynbos* habitat unit include *Leucospermum rodolentum* and *Babiana hirsuta.*

The *Strandveld (Succulent Karoo)* habitat unit consists of low to medium-high, succulent rich vegetation which occurs on deep red-brown sands. It is not considered to fall within a threatened vegetation type; however, two SCC, *Babiana hirsuta* and *Aloe arenicola* have been identified within this habitat unit.

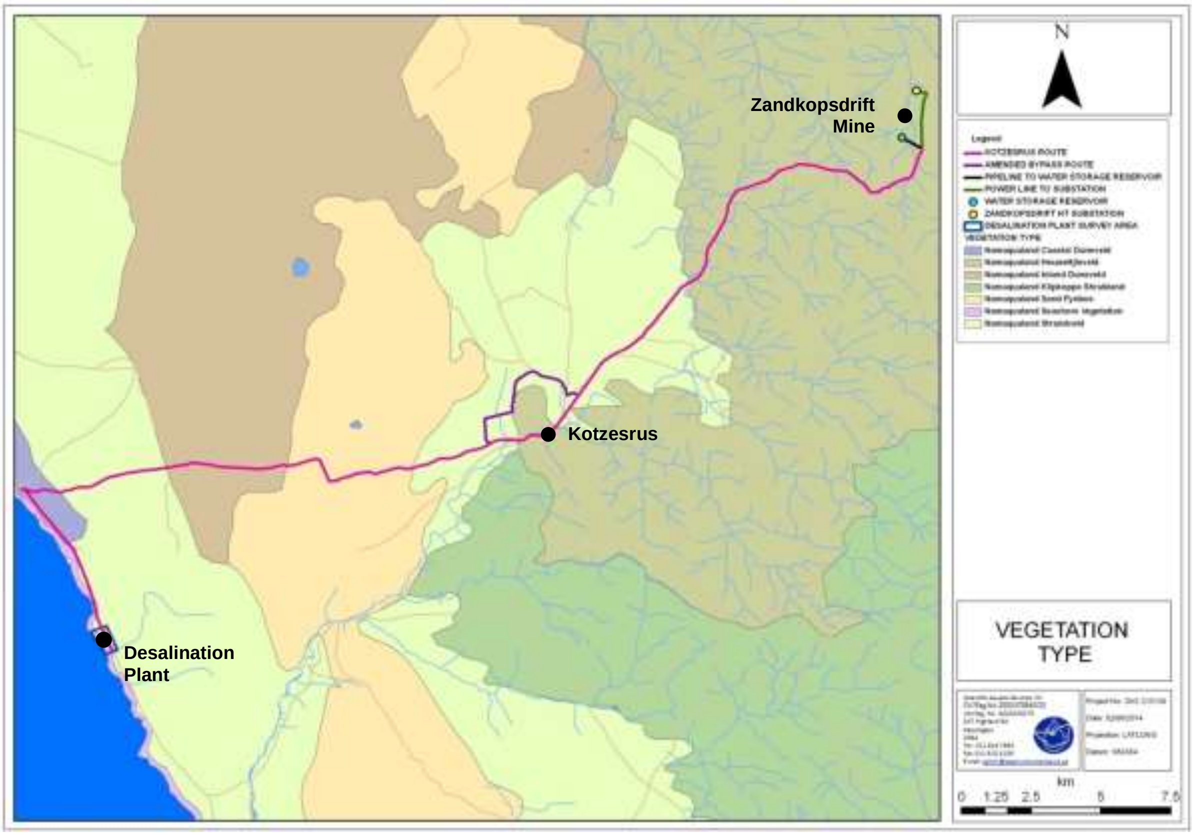


Figure 4-5: Vegetation Types in the Project Area

Source: Zdanow et al., 2014

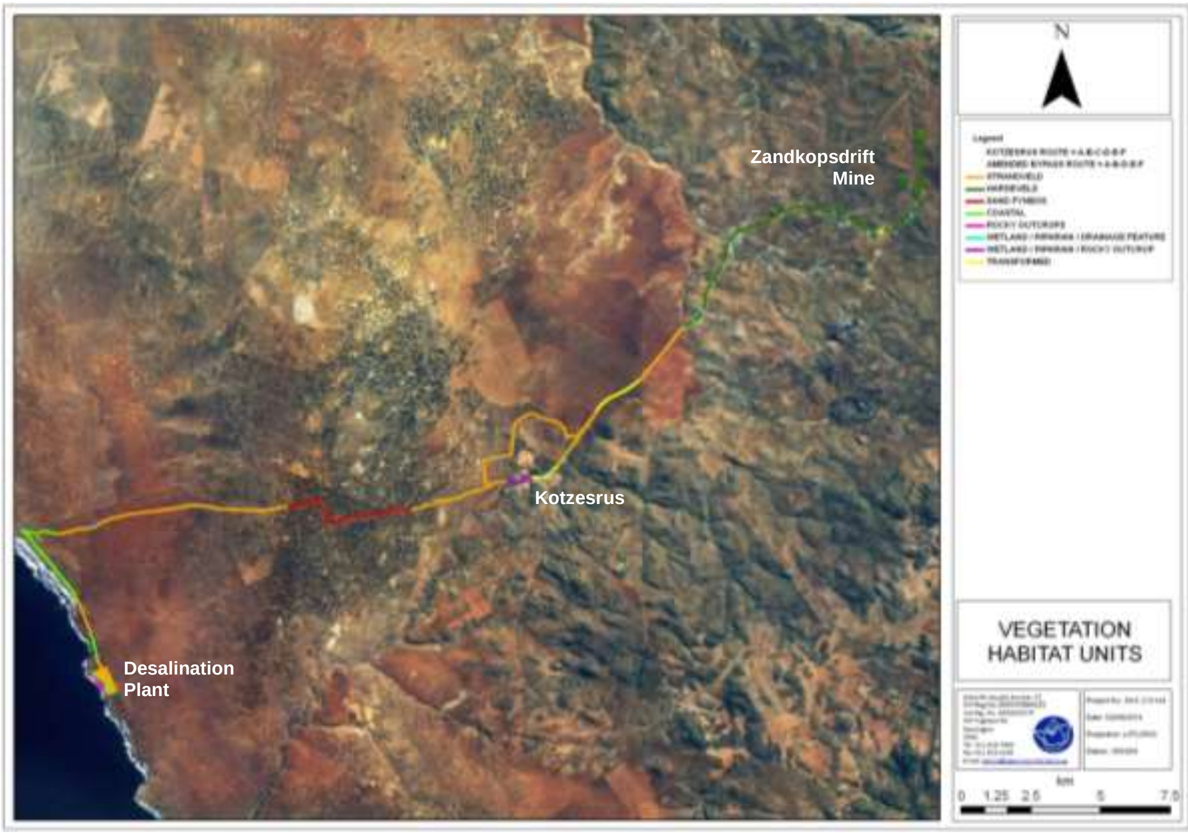


Figure 4-6: Vegetation Habitat Units in the Project Area

Source: van Staden et al., 2014

The *Hardeveld (Succulent Karoo)* habitat unit occurs on shallow gravelly soils and loamy sands. It consists of low growing, succulent rich vegetation and is characterised by the presence of numerous quartzite and clay exposure areas which are known to provide the habitat to support SCC, including *Bulbine bruynsii*. *Bulbine bruynsii* is a rare, localised habitat specialist which has a small global population and is listed as *Vulnerable* in terms of the International Union for Conservation of Nature and Natural Resources (IUCN) Red List for Threatened Species (2013). It also falls within the family Asphodelaceae, which is protected under the NCNCA. A subpopulation of *Bulbine bruynsii* occurs within quartz and clay exposure areas along approximately 950m of the existing gravel road leading from Kotzesrus to the mine, approximately 10 km to the northeast of Kotzesrus (see Figure 4-7 and Figure 4-8).

srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** Quartz and Clay Exposure Areas containing *Bulbine Bruynsii*	Project No. 451101

Figure 4-7: Quartz and Clay Exposure Areas along Kotzesrus Route

Source: Helme, 2014

The *Coastal (Succulent Karoo)* habitat unit is restricted to coastal dune areas and coastal rocky formations. Coastal vegetation is adapted to the specific set of conditions prevailing at the coastal edge and is under direct influence of the sea through the deposition of salt spray and fine airborne sediments of marine origin. Coastal habitats are sensitive environments which can easily be damaged or disrupted. Although the vegetation type in which this habitat unit occurs is not considered threatened, one SCC, *Babiana hirsuta*, was identified within this habitat unit.

The *Brak River*, *tributaries of the Groen River*, *natural ephemeral pans*, *artificial depressions* and *ephemeral drainage features* constitute the *wetland/riparian* habitat unit. Wetland and riparian features are considered to be scarce in the arid Namaqualand region and are considered critical for retaining biodiversity and supporting continued ecosystem functioning and services.

The majority of *rocky outcrop* areas along the alternative routes are restricted to *riparian/wetland* areas and therefore share vegetation characteristic of these areas. The *rocky outcrop* habitat unit is likely to provide niche habitat that could support a wide range of unique floral species. *Rocky outcrop* areas are therefore considered to be of elevated importance in terms of the likely occurrence of floral SCC. Additional *rocky outcrop* areas are also associated with the coastal habitat unit.

The *transformed* habitat unit occurs in areas where vegetation has been transformed through historical clearing for agricultural purposes or the construction of infrastructure associated with the town of Kotzesrus (including the excavation of borrow pits). In these areas little or no natural vegetation remains or the natural vegetation has been significantly disturbed.

4.1.8.3 Ecological Condition of Vegetation Habitat Units

The Vegetation Index Score (VIS) was calculated for each of the habitat units and vegetation sensitivity was determined based on the irreplaceability of the habitat unit, the abundance and diversity of floral species, the presence of SCC, the presence of CBAs and ESAs (see Figure 2-2) and on the degree of disturbance[14]. A summary of the findings for each of the habitat units is presented in Table 4-5 and the sensitivity of the various vegetation types is indicated in Figure 4-8.

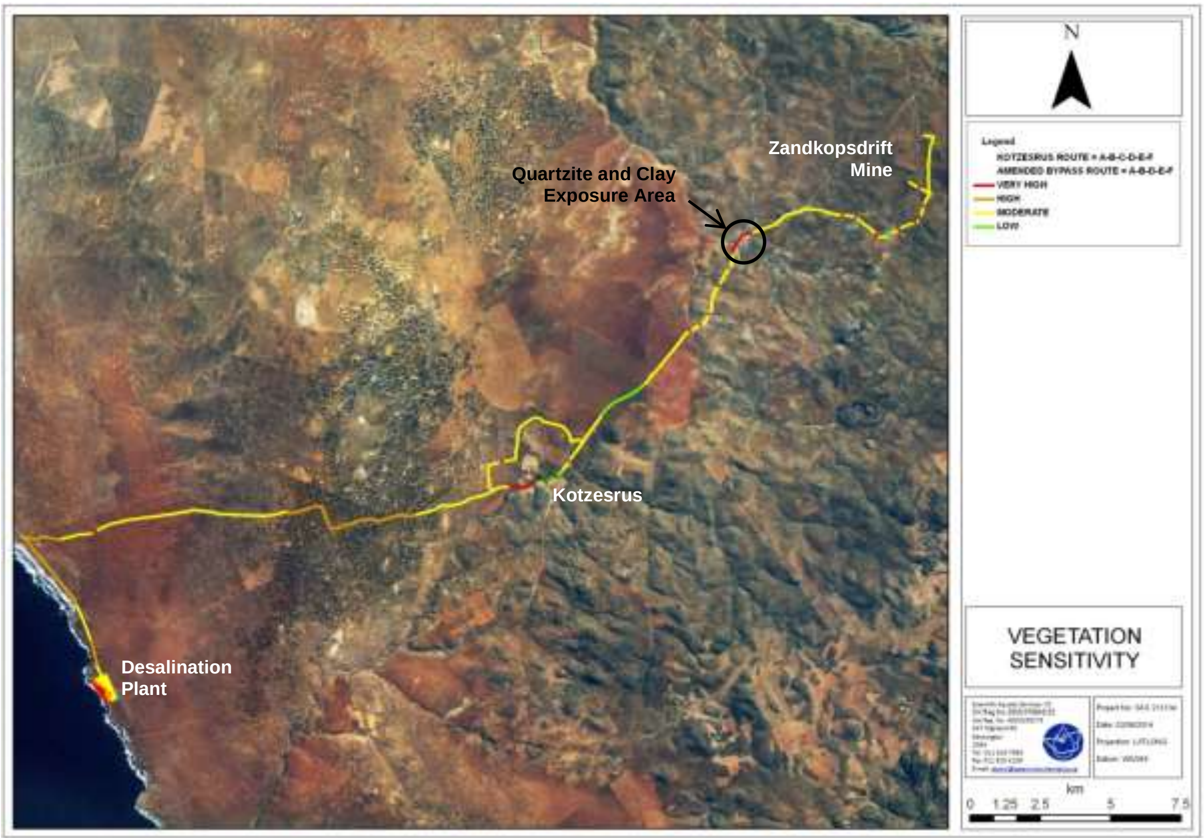


Figure 4-8: Vegetation Sensitivity in the Project Area

Source: Zdanow et al., 2014

[14] See Appendix 4A – Terrestrial and Aquatic Ecology Specialist Study.

Table 4-5: Summary of ecological condition of vegetation habitat units

Habitat Unit		VIS	Sensitivity
Succulent Karoo	Strandveld	*Class B – Largely natural with few modifications*	Moderate
	Hardeveld		Moderate
	Hardeveld – Quartzite and Clay Exposures		Very High
	Coastal		High
Sand Fynbos		*Class A – Natural, unmodified*	High
Wetland/ Riparian		*Class B – Largely natural with few modification*	Very High
Rocky Outcrop		*Class B – Largely natural with few modifications*	Very High
Transformed		*Class E - Loss of natural habitat is extensive.*	*Low*

4.1.9 Fauna

4.1.9.1 Faunal Habitat Units

Four faunal habitat units occur within the study area. These habitats are largely associated with vegetation habitat units (see Section 4.1.8) and include *terrestrial* (S*ucculent Karoo* and *Sand Fynbos*), *rocky outcrop*, *wetland/riparian* and *transformed* habitat units.

Faunal habitat within the project area has remained largely intact, with isolated areas which have been transformed by anthropogenic activities. Terrestrial habitats abutting gravel roads are somewhat disturbed due to vehicular movement in the area and are unlikely to be permanently inhabited by terrestrial species. However, faunal species may inhabit less disturbed areas within the road reserve and faunal species may move through terrestrial habitat units when migrating or foraging. *Rocky outcrop* and *wetland/riparian* habitat units provide niche habitats for faunal species as well as important foraging and breeding habitat. Furthermore, *wetland/riparian* habitat provide important migratory corridors.

4.1.9.2 Mammals

Mammal species that have been identified in the project area include Steenbok (*Raphicerus campestris*), Suricate (*Suricata suricatta*), Bat-eared Fox (*Otocyon megalotis*), Yellow Mongoose (*Cynictis penicillata*), Common Mole Rat (*Cryptomys hottentotus*), Porcupine (Hystrix africaeaustralis), African Wildcat (*Felis silvestris lybica*) and Aardvark (*Ocycteropus afer*). These mammal species are considered to be of *Least C*oncern in terms of the IUCN Red List (2013). However, the majority of mammal species that were identified within the study area are listed as protected species by the NCNCA and three mammal species are listed as protected in terms of NEM: BA.

4.1.9.3 Avifauna

A number of avifaunal species that are considered to be *Threatened* in terms of the IUCN Red Data List (RDL) may occur in the project area. These include Ludwig's Bustard (*Neotis ludwigii*) and the Black Cormorant (*Phalacrocorax neglectus*), both listed as *Endangered*, the Secretarybird (*Sagittarius serpentarius*) and the Black Harrier (*Circus maurus*), both listed as *Vulnerable*, and the Martial Eagle (*Polemaetus bellicosus*) which is listed as *Near Threatened*. However, these species do not permanently inhabit the development footprint area.

Although listed as species of *Least Concern*, a number of avifaunal raptor species that have been identified in the study area are considered to be under threat from small stock farmers, particularly the Lanner Falcon (*Falco biarmicus*), Verreauxs Eagle (*Aquila verreauxii*), Black-chested Snake Eagle (*Circaetus pectoralis*) and the Black-winged Kite (*Elanus caeruleus*). This threat along with loss of foraging habitat puts considerable pressure on these bird species. Although the majority of these species are unlikely to inhabit areas in close proximity to the development footprint, an *Aquila verreauxii* breeding pair has been identified nesting within a tree in close proximity to the *Kotzesrus Route* where it traverses the Brak River.

The remaining avifaunal species identified within the project area are of *Least Concern*. However, the majority of the species identified in the project area are listed as protected species by the NCNCA and two species are listed as protected by NEM: BA.

4.1.9.4 Herpetofauna

Nine reptile species have been identified in the project area. The majority of reptiles are associated with *rocky outcrop* areas, particularly at the coast. However, snake and tortoise species have also been identified within sandy areas. Two reptile species that occur in the project area are considered to be Near *Threatened*: the Namaqua Plated Lizard (*Gerrhosaurus typicus*) and the Speckled Padloper (*Homopus signatus)*. Furthermore, three species identified at the time of the assessment, *Cordylus polyzonus* (Karoo Girdled Lizard), *Cordylus niger* (Black Girdled Lizard) and *Homopus signatus* (Padloper Tortoise) are listed as protected species in terms of the NCNCA.

No amphibians have been identified in the project area. However, the project area is located within the distribution range of three amphibian species, *Breviceps namaquensis* (Namaqua Rain Frog), *Cacosternum namaquense* (Namaqua Caco) and *Amietia fuscigula* (Cape River Frog). *Non-perennial wetland* habitat and *rocky outcrop* areas associated with *wetland/ riparian* habitat could potentially provide sufficient habitat for the breeding of some of these amphibian species. Additional species which may occur within wetland areas and seasonal drainage lines include *Tomopterna delelandii* (Cape Sand Frog), *Bufo robinsoni* (Paradise Toad) and *Strongylopus springbokesis* (Namaqua Stream Frog). All of these species are listed as *Least Concern* However, all species of frogs and toads are listed as protected by the NCNCA.

4.1.9.5 Invertebrates

The study area falls within the Karoo vegetation invertebrate vegetation habitat type. This habitat type is considered to contain a unique assemblage of insects, with an above average representation of beetles, grasshoppers, flies, wasp and lacewings, which emerge for brief periods in late spring. Twenty-four invertebrate species were collected or observed in the project area, all of which are considered to be relatively widespread within the region and none of which is considered to be of conservation concern. It is considered unlikely that any invertebrate, scorpion or spider SCC occur in the project area.

4.1.9.6 Faunal Sensitivity

Rocky outcrop and *wetland/ riparian* habitats are considered to have very high sensitivity. These areas provide niche habitat for specialist faunal species (particularly reptiles), are regionally scarce and are considered more likely to support faunal SCC. *Wetland/riparian* habitat provides important breeding and foraging habitat for faunal species and serves as a migratory corridor.

Terrestrial habitats (*Succulent Karoo* and *Sand Fynbos*) are considered to be abundant in the project area and are considered to have moderate sensitivity. Transformed habitats in the study area include areas associated with the town of Kotzesrus, existing roads and historically cultivated fields. Transformed areas are considered to have low faunal sensitivity.

4.1.9.7 Conservation Areas

The Namaqua National Park is situated approximately 20 km northwest of Volwaterbaai and is administered by South African National Parks (SANParks). The Park was proclaimed in 2001 for the purposes of conserving succulent plants within the Succulent Karoo biome and has recently been expanded to include the coastal area between the Groen and Spoeg Rivers. The Park covers approximately 141 000 ha and stretches from Kamieskroon in the northeast to the Groen River mouth in the southeast (see Figure 4-9) (Higgs et al., 2010).

The KLM SDF proposes that the Namaqua National Park is extended eastwards to include the Skilpad Wildflower Reserve and further east along the N7 boundary. It is also proposed that the Park is extended to the north of Koingnaas to encompass a section of an existing alluvial mining area. These proposals are in accordance with the Draft Management Plan for the Namaqua National Park (2010) (Higgs et al., 2010).

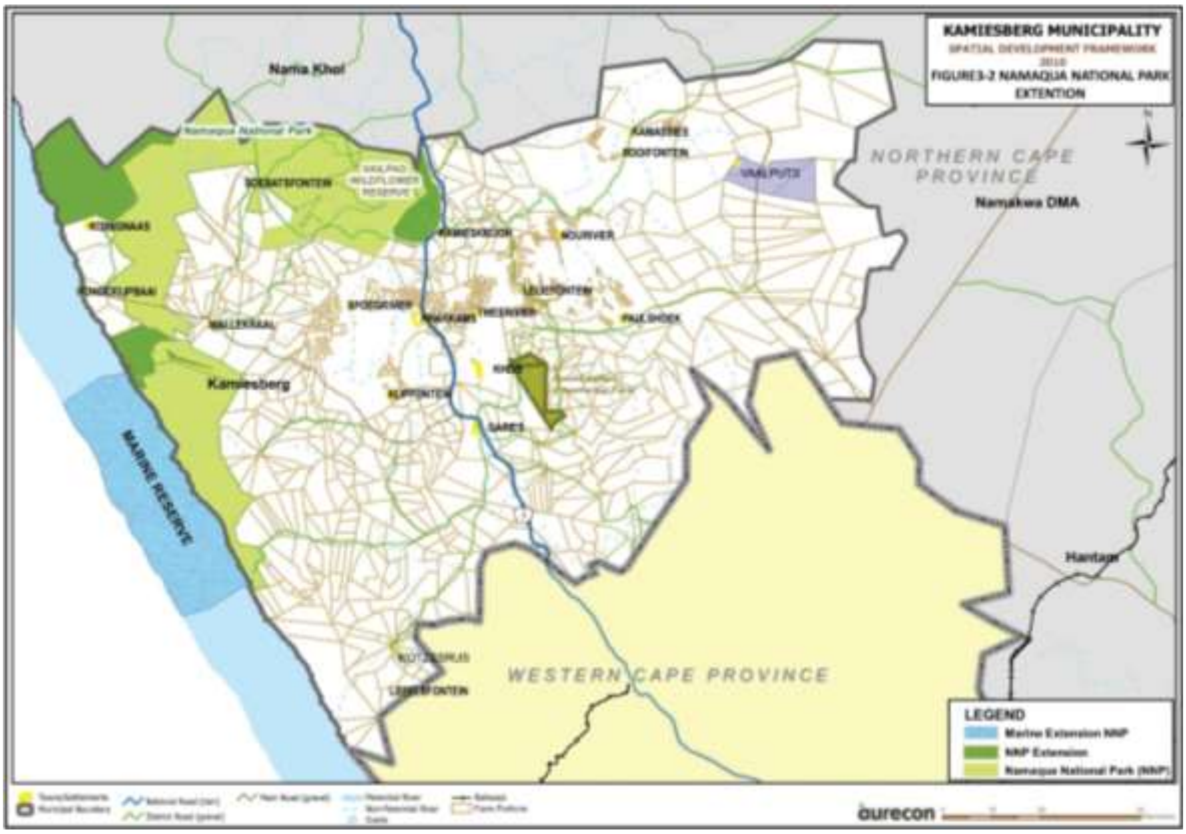


Figure 4-9: Namaqua National Park

Source: Kamiesberg Local Municipality SDF (Higgs et al, 2010)

4.1.9.8 Physical Coastal and Marine Environment

The stretch of coastline along which the desalination plant will be situated is generally characterised as a rocky coastline interspersed with sandy beach areas. The coastline consists of a number of small rocky embayments, headlands and reefs, interspersed with small, generally shelly beaches.

The baseline coastal and marine conditions of the Volwaterbaai area are described in detail in the seawater intake feasibility study compiled by WSP Africa Coastal Engineers in 2012 (WSP, 2012a), as well as the Marine Modelling and Marine and Coastal Ecology specialist studies.

4.1.9.9 Currents

The cold Benguela Current flows in a northward direction along the west coast of southern Africa. This current affects the coastal climate and also provides crucial nutrients supporting the fishing industry. The current is generally slow flowing and only contributes marginally to currents closer to the coastline.

The surfzone is defined as the area where waves from the ocean start to break onto the shore. The Volwaterbaai coastline is characterised by strong surfzone currents that are mainly a result of waves breaking onto the shore. Where waves break at an oblique angle to the shoreline, longshore currents are generated. The direction of these currents varies, depending on the angle of the waves. Longshore currents occur in both rocky and sandy areas along the coast. In sandy beach areas, they result in the longshore transportation of sand. They can also result in rapid beach erosion or accretion.

Rip currents occur along the Volwaterbaai shore and are defined as a seaward return flow of water. These currents typically have sufficiently high velocities to transport sand. Rip current can create deep gullies that form close to the shoreline. This in turn results in beach erosion opposite the gully.

Winds generate the flow of water, particularly in the surface layers. Persistent winds can create flow through the entire water column. Strong southerly summer winds generate circulation along the Volwaterbaai coastline, which is related to upwelling (see below) (WSP, 2012a).

4.1.9.10 Bathymetry

There is limited information regarding bathymetry for the area. Admiralty charts indicate that a depth of 100 m is reached approximately 10 – 12 km offshore. The seabed is considered to be predominantly rocky, with several reefs. Local bathymetry (in close proximity to the brine discharge point) was assessed by a dive survey aimed at confirming the presence or absence of any reefs which may “trap” brine, and to guide detailed design of marine structures (WSP, 2012a).

The dive survey ascertained that within ~70 m of the shore (~4 m depth), the seabed is dominated by relatively fine sand. The nearshore area is characterised by large boulders and a flat reef which is often covered in a thin veneer of sand. The seaward edge of the rocky coastline is strongly influenced by seasonal sand inundation and subsequent erosion. The prevalence of sand on and between the reefs in the surf zone suggests that the shallow subtidal areas have recently become inundated by mobile sediments (Pulfrich & Steffani, 2014).

4.1.9.11 Upwelling

Strong southerly winds displace surface water to the north and away from the coast. This causes water to emerge from deeper layers close to coastal areas, to compensate for displaced surface water. This is known as upwelling and typically occurs in cycles during the spring and summer months.

The water that is upwelled is significantly colder, more turbid, fresher and more nutrient rich than the surface water it replaces. These conditions, particularly the elevated nutrient concentrations, drive increased biological productivity of plankton attracting pelagic and benthic marine organisms. The organic matter of the elevated productivity eventually sinks onto the continental shelf, where this matter decays reducing dissolved oxygen levels. These conditions may extend closer to shore or be mixed into the water column during exceptional climate events causing mass mortality of marine species.

The west coast frequently experiences 'red tides' which are related to the upwelling regime of the area. Red tide consists of an overabundance or a bloom of a species of plankton that explode in numbers during an upwelling event. A red tide with a large enough magnitude and concentration may cause death of pelagic fish by clogging their gills, death of pelagic and benthic organisms due to depleted oxygen levels or poisoning (both direct or indirect) due to toxins produced by certain plankton species (WSP, 2012a).

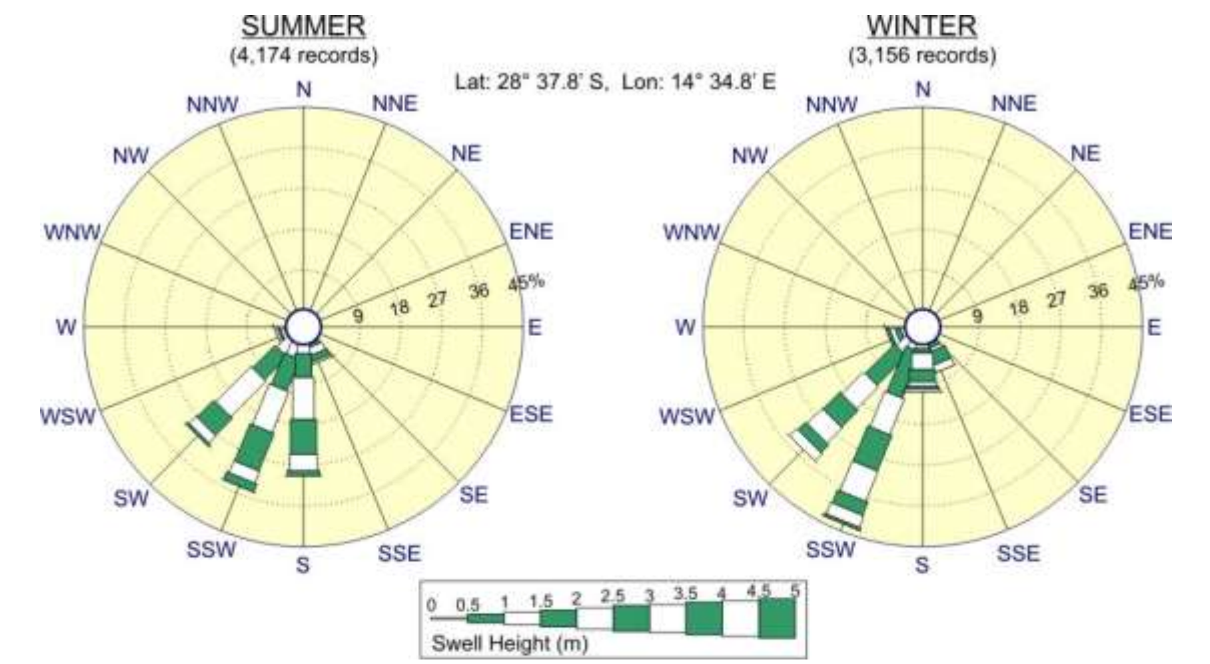
4.1.9.12 Offshore Wave Conditions

The coastline at Volwaterbaai is considered to be particularly exposed and experiences strong wave action. The coastline is impacted by heavy south-westerly swells generated in the roaring forties, as well as significant sea waves generated by the prevailing moderate to strong southerly winds that are characteristic of the region.

Wave action can cause significant damage to coastal infrastructure and predominant wave direction is, therefore, an important consideration in the placement of infrastructure at the coast (WSP, 2012a).

The distribution of swell height and direction has been monitored by a wave-rider buoy moored in 175 m water depth, 180 km offshore, west of the Orange River mouth, over the summer and winter seasons during March 1998 - April 1999 (redrawn from CSIR 2000) (see Figure 4-10). This data is deemed reasonably representative of conditions at Volwaterbaai.

Based on this data, there is little seasonal variation in wave direction along the coast, with the majority of waves coming from a south-westerly to southerly direction. Winter swells are mostly from a south-westerly to south-southwesterly direction (almost 80% of the time) and typically exceed 2 m in height, averaging about 3 m, and often attaining over 5 m. Wind speeds are capable of reaching 100 km/h (during heavy winter south-westerly storms and winter swell heights can exceed 10 m). The dominant peak energy period for waves is ~12 seconds, although longer period swells occur about 30% of the time. Summer swells tend to be smaller on average, typically around 2 m with a more pronounced southerly swell component. These southerly swells tend to be wind-induced, with shorter wave periods (~8 seconds), and are generally steeper than swell waves (Pulfrich & Steffani, 2014).



srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** Offshore Swell Height and Direction	Project No. 451101

Figure 4-10: Offshore Distribution of Swell Height and Direction

Source: Pulfrich and Steffani, 2014

4.1.9.13 Water Levels

Still water levels in the ocean are influenced by a number of factors, including tides, storm surges and sea level rise.

Tides occur as a result of the gravitational forces that the sun and the moon (and other celestial bodies) exert on the earth. The tides along the South African coastline are semi-diurnal, meaning that two high and low tides occur per day. Differences between high and low tides are greatest during spring tides, which occur approximately at full and new moon. Differences between high and low tides are least during neap tides, which occur approximately at quarter and three-quarter moon.

The estimated HAT for the area is +1.25 m in relation to Mean Seawater Level (MSL), while the LAT for the area is -0.9 m in relation to MSL. The HAT and LAT are unlikely to occur in any given year. However, these conditions can occur as a result of storm surges, for example.

Storm surges may significantly increase water levels, and are a result of physical phenomena such as wind set-up, atmospheric pressure effects and wave set-up[15]. Strong onshore winds force surface water towards the land, 'piling-up' against the shoreline. Along the west coast, strong north-westerly onshore winds typically accompany a winter cold front, elevating water levels which may persist for several hours or even days. The cause of most storms is an atmospheric low pressure system. The decreased atmospheric pressure is offset by a rising of the water surface.

[15] These factors have been taken into consideration into consideration in the design of the desalination plant infrastructure.

Wave set-up is the rise in the elevation of the water surface at the shoreline due to onshore mass transport of water by wave breaking action. The degree of set-up depends on the type, size and period of the breaking waves, as well as on the beach slope.

Storm surge, including wave set-up, results in waves breaking higher up the beach than they would under normal conditions. The result is that previously sheltered areas of a coast become exposed to wave action and erosion. The total storm surge for a typical severe winter storm can be in the order of 0.5 m but can be more severe during extreme conditions (WSP, 2012a).

4.1.9.14 Sea Level Rise

The effects of climate change, and particularly sea-level rise, should be taken into account when planning infrastructure that is located close to the shoreline. The Intergovernmental Panel on Climate Change in 2007 predicted that global average sea levels would rise, in response to climate change, by between 0.18 and 0.59 m by the year 2100. Subsequent to these estimates, scientists are in agreement that these figures may be an underestimation and that sea level rise is accelerating. It is suggested that a sea level rise of between 0.5 m and 2.0 m by the year 2100 is appropriate for the southern African coastline (WSP, 2012a). Sea-level rise has been taken into consideration in the design of the desalination plant infrastructure (see Section 3.8).

4.1.10 Coastal and Marine Ecology

The proposed desalination plant site is located within the relatively uniform cool Namaqua marine biogeographic region, which extends from Cape Point to Lüderitz in Namibia (Emanuel et al. 1992; Lombard et al. 2004). The major influence on the coastal ecology of this region is coastal upwelling, which predominantly occurs in the spring/summer associated with south-easterly prevailing winds. High biological productivity is associated with the upwelling process which supplies inorganic nutrients to the eutrophic zone. However, the coastal area is characterised by low marine species richness and low levels of endemism (Awad et al. 2002).

The nearshore biota of west coast marine habitats is relatively robust and naturally adapted to an extremely dynamic environment with high levels of biophysical disturbance. Benthic communities within this region are largely ubiquitous (uniform) and are only differentiated by substrate type (i.e. hard vs. soft bottom), exposure to wave action, or water depth.

Specific habitats in the study area include:

- Sandy intertidal and subtidal substrates,
- Intertidal rocky shores and subtidal reefs, and
- The water body.

The biological communities within the coastal environment consist of many hundreds of species and display considerable temporal and spatial variability. However, no rare or endangered species have been recorded (Pulfrich and Steffani, 2014).

4.1.10.1 Sandy Shore Habitats and Biota

Although the coastline of the study area is dominated by rocky shores, some isolated pockets of sandy beaches occur. Longer sandy beaches occur south of the Brak River mouth and ~3.5 km to the north of the proposed desalination plant site. Sandy beaches are dynamic coastal environments and the composition of faunal communities is largely dependent on the beach morphodynamics, i.e. the interaction of wave energy, beach slope and sand particle size.

Benthic biota of soft bottom substrates constitutes invertebrates that live on, or burrow within, the sediments, and are generally divided into megafauna (>10 cm), macrofauna (animals >1 mm) and meiofauna (<1 mm). The macrofaunal communities of sandy beaches are generally ubiquitous throughout the west coast region, being particular only to substratum type, wave exposure and/or depth zone (Pulfrich and Steffani, 2014).

4.1.10.2 Rocky Substrate Habitat and Biota

Biological communities of rocky intertidal and subtidal reefs throughout the west coast region are determined by wave exposure, turbulence and/or depth zone. West coast rocky intertidal shores can be divided into five zones on the basis of their characteristic biological communities, *viz*.the Littorina, Upper Balanoid, Lower Balanoid, Cochlear/Argenvillei and the Infratidal Zones (see Figure 4-11). These biological zones correspond roughly to tidal levels and tolerance to physical stresses, and communities are determined by biological interactions such as herbivory, competition and predation.

The uppermost part of the shore (the Supralittoral fringe) has more in common with the terrestrial environment and is characterised by low species diversity. The Tiny Periwinkle (*Afrolittorina knysnaensis)* and the Red Alga (*Porphyra capensis*) are the most common macroscopic species. The Upper mid-littoral zone is characterised by the Limpet (*Scutellastra granularis*), the Gastropods (*Oxystele variegata*, *Nucella dubia*, and *Helcion pectunculus*), low densities of the Barnacles (*Tetraclita serrata*, *Octomeris angulosa* and *Chthalamus dentatus*) and green Algae (*Ulva* spp).

Toward the lower shore, within the Lower Mid-littoral and Lower Balanoid zones, biological communities are determined by exposure to wave action. On sheltered and moderately exposed shores, a diversity of algae abounds with a variable representation of green, brown and red algae. The Gastropods (*Cymbula granatina* and *Burnupena* spp) are also common, as is the reef building Polychaete (*Gunnarea capensis*), and the small Cushion Starfish (*Patiriella exigua*). On more exposed shores, almost all of the primary space is likely to be occupied by the dominant invasive Mussel (*Mytilus galloprovincialis*). The invasive Acorn Barnacle (*Balanus glandula)* is also likely to be abundant in the mid zones of semi-exposed shores.

Along the Sublittoral fringe, the large kelp-trapping Limpet (*Scutellastra argenvillei*) dominates forming dense, almost monospecific stands, while *C. granatina*, the dominant grazer on more sheltered shores, also reaches extremely high densities. On more exposed shores *M. galloprovincialis* dominates, while the invasive Mussel (*Mytilus galloprovincialis)* is also likely to occur. In addition to the mussel and limpets, the anemone *Aulactinia reynaudi*, numerous whelk species and the sea urchin *Parechinus angulosus* also occur.

From the Sublittoral fringe to a depth of between 5 and 10 m, the benthos is largely dominated by algae, in particular two species of kelp (*Ecklonia maxima* and *Laminaria*). Kelp beds absorb and dissipate high wave energy and provide important partially-sheltered habitats for a high diversity of marine flora and fauna in kelp-forest communities. They also provide habitat for diverse understorey algae, which provide food and shelter for predators, grazers and filter-feeders. Key predators include the commercially important West Coast Rock Lobster (*Jasus lalandii)* and a number of fish species also occur. Kelp beds support recruitment and complex trophic food webs of numerous species, including commercially important Rock Lobster stocks and are considered a medium sensitivity habitat (Pulfrich and Steffani, 2014).

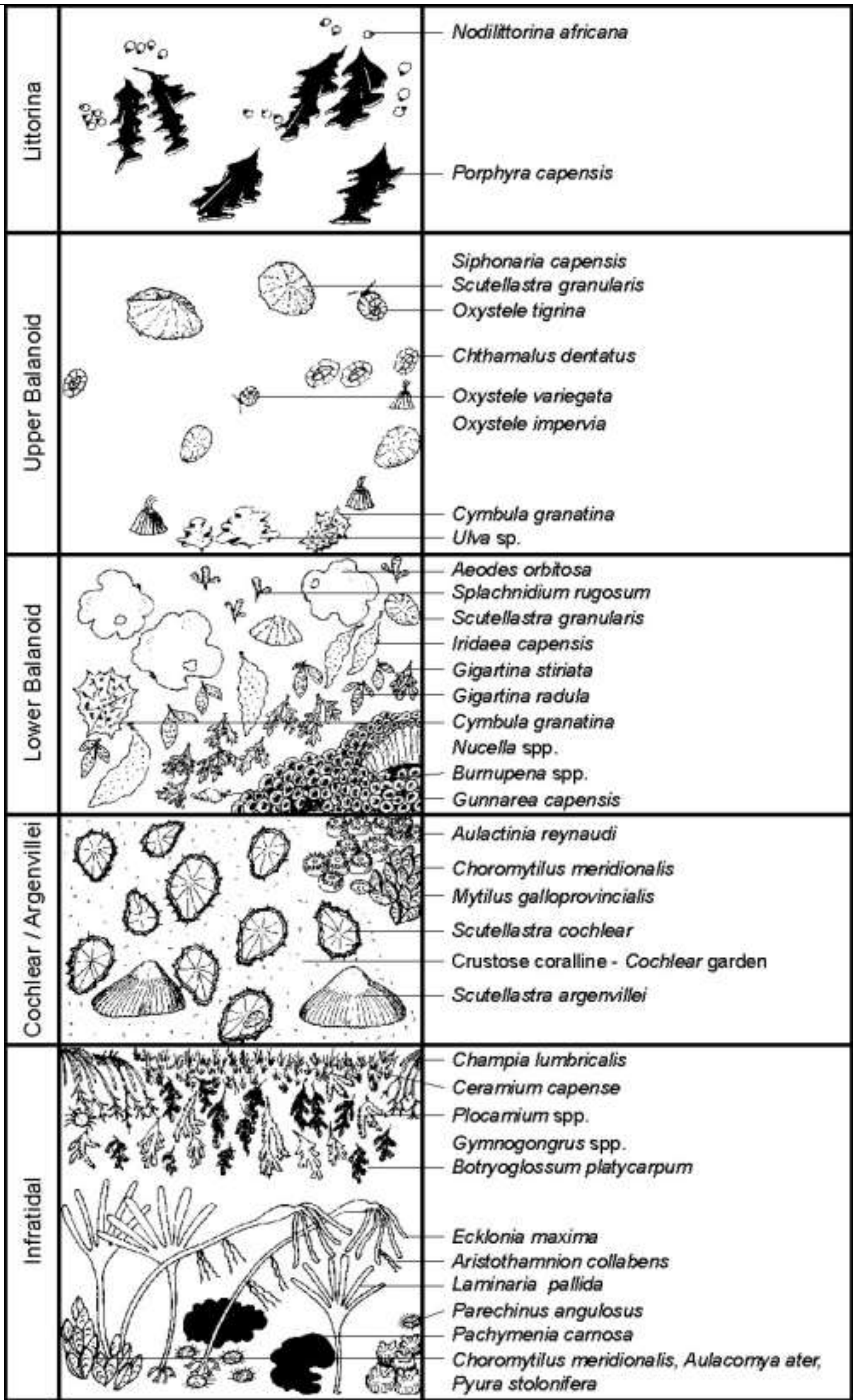


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Figure 4-11: Schematic Representation of the West Coast Intertidal Zonation

Source: Pulfrich and Steffani, 2014

4.1.10.3 The Water Body

The study area is located in the southern Benguela ecosystem and pelagic communities are typical of those of the region. These communities can typically be divided into plankton, fish, and marine mammals (seals, dolphins and whales).

Plankton range from single-celled bacteria to jellyfish, and include bacterio-plankton, phytoplankton, zooplankton, and ichthyoplankton. Phytoplankton includes diatoms, dinoflagellates, coccolithophorids and microflagellates. Zooplankton is characterised by pelagic crustaceans (e.g. copepods, cumaceans, hyperiid amphipods, chaetognaths, mysids, euphausiids), invertebrate larvae (e.g. bivalve, polychaete, *etc*.), pelagic cnidarians, and ichthyoplankton.

A number of fish species occur within the Benguela ecosystem, including small pelagic fish species, demersal fish and line fish species. Several fish species are found in kelp beds off the west coast, and many are caught in gill-nets over rocky reef areas between the Orange River and Cape Columbine. The surf-zone and outer turbulent zone habitats of sandy beaches are considered to be important fish nursery habitats and surf zone fish communities at the west coast have relatively high biomass but low species diversity.

Forty-nine pelagic seabird species feed on the pelagic fish stocks associated with the Benguela ecosystem. Fourteen of these species breed in southern Africa, including Cape Gannet (*Morus capensis)*, African Penguin (*Spheniscus demersus*), four Cormorant species, White Pelican, three Gull species and four Tern species. Breeding areas are distributed along the west coast and islands are particularly important breeding habitat. Species that may migrate through the project area include: Cape Gannets, Kelp Gulls (*Larus dominicanus*), African Penguins, African Black Oystercatcher (*Haematopus moquini*), Bank Cormorant (*Phalacrocorax neglectus*), Cape Cormorant (*Phalacrocorax capensis*) Crowned Cormorant (*Phalacrocorax coronatus*), and Hartlaub's Gull (*Larus hartlaubii*). The Black Oystercatcher is considered *Near Threatened*, while the Bank Cormorant is considered *Endangered*. Black Oystercatchers are susceptible to disturbance from off-road vehicles.

A number of marine mammals are associated with the Benguela ecosystem, including between 28 and 31 species of cetaceans (whales and dolphins) and four species of seals (of which the Cape Fur Seal *Arctocephalus pusillus* is the most common). The Cape Fur Seal is the only seal species that is resident along the west coast of Africa. It occurs at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs. There are three Cape fur seal breeding colonies within the broader study area: at Kleinzee (incorporating Robeiland), at Bucchu Twins near Alexander Bay and at Elephant Rocks near the Olifants River mouth. Non-breeding colonies occur at Strandfontein Point (~5 km north or the Groen River mouth) and on Bird Island at Lamberts Bay. All have important conservation value since they are largely undisturbed at present.

Dusky dolphin (*Lagenorhynchus obscurus*) and Heaviside's dolphin (*Cephalorhynchus heavisidii*) are resident within the Benguela ecosystem coastal waters. Whale species that may be sighted in the area include Southern Right whale (*Balaena glacialis*), Humpback whale (*Megaptera novaeangliae*), and Killer whale (*Orcinus orca*), along with Antarctic Minke (*Balaenoptera acutorostrata*) and Bryde's whale (*B. brydei*). Whales occurring in the nearshore regions of the project area will largely be transitory (Pulfrich and Steffani, 2014).

4.2 Socio-economic Environment

4.2.1.1 Regional Socio-economic Environment

The study area is located within the NDM, which includes the Local Municipalities (LMs) of Richtersveld, Nama Khoi, Kamiesberg, Hantam, Karoo Hoogland and Khâi-Ma. The NDM has the smallest population in the Northern Cape and the overall population density in the District is estimated at one person per square kilometre (NDM, 2012).

According to Census 2011 data available from Statistics South Africa (StatsSA), the NDM had a population of 115 842, more than 10 000 below the 2007 estimate (NDM, 2012), but more than in 2001. This indicates that the population has not grown as rapidly as anticipated, or declined between 2007 and 2011. Some 8.8% of the population reside in the KLM, 10.3% in the Richtersveld LM, 40.6% in the Nama Khoi LM, 18.6% in the Hantam LM, 10.8% in the Karoo Hoogland LM, and 10.7% in the Khâi-Ma LM (Census, 2011).

The NDM has an economic growth rate of 2.03% per annum, which is lower than the Northern Cape Province growth rate (2.4%) and is less than half of the national growth rate (5%) measured from 1996 to 2007. The NDM has an undiversified economy, heavily reliant on mining. Mining contributes approximately 52% to the Gross Geographic Product (GGP) (CNdV, 2012). In 2007, the Nama Khoi LM made the largest contribution to the GGP (41.7%), followed by the Richtersveld LM (17.3%) (NDM, 2012).

Mining and agriculture are the biggest employers in the NDM. Trade, catering and accommodation contribute 13% to the GGP, while the remaining sectors in total contribute less than 10% (see Figure 4-12). The mining growth rate declined by 0.3% between 2001 and 2007, while trade, catering and accommodation (mainly tourism activities) have significantly increased their contribution to both GGP and employment in the NDM. Figure 4-12 indicates that the economy of NDM has diversified from a vulnerable economy with an over reliance on mining in 1995 to a more diversified economy with reliance on mining, community services and trade in 2007 (CNdV, 2012). However, the increase in the community services sector indicates increased dependence on social assistance within the NDM (NDM, 2012).

In 2001, 29 279 persons were employed and 11 663 were unemployed in the NDM, with a total (formal) labour force of 40 942 and an unemployment rate of 28% (CNdV, 2012). According to StatsSA (2011), the unemployment rate in the NDM decreased to 20.1% in 2011. However, the NDM economy remains unable to absorb and employ the full complement of job market entrants and participants (CNdV, 2012).

The highest unemployment rate in 2011 was recorded for the Kamiesberg LM (30.8%) and the lowest was for the Hantam LM (11.8%). Unemployment declined most markedly in the Richtersveld LM, from 35.5% in 2001 to 18.6% in 2011, while in the Khâi-Ma LM unemployment increased from 15.3% in 2001 to 22.1% in 2011 (Census, 2011).

In 2011, 6.6% of the population in the NDM had no education, while the highest level of education for 18.8% of the population was matric, with 7.4% of the population having a tertiary education (StatsSA 2011). Indications are that qualified persons leave the District to seek work elsewhere due to the lack of suitable education facilities and employment opportunities in the District (NDM, 2012).

The IDP identifies economic development and job creation as one of the urgent developmental issues in the NDM (NDM, 2012).

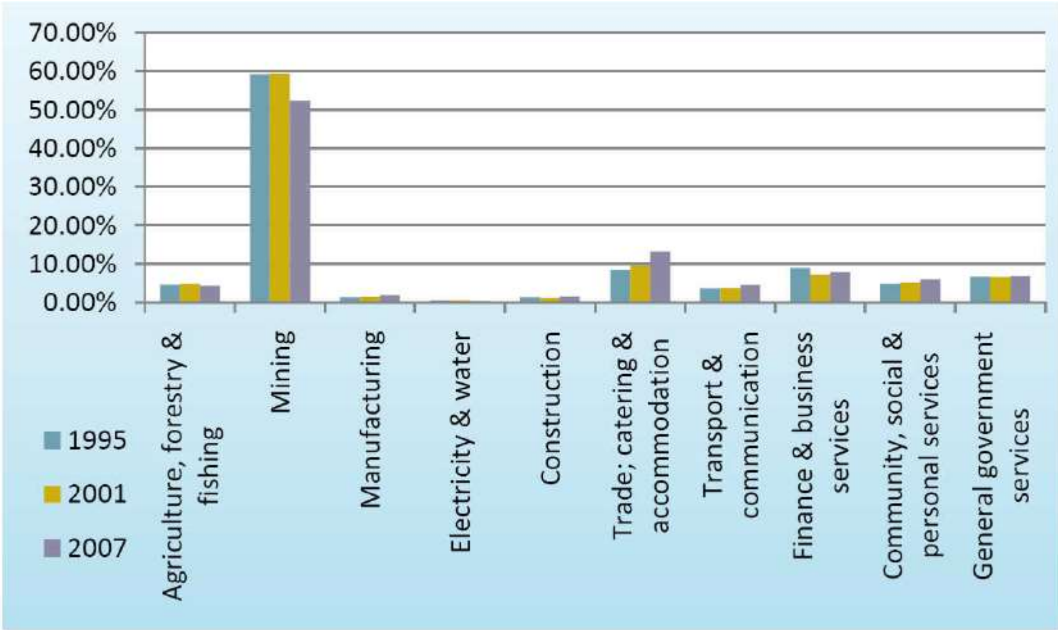


Figure 4-12: Sectoral Contribution to GGP in NDM

Source: Namakwa District Municipality's SDF (CNdV, 2012)

The NDM is characterised by unique flora and several nature reserves are located in the area, including the Namaqua National Park. The unspoilt and sparsely inhabited environment make the NDM highly suitable for adventure tourism and outdoor recreational activities, including camping, fishing, hiking, mountain biking and star gazing. The area is also unique in terms of its historical and cultural heritage (Chidley et al., 2012). The potential for energy production, diamond mining and beneficiation, scientific research and development, mainly in the fields of astronomy and biodiversity, tourism and conservation initiates has also been identified. Development in the agricultural sector is challenging due to the scarcity of suitable land, poor transport networks and linkages to markets (CNdV, 2012).

4.2.2 Local Socio-economic Environment: Kamiesberg Local Municipality

4.2.2.1 Demographics

The population in KLM has declined by approximately 5% between 2001 and 2011 from 10 754 in 2001 to 10 187 in 2011 (Census, 2011) (see Figure 4-13). This is likely due to the out-migration of people as a result of the lack of economic opportunities in the area (Higgs et al. 2010). In contrast the population of the NDM increased by 7% and the Northern Cape by 39% (see Figure 4-14).

Approximately 64% of the KLM population (or approximately 5 193 people) is between 15 and 64 years old (i.e. of working age). The age distribution in the KLM is slightly different to the Northern Cape in general. The KLM has a higher proportion of elderly people (over 65 years) and persons aged between 35 and 64 years old. The KLM also has a lower proportion of individuals aged between 15 and 34 years and 0 and 14 year (see Table 4-6). This confirms the trend of out-migration from the KLM by the younger age bracket.

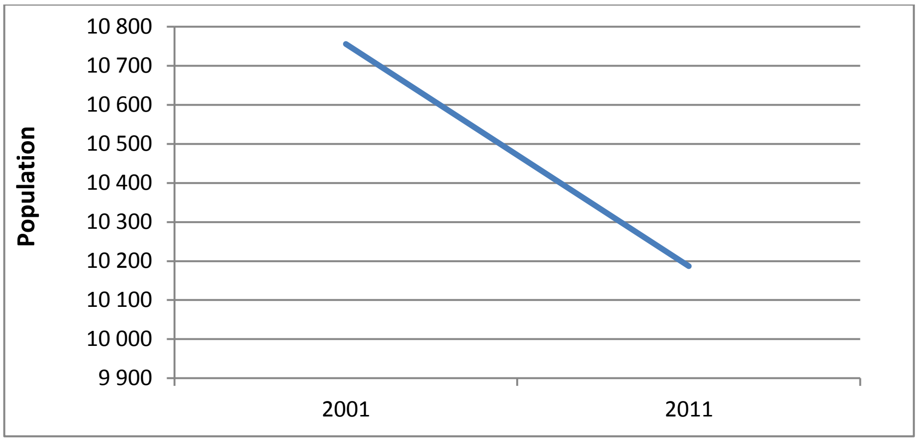


Figure 4-13: Population Decline in the KLM between 2001 and 2011

Source: StatsSA, Census, 2011 and Census, 2001

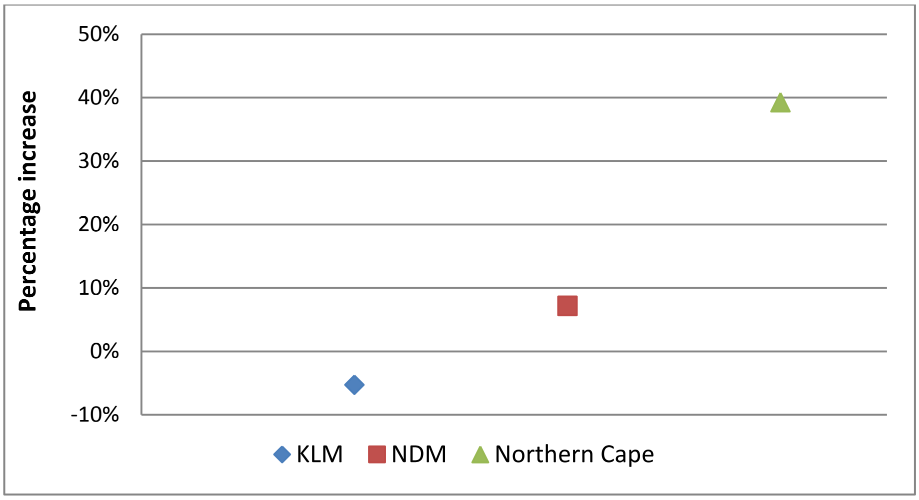


Figure 4-14: Population Growth between 2001 and 2011 in the KLM, NDM and Northern Cape

Source: Census, 2011

Women and men are approximately equally represented in the KLM, with a slightly higher proportion of males (50.4%) to females (49.6%). This is the opposite of the gender distribution in the Northern Cape, which has a slightly higher proportion of females (50.7%) to males (49.3%).

Table 4-6: Age Distribution in the KLM and the Northern Cape in 2011

Age group	KLM	Northern Cape
0-14 years	27%	30%
15-34 years	28%	35%
35-64 years	36%	30%
65 years and older	10%	5%

Source: Census, 2011

The predominant population group in the KLM is Coloured (86%), followed by White (8%) and Black African (5%) (Census, 2011). Comparison with the 2001 Census indicates that it is predominantly Black Africans who have moved into the area in recent years, increasing their proportion of the population from 2% in 2001 to 5% in 2011, while the proportion of Coloureds has remained stable and that of Whites has declined from 11% in 2001 to 8% in 2011.

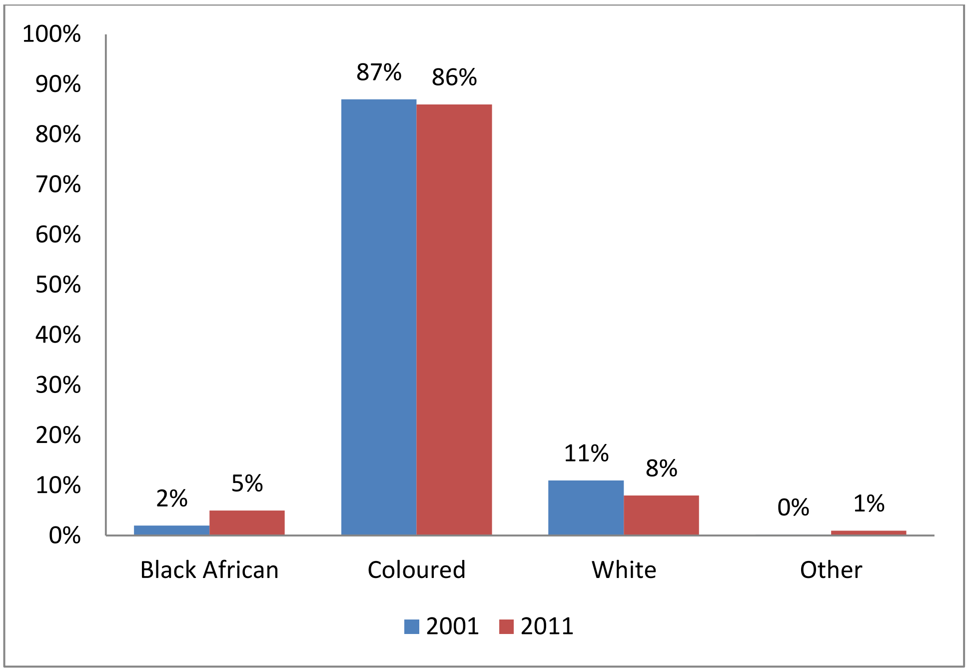


Figure 4-15: Population Structure in the KLM in 2001 and 2011

Source: StatsSA, Census, 2011 and Census, 2001

4.2.2.2 Education

The population of the KLM exhibits a low level of skill. Approximately 4% of the population over 15 years of age have no schooling, 31% have primary school education, 40% have a high school education, 16% have completed Grade 12,1% have a National Training Centre (NTC) qualification, diploma or certificate and 1% have tertiary education (Census, 2011).

Many of the youth are attracted to larger metropolitan areas by both educational and employment opportunities (KLM IDP, 2013).

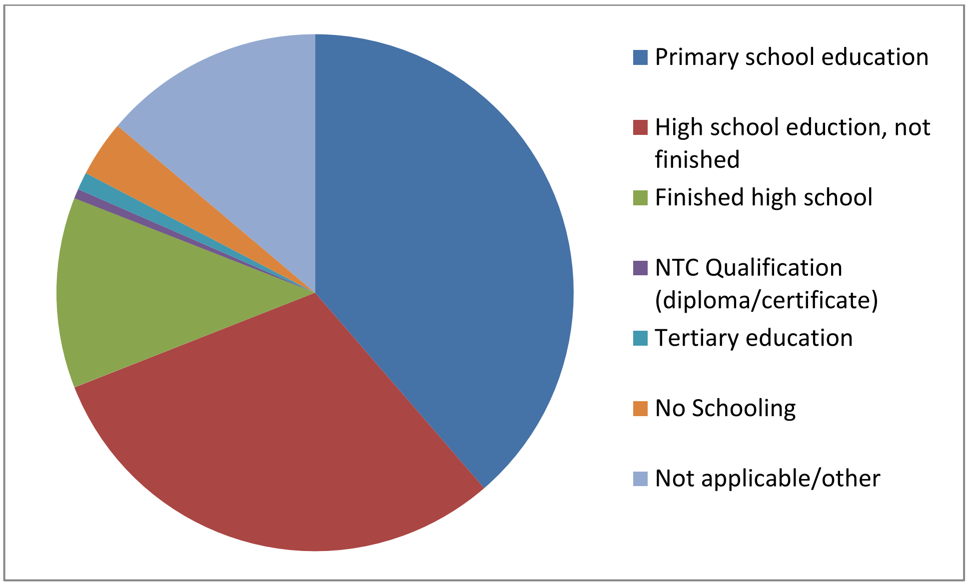


Figure 4-16: Education Level of KLM Population over 15 Years of Age in 2011

Source: StatsSA, Census, 2011 and Census, 2001

4.2.2.3 Economic Sectors and Gross Geographic Product

The average growth rate for GGP in the KLM was 5.4% between 1996 and 2011. This slowed to an average of 4.8% between 2007 and 2011. In 2011 the largest contributor to employment in the local economy was wholesale and retail (21% of total employment in the formal sector). The principal sectors contributing to the GGP of the KLM are also wholesale and retail (including tourism and accommodation) (24%) and finance and business services (25%). Both these sectors have shown a slight proportional increase since 2001. The construction industry has also increased from 7% in 2001 to 12% in 2011 (see Figure 4-17) (KLM IDP, 2013).

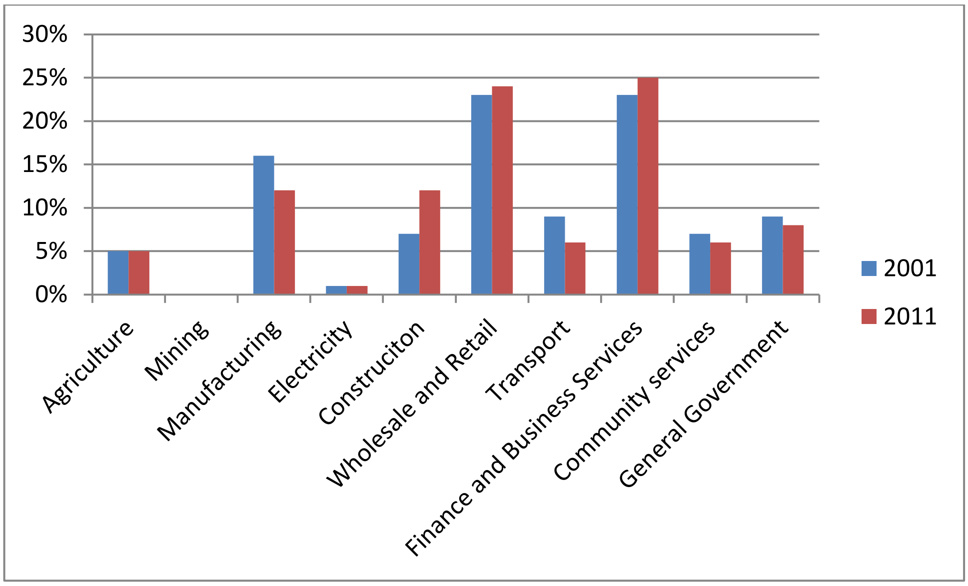


Figure 4-17: Contribution per Sector to GGP in the KLM

Source: KLM IDP (2012)

The construction sector and tourism industry are seasonal in nature and are susceptible to economic changes and political unrest. The promotion of a diversified economy is important to ensure that over-reliance on these sectors does not occur (KLM IDP, 2013).

4.2.2.4 Employment and Income

Approximately 64% of the population in the KLM (6 452 people) is of working age of which 3 185 (49%) actively participated in the labour market in 2011 (Census 2011). An estimated 2 204 people (69% of the population active in the labour market) were employed, while 981 (31%) were unemployed in 2011. Employment rates are lower for Black African and Coloureds than Whites and Indians/ Asians (see Table 4-7).

Total employment figures for persons aged between 15 and 64 years in the KLM are similar to those for the Northern Cape (see Table 4-7), although a larger number of work seekers in the KLM have become discouraged (Census, 2011).

Table 4-7: Employment in the KLM (people aged 15 to 64 years) in 2011

Location	KLM					KLM	NDM	Northern Cape
Population Group Status	**Black African**	**Coloured**	**Indian/ Asian**	**White**	**Other**	**All**	**All**	**All**
Employed	30%	33%	45%	52%	46%	34%	44%	38%
Unemployed	11%	16%	15%	8%	20%	15%	11%	15%
Discouraged	9%	12%	15%	6%	3%	11%	5%	5%
Not active	51%	39%	24%	34%	31%	39%	40%	42%

Source: Census 2011

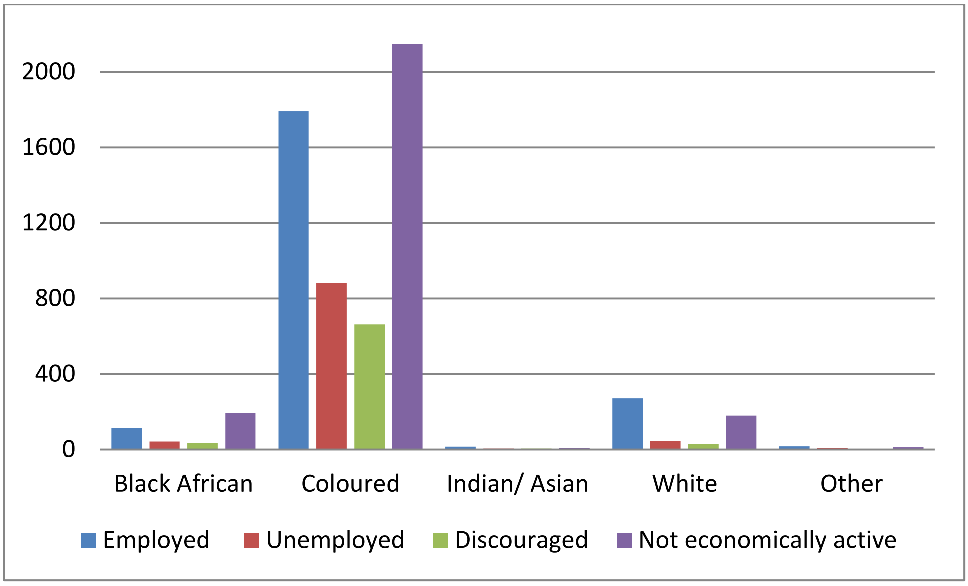


Figure 4-18: Number of Employed People per Population Group in KLM (people aged 15 to 64 years) in 2011

Source: Census, 2011

The income of the KLM population between the ages of 15 and 64 during 2011 is presented in Table 4-8 and Figure 4-19 below[16].

Table 4-8: Monthly Income in the KLM (people aged 15 to 64 years) in 2011

Monthly Income	Number of person	Percentage of income earners
No income	2 662	41%
Less than R800	561	18%
Between R800 and R1600	1 375	43%
Between R1600 and R6400	736	23%
Between R6400 and R12800	236	8%
Over R12800	212	7%

The ability to meet basic needs, such as food, clothing, shelter and basic amenities is largely determined by the level of income earned by households. The low levels of income in the KLM indicate that the majority of the population fall below the poverty level and are eligible for indigent status (and social grants) (Higgs et al., 2010).

[16] Monthly incomes were not specified for 198 people in the survey.

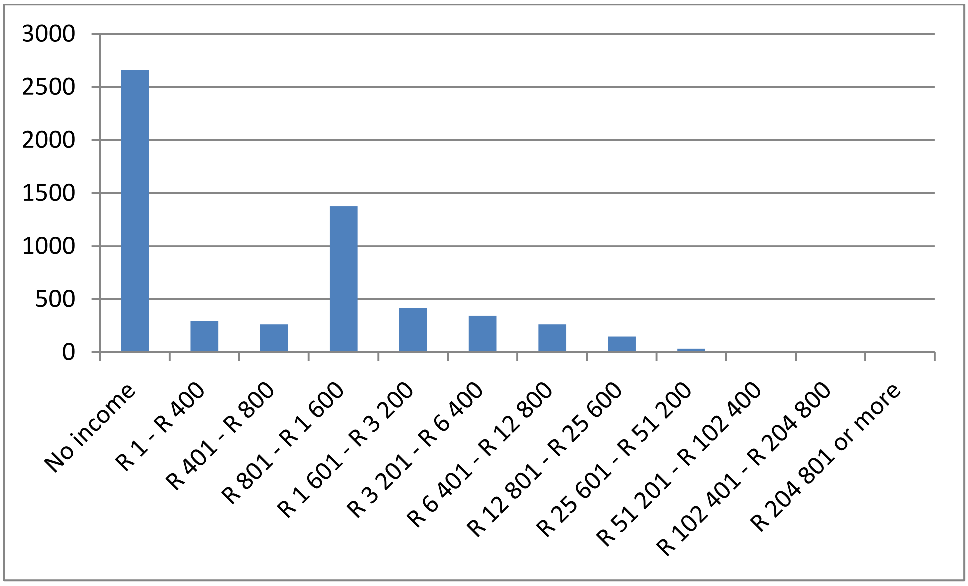


Figure 4-19: Individual Monthly Income in the KLM in 2011

Source: Census 2011

4.2.2.5 Health

According to the NDM Department of Health, there is a shortage of service capacity at both District and Local level. Hypertension, diabetes, HIV/AIDS, tuberculosis, diarrhoea and malnourishment are prevalent within KLM (Higgs et al., 2010).

A formal clinic and community health centre is located in Garies and there are 5 clinics and 10 mobile clinics within the KLM. The satellite clinics are understaffed and full time medical professionals are often not available. The large distances between towns limit the frequency with which clinic services can be provided (Higgs et al., 2010).

4.2.2.6 Service Provision

KLM provides services to the towns and settlements of Garies, Hondeklipbaai, Kamassies, Kamieskroon, Kharkams, Kheis, Klipfontein, Leliefontein, Lepelsfontein, Nourivier, Paulshoek, Rooifontein, Soebatsfontein, Spoegrivier, and Tweerivier. KLM does not provide services to Kotzesrus, Stofkraal, Molsvlei or Rietpoort (KLM IDP, 2013).

Water

KLM has a total of 16 water schemes, including desalination, boreholes and surface water schemes. Water is supplied to all formal households, businesses and farms that are serviced by KLM. The majority of informal households receive water via communal standpipes (KLM IDP, 2013). In 2011, 42% of households in KLM had piped water inside their homes, 53% had piped water inside their yards, while 4% of households had access to Municipal water from a community standpipe less than 200m from their home (Census, 2011).

Most water use in KLM is recorded for domestic purposes, followed by the industrial sector and agriculture. The KLM is challenged in its provision of water by various factors including drought, poor groundwater quality, water losses and general water scarcity. Water supply is often strained during the holiday season (December to February) and water management initiatives have had to be implemented in the past to ensure water supply during this time (KLM IDP, 2013).

A number of small towns within the KLM rely on groundwater. Lepelsfontein previously relied on groundwater which required treatment through desalination. The desalination plant at Lepelsfontein had limited capacity and was only able to provide water twice a week in 2010, through communal standpipes (Higgs et al., 2010).

The upgrading of water networks in Lepelsfontein was identified as a priority in the KLM SDF. KLM's target was to provide 100% of households in Lepelsfontein with access to water by December 2010. The need to upgrade the desalination plant as well as the bulk water supply through a proposed bulk water pipeline between Garies and Lepelsfontein was identified for the 2009/2010 financial year (Higgs et al., 2010). No municipal water is supplied to Kotzesrus which relies on other sources including groundwater abstraction.

Sanitation

In 2011, approximately 46% of households in KLM had access to flush toilets, flush septic tanks or chemical toilets, while 47% made use of Ventilated Improved Pit (VIP) latrines or Urine Diversion Systems (UDS) (KLM IDP, 2013).

In 2010, 100% of residents in Lepelsfontein used non-waterborne sanitation (50% VIP latrines and 50% UDS toilets) (Higgs et al., 2010). Kotzesrus is not provided with sanitation services by the KLM and makes use of alternative sewage disposal methods including septic tanks.

Electricity

In 2011, 88% of households serviced by KLM had access to electricity, 4% used gas and 8% had no access to electricity. According to the IDP, KLM has adequate capacity to deliver bulk electrical services to existing and future residential and commercial development in the area (KLM IDP, 2013).

Lepelsfontein had no access to electricity in 2008, and the electrification of the town was identified as a priority in the KLM SDF (Higgs et al., 2010). The provision of bulk electrical supply to Lepelsfontein was prioritised for the 2009/2010 financial year, while the provision of household electrical connections was identified for the 2011/2012 financial year, with the aim of providing 100% access to electricity to the households of Lepelsfontein (KLM IDP, 2013).

Kotzesrus has no access to municipal electrical services and make use of alternative sources of energy.

Solid Waste Management

In 2011, approximately 78% of households in KLM had their household refuse removed at least once a week by the Municipality. Only 2% of households had no access to waste disposal facilities, while the remainder relied on communal/ private refuse dumps or removal by private companies or KLM on a less frequent basis (KLM IDP, 2013).

4.2.3 Cultural and Historical Environment

4.2.3.1 Historical Context

The Namaqua area was historically occupied by the San (Bushmen) and Khoenkhoen herders. The San are known to have occupied the area within the last 10 000 years and were displaced following the arrival of the Khoenkhoen herders and colonial settlers (Hart, 2006). The Namaqualand interior was historically occupied by a Khoenkhoen pastoralist group named the Little Namaqua. The group lived in temporary encampments and moved seasonally to find better grazing for their herds of cattle and sheep. Indications are that livestock was moved between the Kamiesberg area in the summer and the Sandveld in the winter (Webley & Halkett, 2010, Webley, 2012).

Historically Khoenkhoen herdsmen maintained flocks of sheep and goats throughout Namaqualand; however the arrival of the colonial settlers resulted in the displacement of the San and Khoenkhoen herders. *Trekboere* penetrated Namaqualand in the early 19th century, following which farms were formally granted (Hart, 2014).

Early colonial settlements in the Namaqua area were historically located near sources of water. The area is characterised by a distinct architectural vernacular and unfired mud brick was used as the primary construction material for early colonial buildings (Hart, 2006, Webley & Halkett, 2010). Given that the Namaqualand landscape is quite harsh for farming and that colonial history of the area only extends back for about 200 years, historical archaeological remains of the colonial period are relatively rare (Hart, 2014).

A memorial (the Burden Memorial) is located in the vicinity (within 100m) of the proposed brine discharge site. There are no human remains located near the memorial site, nor is it older than 60 years and discussions regarding the potential re-establishment of the memorial site in an alternative location have commenced with the family of the deceased.

4.2.3.2 Archaeological Context

The arid areas of the Namaqualand coastline are considered to be archaeologically rich (Hart, 2006). The rocky and sandy coastal areas were attractive to early San hunter-gatherers due to the rich abundance marine foods, particularly shellfish. In excess of 1 500 archaeological sites, including shell middens and wind-deflation sites have been documented along the rocky shoreline and adjacent to dune ridges and sandy beaches of the Namaqua coast (ACRM 2013).

Parts of the Namaqualand area were occupied by Early Stone Age (EStA) inhabitants more than one million years ago. It is also estimated that Middle Stone Age (MSA) inhabitants have been exploiting the Namaqua coastline for the past 120 000 years. However, the majority of archaeological sites discovered in the area relate to the history of the San hunter-gatherers and Khoenkhoen herders during the Late Stone Age (LSA) (ACRM, 2013, Hart, 2006, Webley & Halkett, 2010, Webley 2012, Van der Ryst & Küsel, 2012).

The northern Namaqualand coastline contains many thousands of LSA shell middens, which date within the last 6 000 years and contain collections of stone tools, ostrich eggshell fragments and beads, pottery and animal bones. A number of clusters of shell middens are located in the vicinity of the proposed desalination plant. However, shell middens are fairly common in the area (Hart, 2014).

Further inland along the coastal plain there are few archaeological sites and those that are present are often associated with rock shelters, water holes and naturally occurring granite hollows that capture water. Shell middens also occur less frequently along the coast of southern Namaqualand (where the project area is located). Precolonial sites further inland have generally been covered by recent Aeolian sand and are not easily identifiable. However, MSA and EStA sites have been found to occur below the surface within the Dorbank horizon (a past landscape characterised by hard ferricretes and calcretes). These sites are only visible in quarries and cuttings. One such a site has been identified in the vicinity of Kotzesrus (Hart, 2014).

The small town of Kotzesrus developed organically around the Brak River and has a number of historic buildings and structures older than 60 years, including a number of conservation-worthy colonial period buildings. Although the town has never been formally evaluated for its heritage qualities, it is considered to be a place of significant heritage value, worthy of active conservation. Due to its content and context, a field grading of IIIA has been assigned to the town, meaning that it can be considered to be of high local significance.

4.2.3.3 Palaeontological Context

The discovery of fossils in the coastal area surrounding Hondeklipbaai and Kleinzee during mining activities has provided valuable insights into the geological history of southern Africa and the coastal plain marine and Aeolian deposits of the Namaqua coastline are considered to be sensitive from a palaeontological perspective.

The coastal area where the proposed desalination plant occurs is fringed by raised beaches of the Quaternary Curlew Strand Formation. The Mid-Holocene High is preserved in places, mostly in small terraces of compact shelly sand on gently-sloping bedrock, depending on the degree of exposure to open-coast waves. The Holocene High terrace may be present in the southern portion of the desalination plant site, where pale cover overlies the bedrock above high tide and beneath the toe of the aeolian sand slope. The Last Interglacial (LIG) raised beach occurs further inland at higher elevation, extending to 6-7 masl, where it overlies either an older Quaternary raised beach or the eroded edge of the mid-Pliocene Hondeklip Bay Formation. Further up the coastal slope profile the terrestrial deposits are thicker with slightly compact sand overlying a palaeosurface on older, browner aeolian sands with faint internal palaeosurfaces, beneath which are structureless sands that grade downwards to pebbly sand.

The bulk assemblage composition of the shell fossil content of both the Mid-Holocene High beach and the LIG beach is of low palaeontological sensitivity, due to its setting in an open coastal environment, where ancient fossil species are not expected. In addition to shells, sparsely scattered bones may occur in the Curlew Strand Formation beach deposits (including bones of whales, dolphins, seals and seabirds that may be newly-discovered species ancestral to modern species). The aeolian sands and possible colluvia overlying the fossil beach deposits have a sparse fossil bone content, mostly land snails, tortoise shells and mole bones, although bird and mammal bones may occur. The dune slopes adjacent to the coast have a higher content of fossil material due to the attraction of the shoreline for foraging and scavenging. In contrast to fossil shells, all fossil bones have high palaeontological importance.

The *Kotzesrus Route* and *Amended Bypass Route* further inland mainly traverse the Quaternary aeolian sands of the Hardevlei and Koekenaap formations. The eastern portion of the *Kotzesrus Route* traverses the Panvlei Formation soils and pedocretes formed on older sands and colluvia. Loose coversands of varying depth are expected. Where these are thinner, shallow excavations may intersect the underlying harder palaeosurface formed on underlying, older compact sands.

The fossil bone potential of the loose coversands (sand sheets) and dunes along the route inland is overall very low. However, where sand mining has removed the surficial sands down to the underlying, compact palaeosurface on a large areal scale, widely scattered bones, artefacts and sometimes shells are revealed on the palaeosurface. At low points in the landscape, coversands may conceal ephemeral pans which have a greater fossil bone potential (Pether, 2014).

Fossil bones are more likely to occur in the overlying terrestrial sands of the coastal slope at the desalination plant site and along the coastal route. It is very unlikely that fossils will be found in the subtidal shoreface during installation of the intake and discharge points. The likelihood of finding fossil bones in the shallow subsurface along the *Kotzesrus Route* and the *Amended Bypass Route*, from the turnoff eastwards towards Kotzesrus and onward to the mine, is lower than along the coast.

4.2.4 Visual and Aesthetic Environment

The study area is characterised by a number of broad-scale landscape types, briefly described below and illustrated in Figure 4-20.


Area in vicinity of the Zandkopsdrift Mine


Kotzesrus


Example of local architectural vernacular at Kotzesrus


Example of local architectural vernacular at Kotzesrus


The Namaqua Coastline near Volwaterbaai


Memorial located outfall site

srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** Visual Environment	Project No. 451101

Figure 4-20: Visual and Aesthetic Environment

Source: SRK

The proposed Zandkopsdrift Mine is located on Farm Zandkopsdrift 537, on the foothills of the Kamiesberg mountain range. The area is characteristic of the Sandveld region of central Namaqualand, with low succulent Karoo scrubland vegetation within a moderately undulating landscape that is dotted with rocky outcrops and koppies. The succulent vegetation in the area is suitable for livestock grazing and provides habitat to a number of indigenous faunal species, including Steenbok, which is often seen in the area. The undulating landscape at Zandkopsdrift gradually flattens out towards the coastal plain and rocky shoreline at Volwaterbaai.

The proposed route between the Zandkopsdrift Mine and Volwaterbaai passes through Kotzesrus, located in a sheltered valley between two rocky koppies (hills). Historic buildings in the town are representative of the unique 20th century architectural vernacular and construction techniques of the region (see Section 4.2.3.2. Historic buildings include mud brick garbled farmhouses, corrugated iron and wooden frame cottages, a church, a school building, a small shop and graveyard. The town's population has decreased significantly over the last 50 years and the institutional facilities in the town are now seldom used.

The town of Kotzesrus is a distinct feature on the route and is characterised by a unique sense of place, charm and sense of history, due to its architectural typologies and isolated setting in the desolate and arid Karoo environment. The gravel road leading through the town emphasises the geological formations of the surrounding granite koppies and asserts the town's rural character. Some tourists travel to the area to see the wild flowers and enjoy the tranquillity of the relatively unspoilt natural environment in spring during and during the summer holiday periods.

The vegetation changes along the route between Kotzesrus and Volwaterbaai from low Succulent Karoo scrubland to unpalatable Sand Fynbos dominated by restios and low succulent Namaqua Seashore Vegetation. The coastal plain at Volwaterbaai is slightly undulating and, at the coastline, dips down steeply towards the shoreline in places. The area is characterised by rocky protrusions interspersed with sandy beach areas and the cold Benguela Current supports the rich marine ecosystem. However, the coast is isolated and uninhabited and the windswept, arid environment is harsh and unforgiving.

A gravel track runs along the coast at Volwaterbaai and provides access to the coastline for tourists, fishermen and kelp harvesters. Farmers from inland areas often journey to the coast to camp (sometimes illegally), fish and socialise over the Christmas season. At these times this isolated stretch of coast can be become crowded with tents, caravans and windbreaks (Hart, 2014).

In some areas natural vegetation has been cleared for kelp harvesting and sorting. SANParks has recently erected a number of beacons in the area serving as markers for otherwise unidentified beaches and rocky inlets in an effort to enhance the tourism potential of the area.

5 Stakeholder Engagement

Stakeholder engagement forms a key component of the S&EIR process. The objectives of stakeholder engagement are outlined in this Section, followed by a summary of the approach followed and issues raised by the public with regard to the proposed development during project initiation and scoping phases.

5.1 Objectives and Approach to Stakeholder Engagement

The overall aim of public consultation is to ensure that all stakeholders have adequate opportunity to provide input into the process and raise their comments and concerns. More specifically, the objectives of public consultation are to:

- Identify IAPs and inform them about the proposed development and S&EIR process;
- Provide the public with the opportunity to participate effectively in the process and identify relevant issues and concerns;
- Coordinate cooperation between organs of state in the consideration of the assessment; and
- Provide the public with the opportunity to review documentation and assist in identifying mitigation and management options to address potential environmental issues.

5.2 Stakeholder Engagement during the Scoping Phase

The key stakeholder engagement activities undertaken during the Scoping Phase are summarised in Table 5-1 below.

Table 5-1: Stakeholder engagement activities undertaken during the Initiation and Scoping Phases

Task	Objectives	Reference	Dates
Submit Application Forms to NCDENC	Register the application for EA	SRK Project No: 451101 – EA Application Form	24 April 2013 (EA application submission) 25 April 2013 (EA application acceptance)
Place posters on site and advertise commencement of EIA process and release Scoping Report for public comment period	To notify IAPs of the commencement of the EIA process and to provide a description of the proposed project and the affected environment, as well as a description of potential environmental issues, and the proposed approach to the Impact Assessment Phase.	SRK Report Number: 451101/03	29 August 2013
Public comment period	To provide stakeholders with the opportunity to review and comment on the results of the Scoping Phase.	SRK Report Number: 451101/03	2 September to 21 October 2013

Task	Objectives	Reference	Dates
Public Open Days	To present the findings of the Scoping Report to stakeholders and provide an opportunity for questions and discussion.	SRK Report Number: 451101/03	27 to 28 September 2013
Finalise Scoping Report	To record all issues and concerns raised and collate these comments in the final report which provides NCDENC with information for decision-making.	SRK Report Number: 451101/02	December 2013
Notify stakeholder of the availability of Final Scoping Report (including Comments and Responses Report) for a second public comment period	To provide stakeholders with the opportunity to review responses to comments and minor changes to the Scoping Report (if any).		6 February 2014 to 27 February 2014
Submit Final Scoping Report (and public comments) to NCDENC	To provide authorities with information for decision-making.	SRK Report No. 451101/02	6 March 2014 (submission of Final Scoping Report to NCDENC) 16 April 2014 (acceptance of Final Scoping Report by NCDENC)

The key activities are described in further detail below.

5.2.1 Newspaper Advertisements and Posters

Newspaper advertisements announcing the commencement of the S&EIR process, the availability of the Scoping Report and inviting IAPs to register on the project database were placed in:

- One regional newspaper: Die Burger (in Afrikaans) on 29 August 2013; and
- Two local papers: Ons Kontrei and Plattelander (in Afrikaans and English) on 29 August 2013.

The project extends over a considerable area. As such, English and Afrikaans posters with details of the project and EIA process and SRK's contact details were placed at the desalination plant site and central public locations in the following towns:

- Springbok;
- Vredendal;
- Bitterfontein;
- Garies; and
- Molsvlei, Rietpoort, Stofkraal, Lepelsfontein and Kotzesrus.

5.2.2 Identification of Key Stakeholders and IAPs

Relevant IAPs from local, provincial and national authorities, conservation bodies, local forums and representatives and surrounding land owners and occupants were considered for inclusion as IAPs for the project.

Relevant authorities and adjacent landowners were automatically registered as IAPs. As specified in GN R 543: 55(1), all persons who submit written comments, attend meetings or request in writing to be placed on the register were (and will be) registered as IAPs.

The stakeholder database is attached as Appendix 5A and was updated throughout the process.

5.2.3 Notification of Scoping Report for Public Comment

The release of the Scoping Report for public review was communicated to all automatically registered IAPs by post, email or fax on or by 2 September 2013. Hard copies of the full report were placed at the following venues:

- Kotzesrus Cash Store;
- Municipal Service Points in:
    - Lepelsfontein,
    - Stofkraal;
    - Rietpoort; and
    - Molsvlei;
- Garies Public Library;
- Security office at Zandkopsdrift Mine; and
- SRK's office in Rondebosch.
- An electronic version of the report could also be accessed via SRK's website.

Hard copies of the Scoping Report were sent to the following organs of state on 29 August 2013 for comment:

- Department of Water Affairs;
- Department of Environmental Affairs: Oceans and Coasts;
- South African Heritage Resources Association;
- SANPARKS;
- Department of Agriculture, Land Reform and Rural Development: Northern Cape;
- Department of Minerals and Energy: Northern Cape;
- CapeNature;
- Namaqua District Municipality; and
- Kamiesberg Local Municipality.

NCDENC was notified that the reports were sent to the organs of state listed above to request their comment. Proof of notifications was provided to NCDENC with the Final Scoping Report submitted on 6 March 2014.

Stakeholders were provided with a comment period exceeding 40 days (from 1 September to 21 October 2013), with an extension until end November 2013 to accommodate outstanding comments from organs of state. Stakeholders were provided with a second 21 day comment period on the Final Scoping Report and Comments and Responses Report from 6 February 2014 to 27 February 2014.

The Final Scoping Report was submitted to NCDENC, including all comments received and proof of notification to stakeholders on 6 March 2014.

5.2.4 Public Open Days

A number of Public Open Days were held during the initial comment period to provide stakeholders with the opportunity to discuss possible concerns related to the proposed project, with the aim of helping to guide the assessment of potential impacts during the Impact Assessment Phase.

Public Open Days were held in:

- Lepelsfontein at 9:00 on Friday 27 September 2013;
- Kotzesrus at 14:00 on Friday 27 September 2013; and
- Garies at 9:00 on Saturday 28 September 2013.

5.2.5 Issues and Concerns Raised by IAPs during Scoping

Comments received following initial announcement of the project and the release of the Draft Scoping Report for public comment were incorporated into the Comments and Responses Report which was attached to the Final Scoping Report which was released for a second comment period. Stakeholders who submitted written comments during the Scoping Phase are listed in Table 5-2 and stakeholders who submitted written comments during the Public Open Days are listed in Table 5-3. All written comments received during the Scoping Phase are included in Appendix 5B.

Table 5-2: Stakeholders who submitted written comments during the Scoping Phase

#	Stakeholder	Affiliation	Comment received
1.	Colette Scheemeyer	SAHRA Head Archaeologist, South African Heritage Resources Agency (SAHRA)	2 May 2013
2.	Property Owner (anonymous)	Owner of an affected property	22 July & 13 Augustus 2013
3.	Kathryn Smuts (& Colette Scheemeyer)	SAHRA	30 August 2013
4.	Suzanna Erasmus	Wildlife and Environment Society of South Africa (WESSA) (Northern Cape Region)	4 September 2013
5.	Cllr. Christoffel van der Westruis	Councillor: Matzikama Municipality	4 September 2013
6.	Adriaan le Roux	Northern Cape Department of Environment and Nature Conservation (NCDENC)	5 September 2013
7.	Alana Duffel-Canham	CapeNature	11 September 2013
8.	Braam Nieuwoudt	Owner of an affected property	26 September 2013
9.	JS and T Nel	Owners of Remainder of Farm 641	1 October 2013
10.	Bernard van Lente	SANParks	1 November 2013
11.	CJ Arendse	DEA: O&C	1 & 21 November 2013
12.	Joseph Cloete (Vissie)	Kamiesberg Local Municipality	12 November 2013
13.	Alexander Cloete	Northern Cape Department of Agriculture, Land Reform and Rural Development	21 November 2013
14.	Shaun Cloete	Department of Water and Sanitation (DWS)	25 November 2013
15.	Chris Fortuin	Namakwa District Municipality (NDM)	29 November 2013
16.	Theo Schutte	Property Owner	14 January 2014

#	Stakeholder	Affiliation	Comment received
17.	A.C.Odendaal	Kotzesrus CC	23 January 2014
18.	Theo Schutte	Property Owner	30 January 2014
19.	At Odendaal, Dirk Jansen, Wessels Jansen, Herman van der Schyff	Property Owners	5 February 2014
20.	Suzanne Erasmus	WESSA (Northern Cape Region)	10 February 2014
21.	Shaun Cloete	DWS	13 February 2014
22.	Nitasha Baijnath-Pillay	DEA: O&C	18 February 2014
23.	JS&T Nel	Property Owner	26 February 2014
24.	Jenna Lavin and Colette Scheermeyer	SAHRA	4 March 2014

Table 5-3: Stakeholders who submitted written comments during Public Open Days (September 2013)

#	Stakeholder	Public Meeting Venue	Comment received
1.	Ralton Pieters	Lepelsfontein Community Hall	27 September 2013
2.	Josef Marco Owies	Lepelsfontein Community Hall	27 September 2013
3.	Jonathan Witbooi	Lepelsfontein Community Hall	27 September 2013
4.	Abraham Jass	Lepelsfontein Community Hall	27 September 2013
5.	Susana Pieters	Lepelsfontein Community Hall	27 September 2013
6.	Anita Lewies	Lepelsfontein Community Hall	27 September 2013
7.	Rachel Cloete	Lepelsfontein Community Hall	27 September 2013
8.	Maritha Kotze	Kotzesrus Church Hall	27 September 2013
9.	A.J. Cornelissen	Kotzesrus Church Hall	27 September 2013
10.	Tielman Nieuwoudt (verbal)	Kotzesrus Church Hall	27 September 2013
11.	Etienne De Jager	Kotzesrus Church Hall	27 September 2013
12.	Tobias Koordom	Garies Town Hall	28 September 2013
13.	Frederic Links	Garies Town Hall	28 September 2013

Key comments and concerns raised by stakeholders can be summarised as follows:

- **Traffic**: The increase in traffic on existing roads some of which are already in a poor condition, and further deterioration of road;
- **Status of the existing road:** Uncertainty regarding the status of the OG 155 as either a proclaimed public road or a private road (see Section 3.6.5);
- **Impacts on affected landowners and residents of Kotzesrus**: Primarily nuisance and security issues associated with construction activities in Kotzesrus**;**
- **Economic benefits:** The project is anticipated to provide economic benefits to local communities through job creation (including those associated with the proposed Mine for which water is required). Provision of water to local communities (if possible) would be an additional economic benefit;

- **Tourism**: Impacts on access to the coast and the informal camping and recreation in the coastal zone;
- **Heritage:** Impacts on heritage resources, including the sense of place and historical buildings in Kotzesrus; and
- **Sense of place:** Concerns were raised that elements of the project, particularly the construction of power lines and pipelines through Kotzesrus, is not in keeping with the rural sense of place, and that these should preferably be routed around the town.

Many of the comments received from stakeholders during the Scoping Phase could only be addressed in the Impact Assessment Phase of the project, as indicated in the responses provided in the Scoping Report Comments and Responses Report (Report 451101/2, Appendix 5B). These comments and recommendations have been considered in the assessment of impacts in Section 6 of this report.

5.2.6 Submission and Acceptance of Final Scoping Report

The Final Scoping Report, including a Comments and Reponses Report was re-released for a second comment period in February 2014, and was submitted to NCDENC on 6 March 2014, along with additional comments received from IAPs. The Final Scoping Report was accepted by NCDENC on 16 April 2014.

Some additional comments were received from IAPs following the release of the Final Scoping Report. A Comments and Reponses Table is included in Appendix 5C, and captures all comments received (and responses) during the Scoping Phase.

5.3 Stakeholder Engagement during the Impact Assessment Phase

Stakeholder engagement activities during the Impact Assessment Phase are aimed at ensuring that the specialist studies and assessment by the EIA project team adequately address the issues and concerns raised during the Scoping Phase. Opportunity to raise further issues is also provided.

The key public participation activities during the Impact Assessment Phase are summarised in Table 5-4 below.

Table 5-4: Stakeholder engagement activities undertaken and planned during the Impact Assessment Phase

Task	Objectives	Reference	Projected Dates
Public comment period including distribution of an Executive Summary to all registered stakeholders	To provide stakeholders with the opportunity to review and comment on the results of the Impact Assessment Phase, and to obtaining written comments from stakeholders and key stakeholders on the EIA Report.	N/A	October 2014
Finalise EIA Report and submit to NCDENC	To present the findings of the EIA process, incorporating stakeholder comment and submit the EIA Report to the authorities to facilitate their decisions.	SRK Report No. 442874/4	December 2014

The key activities are described in further detail below.

5.3.1 Notification of Draft EIA Report for Public Comment

Registered stakeholders will be notified of the release of the draft EIA Report for public review. Notifications, including copies of the Executive Summary, will be posted, faxed or e-mailed to all registered IAPs on the same date (a list of registered IAPs notified of the Draft EIA Report is included as Appendix 5A).

Hardcopies of this report will be available for public review at the following venues:

- Kotzesrus Cash Store;
- Municipal Service Points in:
    - Lepelsfontein,
    - Stofkraal;
    - Rietpoort; and
    - Molsvlei;
- Garies Public Library;
- Security office at Zandkopsdrift Mine; and
- SRK's office in Rondebosch.

The report is also accessible as an electronic copy on SRK's website www.srk.co.za (via the "recent publications" and then "public documents" links), and available on CD, on request. A hard copy of the Draft EIA Report/EMPr as well as a CD containing an electronic copy has been made available to each of the following authorities, to facilitate comment:

- DWS;
- DEA:O&C;
- SAHRA;
- SANParks;
- Department of Agriculture, Land Reform and Rural Development: Northern Cape;
- Department of Mineral Resources (DMR): Northern Cape;
- CapeNature;
- Namaqua District Municipality; and
- Kamiesberg Local Municipality.

A 40-day comment period commenced on 24 October 2014 and registered IAPs are requested to submit comments to SRK Consulting by 4 December 2014. Comments received in response to the Draft EIA Report will be included in an EIA Report Comments Report and attached to the Final EIA Report.

5.4 Next steps

This Draft EIA Report is not a final report and may be amended based on comments received from authorities or IAPs, and if amended the final version of the report will be released again to IAPs for a 21 day review period. However, if there are no substantive changes necessary following the release of the Draft EIA Report, the report will be submitted in its current form (with minor administrative amendments, e.g. renaming the reports the "Final" version), and an update of key dates in the Impact Assessment Phase. IAPs will be notified of the submission in both cases.

6 Environmental Impact Assessment

6.1 Introduction

6.1.1 Environmental Impacts Identified

Based on the professional experience of the EIA team, legal requirements (Section 2), the nature of the receiving environment (Section 4) and the proposed activity (Section 3) and issues raised in the public participation process (Section 5), the following key environmental issues – potential negative impacts and potential benefits – were identified:

- **Terrestrial and wetland ecology** – Due to the botanical and ecological sensitivity of portions of the development area and the presence of sensitive vegetation types and wetland features, the proposed project may negatively impact threatened species and habitats. Portions of the proposed route traverse undisturbed areas, some of which fall within CBAs and sensitive habitat types and the installation of infrastructure within or adjacent to existing road reserves will disturb these (potentially undisturbed) areas;
- **Terrestrial fauna** – Construction activities may affect terrestrial and avifauna in and around the project, as well as faunal habitats. In addition linear infrastructure could create barriers to the migration of certain faunal species;
- **Marine and coastal ecology** – The construction of infrastructure in the marine and coastal environments may disturb marine biota and coastal ecosystems. Relevant construction activities include blasting, excavation and concrete works below the HMW of the sea, and the movement of construction vehicles in the coastal zone. The abstraction of seawater and the discharge of brine (and potential co-discharges) from the desalination plant into the ocean may result in the entrainment and impingement of biota (fauna and flora) and more intense impacts on marine biota in a sacrificial area characterised by elevated salinity levels and the presence of co-discharges. This impact could be exacerbated should local bathymetry and inadequate design of discharge infrastructure promote the accumulation of brine, rather than rapid mixing and dispersion;
- **Socio-economic** – The construction and operation of the desalination plant and associated infrastructure will create a limited number of employment opportunities, with the associated income generation and skills development. There may be some security concerns, particularly in the vicinity of Kotzesrus, during the construction phase. Impacts also include increased business and tourism opportunities during the construction and operation phases, as well as impacts on service provision.
- **Heritage** – It is possible that sites of archaeological or palaeontological significance are located in the vicinity of the development area; in addition to which a number of historic buildings are located in Kotzesrus. A memorial stone is also located in the vicinity of the proposed seawater intake for the desalination plant. Possible impacts on heritage (archaeological, palaeontological and architectural) resources may thus occur.
- **Visual** – Construction equipment and activities are likely to cause visual intrusion during the construction phase. The placement of the desalination plant and associated infrastructure is also likely to impact on visual character and the sense of place of the project area, particularly at Kotzesrus and at the coast. There may also be some visual impacts associated with the discharge of brine into the coastal environment.

6.1.2 Specialist Studies Undertaken

A number of specialist studies (see Table 4-1 and below) were undertaken as part of the Impact Assessment Phase to investigate the key potential direct, indirect and cumulative impacts (negative and positive) identified during Scoping. These specialist impact studies are as follows:

- Terrestrial and Aquatic Ecology Impact Assessment;
- Marine and Coastal Ecology Impact Assessment (informed by the Marine Modelling Study);
- Heritage Impact Assessment; and
- Palaeontology Impact Assessment.

These specialist reports are included as Appendices 4A to 4E to this report. Socio-economic and visual impacts were assessed by SRK specialists and EAPs, although stand-alone specialist studies were not considered necessary.

Certain impacts which SRK believes to be less significant and do not warrant specialist investigation are assessed in Section 6.2. These impacts include:

- Increased dust and associated impacts on air quality;
- Increased noise and vibration; and
- Increased traffic volumes and deterioration of roads.

6.1.3 Alternatives Assessed in the EIA

During the prefeasibility phase of most projects various development alternatives are investigated. Furthermore, the EIA Regulations, 2010 require that all S&EIR processes must identify and describe “alternatives to the proposed activity that are feasible and reasonable”. Depending on the specific project circumstances the following alternatives may be considered:

- Site Alternatives;
- Design Alternatives;
- Land Use Alternatives;
- Process Alternatives; and
- The ‘No-Go’ Alternative.

In the case of the Volwaterbaai desalination plant project, various alternatives have been considered during the initial screening and scoping phases of the project, many of which were eliminated for technical reasons (refer to Section 3.5). The following route alternatives for linear infrastructure (see Figure 6.1) and position alternatives for the desalination plant (in addition to the No-Go alternative) will be assessed in Sections 6.3 to 6.9.

6.1.3.1 Kotzesrus Route Alternative

This is the preferred alignment for linear infrastructure (roads, power lines and pipelines) along what is currently a combination of 4 x 4 tracks and dirt roads between the desalination plant site and the Zandkopsdrift Mine. The route, which is approximately 48.9 km in length will:

- Follow (and be restricted to) an existing coastal dirt road from the desalination plant in a north-westerly direction for approximately 6.5 km;

- Turn to the east on a 4 x 4 track traversing Farm Strandfontein 559 and follow mostly existing 4 x 4 tracks towards Kotzesrus for approximately 17.5 km through areas of natural vegetation (including sensitive Sand Fynbos vegetation) and farmland that is used mostly for grazing;
- Follow (and be restricted to) the existing gravel road between Kotzesrus and Garies, passing through agricultural (grazing) land for approximately 13 km;
- Turn to the east, following an existing route for approximately 5 km towards the Zandkopsdrift Mine.

6.1.3.2 Amended Bypass Route Alternative

This route alternative largely follows the same alignment as the *Kotzesrus Route*, but bypasses the town of Kotzesrus, to the north. This route deviates from the Kotzesrus Route approximately 2.6 km to the west of Kotzesrus, follows existing tracks and traverses previously undisturbed areas over privately owned farmlands for a distance of approximately 6.4 km, re-joining the *Kotzesrus Route* alignment 1.7 km to the east of the town. The *Amended Bypass Route* is approximately 51.4 km in length.

6.1.3.3 Alternative Positions for Desalination Plant

Five alternative positions for the desalination plant were identified at the Volwaterbaai site (see Figure 6-2), with the final position to be selected based on the findings of specialist studies and the Impact Assessment Phase. All five positions are located within what can be considered a single envelope. Three of the possible locations (A, C and D) are situated to the east (landward) of the road alignment, while two (B and E) are situated on the coastal (western) side.

Apart from environmental considerations, factors influencing the selection of the preferred position include elevation (the ability to pump intake water to the elevation of the desalination plant), distance (the ability to pump intake water over distance), preference for gravitational discharge of water/brine (rather than pumping), visual and aesthetic considerations, geotechnical considerations and earthworks required.

6.1.3.4 No-Go Alternative

The No-Go alternative will be considered in the EIA in accordance with the requirements of the EIA Regulations, 2010. The No-Go alternative entails no change to the status *quo*, in other words the proposed desalination plant site will remain undeveloped and no linear infrastructure will be built. Due to the lack of water in Namaqualand it is unlikely that the Zandkopsdrift Mine would be developed as no feasible alternative water supplies are currently available.

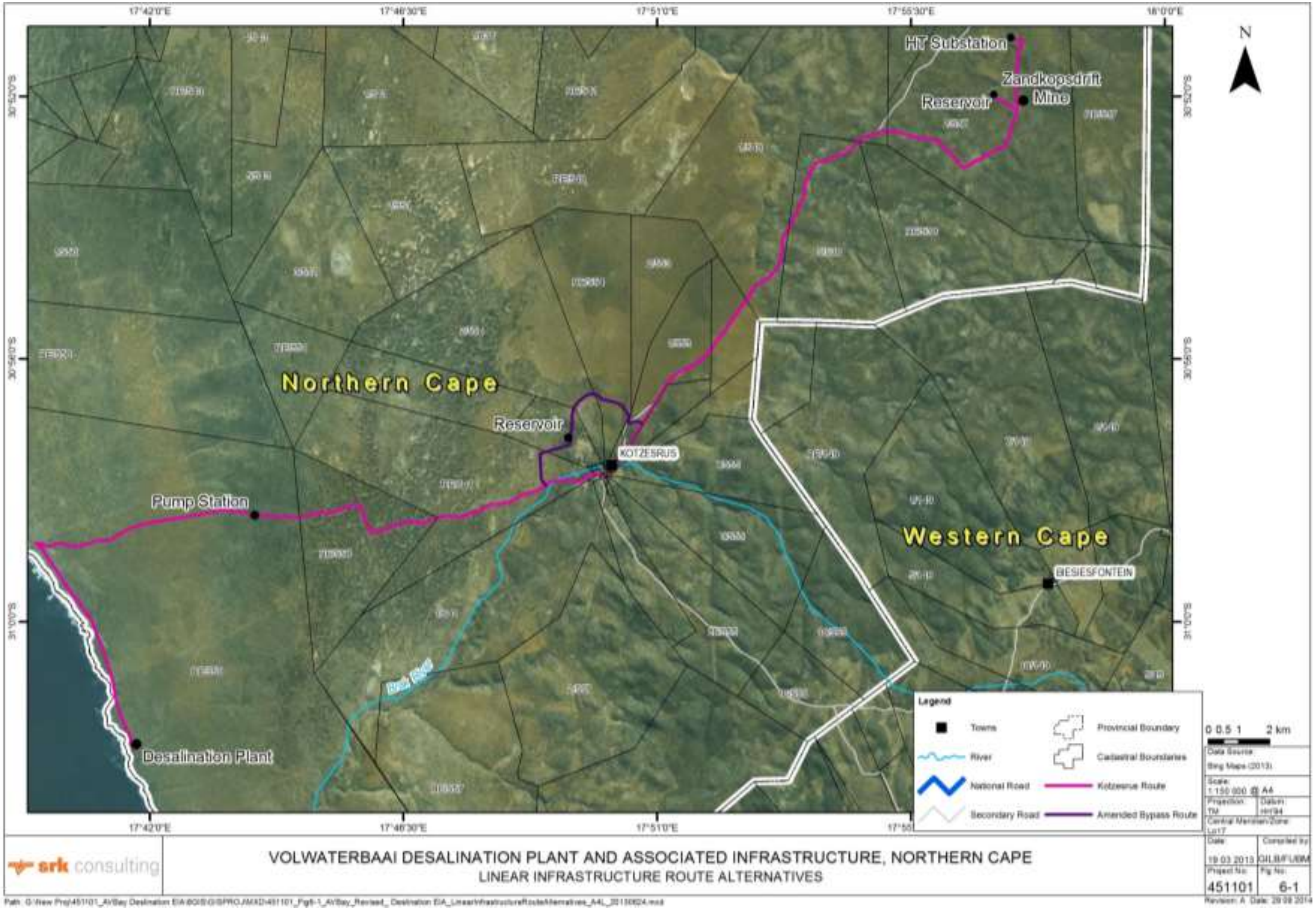


Figure 6-1: Linear Infrastructure Route Alternatives

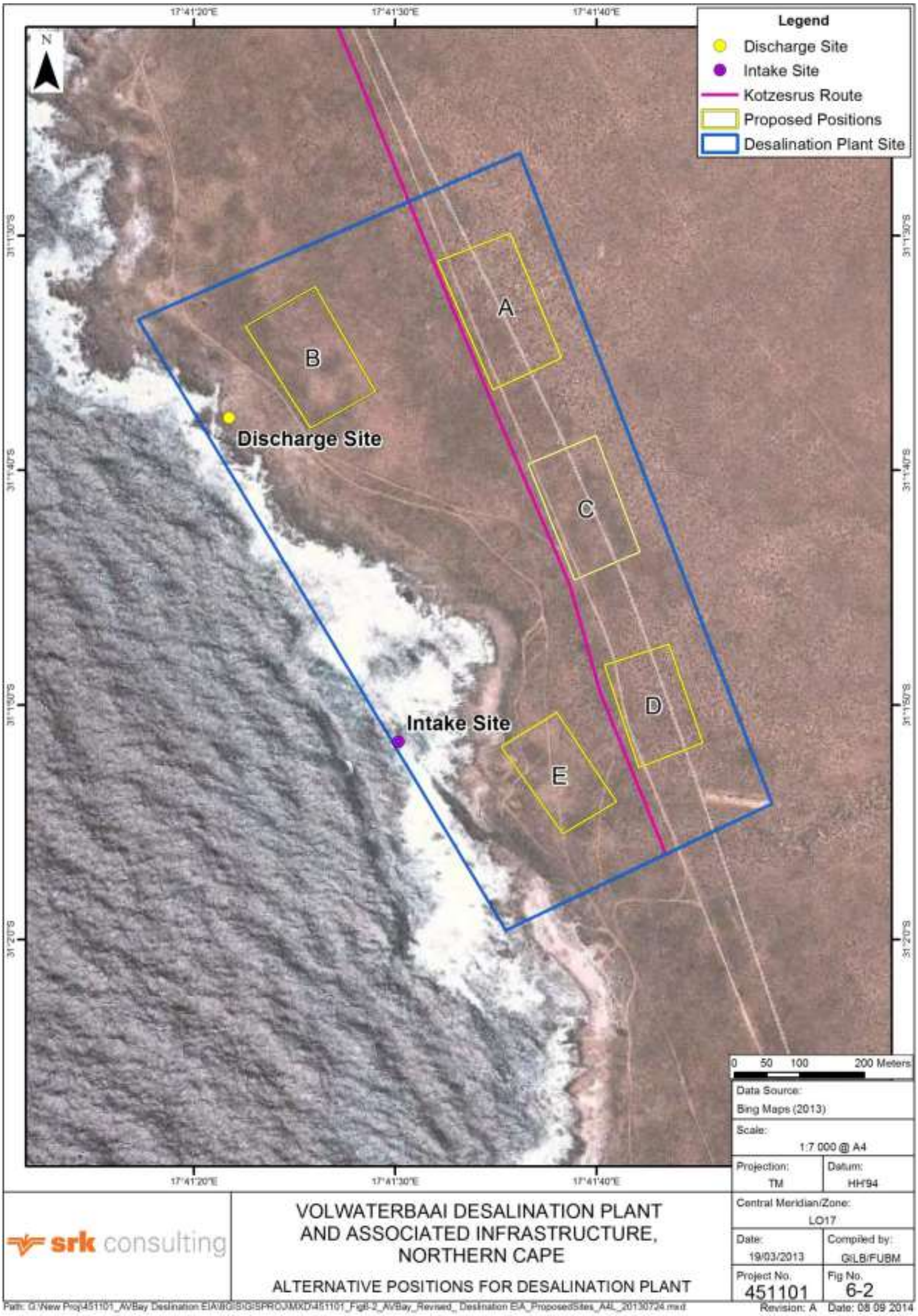


Figure 6-2: Alternative Positions for the Desalination Plant

6.1.4 Impact Rating Methodology

The assessment of impacts was based on specialists' expertise, SRK's professional judgement, field observations and desk-top analysis.

The significance of potential impacts that may result from the proposed project was determined in order to assist decision-makers (typically by a designated authority or state agency, but in some instances, the proponent).

The **significance** of an impact is defined as a combination of the **consequence** of the impact occurring and the **probability** that the impact will occur.

The criteria used to determine impact consequence are presented in the table below.

Table 6-1: Criteria used to determine the consequence of the impact

Rating	Definition of Rating	Score
A. *Extent* *– the area over which the impact will be experienced*		
Local	Confined to project or study area or part thereof (e.g. the development site and immediate surrounds)	1
Regional	The region (District Municipality or Quaternary catchment)	2
(Inter) national	Nationally or beyond	3
B. *Intensity* *– the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources*		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. *Duration* *– the timeframe over which the impact will be experienced and its reversibility*		
Short-term	Up to 2 years and reversible	1
Medium-term	2 to 15 years and reversible	2
Long-term	More than 15 years and irreversible	3

The combined score of these three criteria corresponds to a **Consequence Rating**, as follows:

Table 6-2: Method used to determine the consequence score

Combined Score **(A+B+C)**	3 – 4	5	6	7	8 – 9
Consequence Rating	Very low	Low	Medium	High	Very high

Once the consequence was derived, the probability of the impact occurring was considered, using the probability classifications presented in the table below.

Table 6-3: Probability classification

Probability *– the likelihood of the impact occurring*	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

The overall **significance** of impacts was determined by considering consequence and probability using the rating system prescribed in the table below.

Table 6-4: Impact significance ratings

		Probability			
		Improbable	Possible	Probable	Definite
Consequence	Very Low	INSIGNIFICANT	INSIGNIFICANT	VERY LOW	VERY LOW
	Low	VERY LOW	VERY LOW	LOW	LOW
	Medium	LOW	LOW	MEDIUM	MEDIUM
	High	MEDIUM	MEDIUM	HIGH	HIGH
	Very High	HIGH	HIGH	VERY HIGH	VERY HIGH

Finally the impacts were also considered in terms of their status (positive or negative impact) and the confidence in the ascribed impact significance rating. The prescribed system for considering impacts status and confidence (in assessment) is laid out in the table below.

Table 6-5: Impact status and confidence classification

Status of impact	
Indication whether the impact is adverse (negative) or beneficial (positive).	+ ve (positive – a 'benefit')
	– ve (negative – a 'cost')
Confidence of assessment	
The degree of confidence in predictions based on available information, SRK's judgment and/or specialist knowledge.	Low
	Medium
	High

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **INSIGNIFICANT**: the potential impact is negligible and **will not** have an influence on the decision regarding the proposed activity/development.
- **VERY LOW**: the potential impact is very small and **should not** have any meaningful influence on the decision regarding the proposed activity/development.
- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.
- **MEDIUM**: the potential impact **should** influence the decision regarding the proposed activity/development.
- **HIGH**: the potential impact **will** affect the decision regarding the proposed activity/development.
- **VERY HIGH**: The proposed activity should only be approved under special circumstances.

Practicable mitigation and optimisation measures are recommended and impacts are rated in the prescribed way both without and with the assumed effective implementation of mitigation and optimisation measures. Mitigation and optimisation measures are either:

- **Essential**: measures that must be implemented and are non-negotiable; and
- **Best Practice:** recommended to comply with best practice, with adoption dependent on the proponent's risk profile and commitment to adhere to best practice, and which must be shown to have been considered and sound reasons provided by the proponent if not implemented.

6.1.5 Integration of Studies into the EIA Report and Review

The completed specialist studies and their findings have been integrated into the EIA Report. The key findings of each specialist were evaluated in relation to each other to provide an overall and integrated assessment of the project impacts.

SRK has considered the suite of potential impacts in a holistic manner and in certain instances, based on independent professional judgment and this integrated approach, may have altered impact significance ratings provided by the specialist. Where this has been done it is indicated in the relevant section of the report.

Specialists have made recommendations for the management of impacts, and the EIA team has assessed these recommendations. For the sake of brevity, only **key** (i.e. non-standard essential) mitigation measures are presented in impact rating tables (later in this section), with a collective summary of all recommended mitigation measures presented at the end of discipline.

6.1.6 Factors Informing the Impact Assessment

The impacts of a project are mostly linked to the sensitivity of the receiving environment and proximity or absence of receptors, the extent or footprint or alignment of the development and expected discharges, all of which are briefly summarised below.

- **Sensitivity of the terrestrial biophysical environment:** The western portion of the linear infrastructure route (either alternative) passes through a CBA associated with sensitive Sand Fynbos vegetation which is considered to be botanically sensitive, as well as a quartzite and clay exposure area approximately 10 km northeast of Kotzesrus which provides unique habitat to SCC. In addition, the proposed route and bypass alternative crosses a number of watercourses and wetland features that could be considered ecologically sensitive. It is also possible that a number of threatened avifaunal species may occur in the study area.
- **Sensitivity of the coastal region and marine environment:** The isolated coastal and marine environment is considered to be rich in biodiversity and relatively pristine, in areas where seawater extraction and the discharge of treated brine effluent into the ocean is planned. Local oceanographic conditions including current and wave climates and potential sea-level rise are also important considerations.
- **Sensitivity of the social environment:** The KLM is characterised by low employment and education levels. Kotzesrus is located approximately midway between the desalination plant and the Zandkopsdrift Mine and receptors in the town will likely be affected by the development of the proposed infrastructure either passing through or bypassing the town (depending on the selected route alternative). The desalination plant is remote and only a limited number of receptors will be affected by the desalination plant at Volwaterbaai, including tourists and residents in the area. Construction of the desalination plant and associated infrastructure may create some employment opportunities in the short term, while the operation of the desalination plant may create only a limited number of long term employment opportunities.
- **Development footprint:** The development will include approximately 49 km of linear infrastructure, stretching from the coast at Volwaterbaai to the Zandkopsdrift Mine. Sections of this infrastructure will follow existing 4 x 4 tracks while other sections are currently on undisturbed stretches of land. Some infrastructure, notably the power lines and pipelines are likely to be positioned on relatively undisturbed land adjacent to existing roads (either in or adjacent to the road reserves). Though small, the footprint of the desalination plant and

associated infrastructure in the coastal zone is relatively significant given the current absence of structures in the area, with some infrastructure (seawater intake and discharge facilities) positioned below the HMW of the sea.

- **Brine discharge:** Brine will be discharged from the temporary (during construction) and permanent desalination plants (during operations) into the sea.
- **Scarcity of water:** Namaqualand is a water scarce area, constraining development in the region.
- **Stakeholder perceptions:** While much of the project infrastructure is relatively remote and is likely to raise little concern from stakeholders, a number of private properties in Kotzesrus will be directly affected by the project. These property owners are particularly concerned about disruptions to their farming activities and impacts on property values as well as security and nuisance impacts during construction.

6.2 Less Significant (or Minor) Impacts

More significant impacts are assessed later in this chapter. In addition, there are a number of minor, or less significant, impacts associated with the project:

- Air quality impacts;
- Noise and vibration impacts; and
- Traffic impacts.

These impacts are not expected to be significant nor long term and have therefore not been subjected to specialist investigations and detailed impact analysis. However, they have been assessed by the EIA team through desktop investigation and ground-truthing, and are discussed below. Best practice mitigation measures have also been identified.

6.2.1 Potential Impact A1: Changes in Air Quality due to Project Related Emissions

There are no significant sources of air pollution in the area. Farming activities generate only limited emissions, mainly airborne particulates (dust). It is therefore expected that air quality in the project area is good.

The majority of the roads in the development area are dirt roads and small volumes of dust are (currently) entrained by vehicular movement. During the construction phase, additional vehicles using these roads, particularly heavy vehicles, is likely to increase the volume of dust generated: this may cause nuisance effects, particularly in Kotzesrus, where dwellings abut the road. Drilling, blasting (where required) and bulk earthworks (where required) as well as exhaust fumes from construction vehicles and diesel generators may also impair air quality during the construction phase.

Although wind-generated dust from cleared construction areas is also likely to occur, the linear nature of the development and its alignment following existing roads will limit vegetation clearance. Windblown sand and dust generated at the desalination plant site is unlikely to cause a disturbance, since it is unlikely that large volumes of dust and/or emissions will be generated during construction activities, and due to the absence of receptors in the area.

The number of vehicles (servicing the desalination plant) which will use the road during the operation phase will be limited to those required for routine maintenance, the daily transport of staff and monthly deliveries, approximately 13 return trips per day.

Only a limited volume of dust and gaseous emissions is likely to be generated by the project during the construction phase. Air quality impacts during the operation phase will be localised and of low intensity (for the Kotzesrus Route), while for the *Amended Bypass Route,* Kotzesrus will be unaffected by dust and nuisance impacts. Impacts can be readily mitigated by standard housekeeping measures.

The impact is therefore assessed to be ***insignificant*** during the construction and operation phases.

6.2.1.1 Mitigation Measures: Potential Air Quality Impacts

Essential air quality mitigation measures during **construction and operation** are as follows:

- Maintain all generators, vehicles, vessels and other equipment in good working order to minimise exhaust fumes;
- Avoid clearing of vegetation until absolutely necessary (i.e. just before excavations);
- Stabilise exposed surfaces as soon as is practically possible;
- Avoid excavation and handling and transport of materials which may generate dust under high wind conditions or when a visible dust plume is present;
- Limit construction vehicle speeds to 40 km/hr on gravel roads, 30 km/h on the gravel road though Kotzesrus and 20 km/h on unconsolidated and non-vegetated areas;
- Reduce airborne dust at construction sites and in Kotzesrus through e.g.:
    - Damping dust-generating areas/roads with freshwater; and
    - Covering dumps or stockpiles of lose material with plastic sheeting or netting, especially during windy conditions.

6.2.2 Potential Impact N1: Increased Noise Levels and Vibration due to Project Activities

Noise pollution results from unwanted or excessive noise with effects that range from nuisance to more harmful effects such as sleep disturbance, high stress levels and impaired hearing. Vibration can cause damage to structures.

Existing noise levels in the area are typical of a remote location and both daytime and night time average noise levels are expected to be very low, with noise mostly generated by the occasional movement of vehicles through the area. At the proposed desalination plant site, ambient noise levels generated by wave action are likely to be higher than further inland. There are also fewer receptors in this area compared to Kotzesrus.

Traffic and building activities during the construction phase (including possible blasting) are anticipated sources of noise and/or vibration. Vibration (from blasting) during construction of linear infrastructure through Kotzesrus may result damage structures older than 100 years (heritage structures). Potential damage to heritage structures is assessed in more detail in Section 6.8.

During the operation phase, generators and desalination equipment may generate (occupational) noise; however, there are a limited number of receptors in the area and the noise from the desalination plant is not likely to be higher than ambient noise levels in the area.

Noise and vibration attenuate over distance and will be largely restricted to the construction phase of the project. For the *Amended Bypass Route*, which detours around Kotzesrus, noise and vibration impacts are assessed to be ***insignificant***. For the *Kotzesrus Route*, the impact intensity is expected to be low due to the potential disturbance of sensitive receptors and is therefore assessed to have ***very low*** significance ***assuming*** mitigation measures are implemented.

6.2.2.1 Mitigation Measures: Potential Noise and Vibration Impacts

Essential noise and vibration mitigation measures during construction and operation are as follows:

- Limit noisy construction activities in Kotzesrus to daylight hours from Monday to Saturday or in accordance with relevant municipal bylaws, if applicable;
- Comply with the applicable municipal and / or industry noise regulations;
- Notify adjacent residents or business premises before particularly noisy construction activities will take place;
- Notify adjacent landowners before any blasting takes place and implement the appropriate measures to reduce noise levels and limit the amount of vibration;
- Maintain all generators, vehicles, vessels and other equipment in good working order to minimise excess noise;
- Restrict the use of radios, television sets and other such equipment near receptors so as to not disturb neighbouring residents/tenants;
- Enclose diesel generators used for power supply at Kotzesrus to reduce unnecessary noise; and
- Investigate potential noise reduction measures such as mufflers on equipment if complaints regarding construction noise are received.

6.2.3 Potential Impact T1: Impacts of Project Related Traffic on Existing Road Users and Surrounding Residents

The project area is very isolated and remote and there is very limited traffic in the area. An increase in heavy traffic can damage roads and compromise road surface integrity. Heavy rainfall events may cause further deterioration, exacerbating disturbances caused by heavy vehicles. Worsened road conditions may also reduce accessibility to the isolated towns near Kotzesrus, e.g. Lepelsfontein. An increase in traffic may cause nuisance to residents of Kotzesrus. In addition, road safety may be of concern as a result of increased traffic volumes.

Increased traffic is expected during the construction phase, mainly comprising construction equipment, large vehicles and trucks, as well as smaller passenger vehicles. Twenty-two light passenger vehicles return trips and twenty-six heavy construction vehicle return trips are expected daily during the construction phase. During the operation phase, traffic increases will be limited to the daily movement of staff to the desalination plant, traffic associated with infrastructure maintenance and monthly deliveries. Six light and six heavy vehicle return trips per day and twenty return trips by delivery vehicles per month are anticipated.

Construction activities associated with the project are not expected to significantly increase traffic volumes. The route will be upgraded and maintained to support the volume and type of traffic that will be required for the construction and operation phases of the project. For the Kotzesrus Route, impacts associated with increased traffic are therefore expected to be ***insignificant*** for both the construction and operation phases of the project, ***assuming*** mitigation measures are implemented. For the *Amended Bypass Route,* potential nuisance resulting from increased traffic in Kotzesrus would be eliminated.

6.2.3.1 Mitigation Measures: Potential Traffic Impacts

Essential traffic mitigation measures during construction and operation are as follows:

- Manage construction sites and activities so as to minimise impacts on road traffic as far as possible, e.g. minimise the unnecessary movement of construction vehicles;
- Use appropriate road signage, in accordance with the South African Traffic Safety Manual, providing flagmen, barriers etc. at the various access points where necessary to inform other road uses of construction activities;
- Maintain and repair roads damaged by construction vehicles;
- Implement the necessary measures to maintain roads and road surface integrity;
- Limit construction vehicle speeds to 30 km/h through Kotzesrus and any other villages or towns on gravel roads;
- Ensure that large construction vehicles are suitably marked to be visible to other road users and pedestrians;
- Ensure that all safety measures are observed and that drivers of construction vehicles comply with the rules of the road;
- Ensure that vehicle axle loads do not exceed the technical design capacity of roads; and
- Investigate and respond to complaints about traffic.

6.3 Potential Aquatic Ecology Impacts

6.3.1 Introduction, Terms of Reference and Methodology

This assessment is based on the Terrestrial and Aquatic Ecology Study undertaken by SAS (see Appendix 4A). The purpose of the study was to assess the potential impacts of the development alternatives on terrestrial and aquatic ecology, indicate their environmental acceptability and recommend practicable mitigation measures to minimise potential impacts and maximise potential benefits.

The ToR for the study were to:

- Undertake an ecological investigation based on desktop research as well as seasonal field assessments (where required) focusing on the faunal and floral integrity of the area as well as RDL species of concern in the area;
- Undertake an investigation of the wetlands, rivers and other aquatic features on the property;
- Describe the baseline terrestrial and aquatic ecology of the area, making specific reference to RDL species occurring in the areas as well as the conservation value of the areas proposed for development;
- Identify and assess the impacts of the proposed development on the terrestrial and aquatic biodiversity of the project area during the construction and operation phases of the project, using SRK's standard impact assessment methodology;
- Summarise, categorise and rank all identified impacts on terrestrial and aquatic ecology in appropriate Impact Assessment tables, to be incorporated in the overall EIA. Present the assessment of impacts associated with various alternatives in separate tables where applicable;

- Recommend practicable management measures to avoid and mitigate and/or optimise impacts;
- Compile a monitoring plan to monitor impacts, if required;
- Assist the EIA team in responding to any comments received from stakeholders as they relate to terrestrial and aquatic ecology impacts; and
- Provide technical input required for the submission of applications to the DWS in terms of the NWA.

The Aquatic Ecology Assessment included a literature review, followed by site assessments undertaken in February and August 2013. All wetland features within the study area were identified and a wetland classification assessment was undertaken according to the *Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems* (Ollis *et al*., 2013). In addition, the WET-Health (Macfarlane *et al.,* 2009), wetland ecological and socio-economic service provision (Kotze *et al.* 2008) and EIS of wetlands was determined. The method used for the EIS determination was adapted from the method as provided by DWS (1999) for floodplains. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS Category for the wetland feature or group being assessed.

Delineation of the wetland zones took place according to "*DWA, 2005: A Practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones*". Aspects such as soil morphological characteristics, vegetation types and wetness were used to delineate the temporary zones of the wetlands according to the guidelines. The buffer zones were then delineated around the temporary zone.

6.3.2 Assessment of Impacts: Construction Phase

One potential direct construction phase impact on the aquatic ecology of the area was identified, and assessed separately for each route alternative:

- AE1: Loss of Wetland Habitat and Ecological Structure.

6.3.2.1 Potential Impact AE1: Loss of Wetland Habitat and Ecological Structure

Loss of wetland habitat and ecological structure is mainly associated with the construction of linear infrastructure, as no wetland or surface water features occur close to the desalination plant site. Construction activities through wetland features, site clearing and the disturbance of soils and removal of vegetation and increased stormwater runoff from cleared areas may disturb or cause the permanent loss of wetland habitat within the construction footprint.

The Brak River and its tributaries and a number of tributaries of the Groen River flow through the project area. The Brak River runs to the southwest of Kotzesrus while tributaries to the Groen River run to the northeast. Both river systems are non-perennial and classified as being in good condition.

Ephemeral drainage features (which only convey water immediately after rainfall events) as well as natural and artificial wetland features fall within the project footprint (see Figure 4-4).

Kotzesrus Route

The *Kotzesrus Route* follows an existing provincial gravel road and traverses two ephemeral tributaries of the Groen River (indicated as floodplain wetlands by the NFEPA database) and numerous ephemeral drainage features to the north east of the town of Kotzesrus. These tributaries only flow for very limited periods directly after isolated heavy rainfall events which occur every few years. The existing gravel road through these features has eroded these features and inadequate culvert design has disrupted their hydrological connectivity.

Impacts associated with the construction of linear infrastructure may arise from the upgrading of gravel roads and installation of pipelines and power lines through these wetland features. A single ephemeral drainage feature will also be disturbed during installation of the pipeline which connects to the water storage reservoir in the Zandkopsdrift mining area.

One natural ephemeral pan and two artificial depression wetlands are present near the provincial road to the east of Kotzesrus. However, upgrading of gravel roads and installation of pipelines and power lines is only likely to occur within the 32 m buffer zones of these features, rather than within the features *per se*. In addition, three natural ephemeral pans are located to the west of Kotzesrus. These features are located in a cluster in close proximity to the gravel road and the widening of the existing gravel road and the installation of pipelines and power lines through these features may impact on this wetland habitat.

The *Kotzesrus Route* passes through Kotzesrus and crosses the Brak River whereas the *Amended Bypass Route* does not. The *Kotzesrus Route* will require widening of the existing gravel road which runs through a sensitive well vegetated portion of the Brak River, which is identified as an aquatic CBA (NDBSP, 2008), which may cause significant negative impacts on wetland habitat as well as disturbance of this CBA.

In addition to impacts on wetland habitat, the *Kotzesrus Route* may have significant impacts on wetland hydrological function. During construction, site clearing and vegetation clearing may increase runoff from disturbed areas and increase erosion and incision of wetland areas. Sediment deposition associated with the disturbance of soils and increased sediment runoff during the construction phase may affect the sediment balance of the wetland features and affect water flow through the features.

Due to the limited disturbance footprint associated with the development of the *Kotzesrus Route* and the arid nature of the study area (freshwater features are ephemeral), it is unlikely that impacts associated with the construction of the route will affect the downstream hydrology and habitat of freshwater features. The loss of wetland habitat associated with the development of the *Kotzesrus Route* will be a localised impact. The widening of gravel roads and the installation of pipelines and power lines through wetland features is however likely to result in the permanent removal of wetland habitat and construction related activities such as the indiscriminate movement of construction vehicles and personnel through wetland features is likely to cause high intensity impacts and the long term disturbance of wetland habitat.

The study area is located within a water stressed region and as a result available wetland and riparian habitat is considered to be of increased conservation importance in terms of wetland dependent floral and faunal species. Although most features are ephemeral, these features will still be used as breeding and foraging habitat after rainfall events. Furthermore, both route alternatives are located within an area mainly utilised for livestock grazing with small areas used for cultivation. As a result, the majority of the wetland habitat within the area has not been impacted by anthropogenic activity and can still be considered representative of intact wetland and riparian habitat.

Although upgrading of the areas in which the provincial gravel road currently crosses wetland features (tributaries of the Groen River and ephemeral drainage features) to the east of Kotzesrus and the rehabilitation of these areas may result in a positive impact, the disturbance associated with the development of pipelines and power lines through wetland areas and the loss of wetland habitat associated with the development of the *Kotzesrus Route* through the Brak River generates a (net) negative impact.

The impact isassessed to be of ***high*** significance and with the implementation of mitigation is reduced to ***low*** (Table 6-6).

Table 6-6: Significance of loss of wetland habitat and ecological structure during construction of linear infrastructure along the Kotzesrus Route

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	High 3	Long-term 3	**High** **7**	Definite	**HIGH**	– ve	High
Essential mitigation measures: • Demarcate all sensitive wetland zones outside of the construction footprint and designate these as no-go areas; • Align pipelines and power lines to cross wetlands and drainage features, perpendicularly (or as close as possible to perpendicular) to limit the area of disturbance within the wetland or drainage feature; • Install pipelines and power lines to span over the wetland/drainage feature and the associated 32m buffer zone, where these features cannot be avoided. Where this is not possible, pipeline and power line support structures must be placed in the buffer zone rather than inside the feature; • Permit only essential construction personnel within the wetland habitat and undertake excavations for support structures by hand where placing pipeline and power line support structures within wetland habitat is unavoidable; • Obtain the relevant approvals from DWS for any activities within wetland areas and their associated buffers particularly in terms of Section 21 c and i of the NWA (Act 36 of 1998); • Prevent potentially contaminated run-off from work areas from entering wetland habitats; • Incorporate adequate erosion and stormwater management measures in road design and construction in order to prevent erosion and the associated sedimentation of wetland areas. Management measures may include berms, silt fences, hessian curtains, stormwater diversion away from areas susceptible to erosion and stormwater attenuation. Care should however be taken so as to avoid additional disturbance during the implementation of these measures; • Upgrade bridges/culverts to comply with the requirements listed below, where these upgrades are required for the project: o Bridges and culverts must span the entire width of wetland and drainage features; o Bridge structures must not alter seasonal stream flow patterns; o Habitat connectivity must be maintained beneath bridge structures and culverts, by e.g. constructing underpasses so that they are sufficiently high to allow for the movement of local fauna, including small antelope, and (where possible) sufficiently wide to include a buffer along the margins of the wetland habitat; o Bridges and culverts must not result in the incision and canalisation of the wetland and drainage areas, but must allow for sufficient dispersion of water through wetland and drainage areas to prevent the concentration of flow which could lead to scouring and incision of the system; and • Rehabilitate all wetland areas impacted by construction related activities to ensure that wetland functions are re-instated after construction.								
With mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Definite	**LOW**	**– ve**	High

Amended Bypass Route

Impacts associated with the construction of the *Amended Bypass Route* will be similar to those for the *Kotzesrus Route.* However, by diverting around the town of Kotzesrus, the *Amended Bypass Route* avoids crossing the Brak River, but crosses a small ephemeral drainage feature to the north west of Kotzesrus. The intensity of the impact associated with the *Amended Bypass Route* is substantially reduced in comparison with the *Kotzesrus Route*. Impacts would, however, persist over the long term.

Although upgrading of the areas in which the provincial gravel road currently crosses wetland features (tributaries of the Groen River and ephemeral drainage features) to the east of Kotzesrus and the rehabilitation of these areas may result in a positive impact, the disturbance associated with the development of pipelines and power lines through wetland areas and the loss of wetland habitat generates a (net) negative impact.

The impact is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low*** (Table 6-7).

Table 6-7: Significance of loss of wetland habitat and ecological structure during construction of linear infrastructure along the Amended Bypass Route

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium** **6**	Definite	**MEDIUM**	– ve	High
Essential mitigation measures: • As for Kotzesrus route (Table 6-6)								
With mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Definite	**LOW**	**– ve**	High

6.3.3 Assessment of Impacts: Operation Phase

One potential direct impact on the aquatic ecology of the area was identified during the operation phase, and assessed together for both route alternatives:

- AE2: Loss of Wetland Habitat and Ecological Structure.

6.3.3.1 Potential Impact AE2: Loss of Wetland Habitat and Ecological Structure

Impacts associated with the operation phase will be limited to those caused by the maintenance of infrastructure located within wetland features and the possible erosion and sedimentation of wetland features due to increased runoff velocities from hardened surfaces and ineffective stormwater management. Maintenance activities may destroy some wetland habitat and possibly lead to erosion of these features; however, wetlands occupy a very limited portion of the *Kotzesrus Route* and the probability that maintenance activities will need to be undertaken within wetland features is low. Furthermore, the limited maintenance activities that would need to be undertaken (repairing leaks in pipelines and grading of gravel roads) will not necessarily damage wetland habitat.

The impact would be similar for both route alternatives The impact is assessed to be of ***very low*** significance and with the implementation of mitigation is reduced to ***insignificant*** (Table 6-8).

Table 6-8: Significance of loss of wetland habitat and ecological structure during operation of linear infrastructure along both route alternatives

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Possible	**VERY LOW**	– ve	High
Essential mitigation measures: • Permit only essential personnel within the wetland habitat if maintenance activities within wetland areas are unavoidable; • Disallow heavy machinery and vehicles in wetland areas; • Keep all demarcated sensitive wetland zones outside of the maintenance areas off limits; • Prevent run-off from work areas entering wetland habitats; • Incorporate adequate erosion and stormwater management measures in order to prevent erosion and the associated sedimentation of wetland areas. Management measures may include berms, silt fences, hessian curtains, stormwater diversion away from areas susceptible to erosion and stormwater attenuation. Care should however be taken so as to avoid additional disturbance during the implementation of these measures; and • Monitor water pipelines for leaks and repair any leaks immediately.								
With mitigation	Local 1	Low 1	Short-term 1	**Very Low** 3	Improbable	**INSIGNIFICANT**	– ve	High

6.3.4 The No-Go Alternative

The No-Go alternative entails no change to the *status quo*. With the lack of urban development and noting present land use (livestock farming), it is doubtful that present impacts such as alien vegetation encroachment, erosion and sedimentation would increase in either extent or intensity within the next five years. Therefore, no change is envisioned for the wetland habitat and the EIS of the wetland/riparian features will remain unaltered.

6.3.5 Mitigation Measures: Potential Aquatic Ecology Impacts

Essential aquatic ecology mitigation measures during **construction** are as follows:

- Demarcate all sensitive wetland zones outside of the construction footprint and designate these as no-go areas;
- Align pipelines and power lines to cross wetlands and drainage features, perpendicularly (or as close as possible to perpendicular) to limit the area of disturbance within the wetland or drainage feature;
- Install pipelines and power lines to span over the wetland/drainage feature and the associated 32m buffer zone, where these features cannot be avoided. Where this is not possible, pipeline and power line support structures must be placed in the buffer zone rather than inside the feature;
- Permit only essential construction personnel within the wetland habitat and undertake excavations for support structures by hand where placing pipeline and power line support structures within wetland habitat is unavoidable;
- Obtain the relevant approvals from DWS for any activities within wetland areas and their associated buffers particularly in terms of Section 21 c and i of the NWA (Act 36 of 1998);
- Prevent potentially contaminated run-off from work areas from entering wetland habitats;
- Incorporate adequate erosion and stormwater management measures in road design and construction in order to prevent erosion and the associated sedimentation of wetland areas. Management measures may include berms, silt fences, hessian curtains, stormwater diversion

away from areas susceptible to erosion and stormwater attenuation. Care should however be taken so as to avoid additional disturbance during the implementation of these measures;

- Upgrade bridges/culverts to comply with the requirements listed below, where these upgrades are required for the project:
  - Bridges and culverts must span the entire width of wetland and drainage features;
  - Bridge structures must not alter seasonal stream flow patterns;
  - Habitat connectivity must be maintained beneath bridge structures and culverts, by e.g. constructing underpasses so that they are sufficiently high to allow for the movement of local fauna, including small antelope, and (where possible) sufficiently wide to include a buffer along the margins of the wetland habitat;
  - Bridges and culverts must not result in the incision and canalisation of the wetland and drainage areas, but must allow for sufficient dispersion of water through wetland and drainage areas to prevent the concentration of flow which could lead to scouring and incision of the system; and
- Rehabilitate all wetland areas impacted by construction related activities to ensure that wetland functions are re-instated after construction.

Essential aquatic ecology mitigation measures during **operation** are as follows:

- Permit only essential personnel within the wetland habitat if maintenance activities within wetland areas are unavoidable;
- Disallow heavy machinery and vehicles in wetland areas;
- Keep all demarcated sensitive wetland zones outside of the maintenance areas off limits;
- Prevent run-off from work areas entering wetland habitats;
- Incorporate adequate erosion and stormwater management measures in order to prevent erosion and the associated sedimentation of wetland areas. Management measures may include berms, silt fences, hessian curtains, stormwater diversion away from areas susceptible to erosion and stormwater attenuation. Care should however be taken so as to avoid additional disturbance during the implementation of these measures; and
- Monitor water pipelines for leaks and repair any leaks immediately.

Best practice aquatic ecology mitigation measures during **construction** are as follows:

- Restrict clearing and earthworks for construction through wetland and drainage areas to the drier summer months, if possible, to avoid erosion of exposed soils and sedimentation of wetland habitats associated with the route alternative.

6.4 Potential Botanical Impacts

6.4.1 Introduction, Terms of Reference and Methodology

This assessment is based on the Terrestrial and Aquatic Ecology Study undertaken by SAS (see Appendix 4A). The purpose of the study was to assess the potential impacts of the development alternatives on terrestrial and aquatic ecology, indicate their environmental acceptability and recommend practicable mitigation measures to minimise potential impacts and maximise potential benefits. The ToR for the study is provided in Section 6.3.1.

Two site visits were undertaken by the specialists during February and August 2013 (peak Spring flowering period) in order to determine the ecological importance and sensitivity of the study area. A thorough ‘drive through’ of the area was undertaken to ascertain general habitat types throughout the study area. Special emphasis was placed on areas that may potentially support floral SCC as listed by the SANBI (National Herbarium Pretoria Computerised Information System) PRECIS database and RDL faunal species. Portions of the study area were inspected on foot in order to ascertain dominant floral communities, species and habitat diversities.

The VIS was assessed to determine the ecological state, allowing for an accurate and consistent description of the PES of each habitat unit.

Prior to the field visit, a record of floral SCC as well as protected species and their habitat requirements was acquired from SANBI for the quarter degree square (QDS) associated with the study area. Throughout the vegetation assessment special attention was paid to the identification of any SCC and suitable habitat that could potentially sustain these species.

6.4.2 Assessment of Impacts: Construction Phase

The loss of floral habitat, biodiversity and SCC is the only potential direct impact on vegetation during the construction phase. Construction activities leading to this impact include clearing of vegetation from the construction footprint, disturbance of soil and dust generation.

This impact will however differ in significance in various areas within the project footprint. Due to the sensitivity of the quartzite and clay exposure areas, which support SCC, the impacts on these areas have been assessed separately from the remainder of the habitat types along the route alternatives, where impacts are similar.

The botanical impact assessed for the construction is:

- B1: Loss of Floral Habitat, Biodiversity and SCC.

This has been assessed separately for:

- Each route alternative for the linear infrastructure;
- The portion of the linear infrastructure passing through the quartzite and clay exposure area; and
- Desalination plant positions A,C or D; and
- Desalination plant positions B or E.

6.4.2.1 Potential Impact B1: Loss of Floral Habitat, Biodiversity and SCC

Kotzesrus Route

The majority (approximately 70%) of the length of the *Kotzesrus Route* will traverse *Strandveld* habitat considered to be of low to moderate sensitivity. Smaller areas of high sensitivity (*Sand Fynbos* and *Coastal* habitats) occur along approximately 26% of the route and rocky outcrops habitats, considered to have very high sensitivity occupy approximately 2% of the route. In addition, the *Kotzesrus Route* crosses areas identified as CBAs and ESAs (see Figure 2-2).

Existing tracks followed by the *Kotzesrus Route* to the west of Kotzesrus will need to be widened to 4 m in order to accommodate large construction vehicles, and vegetation to either side of the road will be cleared to install pipelines and construct power line support structures. This will destroy predominantly moderate sensitivity *Strandveld* vegetation and high sensitivity *Sand Fynbos* and *Coastal* vegetation, and may destroy very high sensitivity *rocky outcrop* areas associated with the

Brak River crossing. Although the gravel road to the east of Kotzesrus will not be widened, pipelines and power lines will still need to be installed adjacent to the road which will result in the disturbance and loss of areas of moderate and low sensitivity vegetation. The development of the *Kotzesrus Route* and the associated removal of vegetation is also likely to result in the loss of floral SCC and protected species such as *Leucospermum rodolentum, Babiana hirsuta* and *Aloe arenicola*. Furthermore, the removal of vegetation and disturbance of soils as well as the increased construction traffic may marginally increase dust generation.

The impact associated with the loss of floral habitat, diversity and SCC is considered to be local in extent, manifesting over the long term. Although the majority of the habitat which will be disturbed or lost is considered to be of a low to moderate sensitivity. linear infrastructure through the Brak River will destroy highly sensitive rocky outcrop areas and the impact associated with the loss is considered to be of a high intensity. The overall impact is therefore considered to be of a high significance prior to the implementation of mitigation measures.

The impact is assessed to be of ***high*** significance and with the implementation of mitigation is reduced to ***low*** (Table 6-9).

Table 6-9: Significance of loss of floral habitat, biodiversity and SCC during construction of linear infrastructure along the Kotzesrus Route

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	High 3	Long-term 3	**High 7**	Definite	**HIGH**	– ve	High
Essential mitigation measures: • Limit the construction footprint to what is absolutely essential, in order to minimise environmental damage; • Strictly control edge effects of construction activities such as erosion and alien vegetation proliferation; • Limit the removal of vegetation from the road reserve and servitude to that which is essential; • Ideally construct the pipeline within the road reserve, or alternatively as close as possible to the road / road reserve edge; • Install pipelines and power lines above ground on support structures (plinths) with minimal footprints; • Ensure that as far as possible all infrastructure is placed outside of rocky outcrop areas; • Compile a detailed rescue and relocation plan and attempt to rescue and relocate SCC to a suitable habitat outside of the construction footprint area; • Appoint/designate a suitably experienced person to oversee the removal and rescue and relocation of all SCC; and • Obtain special authorisation from the NCDENC for SCC, protected and indigenous species to be cut, disturbed, damaged or destroyed.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Definite	**LOW**	**– ve**	High

Amended Bypass Route

The *Amended Bypass Route* avoids the disturbance of very high sensitivity rocky outcrop areas. The impact associated with the loss of floral habitat, diversity and SCC is restricted to the local area and is therefore considered to be local in extent. However, vegetation will need to be removed permanently in order to make way for the development of new infrastructure and so the duration of the impact is considered long term.

The impact is thus assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low*** (Table 6-10).

Table 6-10: Significance of loss of floral habitat, biodiversity and SCC during construction of linear infrastructure along the Amended Bypass Route

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Definite	**MEDIUM**	– ve	High
Key mitigation measures: • As for Kotzesrus Route (Table 6-9)								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Definite	**LOW**	**– ve**	High

Quartzite and Clay Exposure Areas

Both the *Kotzesrus* and *Amended Bypass Routes* will pass through an area of exposed quartzite and clay approximately 10 km northeast of Kotzesrus. This habitat of very high sensitivity exists within the road reserve for a distance of 950 m i.e. approximately 1.8% of the total road length. The development of linear infrastructure in this area requires the removal of vegetation and disturbance of this habitat. Although the existing gravel road (which will not need to be widened) traverses these areas, this sensitive habitat will still be disturbed during the installation of the pipeline and power line within the road reserve or a servitude outside the road reserve. Construction vehicles and personnel in the road reserve and servitude will disturb the quartzite layer and permanently alter the habitat and potentially damage SCC individuals such as the rare dwarf succulent *Bulbine bruynsii*.

Recent surveys of the area led the discovery of additional sub-populations of *Bulbine bruynsii* (Helme, 2014), which, although locally common is still considered to be rare within the region and the loss of individuals of the species together with their associated habitat is therefore considered of a regional significance. The impact intensity is therefore considered to be high and the overall impact significance is considered to be very high prior to the implementation of mitigation measures.

With the implementation of mitigation measures the intensity of the impact may be reduced to low, however, vegetation will be permanently removed to make way for pipeline and power line support structures and areas in the immediate surroundings of these structures are likely to be disturbed. The restoration of disturbed quartzite and clay areas is likely to take many years and certain species may not return due to the compaction of soils and the changes to soil structure. Therefore, although the intensity of the impact can be significantly reduced, the duration of the impact will remain long term. By limiting the disturbance footprint, and the rescue and relocation any individuals of *Bulbine bruynsii* to be disturbed by construction to a suitable habitat, thereby preventing their loss, the extent and intensity of this impact can be reduced.

The impact is assessed to be of ***very high*** significance and with the implementation of mitigation is reduced to ***low*** for both route alternatives (Table 6-11).

Table 6-11: Significance of loss of floral habitat, biodiversity and SCC during construction in the quartzite and clay exposure areas

<table>
<tr><th></th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th></tr>
<tr><td>Without mitigation</td><td>Regional
2</td><td>High
3</td><td>Long-term
3</td><td>Very High
8</td><td>Definite</td><td>VERY HIGH</td><td>– ve</td><td>High</td></tr>
<tr><td colspan="9">Essential mitigation measures:

Limit the footprint of construction activities to what is absolutely essential in order to minimise environmental damage;
Strictly control edge effects of construction activities such as erosion and alien vegetation proliferation;
Demarcate the construction footprint (final route of power lines and pipelines) for the duration of construction. No disturbance may take place outside the demarcated area, and access should be from the existing road;
Locate power lines and pipelines in proximity to quartzite and clay exposure areas to the west of the existing gravel road;
Ideally construct the pipeline within the road reserve or alternatively as close as possible to the road / road reserve edge;
Install pipelines and power lines above ground on support structures. These support structures (plinths) must have as small a footprint as possible;
Ideally place the pipe onto the plinths by crane from the road edge, in order to minimise disturbance (trampling, temporary storage of pipe, etc.) to sensitive areas between the plinths;
Demarcate and cordon off individuals of Bulbine bruynsii within the construction footprint, with a 2 m buffer around each individual or group of individuals. Position support structures for pipelines and power lines (and associated construction disturbance areas) so that they do not encroach on any such cordoned off areas. Note: this may require that support structures are unevenly spaced in these areas;
Remove and translocate the affected individuals of Bulbine bruynsii immediately to a suitable area outside the development footprint, if it is unavoidable that they will be disturbed;
Identify plinth positions between June and September (the year before construction if necessary), since Bulbine bruynsii plants are only evident above ground from at this time of year. Do so in conjunction with someone capable of identifying these plants in the field and translocate any plants potentially in the plinth footprint;
Obtain special authorisation from the NCDENC (Bulbine bruynsii falls within the family Asphodelaceae which is protected under the NCNCA), if individuals are to be translocated,
Undertake excavations for power line and pipeline support structures traversing quartzite and clay exposure areas manually, where possible;
Limit the number of construction personnel allowed into the sensitive habitat areas where pipelines traverse quartzite and clay exposure areas;
Submit method statements for all construction activities in quartzite and clay exposure areas, for review by a suitably qualified professional;
Appoint an Environmental Control Officer (ECO) to supervise all construction activities in quartzite and clay exposure areas throughout the construction period, to ensure compliance with all mitigation requirements;
Restrict material and equipment storage areas to areas falling outside of sensitive quartzite and clay exposure areas;
Do not store material removed during excavations for power line and pipeline support structures within the road reserve adjacent to quartzite and clay exposure areas. Temporarily remove construction related material to a designated area offsite and permanently remove construction related waste and refuse from site.
</td></tr>
<tr><td>With mitigation</td><td>Local
1</td><td>Low
1</td><td>Long-term
3</td><td>Low
5</td><td>Definite</td><td>LOW</td><td>– ve</td><td>High</td></tr>
</table>

Desalination Plant Positions A, C and D

The development of the desalination plant in positions A, C or D will require the removal and disturbance of approximately 15 000 m^2 of moderate sensitivity *Strandveld* vegetation and associated SCC. Furthermore, the disturbance may encourage the proliferation of alien and invasive species within the area.

The impact associated with the development of the desalination plant in any of these positions will be local in extent and permanent. However, the impact intensity associated with the removal of the moderate sensitivity vegetation is considered medium.

The impact is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low*** for desalination plant positions A, C and D (Table 6-12).

Table 6-12: Significance of loss of floral habitat, biodiversity and SCC during construction of the desalination plant in positions A, C and D

<table>
<tr><th></th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th></tr>
<tr><td>Without mitigation</td><td>Local
1</td><td>Medium
2</td><td>Long-term
3</td><td>Medium
6</td><td>Definite</td><td>MEDIUM</td><td>– ve</td><td>High</td></tr>
<tr><td colspan="9">Essential mitigation measures:
• Strictly control edge effects of construction activities such as erosion and alien vegetation proliferation;
• Compile a detailed search and relocation plan and attempt to relocate SCC to a suitable habitat outside of the construction footprint area if it is unavoidable that SCC such as Babiana hirsuta will be disturbed;
• Appoint/designate a suitably experienced person to oversee the removal and rescue and relocation of all SCC;
• Obtain special authorisation for SCC, protected and indigenous species to be cut, disturbed, damaged or destroyed from the NCDENC;
• Remove alien and weed species encountered within the desalination plant property in order to comply with existing legislation (amendments to the regulations under CARA and Section 28 of NEMA). In this regard:
o Take care with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used, particularly in areas close to SCC;
o Keep footprint areas as small as possible when removing alien plant species;
o Dispose of removed alien plant material at a registered waste disposal site.</td></tr>
<tr><td>With mitigation</td><td>Local
1</td><td>Low
1</td><td>Long-term
3</td><td>Low
5</td><td>Definite</td><td>LOW</td><td>– ve</td><td>High</td></tr>
</table>

Desalination Plant Positions B and E

The development of the desalination plant in positions B and E will require the removal and disturbance of approximately 15 000 m^2 of high sensitivity coastal vegetation and associated SCC, and the disturbance created may encourage the proliferation of alien and invasive species. Furthermore, edge effects of construction may adversely affect coastal rocky outcrop areas in close proximity to the construction footprint.

The impact associated with the development of the desalination plant will be local in extent and permanent. Although the coastal habitat unit is considered to be of a high sensitivity, the desalination site is small when considering the total extent of the coastal habitat present and the intensity of the loss of habitat is therefore considered to be medium.

The impact is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low*** for desalination plant positions B and E (Table 6-13).

Table 6-13: Significance of loss of floral habitat, biodiversity and SCC during construction of the desalination plant in positions B and E

<table>
<tr><th></th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th></tr>
<tr><td>Without mitigation</td><td>Local
1</td><td>Medium
2</td><td>Long-term
3</td><td>Medium
6</td><td>Definite</td><td>MEDIUM</td><td>– ve</td><td>High</td></tr>
<tr><td colspan="9">Essential mitigation measures:
• As for desalination plant positions A, C and D (see Table 6-12);
• Ensure that the edge effects of construction related activities do not impact upon coastal rocky outcrop areas.</td></tr>
<tr><td>With mitigation</td><td>Local
1</td><td>Low
1</td><td>Long-term
3</td><td>Low
5</td><td>Definite</td><td>LOW</td><td>– ve</td><td>High</td></tr>
</table>

6.4.3 Assessment of Impacts: Operation Phase

The loss of floral habitat, biodiversity and SCC is the only potential direct impact on the vegetation of the area identified during the operation phase. Activities leading to this impact during the operation phase are maintenance activities on project infrastructure and the potential proliferation of invasive alien vegetation in areas in which the natural vegetation has been disturbed.

The botanical impact assessed for the operations is:

- B2: Loss of Floral Habitat, Biodiversity and SCC.

This is assessed separately for the linear infrastructure, including through the quartzite and clay exposure area; and the desalination plant. The operation phase impacts for various alternatives will be similar.

6.4.3.1 Potential Impact B2: Loss of Floral Habitat, Biodiversity and SCC

Kotzesrus and Amended Bypass Routes

The impact of linear infrastructure on vegetation during the operation phase is associated with an increase in traffic on the road and concomitant dust generation, as well as disturbance of natural vegetation during maintenance. Furthermore, leaks from pipelines and a change in water availability may alter habitat characteristics, particularly in very high sensitivity quartzite and clay exposure areas.

The increase in operational traffic will be very limited and the associated dust generation will be minimal. Maintenance activities and infrastructures repairs could have impacts similar to those for construction, especially in sensitive habitats, i.e. loss of natural vegetation and the proliferation of alien and invasive species.

The impact associated with the operation phase is therefore considered of a local extent, of a low intensity and of long term duration. However, the probability of the impact is relatively low as maintenance will not necessarily induce potential impacts.

Impacts in the quartzite and clay exposure area during the operation phase will be similar to those for the remainder of the route (as discussed above), but in a more sensitive habitat, warranting additional mitigation.

The impact is assessed to be of ***very low*** significance and with the implementation of mitigation, is reduced to ***insignificant*** for both route alternatives (Table 6-14).

Table 6-14: Significance of loss of floral habitat, biodiversity and SCC during operations of linear infrastructure

	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Without mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Possible	**VERY LOW**	– ve	High
Essential mitigation measures: • If maintenance activities within very high sensitivity habitats (including quartzite and clay exposure areas) are unavoidable, undertake these activities manually; • Do not permit heavy machinery into very high sensitivity habitat units (including quartzite and clay exposure areas); • Restrict the number of personnel entering into very high sensitivity habitats (including quartzite and clay exposure areas) during maintenance activities; • Ensure that maintenance activities are restricted to the road reserve and do not encroach into surrounding open veld areas and that these open veld areas are strictly off-limits to maintenance vehicles and personnel; • Strictly prohibit maintenance personnel from collecting plant material from surrounding natural areas;								

<table>
<tr><td colspan="9">• Monitor water pipelines for leaks (specifically in very high sensitivity habitats where a change in water availability may alter habitat characteristics) and repair any leaks immediately.</td></tr>
<tr><td>With mitigation</td><td>Local
1</td><td>Low
1</td><td>Short-term
1</td><td>Very Low
3</td><td>Improbable</td><td>INSIGNIFICANT</td><td>– ve</td><td>High</td></tr>
</table>

Desalination Plant

Maintenance during the operation phase and an increase in anthropogenic activity and disturbance within natural areas surrounding the desalination plant (irrespective of location) may destroy natural vegetation and lead to the proliferation of alien and invasive species. However, natural areas surrounding the desalination plant will not necessarily be disturbed by maintenance personnel (since a relatively low number of personnel will be required on site) and alien vegetation is not common on site and so will not necessarily proliferate with the limited level of disturbance associated with the operation phase. The probability of the impact is therefore considered to be relatively low. Furthermore, the intensity of the impact associated with any disturbance is likely to be low and along with the duration of the impacts, can be reduced further with the implementation of mitigation measures.

The impact is assessed to be of ***very low*** significance and with the implementation of mitigation is reduced to ***insignificant*** for the desalination plant in any of the alternative positions (Table 6-15).

Table 6-15: Significance of loss of floral habitat, biodiversity and SCC during operation of the desalination plant

<table>
<tr><th></th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th></tr>
<tr><td>Without mitigation</td><td>Local
1</td><td>Low
1</td><td>Long-term
3</td><td>Low
5</td><td>Possible</td><td>VERY LOW</td><td>– ve</td><td>High</td></tr>
<tr><td colspan="9">Key mitigation measures:
• Remove alien and weed species encountered within the study area in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act,
• Ensure that maintenance activities do not encroach into surrounding open veld areas and that these open veld areas are strictly off-limits to maintenance vehicles and personnel;
• Strictly prohibit maintenance personnel from collecting plant material from surrounding natural areas;
• Monitor sea water intake and brine pipelines for leaks and repair any leaks immediately.</td></tr>
<tr><td>With mitigation</td><td>Local
1</td><td>Low
1</td><td>Short-term
1</td><td>Very Low
3</td><td>Improbable</td><td>INSIGNIFICANT</td><td>– ve</td><td>High</td></tr>
</table>

6.4.4 The No-Go Alternative

The No-Go alternative entails no change to the status *quo*.

The study area is located within an area mainly utilised for livestock grazing with isolated areas used for crop cultivation. Furthermore, farms tend to be relatively large within the region with low carrying capacity. As a result, impacts due to trampling and overgrazing typically associated with grazing, were not considered significant and the study area therefore comprises intact floral and faunal habitat.

With the lack of urban development near the proposed route alternatives and noting the present land use (small scale livestock farming), it is doubtful that existing impacts due to anthropogenic activities would increase in either extent or intensity within the next five years. It is therefore expected that floral and faunal habitat and diversity would remain the same if the proposed development does not proceed.

6.4.5 Mitigation Measures: Potential Botanical Impacts

Essential botanical mitigation measures during **construction** are as follows:

- Limit the construction footprint to what is absolutely essential, in order to minimise environmental damage;
- Strictly control edge effects of construction activities such as erosion and alien vegetation proliferation, and particularly to avoid effects on terrestrial and coastal rocky outcrop areas;
- Limit the removal of vegetation from the road reserve and servitude to that which is essential;
- Ideally construct the pipeline within the road reserve, or alternatively as close as possible to the road / road reserve edge;
- Install pipelines and power lines above ground on support structures (plinths) with minimal footprints;
- Ensure that as far as possible all infrastructure is placed outside of rocky outcrop areas;
- Compile a detailed rescue and relocation plan and attempt to rescue and relocate SCC to a suitable habitat outside of the construction footprint if it is unavoidable that SCC such as *Babiana hirsuta* will be disturbed;
- Appoint/designate a suitably experienced person to oversee the removal and rescue and relocation of all SCC;
- Obtain special authorisation from the NCDENC for SCC, protected and indigenous species to be cut, disturbed, damaged or destroyed;
- Remove alien and weed species encountered at the desalination plant site in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act, 1998). In this regard:
    - Take care with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
    - Keep footprint areas as small as possible when removing alien plant species;
    - Dispose of removed alien plant material at a registered waste disposal site.

Additional essential botanical mitigation measures during **construction within quartzite and clay exposure areas** are as follows (see Figure 4-7):

- Demarcate the construction footprint (final route of power lines and pipelines) for the duration of the construction. No disturbance may take place outside the demarcated area, and access should be from the existing road;
- Locate power lines and pipelines in close proximity to quartzite and clay exposure areas to the west of the existing gravel road;
- Ideally place the pipe onto the plinths by crane from the road edge, in order to minimise disturbance (trampling, temporary storage of pipe, etc.) to sensitive areas between the plinths;
- Demarcate and cordon off individuals of *Bulbine bruynsii* within the construction footprint, with a 2 m buffer around each individual or group of individuals. Position support structures for pipelines and power lines (and associated construction disturbance areas) so that they do not

encroach on any such cordoned off areas. Note: this may require that support structures are unevenly spaced in these areas;

- Remove and translocate the affected individuals of *Bulbine bruynsii* immediately to a suitable area outside the development footprint, if it is unavoidable that they will be disturbed;
- Identify plinth positions between June and September (the year before construction if necessary), since *Bulbine bruynsii* plants are only evident above ground from at this time of year. Do so in conjunction with someone capable of identifying these plants in the field and translocate any plants potentially in the plinth footprint;
- Obtain special authorisation from the NCDENC (*Bulbine bruynsii* falls within the family Asphodelaceae which is protected under the NCNCA), if individuals are to be translocated;
- Undertake excavations for power line and pipeline support structures traversing quartzite and clay exposure areas manually, where possible;
- Limit the number of construction personnel allowed into the sensitive habitat areas where pipelines traverse quartzite and clay exposure areas;
- Submit method statements for all construction activities in quartzite and clay exposure areas, for review by a suitably qualified ecologist;
- Appoint an ECO to supervise all construction activities in quartzite and clay exposure areas throughout the construction period, to ensure compliance with all mitigation requirements;
- Restrict material and equipment storage areas to areas falling outside of sensitive quartzite and clay exposure areas;
- Do not store material removed during excavations for power line and pipeline support structures within the road reserve adjacent to quartzite and clay exposure areas. Temporarily remove construction related material to a designated area offsite and permanently remove construction related waste and refuse from site.

Essential botanical mitigation measures during **operation** are as follows:

- Remove alien and weed species encountered on the desalination plant property in order to comply with existing legislation (amendments to the regulations under CARA and Section 28 of NEMA. In this regard:
  - Take care with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
  - Keep footprint areas as small as possible when removing alien plant species;
  - Dispose of removed alien plant material at a registered waste disposal site.
- If maintenance activities within very high sensitivity habitats (including quartzite and clay exposure areas) are unavoidable, the activities must be undertaken manually;
- Do not permit heavy machinery into very high sensitivity habitat units (including quartzite and clay exposure areas);
- Restrict the number of personnel entering into very high sensitivity habitats (including quartzite and clay exposure areas) during maintenance activities;

- Ensure that maintenance activities are restricted to the road reserve and area directly surrounding the desalination plant and do not encroach into surrounding open veld areas and that these open veld areas are strictly off-limits to maintenance vehicles and personnel;
- Strictly prohibit maintenance personnel from collecting plant material from surrounding natural areas;
- Monitor all water, seawater and brine pipelines for leaks (specifically in very high sensitivity habitats where a change in water availability may alter habitat characteristics) and repair any leaks immediately.

Best practice botanical mitigation measures during **construction** are as follows:

- Remove alien and weed species encountered along linear infrastructure in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act, 1998). In this regard:
    - Take care with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
    - Keep footprint areas as small as possible when removing alien plant species;
    - Dispose of removed alien plant material at a registered waste disposal site.
- Restrict vegetation clearing for construction to the dry dormancy period within the region (November to April) as far as possible to minimise damage in more sensitive habitat units such as *rocky outcrops*, *Sand Fynbos* and *Coastal* areas; and
- Enforce a speed limit for construction vehicles of 40 km/h to curb dust generation.

Additional best practice botanical mitigation measures during **construction** within quartzite and clay exposure areas are as follows:

- In order to minimise damage, clearing of vegetation for construction within quartzite and clay exposure areas should be restricted to the dry dormancy period within the region (November to April) as far as possible; and
- Enforce a speed limit for construction vehicles of 40 km/h in order to curb dust generation.

Best practice botanical mitigation measures during **operation** are as follows:

- Enforce a speed limit for operational and maintenance vehicles of 40 km/h in order to curb dust generation.

6.5 Potential Impacts on Fauna

6.5.1 Introduction, Terms of Reference and Methodology

This assessment is based on the Terrestrial and Aquatic Ecology Study undertaken by SAS (see Appendix 4A). The purpose of the study was to assess the potential impacts of the development alternatives on terrestrial and aquatic ecology, indicate their environmental acceptability and recommend practicable mitigation measures to minimise potential impacts and maximise potential benefits. The ToR for the study is provided in Section 6.3.1.

Two site visits were undertaken by the specialists as described in Section 6.4.1 above. Portions of the study area were inspected on foot to identify dominant faunal communities, species and habitat diversities. The presence of any faunal inhabitants of the study area was also assessed through direct visual observation or identifying species through calls, tracks, scats and burrows.

Given the inherent limitations of faunal field assessments which seldom identify all faunal species potentially occurring in the area, the Red Data Sensitivity Index (RDSIS) has been developed by SAS to provide an indication of the potential RDL faunal species that could occur in the area, while simultaneously providing a quantitative measure of the study area's value in terms of conserving faunal diversity. The RDSIS is based on the principle that when the knowledge of the species' historical distribution is combined with a field assessment that identifies the degree to which the property supports a certain species habitat and food requirements, inferences can be made about the chances of that particular species occurring on the property. Repeating this procedure for all the potential RDL faunal species of the area and collating this information then provides a sensitivity measure of the study area that has been investigated.

6.5.2 Assessment of Impacts: Construction Phase

The main potential direct impact on fauna for the construction phase is:

- F1: Altered faunal habitat, diversity and RDL/protected species.

Activities leading to potential impacts on faunal habitat, diversity and protected species include clearing of construction areas and the resultant loss of faunal habitat, roadkills and illegal hunting and poaching. Impacts differ for various alternatives and the impact is assessed separately for:

- Each route alternative for the linear infrastructure;
- Desalination plant positions A,C or D; and
- Desalination plant positions B or E.

6.5.2.1 Potential Impact F1: Altered Faunal Habitat, Diversity and RDL Species

Kotzesrus Route

Construction of linear infrastructure along the *Kotzesrus Route* will require the permanent removal of vegetation and associated faunal habitat from the road reserve. However, current traffic is likely to discourage faunal species from permanently inhabiting the road reserve, particularly in areas of moderate and low faunal sensitivity. Faunal species are therefore more likely to migrate through the area and it is highly likely that species will vacate the construction area and relocate to similar areas prior to the commencement of major construction activities. However, the important reptile and amphibian rocky outcrop niche habitat will be destroyed and faunal species in these areas would not necessarily be able to migrate to similar habitat elsewhere. RDL reptile species such as *Gerrhosaurus typicus* (Namaqua Plated Lizard) and protected reptile species such as *Cordylus polyzonus* (Karoo girdled lizard) and *Cordylus niger* (Black girdled lizard) may be permanently lost from these areas. The protected amphibian species *Cacosternum namaquensis* (Namaqua Caco) is also known to aestivate[17] within rocky areas and may therefore also be lost. Furthermore, an *Aquila verreauxii* (Verreauxs Eagle) breeding pair listed as protected by the NCNCA was identified nesting in a tree in close proximity to the very high sensitivity rocky outcrop habitat near the Brak River and

[17] A state of animal dormancy similar to hibernation, characterized by inactivity and a lowered metabolic rate, that is entered in response to high temperatures and arid conditions and usually takes place during the summer months.

the pair may be forced to vacate their nest. Juveniles in the nest at the time of construction may be abandoned.

Fauna may also be negatively impacted by collisions with construction vehicles, and illicit poaching may increase if not controlled.

The impact associated with the loss of faunal habitat, diversity, RDL and protected species is considered of a local extent, but of high intensity. Implementation of mitigation measures will not prevent the permanent destruction of faunal habitat and the duration and probability of the impact will therefore remain long term and definite.

The impact is assessed to be of ***high*** significance and with the implementation of mitigation is reduced to ***low*** (Table 6-16).

Table 6-16: Significance of impact on faunal habitat, biodiversity and RDL species and fauna during construction of linear infrastructure along the Kotzesrus Route

	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Without mitigation	Local 1	High 3	Long-term 3	**High** 7	Definite	**HIGH**	**– ve**	High
Essential mitigation measures: • Strictly control edge effects of construction activities such as erosion and alien vegetation proliferation; • Limit the removal of vegetation and associated faunal habitat from the road reserve to that which is essential; • Ensure that as far as possible all infrastructure is placed outside rocky outcrop areas; • Reduce noise levels in areas in close proximity to the Brak River crossing in order to avoid the disturbance of the *Aquila verreauxii* (Verreauxs Eagle) breeding pair; • Rescue and relocate fauna encountered within the construction footprint, particularly slower moving species such as tortoises; • Strictly prohibit the trapping and hunting of fauna by construction personnel; and • Enforce a speed limit for construction vehicles of 40 km/h in order to reduce collision of construction vehicles with fauna.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Definite	**LOW**	**– ve**	High

Amended Bypass Route

The impact associated with the construction of linear infrastructure along the *Amended Bypass Route* will be similar to that of the *Kotzesrus Route*, however, this route does not pass through very high sensitivity rocky outcrop areas.

The impact associated with development of the *Amended Bypass Route* is therefore considered to be of a local extent, of a low intensity.

The impact is assessed to be of ***low*** significance and with the implementation of mitigation is reduced to ***very low*** (Table 6-17).

Table 6-17: Significance of impact on faunal habitat, biodiversity and RDL species and fauna during construction of linear infrastructure along the Amended Bypass Route

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Long-term 3	**Low** 5	Definite	**LOW**	**– ve**	High
Essential mitigation measures: • Strictly control edge effects of construction activities such as erosion and alien vegetation proliferation; • Limit the removal of vegetation and associated faunal habitat from the road reserve to that which is essential; • Rescue and relocate fauna encountered within the construction footprint, particularly slower moving species such as tortoises; • Strictly prohibit the trapping and hunting of fauna by construction personnel; and • Enforce a speed limit for construction vehicles of 40 km/h in order to reduce collision of construction vehicles with fauna.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Definite	**VERY LOW**[18]	**– ve**	High

Desalination Plant Positions A, C and D

Construction of the desalination plant in position A, C or D will destroy moderate sensitivity faunal habitat. However, faunal species will relocate from the construction footprint to similar habitat prior to construction. The impact will therefore be of a local extent, and low intensity, although permanent. This also applies to impacts associated with the loss of faunal species to poaching, hunting and collisions.

The impact is assessed to be of ***low*** significance and with the implementation of mitigation is reduced to ***very low*** for desalination plant positions A, C and D (Table 6-18).

Table 6-18: Significance of impact on faunal habitat, biodiversity and RDL species and fauna during construction of the desalination plant in positons A, C or D

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Long-term 3	**Low** 5	Definite	**LOW**	**– ve**	High
Essential mitigation measures: • Strictly control edge effects of construction activities such as erosion and alien vegetation proliferation; • Limit the removal of vegetation and associated faunal habitat from the construction footprint to that which is essential; • Where possible, install seawater intake and discharge pipelines within existing gravel road reserves in order to reduce impact on surrounding natural habitat; • Rescue and relocate fauna occurring within the construction footprint, particularly slower moving species such as tortoises; and • Strictly prohibit the trapping and hunting of fauna by construction personnel.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Definite	**VERY LOW**[19]	**– ve**	High

Desalination Plant Positions B and E

The development of the desalination plant in position B or E will have similar impacts to positions A, C or D. However, positions B and E are located closer to coastal rocky outcrop areas that provide

[18] It is the professional opinion of the specialist that overall impact significance associated with the construction of the desalination plant in these positions reduces to very low with the implementation of mitigation measures.

[19] It is the professional opinion of the specialist that overall impact significance associated with the construction of the desalination plant in these positions reduces to very low with the implementation of mitigation measures.

niche habitat to faunal species and the risk that these very high sensitivity faunal habitat areas may be impacted by edge effects of construction activities is therefore higher. The impact will therefore be of a local extent, of a permanent duration and of a medium intensity.

The impact is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low*** for construction of the desalination plant positions B or E (Table 6-19).

Table 6-19: Significance of impact on faunal habitat, biodiversity and RDL species and fauna during construction of the desalination plant in positons B or E

	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium** 6	Definite	**MEDIUM**	**– ve**	High
Essential mitigation measures: • As for positions A, C and D (Table 6-18) • Ensure that the edge effects of construction related activities do not impact on very high sensitivity coastal rocky outcrop areas.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Definite	**LOW**	**– ve**	High

6.5.3 Assessment of Impacts: Operation Phase

The two main potential direct impacts on fauna during the operation phase are:

- F2: Impacts on faunal habitat, diversity and RDL/protected species; and
- F3: Disruption of faunal migratory corridors.

Activities causing potential impacts on fauna include maintenance, collisions with power lines and maintenance vehicles and illegal trapping and hunting. Operation phase impacts are similar for various alternatives, and are not assessed separately.

6.5.3.1 Potential Impact F2: Impact on Faunal Habitat, Diversity and RDL Species

Linear Infrastructure

The key impact will be increased collisions with fauna associated with increases maintenance vehicle traffic. However the increase will be very limited and resultant collisions with fauna are expected to be minimal. Avifaunal species including the RDL species *Sagittarius serpentarius* (Secretary Bird) may collide with additional power lines in the area – an impact which cannot be mitigated, although the likelihood of this occurring is relatively low. During maintenance, hunting and poaching may also increase if uncontrolled. The low number of personnel required reduces the likelihood of this impact occurring.

The impact is assessed to be of ***very low*** significance and with the implementation of mitigation will remain ***very low*** (Table 6-20).

Table 6-20: Significance of impact on faunal habitat, biodiversity and RDL species and fauna during operation of linear infrastructure

<table>
<tr><th></th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th></tr>
<tr><td>Without mitigation</td><td>Local
1</td><td>Low
1</td><td>Long-term
3</td><td>Low
5</td><td>Possible</td><td>VERY LOW</td><td>– ve</td><td>High</td></tr>
<tr><td colspan="9">Essential mitigation measures:
• Ensure that maintenance activities are restricted to the road reserve and do not encroach into surrounding open veld areas and that these open veld areas are strictly off-limits to maintenance vehicles and personnel;
• Strictly prohibit the trapping and hunting of fauna by maintenance personnel;
• Enforce a speed limit for operational and maintenance vehicles of 40km/h in order to reduce collision of maintenance vehicles with fauna; and
• Rescue and relocate any faunal species encountered particularly slower moving species such as tortoises.</td></tr>
<tr><td>With mitigation</td><td>Local
1</td><td>Low
1</td><td>Long-term
3</td><td>Low
5</td><td>Improbable</td><td>VERY LOW</td><td>– ve</td><td>High</td></tr>
</table>

Desalination Plant

Maintenance of the desalination plant and increased anthropogenic activity and disturbance in natural areas around the desalination plant may affect faunal habitat and disturb faunal communities. Furthermore, it is possible that the presence of operational staff may increase hunting and poaching of faunal species. The likelihood of these impacts is however relatively low, as is the anticipate intensity of the impact, given the small number of operational staff. These impacts can also be controlled or prevented relatively easily.

The impact is assessed to be of very ***low*** significance and with the implementation of mitigation is reduced to ***insignificant*** (Table 6-21).

Table 6-21: Significance of impact on faunal habitat, biodiversity and RDL species and fauna during operation of the desalination plant

<table>
<tr><th></th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th></tr>
<tr><td>Without mitigation</td><td>Local
1</td><td>Low
1</td><td>Long-term
3</td><td>Low
5</td><td>Possible</td><td>VERY LOW</td><td>– ve</td><td>High</td></tr>
<tr><td colspan="9">Essential mitigation measures:
• Ensure that maintenance activities do not encroach into surrounding open veld areas and that these open veld areas are strictly off-limits to maintenance vehicles and personnel; and
• Strictly prohibit the trapping and hunting of fauna by maintenance personnel</td></tr>
<tr><td>With mitigation</td><td>Local
1</td><td>Low
1</td><td>Short-term
1</td><td>Very Low
3</td><td>Improbable</td><td>INSIGNIFICANT</td><td>– ve</td><td>High</td></tr>
</table>

6.5.3.2 Potential Impact F3: Disruption of Faunal Migratory Corridors

Linear infrastructure, primarily pipelines and roads, may affect migratory corridors, and is similar for both route alternatives. The desalination plant is not likely to create any significant barriers to migration and is not assessed.

Pipelines may disrupt faunal migration through the study area, particularly if installed too close to ground level. *Raphicerus campestris* (Steenbok) and *Sylvicapra grimmia* (Common duiker) would need to move under or jump over pipelines and smaller reptile species such as tortoises will need to move below the pipelines. Approximately 6.5 km of the route will run parallel to the coast line (along the existing gravel road within 500 m of the coast) and may prevent migration of faunal species to and from coastal areas. In addition, the migration of faunal species from areas to the north of the study area to the Brak River located to the south may be disrupted. A steep embankment on either side of the gravel road may affect the ability of smaller faunal taxa to cross the road safely.

The impact associated with the disruption of faunal migratory corridors is considered of a local extent and will be of long term duration. Although faunal migration through the area is already disrupted by numerous boundary fences, pipelines too close to the ground will further disrupt the movement of medium sized faunal species and the additional impact is therefore likely to be of a medium intensity. If pipelines are buried below ground, the restriction on faunal migration through the area will be reduced. However, burying pipelines is likely to create a higher level of disturbance to faunal habitat during construction and is therefore not recommended.

The impact is assessed to be of ***medium*** significance with and without the implementation of mitigation for both route alternatives (Table 6-22).

Table 6-22: Significance of disruption of faunal migratory corridors

	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium** 6	Probable	**MEDIUM**	**– ve**	High
Essential mitigation measures: • Design gravel roads in such a way to allow for either a gradual kerb or regular ‘exits’ from the road in order to allow faunal species such as tortoises to safely cross. Regularly inspect gravel roads to ensure this.								
With mitigation	Local 1	Medium 2	Long-term 3	**Medium** 6	Probable	**MEDIUM**	**– ve**	High

6.5.4 The No-Go Alternative

The No-Go impacts are as described for botanical impacts discussed in Section 6.4.4, due to the direct correlation between vegetation and faunal habitats.

6.5.5 Mitigation Measures: Potential Faunal Impacts

Essential fauna mitigation measures during **construction** are as follows:

- Strictly control edge effects of construction activities such as erosion and alien vegetation proliferation;
- Ensure that the edge effects of construction related activities do not impact on very high sensitivity terrestrial or coastal rocky outcrop areas;
- Limit the removal of vegetation and associated faunal habitat from the road reserve to that which is essential;
- Rescue and relocate fauna encountered within the construction footprint, particularly slower moving species such as tortoises;
- Strictly prohibit the trapping and hunting of fauna by construction personnel; and
- Enforce a speed limit for construction vehicles of 40 km/h in order to reduce collision of construction vehicles with fauna.

Additional essential fauna mitigation measures during **construction**, specific to the Kotzesrus route are as follows**:**

- Reduce noise levels in areas in close proximity to the Brak River crossing in order to avoid the disturbance of the *Aquila verreauxii* (Verreauxs Eagle) breeding pair and prevent staff from approaching or disturbing the nest (if present); and
- Attach visible tags to power lines, cables and infrastructure in order to limit potential deadly avifaunal collisions.

Additional essential fauna mitigation measures during **construction** of the desalination plant are as follows**:**

- Where possible, install seawater intake and discharge pipelines within existing gravel road reserves in order to reduce impact on surrounding natural habitat.

Essential fauna mitigation measures to address **operational** impacts are as follows:

- Design gravel roads in such a way to allow for either a gradual kerb or regular 'exits' from the road in order to allow faunal species such as tortoises to safely cross. Regularly inspect gravel roads to ensure this;
- Ensure that maintenance activities are restricted to the road reserve and do not encroach into surrounding open veld areas and that these open veld areas are strictly off-limits to maintenance vehicles and personnel;
- Strictly prohibit the trapping and hunting of fauna by maintenance personnel;
- Enforce a speed limit for operational and maintenance vehicles of 40 km/h in order to reduce collision of maintenance vehicles with fauna; and
- Rescue and relocate any faunal species encountered particularly slower moving species such as tortoises.

Best practice fauna mitigation measures during **construction** are as follows:

- Investigate the possibility of installing pipelines at a minimum height of 30 cm above the ground to allow small faunal species may move naturally under this unnatural barrier;
- Attach visible tags to power lines, cables and infrastructure in order to limit potential deadly avifaunal collisions; and
- Inform staff about dominant faunal species, associated habitat and importance of their conservation in the region.

6.6 Potential Impacts on Marine and Coastal Ecology

6.6.1 Introduction, Terms of Reference and Methodology

This assessment is based on the Marine and Coastal Ecology Assessment undertaken by PISCES Environmental services and Steffani Marine Environmental Consultant (see Appendix 4B), which in turn was informed by the Hydrodynamic Marine Modelling Study undertaken by PRDW (see Appendix 4C).

The Terms of Reference for the Hydrodynamic Marine Modelling Study were to:

- Determine and describe the baseline physical coastal processes including waves, currents and tides;
- Undertake a desktop assessment of coastal processes and dispersion characteristics at the proposed site of the desalination plant, intake and discharge points and provide guidance on the expected environmental issues and possible fatal flaws early on in the project;
- Undertake the required numerical modelling to evaluate the dispersion of brine from the desalination plant and associated impacts;
- Provide an interpretation of the outputs/findings of the modelling studies to inform the assessment of impacts on marine and coastal ecology by the Marine Ecologists;
- Provide recommendations for mitigation and monitoring of impacts; and
- Provide technical input required for the submission of applications to the DEA in terms of NEM: ICMA.

The study included characterisation of the discharge of brine from the desalination plant, including discharge rates, the discharge point and constituent concentrations. Applicable water quality guidelines were then used calculate the required dilutions for each constituent.

Numerical modelling was used to simulate both the physical coastal processes at the site, including waves, currents and water levels, as well as the dispersion and dilution of the brine and associated co-discharges. The model results were then interpreted to inform the assessment of impacts on marine ecology. The study modelled discharges associated with the proposed 8 Mm^3/year capacity desalination plant.

In order to model the dispersion of brine under a range of environmental conditions, 46 scenarios were developed from an analysis of wave, wind and water level conditions at Volwaterbaai. Based on these, three scenarios were assessed, serving as a good indication of the range of model results obtained. These three scenarios effectively represent stormy conditions, typical summer conditions, and extreme calm conditions.

The ToR for the Marine and Coastal Ecology study were to:

- Undertake a site visit to inspect the immediate and surrounding area associated with the marine infrastructure of the project in order to gather general information on the sandy beach and rocky intertidal ecology of the area;
- Describe the existing marine and coastal baseline characteristics of the study area and place these in a regional context; in doing so highlight sensitive and threatened habitats, and threatened or rare marine fauna and flora;
- Describe pertinent characteristics of the marine environment including, amongst others, the following components:
    - Marine baseline conditions;
    - Waves, tides and currents;
    - Surf-zone currents and processes;
    - Upwelling;
    - Nutrients;

  - Turbidity;
  - Organic inputs;
  - Low oxygen events;
  - Rocky shore communities;
  - Sandy beach communities;
  - Pelagic communities;
  - Marine mammals and seabirds;
  - Extractive and non-extractive users of the area;
  - Future use scenarios

- Review and provide an expert interpretation of all the relevant, available local and international publications and information sources on the disturbances and risks associated with hypersaline effluents;
- Identify and describe all factors resulting from the construction and operation of the desalination plant and associated infrastructure that may influence the marine and coastal environments in the region, based on existing information and data collected during the site visit;
- Assess the impacts of the proposed development on the marine biology of the project area during the construction and operation phases of the project using SRK's prescribed impact assessment methodology;
- Summarise, categorise and rank all identified marine and coastal impacts in appropriate EIA tables, to be incorporated in the overall EIA;
- Identify and describe potential cumulative impacts resulting from the proposed development in relation to proposed and existing developments in the surrounding area;
- Recommend mitigation measures to minimise impacts and/or optimise benefits associated with the proposed project;
- Provide recommendations for draft a monitoring campaign, if applicable; and
- Compile an EMP (or relevant sections of the EMP) for the marine aspects of the construction and operation phases of the intake structure and brine disposal systems.

Although the Marine and Coastal Ecology Study largely adopted a desktop approach, qualitative information on the intertidal and shallow subtidal environments collected during the site visit and during exploratory dives at the proposed discharge location, were used to inform the description of the baseline environment. This combined approach was deemed adequate to contextualise and gauge potential impacts associated with the desalination plant. The assessment of impacts associated with the brine discharge was based on the results of the modelling study undertaken by PRDW, thereby adding confidence to the assessment of the likely extent and duration of the hypersaline effluent plumes for different seasonal oceanographic scenarios.

6.6.2 Marine Water Quality Guidelines

The South African Water Quality Guidelines for Coastal Marine Waters (DWAF 2005) provide recommended target values (as opposed to standards) for a range of substances. Site-specific environmental quality objectives, based on the requirements of the site-specific marine ecosystems, as well as other (existing and future) beneficial uses of the receiving environment, should be based on the above-mentioned guidelines, supplemented by additional information obtained from published literature, best available international guidelines (e.g. ANZECC 2000; World Bank 1998), and site-specific data and information (e.g. obtained through numerical modelling outputs). Recommended target values are also reviewed and summarised in the Benguela Current Large Marine Ecosystem (BCLME) document on water quality guidelines for the BCLME region (CSIR 2006).

Recommended target values based on these guidelines are summarised in in Table 6-23.

The mixing zone (as referred to in Table 6-23) is the area around an effluent discharge point where effluent is actively diluted by the water of the receiving environment. This zone usually encompasses the near-field and mid-field regions of dilution to allow for the discharge plume to mix throughout the water column. Within the mixing zone, no water quality criteria for physical and chemical stressors are defined (with the exception of a select few contaminants that may potentially bioaccumulate). Instead, these water quality criteria ('trigger values') are defined at the boundary of the mixing zone to ensure the quality of nearby waters does not deteriorate as a result of the effluent discharge. The boundaries of a proposed mixing zone are typically defined according to an estimated distance from the discharge point at which point defined water quality guidelines will be met, as predicted by numerical modelling of the discharge.

Table 6-23: Water quality guidelines for the discharge of a high-salinity brine into the marine environment

Variable	South Africa (DWAF 2005)	Australia/New Zealand (ANZECC 2000)	World Bank[20] (1998)	US Environmental Protection Agency (EPA 2006)
Zone of impact / mixing zone	To be kept to a minimum, the acceptable dimensions of this zone informed by the EIA and requirements of licensing authorities, based on scientific evidence.	No guideline found	100 m radius from point of discharge for temperature	No guideline found
Temperature	The maximum acceptable variation in ambient temperature is ± 1°C	Where an appropriate reference system is available, and there are sufficient resources to collect the necessary information for the reference system, the median (or mean) temperature should lie within the range defined by the 20%ile and 80%ile of the seasonal distribution of the ambient temperature for the reference system.	< 3°C above ambient at the edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 m from the point of discharge when there are no sensitive aquatic ecosystems within this distance.	No guideline found
Salinity[21]	33 – 36 psu	Low-risk trigger concentrations for salinity are that the median (or mean) salinity should lie within the 20%ile and 80%ile of the ambient salinity distribution in the reference system(s). The old salinity guideline (ANZECC 1992) was that the salinity change should be <5% of the ambient salinity.	No guideline found	No guideline found
Total residual Chlorine	No guideline, however, deleterious effects recorded for concentrations as low as 2 – 20 µg/ ℓ. A conservative trigger value is <2 µg/ℓ.	3 µg Cl/ℓ measured as total residual chlorine (low reliability trigger value at 95% protection level, to be used only as an indicative interim working level) (ANZECC 2000)[22]	0.2 mg/ℓ at the point of discharge prior to dilution	Long-term and short-term water quality criteria for chlorine in seawater are 7.5 µg/l and 13 µg/l, respectively
Total residual	No guideline exists, suggest values ranging	No guideline found	No guideline found	No guideline found

[20] World Bank guidelines are based on maximum permissible concentrations at the point of discharge and do not explicitly take into account the receiving environment, i.e. no cognisance is taken of the differences in transport and fate of pollutants between, e.g. a surf-zone and an open and exposed coastline.

[21] The ANZECC (2000) Water Quality guideline for salinity is less stringent than, but roughly approximates, the South African Water Quality guideline that requires that salinity remains within the range of 33 psu to 36 psu (=ΔS of approximately 1 psu). Effects on marine biota are primarily observed for increases of >4 psu above ambient level. ΔS 1 psu and 4 psu have been chosen for assessment purposes.

[22] In case of chlorine "shocking", which involves using high chlorine levels for a short period of time rather than a continuous low-level release, the target value is a maximum value of 2 mg/ℓ for up to 2 hours, not to be repeated more frequently than once in 24 hours, with a 24-hour average of 0.2 mg/ℓ (The same limits would apply to bromine and fluorine)

Dibromonitrilo propionamide (DBNPA)	between 0.035 mg/ ℓ and 0.070 mg/ ℓ			
Dissolved oxygen (DO)	For the west coast, the dissolved oxygen should not fall below 10 % of the established natural variation. For the south and east coasts the dissolved oxygen should not fall below 5 mg/ℓ (99 % of the time) and below 6 mg/ℓ (95 % of the time)	Where an appropriate reference system is available, and there are sufficient resources to collect the necessary information for the reference system, the median lowest diurnal DO concentration for the period for DO should be >20%ile of the ambient dissolved oxygen concentration in the reference system(s) distribution. The trigger value should be obtained during low flow and high temperature periods when DO concentrations are likely to be at their lowest.	No guideline found	No guideline found
Nutrients	Waters should not contain concentrations of dissolved nutrients that are capable of causing excessive or nuisance growth of algae or other aquatic plants or reducing dissolved oxygen concentrations below the target range indicated for dissolved oxygen (see above)	Default trigger values for the low rainfall southern Australian region PO_4-P: 100 µg/ℓ NO_x-N: 50 µg/ℓ NH_4+-N: 50 µg/ℓ	No guideline found	No guideline found
Chromium	8 µg/ℓ (as total Cr)	Marine moderate reliability trigger value for chromium (III) of 10 µg./ℓ with 95% protection Marine high reliability trigger value for chromium (VI) of 4.4 µg/ℓ at 95% protection.	0.5 mg/ℓ (total Cr) for effluents from thermal power plants	1 100 µg/ℓ for highest concentration at brief exposure without unacceptable effect. 50 µg/ℓ highest concentration at continuous exposure without unacceptable effect
Iron	No guideline found	Insufficient data to derive a reliable trigger value. The current Canadian guideline level is 300 µg/ℓ	1.0 mg/ℓ for effluents from thermal power plants	No guideline found
Molybdenum	No guideline found	Insufficient data to derive a marine trigger value. A low reliability trigger value of 23 µg/ℓ was adopted as indicative interim working levels.	No guideline found	No guideline found
Nickel	25 µg/ℓ (as total Ni)	7 µg/ℓ at a 99% protection level is recommended for slightly-moderately disturbed marine systems.	No guideline found	74 µg/ℓ for highest concentration at brief exposure without unacceptable effect. 8.2 µg/ℓ highest concentration at continuous exposure without unacceptable effect
Chromium	8 µg/ℓ (as total Cr)	Marine moderate reliability trigger value for chromium (III) of 10 µg./ℓ with 95% protection Marine high reliability trigger value for chromium (VI) of 4.4 µg/ℓ at 95% protection.	0.5 mg/ℓ (total Cr) for effluents from thermal power plants	1 100 µg/ℓ for highest concentration at brief exposure without unacceptable effect. 50 µg/ℓ highest concentration at continuous exposure without unacceptable effect

6.6.3 Assessment of Impacts: Construction Phase

Construction impacts on the marine and coastal environment are primarily associated with the installation of the seawater intake and brine discharge structures, which will disturb high-shore, intertidal and shallow subtidal habitats at the construction site. Construction will involve substantial excavation activities on the intertidal rocky shore and in the surf-zone, as well as extensive heavy vehicle traffic on the shore, with potential for associated hydrocarbon spills. Although activities in the intertidal zone will be localised and confined to within a hundred metres of the construction site, the boulders and sediments will be thoroughly displaced and associated macrofauna will almost certainly be entirely eliminated. Rock blasting will be necessary to reach the required depth, disturbing coastal and marine biota. Physical removal of sediments or bedrock in the trench will destroy all associated sessile benthic biota. Excavations within the intertidal and subtidal zones may increase suspended sediments in the water column and physical smothering of macrofauna by sediments.

A temporary desalination plant will be utilised to provide water for construction purposes, with potential impacts on the marine environment.

Six potential direct construction phase impacts on marine and coastal ecology were identified:

- M1: Disturbance of coastal ecology;
- M2: Impacts of contamination on marine biota;
- M3: Impacts of increased turbidity and smothering through redepostition of suspended sediments
- M4: Disturbance and injury of shorebirds and marine biota through construction noise and blasting;
- M5: Elimination of benthic communities through the loss of substratum; and
- M6: Impacts of temporary desalination plant on marine environment.

6.6.3.1 Potential Impact M1: Disturbance of Coastal Ecology

The installation of seawater intake structures and brine discharge pipelines will involve considerable disturbance of the high-shore, intertidal and shallow subtidal habitats. The intake and outfall points of the desalination plant pipelines will be located below the low water mark, in the surf-zone.

The intake structure will require excavation of an intake channel and basin to a depth of 3 - 3.5 m below mean sea level, entailing trenching and blasting of bedrock in the intertidal and shallow subtidal zones. The brine discharge pipeline will be placed in a rocky gully and similarly be trenched or encased in concrete to provide stability on the seabed and adequately protect it where it crosses the surf-zone. The physical removal of sediments or bedrock in the intake channel and basin, and discharge pipeline trench, and disposal thereof into the surf-zone will destroy benthic biota within the marine construction zone. Mobile organisms such as fish, shore birds and marine mammals, on the other hand, are capable of avoiding construction activities and although severely disturbed, should not be significantly affected by excavation activities.

Individual pipeline sections will be fabricated by the supplier and transported to site. This will require a sufficiently large and relatively flat onshore laydown area (immediately inland of the final pipeline position). Coastal vegetation and associated fauna at the pipeline construction sites will almost certainly be severely disturbed or removed. The pipe sections will be butt-welded together into long strings, placed in the trenches and subsequently covered with concrete and rock. Boulders and sediments will be displaced in the process and the associated biota will most likely be eliminated. Any shorebirds feeding and/or roosting in the area will also be disturbed and displaced for the duration of construction.

Activities will remain localised and confined to within 100 m of the construction site and the duration of the disturbance should also only be limited to a period of about 18 months. Active rehabilitation of intertidal communities is not possible, but rapid natural recovery of disturbed habitats in the turbulent intertidal and surf-zone areas can be expected. Furthermore, the exposed pipeline will serve as a new 'hard-bottom' substrate for colonisation by marine benthic communities. The ecological recovery of marine habitats is generally defined as the establishment of a successional community of species, which progresses towards a community that is similar in species composition, population density and biomass to that previously present. In general, communities of short-lived species and/or species with a high reproduction rate (opportunists) may recover more rapidly than communities of slow growing, long-lived species. Opportunists are usually small, mobile, highly reproductive and fast growing species and are the early colonisers. Habitats in the nearshore wave-base regime, which are subjected to frequent disturbances, are typically inhabited by these opportunistic species. Recolonisation will start rapidly after cessation of trenching, and species numbers may recover within short periods (weeks) whereas biomass often remains reduced for several years.

Studies of the disturbance of beach macrofauna and rocky shore communities on the southern African West Coast by shore beach mining activities and shore-based diamond diving operations have ascertained that, provided physical changes to beach morphology and rocky intertidal zones are kept to a minimum, biological 'recovery' of disturbed areas will occur within 2-5 years. Disturbed subtidal communities within the wave base (<40 m water depth) might recover even faster.

The impact of disturbance of the intertidal and subtidal rocky shore during installation of the intake and discharge pipelines is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low*** (Table 6-24)***.***

Table 6-24: Significance of disturbance to coastal ecology

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	High 3	Medium-term 2	**Medium** 6	Definite	**MEDIUM**	**– ve**	High
Essential mitigation measures: • Restrict disturbance of the intertidal and subtidal areas to the smallest area possible; • Lay pipeline in such a way that required rock blasting is kept to a minimum; • Restrict traffic on upper shore to the minimum required; and • Restrict traffic to clearly demarcated access routes and construction areas only.								
With mitigation	Local 1	High 3	Short-term 1	**Low** **5**	Definite	**LOW**	**– ve**	High

6.6.3.2 Potential Impact M2: Impacts of Contamination on Marine Biota

Construction activities in the intertidal zone will require heavy on shore traffic, with elevated potential for accidental spillage or leakage of fuel, chemicals or lubricants. Accidental release of liquid hydrocarbons may contaminate water and/or sediments in the marine and coastal environment: effects include physical oiling and toxicity impacts to marine fauna and flora, localised mortality of plankton, pelagic eggs and fish larvae, and habitat loss or contamination. Many of the compounds in petroleum products are known to smother organisms, lower fertility and cause disease in aquatic organisms. Hydrocarbons are incorporated into sediments through attachment to fine dust particles, sinking and deposition in low turbulence areas. Due to differential uptake and elimination rates filter-feeders particularly mussels can bioaccumulate organic (hydrocarbons) contaminants.

Concrete work will be required in the intertidal and shallow subtidal zones during construction and installation of the pipelines. Cement is highly alkaline, and wet cement is strongly caustic, with the setting process being exothermic. Excessive spillage of cement in the intertidal area may increase alkalinity in the water column with potential sublethal or lethal effects on marine organisms.

During construction (and also during operation), litter may enter the marine environment. Marine litter travels over long distances with ocean currents and winds and, aside from being unsightly, can cause serious harm to marine organisms, such as turtles, birds, fish and marine mammals. Considering the very slow rate of decomposition of most marine litter, a continuous input of large quantities will gradually increase litter in the coastal and marine environment.

Potential hydrocarbon spills and pollution in the intertidal zone during installation of the intake and discharge pipelines is thus deemed of medium intensity within the immediate vicinity of the construction sites, with impacts persisting over the short- to medium-term. The impact is assessed to be of ***low*** significance and with the implementation of mitigation is reduced to ***insignificant*** (Table 6-25).

Table 6-25: Significance of detrimental effects on marine biota through accidental hydrocarbon spills and litter in the coastal zone during construction

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Medium 2	Medium-term 2	**Low** **5**	Probable	**LOW**	– ve	High
Essential mitigation measures: • Conduct a comprehensive environmental awareness programme amongst contracted construction personnel; • Ensure that oils and lubricants used for maintenance of equipment in the field are correctly contained; • Maintain vehicles and equipment to ensure that no oils, diesel, fuel or hydraulic fluids are spilled; • Ensure that all construction vehicles used in the coastal zone have a spill kit (peatsorb/ drip trays) on-board to be used in the event of a spill; • No mixing of concrete may be allowed in the intertidal zone; • Regularly clean up concrete spilled during construction; • No dumping of excess concrete or mortar may be allowed on the sea bed, or in the coastal zone; and • Ensure regular collection and removal of refuse and litter from intertidal areas.								
With mitigation	Local 1	Low 1	Short-term 1	**Very Low** **3**	Possible	**INSIGNIFICANT**	– ve	High

6.6.3.3 Potential Impact M3: Impacts of Increased Turbidity and Smothering Through Redeposition of Suspended Sediment

Excavations and the displacement of sediments and boulders in the intertidal and/or surf zone will increase suspended sediments in the water column and physically smother biota. The effects of elevated levels of particulate inorganic matter and depositions of sediment have been well studied, and are known to have marked, but relatively predictable effects in determining the composition and ecology of intertidal and shallow subtidal benthic communities. Increased suspended sediments in the surf-zone and nearshore can potentially affect light penetration and thus phytoplankton productivity and algal growth and load the water with inorganic suspended particles, which may affect the feeding and absorption efficiency of filter-feeders, and can cause scouring.

Rapid deposition of material from the water column will have a smothering effect. Some mobile benthic animals inhabiting soft-sediments are able to migrate vertically through more than 30 cm of deposited sediment. Sand inundation of reef habitats is known to directly affect species diversity, with community structure and species richness evidently controlled by the frequency, nature and scale of disturbance of the system by sedimentation. For example, frequent sand inundation may destroy grazers resulting in the proliferation of algae.

Marine construction activities for the Volwaterbaai desalination plant will be highly localised. The impact of sediment plumes is likewise expected to be localised and of short duration (only a couple of hours extending to a few days after cessation of excavation activities). Since the biota of sandy and rocky intertidal and subtidal habitats in the wave-dominated nearshore areas of southern Africa are well adapted to high suspended sediment concentrations, periodic sand deposition and resuspension impacts are expected to occur at a sublethal level only, i.e deemed to be of low intensity. As elevated suspended sediment concentrations are an unavoidable consequence of construction activities in the intertidal zone, no direct mitigation measures, other than the no-project alternative, are possible. Impacts can however be kept to a minimum through responsible construction practices.

The impact is assessed to be of ***very low*** significance without and with the implementation of mitigation (Table 6-26).

Table 6-26: Significance of reduced physiological functioning of marine organisms due to increased turbidity and smothering by suspended sediments

	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	Definite	**VERY LOW**	– ve	High
Essential mitigation measures: • No dumping of construction materials in the intertidal and subtidal zones may be allowed.								
With mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	Probable	**VERY LOW**	– ve	High

6.6.3.4 Potential Impact M4: Disturbance and Injury of Shore Birds and Marine Biota through Construction Noise and Blasting

During pipeline trenching operations, noise and vibrations from excavation machinery may affect surf-zone biota, marine mammals and shore birds in the area. Construction noise is generally of a frequency much lower than that used by marine mammals for communication, which is, therefore, unlikely to be significantly affected. Furthermore, the area affected by noise is very small compared to the population distribution ranges of surf-zone fish species, resident cetacean species and the Cape fur seal. Fish and marine mammals, as well as shorebirds and terrestrial biota are highly mobile and should vacate noise-affected area.

Trenching of the pipeline and construction of the intake basin will require blasting, though probable blast levels, blasting practice and duration have not yet been determined: consequently, the assessment that follows is generic only.

Explosives generate chemical energy, which is released as physical, thermal, and gaseous products. The most important of these for marine organisms is the physical component which, as a shock wave, passes into the surrounding medium. Depending on the blasting practice, some energy may enter the water column, and cause damage to aquatic life at, or some distance from the shot point. Thermal energy dissipation, in contrast, is generally limited to the immediate vicinity (<10 m) of the source, and in shallow water gaseous products produce minor shock wave amplitudes.

Two damage zones are associated with an underwater explosion:

- An immediate kill zone of relatively limited extent, but within which all animals are susceptible to damage, and
- A more extensive remote damage zone in which damage is caused by negative pressure pulses, generated when the compression wave is reflected from an air-water interface. The negative pulses act on gas bodies within the organism inducing injuries such as haemorrhaging and contrusions of the gastro-intestinal tract (mammals and birds) or rupture of swimbladders in fish.

Based on available literature, effects of blasting on macrophytes is generally limited to the immediate vicinity of the charges. Marine invertebrates appear to be relatively immune to blast effects in terms of obvious injury or mortalities, suggesting that any blast-effects are likely to remain confined.

In fish, the swim bladder is the organ most frequently damaged by blasting, potentially leading to high mortality in the immediate vicinity of blasting. In contrast, fish species without swim bladders seem to be largely immune to underwater explosions. Egg and fish larvae may also be affected by underwater explosions, but impact ranges seem to be restricted to the immediate vicinity of blasting. Although injury or mortality of fish and/or their eggs and larvae in the immediate vicinity of blasting is likely to occur, the probability of the blasting programme having a measurable effect at the population level on fish in the study area is judged to be low (unlikely), as surf-zone and nearshore species along the Namaqualand coastline are widely distributed.

The limited information available on blasting effects on swimming and diving birds suggests that mortality occurs primarily within the immediate vicinity (< 10 m) of the blast. Effects on sea turtles may occur up to a distance of 1 km from the underwater explosion. However, in the study area, turtles are infrequent visitors in the shallow nearshore regions.

Injuries to marine mammals generated by underwater explosions are primarily trauma to organs containing gas, and mortality can occur in the immediate vicinity of blasting. Given the comparatively low number of seals in the study area, any population level mortality effects or injuries are judged to be insignificant. Although occurring in the study area, whales and dolphins are infrequent visitors in the shallow nearshore regions, being more common further offshore. However, Heaviside's Dolphin and the Common Bottlenose Dolphin occur in shallow waters (<50 m) and could be vulnerable to detonations.

Disturbance and injury to marine biota due to construction noise is thus deemed of low intensity within the immediate vicinity of the construction sites, with impacts persisting over the very short-term only. In the case of blasting, however, the impact would be of high intensity, but also persist over the very short-term only.

The impact is assessed to be of ***low*** significance and with the implementation of mitigation is reduced to ***very low*** (Table 6-27).

Table 6-27: Significance of Disturbance and injury of shore birds and marine biota through construction noise and blasting

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	High 3	Short-term 1	**Low** **5**	Definite	**LOW**	– ve	Medium
Essential mitigation measures: • Restrict blasting to the absolute minimum required and a maximum of one blast per day; • Use blasting methods which minimise the environmental effects of shock waves through the use of smaller, quick succession blasts directed into the rock. • Avoid onshore blasting during the breeding season of shore-birds. • Undertake visual observation prior to blasting to ensure there are no marine mammals and turtles present in the immediate vicinity (approximately 2 km radius).								
With mitigation	Local 1	Low 1	Short-term 1	**Very Low** **3**	Probable	**VERY LOW**	– ve	Medium

6.6.3.5 Potential Impact M5: Elimination of Benthic Communities through Loss of Substratum

Disturbances in the intake basin and pipeline corridor will effectively eliminate any (sandy or rocky) biota in the structural footprint, and reduce the area of seabed available for colonisation by marine benthic communities. This loss of substratum will be temporary, as the structures themselves will provide an alternative substratum for colonising communities.

The composition of colonising communities on artificial structures depends on the age (length of time immersed in water) and the composition of the substratum, and usually differs from the communities of nearby natural rocky reefs. Colonization of hard substratum goes through successional stages. Early successional communities are characterized by opportunistic algae (e.g. Ulva sp., Enteromorpha sp.). These are eventually displaced by slower growing, long-lived species such as mussels, sponges and/or coralline algae, and mobile organisms, such as urchins and lobsters, which feed on the fouling community. With time, a consistent increase in biomass, cover and number of species can usually be observed. Depending on the supply of larvae and the success of recruitment, the colonisation process can take up to several years.

The impact is therefore assessed to be of ***very low*** significance with and without mitigation (Table 6-28).

Table 6-28: Significance of elimination of benthic communities through loss of substratum in structural footprint

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low** **3**	Definite	**VERY LOW**	– ve	High
Essential mitigation measures: • No mitigation possible								
With mitigation	Local 1	Low 1	Short-term 1	**Very Low** **3**	Definite	**VERY LOW**	– ve	High

6.6.3.6 Potential Impact M6: Impacts of Temporary Desalination Plant on the Marine Environment

A containerised desalination plant will be temporarily used to supply fresh water during the construction phase. Water will be abstracted from the sea via a submersible pump positioned in a tidal pool close to the shore and be conveyed to the temporary desalination plant via a 50 mm pipe.

Waste streams will be similar to those described for the operation phase of the main desalination plant (Section 3.7). Intake and discharge rates are 67 m^3/d and 36.5 m^3/d, respectively. Brine will contain traces of membrane antiscalant, $FeCl_3$ and suspended solids from the backwash waste (~18% of the brine volumes discharged daily), and will be discharged into the surf-zone as a single waste stream via a 50 mm pipe. The impacts of this temporary, low volume discharge into the turbulent surf-zone environment are deemed to be insignificant.

Similarly, the disturbance of the intertidal area during installation of the temporary desalination plant is expected to be insignificant, primarily amounting to the 80 m^2 footprint of the fenced in area above the high water mark enclosing the plant.

The impact is assessed to be ***insignificant*** with and without the implementation of mitigation (Table 6-29).

Table 6-29: Significance of impacts of the temporary desalination plant on the marine environment

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	Improbable	**INSIGNIFICANT**	– ve	High
Essential mitigation measures: • Keep the footprint of the temporary desalination plant in the coastal zone to the absolute minimum required; and • Ensure that brine and co-pollutants are discharged into the surf-zone below the low water mark.								
With mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	Improbable	**INSIGNIFICANT**	– ve	High

6.6.4 Assessment of Impacts: Operation Phase

The key potential impacts on the marine environment of the proposed desalination plant are mostly associated with discharge of brine into the marine environment. Seven key potential direct impacts on marine ecology were identified during the operation phase:

- M7: Loss of marine species through impingement and entrainment;
- M8: Reduced physiological functioning of marine organisms due to elevated salinity;
- M9: Reduced physiological functioning of marine organisms due to elevated temperature;
- M10: Chronic effects on marine organisms due to formation of halogenated by-products;
- M11: Detrimental effects on marine organisms through discharge of co-pollutants in backwash water;
- M12: Detrimental effects on marine organisms due to residual biocides and chemicals in brine; and
- M13: Detrimental effects of heavy metals from corrosion processes on marine organisms.

A number of less significant impacts were also identified and assessed by the specialist. These are not discussed in detail below; however mitigation measures are incorporated in Section 6.6.6 of this report. These impacts, which are typically of ***low***/***very low*** significance and reduced to ***very low***/***insignificant*** with the implementation of mitigation include:

- Impacts of flow distortion on marine organisms;
- Avoidance behaviour by invertebrates, fish and marine mammals of the discharge area;

- Reduced physiological functioning of marine organisms due to reduced dissolved oxygen concentrations;
- Reduction in dissolved oxygen concentrations due to dechlorination; and
- Excessive bacterial re-growth in brine after chlorination.

6.6.4.1 Potential Impact M7: Loss of Marine Species through Impingement and Entrainment

Intake of water directly from the ocean will lead to a loss of marine species through impingement and entrainment. Impingement refers to injury or mortality of larger organisms (e.g. fish, jellyfish) trapped against intake screens, whereas entrainment affects smaller organisms which slip through the screens and are transported into the plant with the feed water. Impingement mortality is typically due to suffocation, starvation, or exhaustion when pinned against intake screens or from the rakes used to clear screens of debris. The significance of impingement is related primarily to the location of the intake structure and is a function of intake velocity. The average intake velocity of the feedwater will be ~0.1 - 0.15 m/s (comparable to background currents in the oceans) which will allow mobile organisms to swim away from the intake.

Entrainment effects are likely to persist, as most of the entrained organisms are too small to be screened out without significantly reducing the intake water volume. Entrained material includes holoplanktic organisms (permanent members of the plankton, such as copepods, diatoms and bacteria) and meroplanktic organisms (temporary members of the plankton, such as juvenile shrimps and the planktonic eggs and larvae of invertebrates and fish). Mortality rates are likely to be 100%.

Although mortality caused by entrainment may affect the productivity of coastal ecosystems, the effects are difficult to quantify. Planktic organisms show temporal and spatial variations in species abundance, diversity and productivity, but it can be assumed that species common in the Benguela region will be prevalent in the surface waters of the project area. Furthermore, plankton species have rapid reproductive cycles. Therefore, it is unlikely that a single desalination facility of the capacity proposed at Volwaterbaai will have a substantial negative effect on the ability of plankton organisms to sustain their populations. The entrainment of eggs and larvae from common invertebrate and fish species is also unlikely to adversely affect the ability of these species to reproduce successfully.

A further potential concern is the removal of particulate matter from the water column, where it is a significant source of food for surf-zone and nearshore communities. For the comparatively small feed-water volumes required for the Volwaterbaai desalination plant this is unlikely to be of significance, as the surf-zone in the study area is particularly productive, and particulate organic matter frequently accumulates on the shore as foam and scum.

Although an entrainment and impingement study is typically recommended for large desalination plants, the comparatively low volumes of feed-water to be extracted from the surf-zone for this project would not justify such a study. Considering the comparatively low feed-water volumes required for this project and the fact that feed-water will be abstracted from an intertidal gully, the loss of marine species through impingement and entrainment is deemed of low intensity, but with impacts persisting over the operational life time of the plant. The impact is therefore assessed to be of ***low***[23] significance with and withoutthe implementation of mitigation (Table 6-30).

[23] Although SRK's impact assessment methodology would rate this impact as of medium significance, based on the professional judgement and experience of the marine ecology specialist, this impact is considered to be of low significance.

Table 6-30: Significance of the loss of marine species through impingement and entrainment

	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Definite	**LOW**	– ve	High
Essential mitigation measures: • Adjust seawater intake velocities to <0.15 m/s; and • Ensure installation of screens on the end of the intake pipes, or the use of a screen box or shroud.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Probable	**LOW**	– ve	High

6.6.4.2 Potential Impact M8: Reduced Physiological Functioning of Marine Organisms due to Elevated Salinity

The desalination plant will discharge a high-salinity brine into the surf-zone through a single outfall pipeline. Due to its increased salinity (~1.7 times that of seawater), the brine is denser (heavier) than surrounding seawater and will sink towards the seabed and be advected away from the discharge point in the near-bottom layers of the water column, flowing down-slope (i.e. offshore) into deeper water. For the proposed discharge, the jet stream from the pipe end will propel brine directly into oncoming rolling waves, ensuring rapid mixing with the surrounding seawater. In the shallow gully, the effluent plume may reach the surface. Depending on the discharge velocity, the volumes of brine being discharged and the local environmental conditions, thorough mixing throughout the water column is expected. However, depending on the degree of mixing, the diluted brine may again sink towards the seabed and continue to dilute due to natural mixing processes. The region in which the brine settles to the seafloor is termed the “near field” or “sacrificial mixing zone” as it represents an area in which large changes in water quality, sediments or biota can be expected. In other words, salinity or contaminant concentrations will be such that they will result in changes beyond natural variation in the natural diversity of species and biological communities, rates of ecosystem processes and abundance/biomass of marine life. Although the surf-zone exhibits a significant quantum of turbulent energy, it has a limited capacity to transport the brine to the open ocean. If the mass of the saline discharge exceeds the threshold of the surf-zone’s salinity load transport capacity, the excess salinity would begin to accumulate in the surf-zone and could ultimately increase long-term salinity increment in this zone beyond the level of tolerance of the aquatic life. This salinity threshold mixing/transport capacity of the surf-zone was determined using hydrodynamic modelling undertaken by PWDW.

All marine organisms have a range of tolerance to salinity, which is related to their ability to regulate the osmotic balance of their individual cells and organs to maintain positive turgor pressure. Aquatic organisms are commonly classified in relation to their range of tolerance as stenohaline (able to adapt to only a narrow range of salinities) or euryhaline (able to adapt to a wide salinity range), with most organisms being stenohaline.

Salinity changes may affect aquatic organisms in two ways:

- Direct toxicity through physiological changes (particularly osmoregulation), and
- Indirectly by modifying the species distribution.

Salinity changes can also alter water column structure (e.g. stratification) and water chemistry (e.g. dissolved oxygen saturation and turbidity). For example, fluctuation in the salinity regime has the potential to influence dissolved oxygen concentrations, and changes in the stratification could alter the distribution of organisms in the water column and sediments. Behavioural responses to changes in salinity regime include avoidance by mobile animals, such as fish and macro-crustaceans (by moving away from adverse salinity) and avoidance by sessile animals (by reducing contact with water by closing shells or by retreating deeper into sediments).

However, in marine ecosystems adverse effects or changes in species distribution are anticipated more from a reduction rather than an increase in salinity. Relatively little information exists on the long-term effects of hypersaline brine on organisms in coastal marine systems. However, it has been observed that salinity has a toxic effect on numerous organisms dependent on specific sensitivities to salinity, and by upsetting the osmotic balance, can lead to the dehydration of cells.

Sub-lethal effects of changed salinity regimes (or salinity stress) can include modification of metabolic rate, change in activity patterns, slowing of development and alteration of growth rates, lowering of immune function and increased mortality rates. High saline concentration can also lead to an increase in water turbidity, which is likely to reduce light penetration, an effect that might disrupt photosynthetic processes. Increased salinity can also reduce the production of plankton, particularly of invertebrate and fish larvae. One of the main factors of a change in salinity is its influence on osmoregulation, which in turn affects uptake rates of chemical or toxins by marine organisms. In a review on the effects of multiple stressors on aquatic organisms, Heugens et al. (2001) found that, in general, metal toxicity increases with decreasing salinity, while the toxicity of organophosphate insecticides increases with increasing salinity. For other chemicals no clear relationship between toxicity and salinity was observed. Some evidence, however, also exists for an increase in uptake of certain trace metals with an increase in salinity.

The South African Water Quality Guidelines (DWAF 1995) set an upper target value for salinity of 36 psu. The paucity of information on the effects of increased salinity on marine organisms makes an assessment of the high salinity plume difficult. However, this guideline seems sufficiently conservative to suggest that no adverse effects should occur for salinity <36 psu. At levels exceeding 40 psu, however, significant effects are expected, including possible disruptions to molluscan bivalves (e.g. mussels/oysters/clams) and crustacean (and possibly fish) recruitment as salinities >40 psu may affect larval survival. This applies particularly to the larval stages of fishes and benthic organisms in the area, which are likely to be damaged or suffer mortality due to osmotic effects, particularly if the encounter with the discharge effluent is sudden.

The brine from the desalination plant will have a salinity of ~66 psu and will be discharged into the turbulent surf-zone where the effluent would be expected to be rapidly diluted. Toxic effects of elevated salinities are likely to be experienced only by a very limited range of sensitive species, which may consequently be excluded from the sacrificial zone and/or the discharge gully. Most intertidal and shallow subtidal species are likely to experience sub-lethal effects only, if at all, and these would be restricted to within the immediate vicinity (i.e. within the discharge gully) of the outfall. As benthic communities within this region are largely ubiquitous and naturally highly variable at temporal and spatial scales, the loss or exclusion of sensitive species within the highly localised area around the outfall can be considered insignificant in both a local and regional context.

The results of the hydrodynamic modelling of the changes in salinity associated with the planned discharge of brine from the Volwaterbaai desalination plant are presented in Figure 6-3 to Figure 6-4 below. Figure 6-3 presents the anticipated increase in salinity at the surface of the ocean for stormy, typical summer and calm conditions respectively, as well as the anticipated increases in salinity at the ocean floor.

An increase of 1 psu is recommended as the salinity guideline, while a dilution of 30 in terms of co-discharges is recommended to meet the South African Water Quality Guidelines for Coastal Marine

(DWAF, 1995). A salinity increase of 1 psu corresponds to a dilution of 29 and therefore the size of the impacted areas in terms of the salinity guideline and the required dilution are the same.

The model results indicate that the maximum salinity footprint where the water quality guideline of ΔS 1 psu would be exceeded, occurs within 75 m of the discharge point at the water surface and within 250 m of the discharge point at the seabed. This, however occurs only under 'worst-case' conditions during a very calm period and for a very small percentage of time (see Figure 6-4).

For most of the year, plume dimensions are far smaller, with the brine footprint at the surface never exceeding water quality guidelines, whereas at the seabed a <1 psu change in salinity is met within 50 m of the discharge point for 50% of the time. As would be expected, brine footprints are comparatively small during the typically rough conditions along the coastline of the study area, with plume footprints near the seabed extending beyond 100 m from the discharge point only during rare calm sea conditions.

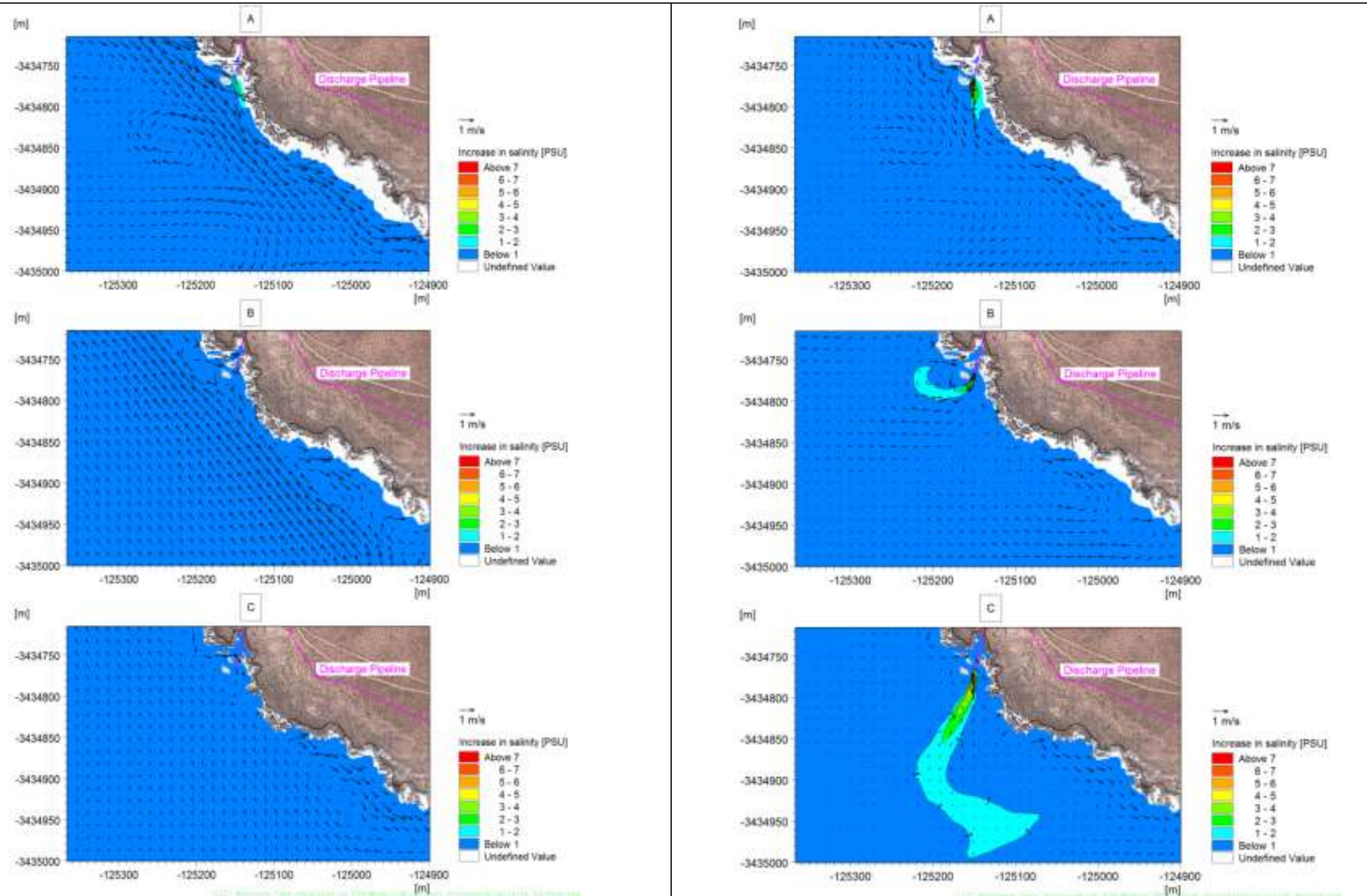
Under calm conditions the brine is not sufficiently mixed within the discharge gully and remains close to the seabed due to its greater density. The plume thus extends through the narrow surf-zone, potentially pooling in seabed depressions, and thereby resulting in a much more extensive footprint. Frequent strong wind or storm events that are typical for this coastline are, however, likely to prevent any long term cumulative build-up of high–density saline pools at the seafloor. Any detrimental effects on marine organisms would thus be sub-lethal and transient, and unlikely to be detectable above natural environmental perturbations.

For the assessment of impacts on marine ecology, the worst case conditions, i.e. extremely calm conditions during which mixing of brine with the surrounding water column would be most limited, are assumed. This assessment has thus taken a conservative approach as under typical wind and wave conditions the observed effluent footprints would be considerably reduced or undetectable.

The impact is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low*** (see Table 6-31).

Table 6-31: Significance of reduced physiological functioning of marine organisms due to elevated salinity

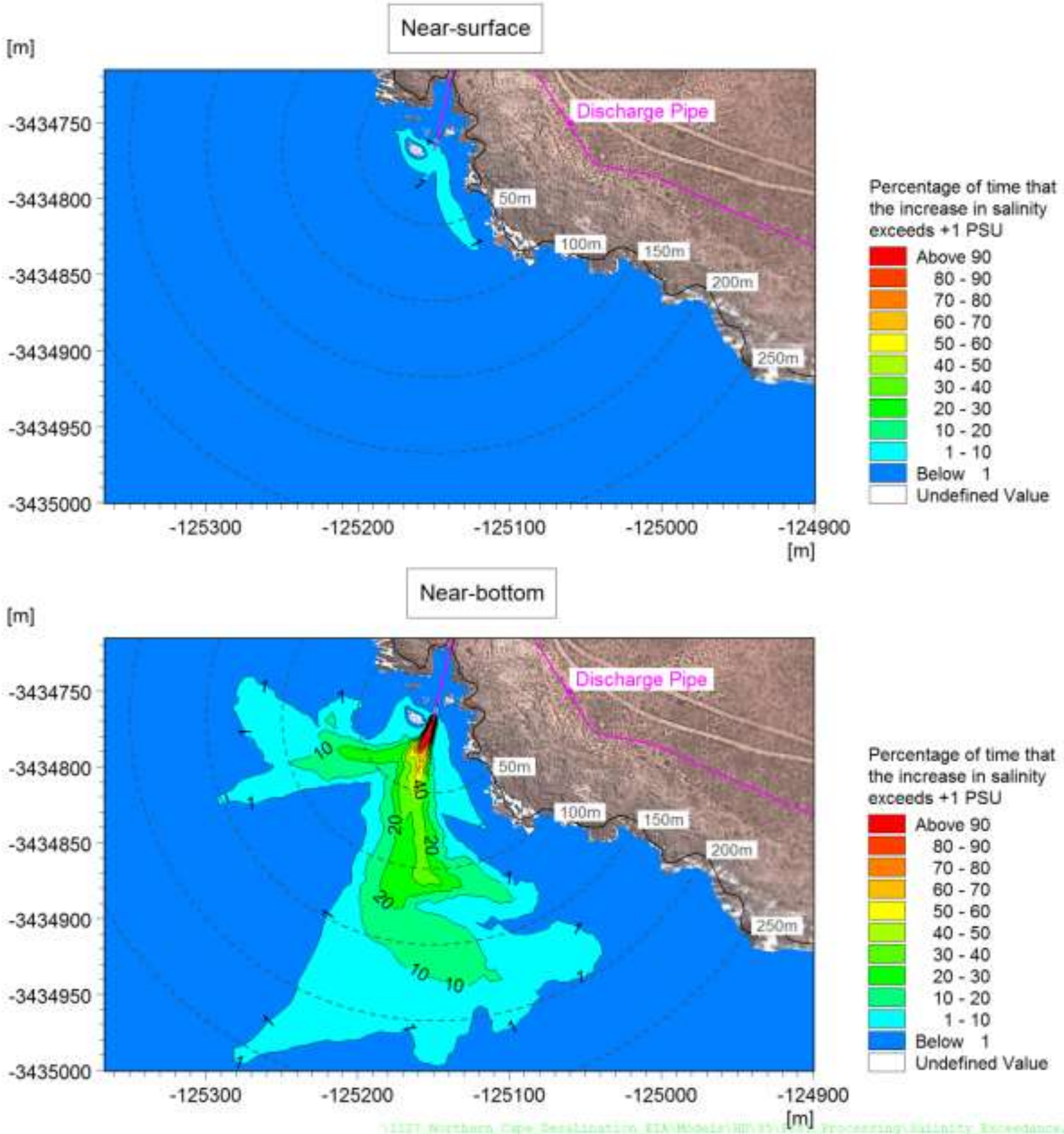
	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Probable	**MEDIUM**	– ve	High
Essential mitigation measures: • Ensure engineering designs at the seaward end of the discharge pipe achieve the highest required dilution of brine (29x), thereby limiting increased salinities to the minimum achievable mixing zone only.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Possible	**LOW**	– ve	High



srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** Salinity Increases at Ocean Surface and Ocean Floor	Project No. 451101

Figure 6-3: Typical increases in salinity at the ocean surface and the ocean floor under stormy (A), typical (B) and calm (C) conditions

Source: PRDW, 2014



srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** Salinity Exceedances	Project No. 451101

Figure 6-4: Percentage of time that the increase in salinity exceeds 1 psu

Source: PRDW, 2014

The effect of elevated salinities on the physiological functioning of marine organisms is considered to be of medium intensity and localised (within a maximum of 250 m under transient, 'worst-case' conditions, but typically within 50 m). Impacts will, however, persist over the operational life time of the plant. Mitigation in the form of suitable engineering designs to ensure adequate dispersion and dilution of the brine in the receiving surf-zone environment would reduce the significance of this impact.

6.6.4.3 Potential Impact M9: Reduced Physiological Functioning of Marine Organisms due to Elevated Temperature

In terms of the design specifications for the Volwaterbaai desalination plant intake water, will not be heated through the desalination process, though piping of water to the desalination plant may potentially result in a slight elevation in temperature, in the range of +1 to 2°C above ambient water temperature. On discharge, the slightly heated, dense effluent would sink towards the seabed where the receiving water may potentially have a lower temperature than the brine. However, discharge into the oncoming waves will ensure rapid dispersal throughout the water column, and no changes in absolute or mean temperatures of receiving water are expected. Only under conditions of extreme calm, when the receiving waters may be stratified, would a thermal footprint be expected.

Bamber (1995) defined four categories for direct effects of thermal discharges on marine organisms:

- Increases in mean temperature;
- Increases in absolute temperature;
- High short term fluctuations in temperature; and
- Thermal barriers.

Increases in mean temperature

Changes in water temperature can have a substantial impact on aquatic organisms and ecosystems by influencing the physiology of the biota and affecting ecosystem functioning. A number of international studies concluded that at elevated temperatures of <5°C above ambient seawater temperature, little or no effects on species abundances and distribution patterns are likely to be discernible. On a physiological level, however, some adverse effects may be observed, mainly in the development of eggs and larvae.

The South African Water Quality Guidelines recommend that the maximum acceptable variation in ambient temperature should not exceed 1°C (DWAF 1995), which is an extremely conservative value in view of the negligible effects of thermal plumes on benthic assemblages reported elsewhere for an increase of +5°C or less.

All benthic species have preferred temperature ranges and it is reasonable to expect that those closest to their upper limits (i.e. boreal as opposed to temperate) would be negatively affected by an increase in mean temperature. The sessile biota in the Benguela region are, however, naturally exposed to wide temperature ranges due to surface heating and rapid vertical mixing of the water column and intrusions of cold bottom shelf water into the system and these biota are likely to be relatively robust and well-adapted to substantial natural variations in temperature.

The application of the Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) water quality guideline (that requires that the median temperature in the environment with an operational discharge should not lie outside the 20 and 80 percentile temperature values for a reference location or ambient temperatures observed prior to the construction and operation of the proposed discharge), may be more appropriate to the high temperature variability conditions in the study area. Conditions in the surf-zone are, however, expected to be well mixed and thermoclines would not be expected.

Although not modelled for the current study, no discernible temperature footprint would be expected as temperature differences between the brine and receiving waters are expected to be <2°C, complying with both the South African Water Quality Guidelines (DWAF 1995) as well as the ANZECC (2000) guidelines.

Increased absolute temperature

The maximum observed sea surface temperature in the region typically is <18°C. Strong wind events and wave action in the surf-zone are likely to mix the water column to such an extent that bottom waters will have similar water temperatures to surface waters. The discharged brine will not be heated above this naturally occurring maximum temperature and therefore an increase in absolute temperature is not expected and is not further assessed here.

Short term fluctuations in temperature and thermal barriers

Temperature fluctuations are typically caused by variability in flow or circulation driven by frequently reversing winds or tidal streams. As noted above, although likely well mixed by surf-zone turbulence, the receiving waters in the area may vary rapidly in temperature and the ecological effects of potential brine-induced changes of <2°C in temperature are therefore not further assessed.

For thermal barriers to be effective in limiting or altering marine organism migration paths they need to be persistent over time and cover a large cross-sectional area of the water body. The marine modelling predictions show that this will not be the case and the effect of thermal barriers is therefore considered insignificant.

The effects of elevated temperature on marine communities are considered to be of low intensity. Impacts will, however, persist over the operational life time of the plant.

The impact is assessed to be of ***very low*** significance with and without mitigation (Table 6-32).

Table 6-32: Significance of reduced physiological functioning of marine organisms due to elevated temperature

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Possible	**VERY LOW**	– ve	High
Essential mitigation measures: • Ensure engineering designs at the seaward end of the discharge pipe achieve the highest required dilution of brine (29x), thereby limiting potential thermal footprints to the mixing zone only.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Improbable	**VERY LOW**	– ve	High

6.6.4.4 Potential Impact M10: Chronic Effects on Marine Organisms due to Formation of Halogenated By-products

A major disadvantage of chlorination is the formation of organohalogen compounds (e.g. trihalomethanes (THMs), see Appendix A.2 of Appendix 4B). However, as only a low percentage of the total added chlorine is recovered as halogenated by-products, and as by-product diversity is high, the environmental concentration of each substance can be expected to be relatively low. Dechlorination will also considerably reduce the potential for by-product formation. Nonetheless, there is some evidence in literature that chlorinated-dechlorinated seawater increases mortality of test species and chronic effects of dechlorinated seawater were observed, which were assumed to be due to the presence of halogenated organics formed during chlorination.

The effects of halogenated by-products on marine communities are considered to be of medium intensity, but effects will be chronic and endure over the long-term. As only a very small percentage of the chlorine will transform into toxic by-products that cannot be eliminated by dechlorination chronic effects on marine organisms are considered unlikely. Direct mitigation is not possible as chlorine chemistry is complex and the type and concentration of by-product formation cannot be predicted.

The impact is assessed to be of ***low*** significance (Table 6-33). No mitigation is possible.

Table 6-33: Significance of chronic effects on marine organisms due to formation of halogenated by-products

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Improbable	**LOW**	– ve	High
Essential mitigation measures: • No mitigation possible								
With mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Improbable	**LOW**	– ve	High

6.6.4.5 Potential Impact M11: Detrimental Effects on Marine Organisms through Discharge of Co-Pollutants in Backwash Water

In addition to the biocide dosing, the pre-treatment of the feed-water includes the removal of suspended solids, the control of scaling, and the periodic cleaning of the RO membranes (CIP process). Specifications and volumes of cleaning chemicals that may be used in the pre-treatment and CIP process and may be co-discharged with the brine effluent are listed in Table 3-5. As different chemicals are suited for different types of membranes, exact specifications for the additives will only be known once the desalination plant operator has been appointed and the membrane type has been determined. This section thus describes the use and effects of cleaning chemicals conventionally used in desalination plants with an open water intake.

Flocculants

$FeCl_3$ will be used as primary coagulant or flocculant in the pre-treatment system (see Section 3.7.1). When added to water, a hydrolysis reaction produces an insoluble Ferric Hydroxide precipitate that binds non-reactive molecules and colloidal solids into larger aggregations that can then be more easily settled or filtered from the water before it passes through to the RO membranes. Dosing of H_2SO_4 to establish slightly acidic pH values and addition of coagulant aids such as polyelectrolytes can enhance the coagulation process. The resulting Ferric Hydroxide floc is retained when the seawater passes through the filter beds. The filters are backwashed on a periodic basis (a few times every day), using filtered seawater or permeate (process water), to clean the particulate material off the filters. This produces a sludge that contains mainly sediments and organic matter, and filter coagulant chemicals. If co-discharged to the sea, $FeCl_3$ may cause discolouration of the receiving water, and sludge discharge may lead to increased turbidity and smothering effects. Residual ferric hydroxide in the brine would thus be minimal to non-detectable.

Antiscalants

Scaling on the inside of tubes or on RO membranes impairs plant performance. Antiscalants are commonly added to feed-water to prevent scale formation. Their use may cause a nutrient surplus and an increase in primary production at the discharge site, through formation of algal blooms and increased growth of macroalgae. When the organic material decays, this in turn can lead to oxygen depletion.

In contrast, phosphonate and organic polymer antiscalants have a low toxicity to aquatic invertebrate and fish species, but some substances exhibit an increased toxicity to algae. The typical antiscalant dosing rate in desalination plants (1–2 mg/ℓ), however, is a factor of 10 lower than the level at which a chronic effect was observed (20 mg/ℓ), and it is 10 to 5 000 times lower than the concentrations at which acutely toxic effects were observed. Phosphonate will be used as the antiscalant for the desalination plant, with predicted antiscalant concentration in the brine of 4.7 mg/ ℓ, which is still far below chronic effects level. Due to the antiscalants capability of binding nutrients they may, however, interfere with the natural processes of dissolved metals in seawater following discharge. Some of these metals may be relevant micronutrients for marine algae.

Cleaning in Place Chemicals

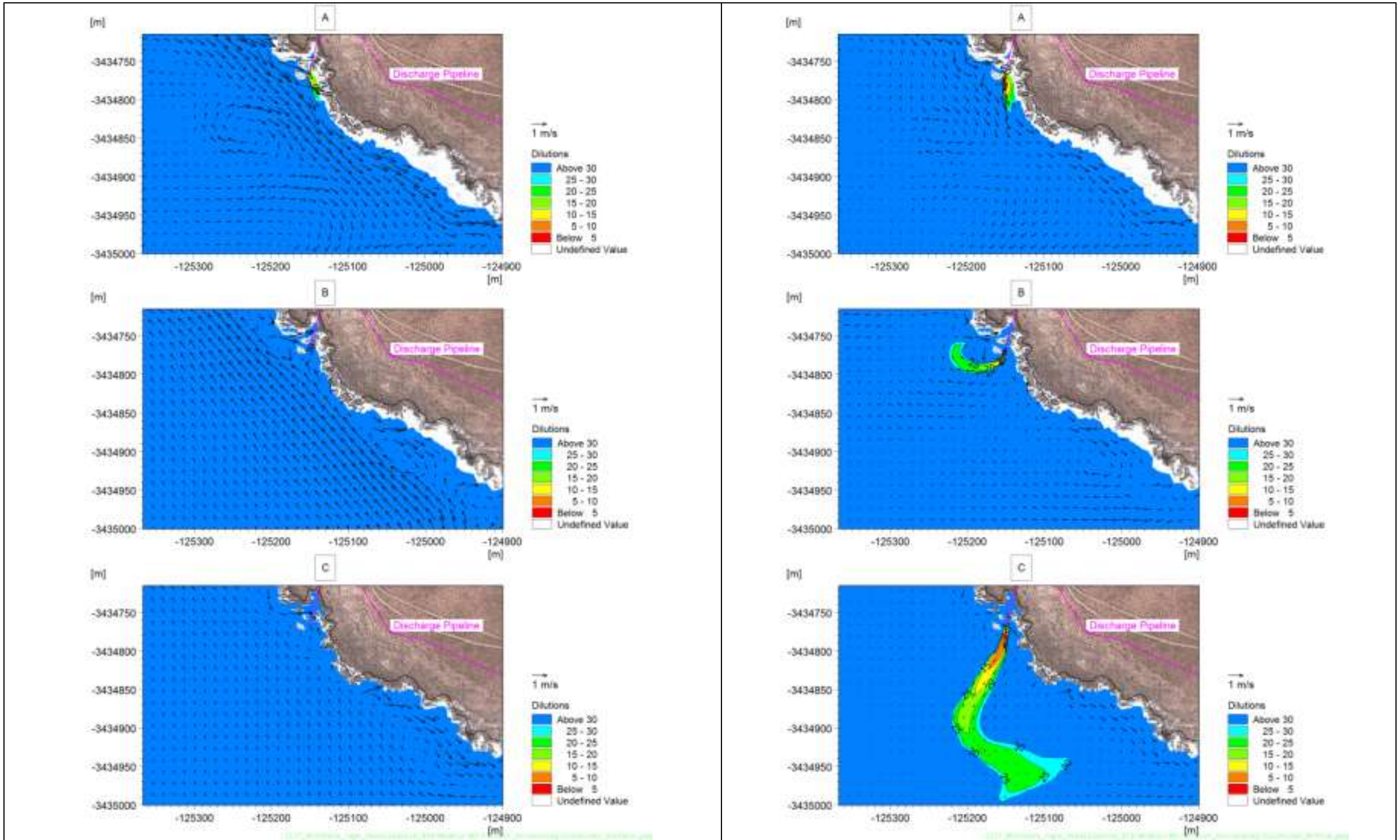
Despite feed-water pre-treatment, membranes may become fouled by biofilms, accumulation of suspended matter and scale deposits, necessitating periodic cleaning, typically every three to six months depending on feedwater quality. The cleaning interval currently suggested for the proposed desalination plant is four times per year. The chemicals used are mainly weak acids and detergents. Alkaline cleaning solutions (pH 11-12) are used to remove silt deposits and biofilms, whereas acidified solutions (pH 2-3) remove metal oxides and scales. Other chemicals such as detergents, oxidants, complexing agents and/or non-oxidising biocides for membrane disinfection, are often added to improve the cleaning process. These chemicals are usually generic types or special brands recommended by the membrane manufacturers. Common cleaning chemicals include H_2SO_4, Ethylenediaminetetra-acetic acid, Sodium tripolyphosphate, and Trisodium phosphate, and DBNPA as the non-oxidising biocide[24].

After the cleaning process is complete and the cleaning agents have been circulated through the membranes, the membranes are rinsed with product water several times. It is proposed that the residual membrane cleaning solution and rinse water will be blended with the other residual streams from the DAF and filtration systems, and drip-fed into the brine effluent. Generally, the toxicity of the various chemicals used in the pre-treatment and CIP process (aside from biocides) is relatively low (see Appendix A.3 of Appendix 4B), and none of the products are listed as tainting substances (DWAF, 1995).

For the assessment of co-discharges with the brine, the hydrodynamic model used dilution target values of 30-times dilution. These are merely nominal conservative required dilutions that provide indicative results for potential co-discharges. The assumption here is that the respective water quality guidelines will be sufficiently stringent for required dilutions of 30 to be necessary.

Figure 6-5 illustrates the dilution footprints at the ocean surface and ocean floor respectively, under different conditions. Figure 6-6 indicates the percentage of time that the dilution rate of 30 times is not reached. The assessments of impacts on marine ecology are based on 30 times dilution contours.

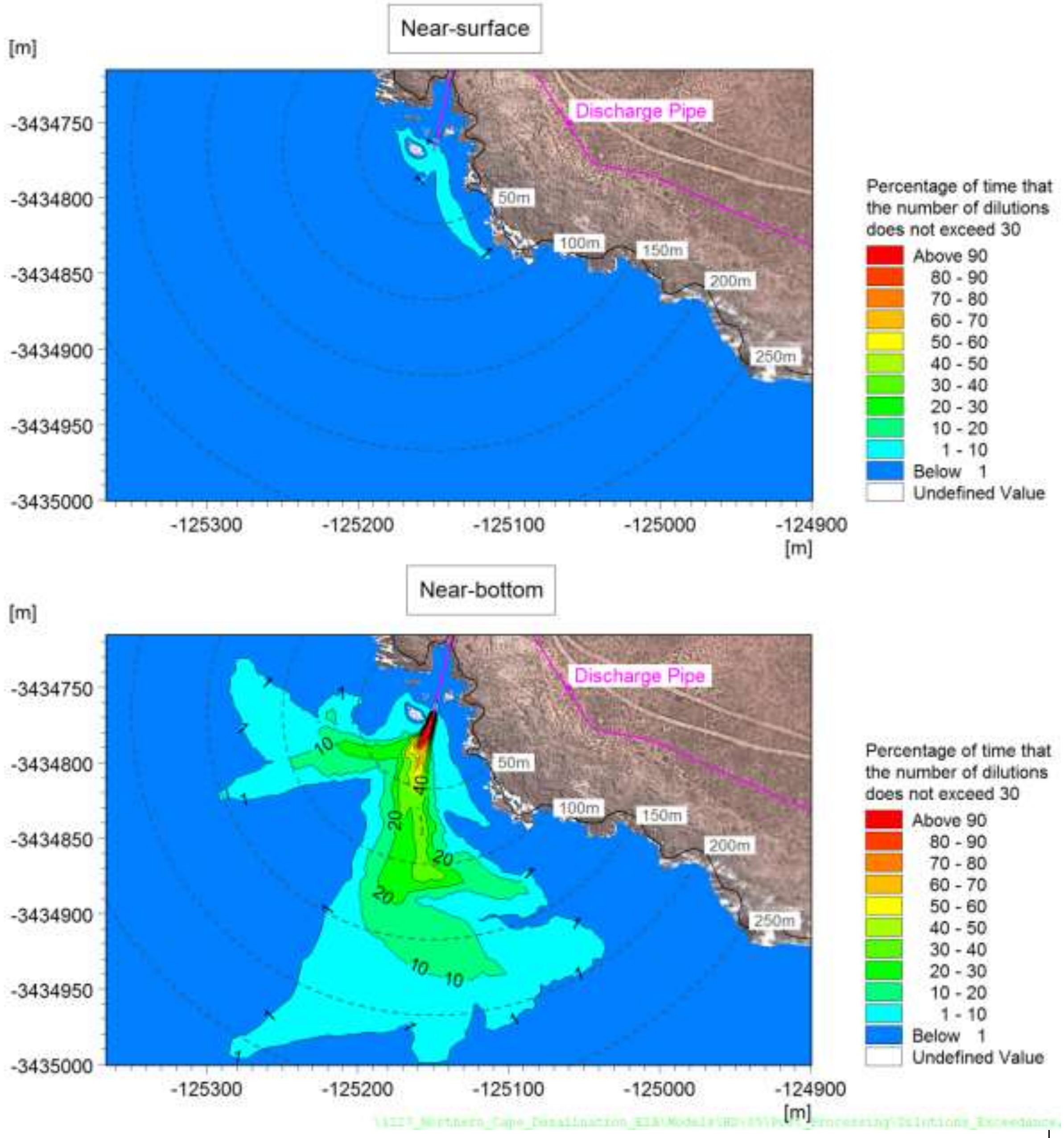
[24] Appendix A.3 of Appendix 4B provides a short summary of the environmental fates and effects of these chemicals.



srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** Dilution Factors at Ocean Surface and Ocean Floor	Project No. 451101

Figure 6-5: Dilution factors of co-discharges at ocean surface and ocean floor under stormy (A), typical (B) and calm (C) conditions

Source: PRDW, 2014



srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** Dilution Exceedance	Project No. 451101

Figure 6-6: Percentage of time that number of dilutions does not exceed 30

Source: PRDW, 2014

The maximum distance from the discharge point where the required dilution of 30 was not achieved for 1% of the time (or approximately 7 hours per month) is ~ 250 m near the seabed during periods of extreme calm. Although the reported maximum footprint is relatively large, it represents the worst-case scenario and will only occur for a very short periods under certain weather conditions (very calm conditions). It is unlikely that in such a short time a surplus of nutrients will lead to a significant increase in algal production, or in the case of antiscalants, to a noticeable reduction in micronutrients. Mitigating measures include discharge of the brine through a diffuser, and the avoidance of polyphosphate antiscalants. A Whole Effluent Toxicity test of the discharged brine is recommended to more reliably assess the impact of any co-discharged constituents and to calculate the required dilution rate.

The assessment of co-pollutants has thus adopted a conservative approach, as under typical wind and wave conditions the observed co-pollutant footprints would be considerably reduced or undetectable. The model results for typical dilutions and dispersion of co-pollutants in the brine showed similar footprints for a dilution factor of 30, to those obtained for salinity.

The effects on marine communities of discharging co-pollutants with the brine are considered to be of medium intensity, will remain localised (within a maximum of 250 m under transient, 'worst-case' conditions, but typically within 50 m), but would persist over the life time of the plant. The impact is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***very low*** (see Table 6-34).

Table 6-34: Significance of detrimental effects on marine organisms through discharge of co-pollutants in backwash waters

	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Probable	**MEDIUM**	– ve	High
Essential mitigation measures: • Use low-toxicity chemicals as far as practicable; • Limit the use of scale-control additives to minimum practicable quantities; • Avoid antiscalants that increase nutrient levels (e.g. polyphosphate antiscalants); • Select an antiscalant that has relevant eco-toxicological testing; • Conduct Whole Effluent Toxicity (WET) testing of the brine effluent; and • Collect residual cleaning solutions and membrane filter washes and neutralize and remove solids before discharge.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Probable	**LOW**	– ve	High

6.6.4.6 Potential Impact M12: Detrimental Effects on Marine Organisms due to Residual Biocides and Chemicals in Brine

Brine will contain traces of biocide and other chemical residuals from the pre-treatment of intake water and RO membrane cleaning processes. Table 3-5 lists the expected composition of the brine effluent.

Chemical pre-treatment of the intake water and periodic cleaning of the RO membranes is essential for the effective operation of desalination plants. Pre-treatment and cleaning include treatment against biofouling, suspended solids and scale deposits. The type of pre-treatment system used is determined primarily by the intake type and feed-water quality.

The main components of the pre-treatment system for the Volwaterbaai desalination plant are:

- Control of biofouling by addition of an oxidising (chlorine-based) or non-oxidising (e.g. DBNPA) biocide, and dechlorination with SMBS (in the case of chlorine-based products);
- Removal of suspended material by coagulation and membrane filtration (i.e. ultrafiltration membrane);
- Control of scaling by acid addition (lowering the pH of the incoming seawater) and/or dosing of special 'anti-scalant' chemicals; and
- Cartridge filters as a final protection barrier against suspended particles and microorganisms before the RO units.

The open channel intake basin design is likely to necessitate high pre-treatment and screen maintenance to reduce the intake of extensive algal growth, floating debris, grease and oil, thus increasing the amount of biocides and/or chemicals co-discharged with the brine.

Chlorination of the intake water is undertaken to ensure that the pumping systems (e.g. intake pipe and membranes) are maintained free of biofouling organisms. For example, larvae of sessile organisms (e.g. mussels, barnacles) can grow in the intake pipe, and impede the intake flow of the feed-water. Biofouling of the membranes by algae, fungi and bacteria can rapidly lead to the formation and accumulation of slimes and biofilms, which can increase pumping costs and reduce the lifespan of the membranes.

There are two main groups of biocides: the oxidising biocides and the non-oxidising biocides. Oxidising biocides include chlorine and bromine-based compounds and are non-selective with respect to the organisms they kill. Non-oxidising biocides are more selective, in that they may be more effective against one type of micro-organisms than another. A variety of active ingredients are used as non-oxidising biocides, including quaternary ammonium compounds, isothiazolones, halogenated bisphenols, thiocarbamates as well as others. In desalination plants, the non-oxidising DBNPA is frequently used as an alternative to an oxidising biocide. DBNPA has extremely fast antimicrobial action and degrades rapidly to relatively non-toxic end products.

For the Volwaterbaai desalination plant, it is proposed that either sodium hypochlorite (NaOCl) or chlorine gas will be used as an oxidising biocide. The chlorine-based biocide will be added intermittently at the plant’s intake structure as shock dosages of 10 minute duration every 4 hours.

Before the feed-water enters the RO units, residual chlorine needs to be neutralised with SMBS to avoid membrane damage, as RO membranes are typically made from polyamide materials which are sensitive to oxidising chemicals such as chlorine. As a consequence, chlorine concentration will be very low to non-detectable in the brine effluent of the plant and is thus assumed to be below the 3 µg/ℓ limit as permitted by ANZECC (2000), which provides the most conservative guideline value (see Table 5 in Appendix 4B). Compliance with the guidelines is thus expected.

The effects of residual chlorine and biocides on marine communities are considered to be of high intensity, but effects will likely remain localised. Impacts will persist over the medium-term as impacted marine communities will recover within 2-5 years. The impact is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***insignificant*** (Table 6-35).

Table 6-35: Significance of detrimental effects on marine organisms due to residual chlorine levels

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	High 3	Medium 2	**Medium 6**	Definite	**MEDIUM**	– ve	High
Essential mitigation measures: • Implement shock dosing of biocide in preference to continual dosing; • Dechlorinate effluent prior to discharge with sodium metabisulphite (SMBS); • Undertake ‘pigging’ of intake and discharge pipelines to reduce the need for and costs of biocides.								
With mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	Improbable	**INSIGNIFICANT**	– ve	High

6.6.4.7 Potential Impact M13: Detrimental Effects on Marine Organisms of Heavy Metals from Corrosion Processes

Brine from desalination plants often contains low concentrations of heavy metals that pass into solution when the plant’s interior surfaces corrode. In RO plants, non-metal equipment and stainless steels are typically used and brine may contain traces of iron, nickel, chromium and molybdenum, though contamination levels are generally low. Heavy metals tend to enrich in suspended material and finally in sediments, so that areas of restricted water exchange and soft bottom habitats impacted by the discharge could be affected by heavy metal accumulation. Many benthic invertebrates feed on this suspended or deposited material, with the risk that metals are enriched in their bodies and passed on to higher trophic levels.

The effects on marine communities of heavy metals in the brine from corrosion processes are considered to be of medium intensity, but will likely remain localised. As heavy metals can accummulate in the sediments, the effects would persist in the long-term. The impact is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***very low*** (Table 6-36)

Table 6-36: Significance of detrimental effects on marine organisms of heavy metals from corrosion processes

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Probable	**MEDIUM**	– ve	High
Essential mitigation measures: • Design the plant to reduce corrosion to a minimum by ensuring that dead spots and threaded connections are eliminated. Corrosion resistance is considered good when the corrosion rate is <0.1 mm/a (UNEP 2008).								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Improbable	**VERY LOW**	– ve	High

6.6.5 The No-Go Alternative

For the No-Go alternative, natural processes at the desalination plant discharge and intake points would remain unaltered.

6.6.6 Mitigation Measures: Potential Impacts on Marine and Coastal Ecology

Essential marine mitigation measures during **construction** are as follows:

- Restrict disturbance of the intertidal and subtidal areas to the smallest area possible;
- Lay pipeline in such a way that required rock blasting is kept to a minimum;
- Restrict traffic on upper shore to the minimum required;
- Restrict traffic to clearly demarcated access routes and construction areas only;
- Conduct a comprehensive environmental awareness programme amongst contracted construction personnel;
- Ensure that oils and lubricants used for maintenance of equipment in the field are correctly contained;
- Maintain vehicles and equipment to ensure that no oils, diesel, fuel or hydraulic fluids are spilled;
- Ensure that all construction vehicles used in the coastal zone have a spill kit (peatsorb/ drip trays) on-board to be used in the event of a spill;
- No mixing of concrete may be allowed in the intertidal zone;
- Regularly clean up concrete spilled during construction;
- No dumping of excess concrete or mortar or construction materials may be allowed on the sea bed, intertidal, subtidal or coastal zone;
- Ensure regular collection and removal of refuse and litter from intertidal areas;

- Restrict blasting to the absolute minimum required and a maximum of one blast per day;
- Use blasting methods which minimise the environmental effects of shock waves through the use of smaller, quick succession blasts directed into the rock;
- Avoid onshore blasting during the breeding season of shore-birds;
- Undertake visual observation prior to blasting to ensure there are no marine mammals and turtles present in the immediate vicinity (approximately 2 km radius);
- Keep the footprint of the temporary desalination plant in the coastal zone to the absolute minimum required; and
- Ensure that brine and co-pollutants from the temporary desalination plant are discharged into the surf-zone below the low water mark.

Essential marine mitigation measures to address **operation** impacts are as follows:

- Adjust seawater intake velocities to <0.15 m/s;
- Ensure installation of screens on the end of the intake pipes, or the use of a screen box or shroud;
- Ensure engineering designs at the seaward end of the discharge pipe achieve the highest required dilution of brine (29x), thereby limiting increased salinities to the minimum achievable mixing zone only;
- Implement shock dosing of biocide in preference to continual dosing to avoid bacterial resistance to the biocide;
- Undertake ‘pigging’ of intake and discharge pipelines to reduce the need for and costs of biocides;
- Dechlorinate effluent prior to discharge with sodium metabisulphite (SMBS);
- Avoid over-dosing of SMBS;
- Aerate the effluent prior to discharge;
- Monitor the brine for excessive bacterial re-growth and if necessary use SMBS shock dosing to reduce bacterial numbers (note that the brine will be oxygen depleted after this treatment and needs to be aerated before discharge);
- Use low-toxicity chemicals as far as practicable;
- Limit the use of scale-control additives to minimum practicable quantities;
- Avoid antiscalants that increase nutrient levels (e.g. polyphosphate antiscalants);
- Select an antiscalant that has relevant eco-toxicological testing;
- Conduct Whole Effluent Toxicity (WET) testing of the brine effluent to more reliably assess the impact of any co-discharged constituents and to calculate the required dilution rate;
- Collect residual cleaning solutions and membrane filter washes and neutralize and remove solids before discharge; and
- Design the plant to reduce corrosion to a minimum by ensuring that dead spots and threaded connections are eliminated. Corrosion resistance is considered good when the corrosion rate is <0.1 mm/a (UNEP 2008).

Best practice marine mitigation measures during **construction** are as follows:

- Implement good housekeeping practices during construction;
- Develop and implement a responsible blasting schedule, which allows seals and other scavengers feeding on dead fish to have left the area before the next blasting event;
- Visually search the area around the blasting site for marine mammals, sea turtles or flocks of swimming and diving birds. Postpone blasting if any are observed within a 2 km radius of the blasting site;
- Use low-toxicity chemicals in the temporary desalination plant as far as practicable; and
- Leave the marine pipeline in place post closure to prevent unnecessary disturbance of the seabed and associated communities.

Best practice marine mitigation measures to address **operation** impacts are as follows:

- Design outlet velocities so as to minimise the potential for flow distortion;
- Ensure efficient CIP process and adequate maintenance of plant;
- Implement a water quality monitoring programme to validate the predictions of the hydrodynamic modelling study and monitor constituents of the effluent to ensure compliance with water quality guidelines;
- Establish limits for heavy metal concentrations in the brine discharges and monitor the brine regularly to avoid exceedance of these limits; and
- Although an entrainment and impingement study is typically recommended for large desalination plants, the comparatively low volumes of feed-water to be extracted from the surf-zone for this project would not justify such a study.

6.7 Potential Socio-economic Impacts

This impact has been assessed by SRK specialists using SRK's standard Impact Assessment rating methodology and a stand-alone specialist study has not been produced.

6.7.1 Assessment of Impacts: Construction Phase

The KLM is characterised by high unemployment and low income levels, with a 31% unemployment rate and the majority of the population falling below the poverty line (see Section 4.2.2). Temporary employment opportunities may be created during the construction phase.

Increased traffic during the construction phase would likely be beneficial to businesses, guest houses and local shops in the Kotzesrus area, but may also lead to some security concerns.

The socio-economic impacts assessed for the construction phase thus include:

- SE1: Increased employment, income and skills development;
- SE2: Increased business and tourism opportunities; and
- SE3: Security concerns.

6.7.1.1 Potential Impact SE1: Increased Employment, Income and Skills Development

A limited number of new employment opportunities will be created during construction, including 40 direct temporary jobs during the first 18 months and 60 over the following 12 months. Local labour will be used as far as possible and skills training will be implemented where possible, should sufficient skilled labour be unavailable in the area.

Although a limited number of new employment opportunities will be created, the use of local contractors and sub-contractors will support the regional construction industry during the short term and will contribute to skills development and income generation. The proposed project will to a limited extent indirectly contribute to job creation and poverty alleviation in the KLM.

The impact is assessed to be ***insignificant*** (positive) and with the implementation of mitigation is increased to ***very low*** (positive) (Table 6-37).

Table 6-37: Significance of increased employment and income

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	Possible	**INSIGNIFICANT**	+ve	Low
Key Mitigation Measures: • Survey skills levels in local communities, and employ people based on the availability of local skill; and • Promote skills development as opposed to the importation of skills, where possible.								
With mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	Probable	**VERY LOW**	+ve	Low

6.7.1.2 Potential Impact SE2: Increased Business and Tourism Opportunities

A limited increase in traffic in the area may benefit local businesses, shops and guest houses in the vicinity of Kotzesrus during the construction phase, for both route alternatives.

The impact is assessed to be of ***very low*** (positive) significance with and without the implementation of mitigation measures (Table 6-38).

Table 6-38: Significance of increased business and tourism opportunities

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	Probable	**VERY LOW**	+ve	Low
Key Mitigation Measures: • None.								
With mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	Probable	**VERY LOW**	+ve	Low

6.7.1.3 Potential Impact SE3: Increased incidence of crime

The Kotzesrus area is very isolated and increased accessibility and an influx of people during the construction phase may increase the (perceived) incidence of crime, causing concern to local residents, particularly in the vicinity of Kotzesrus. Local workers will be used and transported to construction sites on a daily basis, where required. Workers will be adequately supervised while construction is taking place. Only a limited number of workers will be employed during the construction phase.

The impact is assessed to be ***insignificant*** with and without mitigation (Table 6-39).

Table 6-39: Significance of increased incidence of crime

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low** **3**	Possible	**INSIGNIFICANT**	-ve	Low
Essential Mitigation Measures: • None.								
With mitigation	Local 1	Low 1	Short-term 1	**Very Low** **3**	Improbable	**INSIGNIFICANT**	-ve	Low

6.7.2 Assessment of Impacts: Operation Phase

Some permanent employment opportunities will be created during the operation phase of the project, while improved accessibility to the coast and the Kotzesrus area may lead to increased business and tourism opportunities in the project area and surrounding areas.

The socio-economic impacts assessed for the operation phase thus include:

- SE4: Increased employment, income and skills development; and
- SE5: Increased business and tourism opportunities.
- SE6: Improved service provision

6.7.2.1 Potential Impact SE4: Increased Employment, Income and Skills Development

A very limited number of permanent employment opportunities (between 5 and 7 people) will be created by the desalination plant. However, the desalination plant will supply water to the Zandkopsdrift Mine, which is expected to create approximately 230 new employment opportunities for approximately 30 years.

The impact is assessed to be of ***low*** (positive) significance with and without mitigation (Table 6-40).

Table 6-40: Significance of increased employment and income

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Probable	**LOW**	+ve	Low
Key Mitigation Measures: • Award installation, customisation and maintenance contracts to South African companies in instances where plant, material or goods must be procured abroad; • Survey skills levels in local communities, and employ people based on the availability of local skill; and • Promote skills development as opposed to the importation of skills, where possible.								
With mitigation	Local 1	Low 1	Long-term 3	**Low** **3**	Definite	**LOW**	+ve	Low

6.7.2.2 Potential Impact SE5: Increased Business and Tourism Opportunities

Kotzesrus Route

The upgrade of the *Kotzesrus Route* will improve accessibility to Kotzesrus and the coast. Increased traffic would likely be beneficial to businesses, guest houses and local shops in Kotzesrus and surrounding areas and may benefit coastal tourism, particularly during summer and spring. Conversely, the construction of linear infrastructure through Kotzesrus may also impair the rural character and unique heritage of the town, reducing its tourism potential (see Section 6.8).

The impact is thus assessed to be of ***very low*** (positive) significance with and without mitigation (Table 6-41).

Table 6-41: Significance of increased business and tourism opportunities with use of the Kotzesrus Route

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Long-term 3	**LOW 3**	Possible	**VERY LOW**	+ve	Low
Key Mitigation Measures: • None								
With mitigation	Local 1	Low 1	Long-term 3	**LOW 3**	Possible	**VERY LOW**	+ve	Low

Amended Bypass Route

The possible routing of light vehicles through the town and heavy vehicles around the town during the operation phase may increase the likelihood of positive benefits associated with increased activity in the town. The placement of linear infrastructure along the bypass route would also help to retain the town's rural character and thereby, its tourism potential.

The impact is thus assessed to be of ***very low*** (positive) significance and with the implementation of mitigation is increased to ***low*** (Table 6-42).

Table 6-42: Significance of increased business and tourism opportunities with use of the Amended Bypass Route

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Possible	**VERY LOW**	+ve	Low
Key Mitigation Measures: • Divert heavy vehicles around Kotzesrus; and • Encourage light vehicles and personnel to drive through Kotzesrus.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Possible	**VERY LOW**	+ve	Low

6.7.2.3 Potential Impact SE6: Improved Service Provision

Service provision in the KLM is challenging (see Section 4.2.2.6). The KLM does not provide water and electricity to Kotzesrus, which relies on other sources, including groundwater abstraction and alternative energy sources. The KLM does provide water and electricity to Lepelsfontein, however, the upgrading of water networks in Lepelsfontein has been identified as a priority in the KLM SDF.

The opportunity exists to provide the community with fresh product water from the storage reservoir located at Kotzesrus. KLM does not currently provide water supply services to Kotzesrus or other villages in the areas (e.g. Lepelsfontein). An agreement between the KLM, Sedex Desalination and the communities of Kotzesrus and Lepelsfontein is not yet in place. This will be negotiated at a later stage.

Although there are a limited number of residents in the town of Kotzesrus, the intensity of the impact of the provision of water is assessed to be medium. Similarly, the benefit of a reliable potable water supply to the town of Lepelsfontein would also have a considerable impact on service provision to the town, in this water stressed environment.

The impact is assessed to be of ***very low*** (positive) significance and with the implementation of mitigation is increased to ***low*** (Table 6-43).

Table 6-43: Significance of improved service provision

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Improbable	**VERY LOW**	+ve	Low
Key Mitigation Measures: • Investigate the opportunity of providing water to villages in close proximity to the project infrastructure.								
With mitigation	Local 1	Low 2	Long-term 3	**LOW 5**	Possible	**VERY LOW**	+ve	Low

6.7.3 The No-Go Alternative

The No-Go alternative will bring none of the socio-economic benefits of the project such as income generation, employment and skills transfer. Increased crime and security concerns, as well as potential business and tourism opportunities associated with increased activity during the construction phase would not materialise. The Zandkopsdrift Mine would not have a viable water supply and the significant economic benefits of the mine would be lost. The No-Go alternative would represent an economic loss to an area with a lack of economic prospects and is less preferable than the development proposal.

6.7.4 Mitigation Measures: Potential Socio-economic Impacts

Essential socio-economic mitigation measures during **construction and operation** are as follows:

- Prioritise procurement of goods and services from local suppliers during construction, especially from suitably accredited Broad Based Black Economic Empowerment (BBBEE) suppliers;
- Commit to local procurement targets based on information on local availability, giving preference to suitably accredited BBBEE suppliers;
- Determine which goods can be realistically sourced within the KLM through partnership with local government, the local business chamber and Non-Governmental Organisations (NGOs);
- Determine areas of potential supplier development to encourage local supply and train/enable suppliers accordingly;
- Encourage and support life skills education programmes which focus on responsible personal financial management;
- Ensure maximum procurement of goods and services from suppliers located in the KLM and NDM;
- Maximise opportunities for the training of unskilled and skilled workers from local communities and use local sub-contractors where possible;
- Promote skills development as opposed to the importation of skills, where possible;
- Train new staff where skill shortages exist;
- Survey skills levels in local communities, and employ people based on the availability of local skills;
- Develop workforce skills that will promote local economic integration and entrepreneurship;
- Implement a grievance mechanism;

Essential socio-economic mitigation measures to address **operation** impacts are as follows:

- Award installation, customisation and maintenance contracts to South African companies in instances where plant, material or goods must be procured abroad;
- Survey skills levels in local communities, and employ people based on the availability of local skills;
- Promote skills development as opposed to the importation of skills, where possible;
- Divert heavy vehicles around Kotzesrus (with the use of the *Amended Bypass Route*); and
- Encourage light vehicles and personnel to drive through Kotzesrus (with the use of the *Amended Bypass Route)*.

Best practice socio-economic mitigation measures during **construction** are as follows:

- Ensure that workers are sourced from local communities as far as possible;
- Ensure that workers are kept within construction areas and are not allowed to move around freely in surrounding areas;
- Ensure adequate supervision of workers within construction areas.

6.8 Potential Cultural Heritage Impacts

6.8.1 Introduction, Terms of Reference and Methodology

This assessment is based on the HIA undertaken by ACO Associated (see Appendix 4D). The purpose of the study was to assess the potential impacts of the development alternatives on heritage resources, indicate the acceptability of impacts and recommend practicable mitigation measures to minimise potential impacts and maximise potential benefits.

The ToR for the study were to:

- Identify any areas of concern associated with the proposed layout of project infrastructure and alternative road and pipeline route alignments as early on in the project as possible;
- Provide a description of the baseline environment in terms of heritage and archaeology, based on a desktop review of existing information;
- Undertake a field trip to investigate the alternative road and pipeline routes and the locations of the desalination plant;
- Record all Heritage Sites and features photographically and provide GPS coordinates for all features of interest;
- Identify, describe and assess the impacts of the proposed development on the heritage resources in the area, including Stone Age and historical archaeology, the built environment, the cultural landscape and graves and burials;
- Summarise, categorise and rank all identified impacts on heritage resources in appropriate Impact Assessment tables, to be incorporated in the overall EIA. Present the assessment of impacts associated with various alternatives in separate tables where applicable;
- Recommend practicable management measures to mitigate and/or optimise impacts;
- Compile a monitoring plan to monitor impacts, if required;
- Ensure that the reports meet the requirements of the SAHRA; and

- Advise on, and provide technical input required for the submission of applications to SAHRA in terms of the NHRA.

The HIA included a literature review, followed by site assessments undertaken in August 2013. During the survey, positions of archaeological finds were recorded. Photographs were taken in order to capture representative samples of both the affected heritage and the landscape setting.

A desktop Palaeontology study was also undertaken by John Pether in 2014, comprising a literature review (see Appendix 4E).

The ToR for the palaeontology study were to:

- Undertake a desktop study to describe the expected palaeontological resources in the areas of the proposed development (including all alternatives) and place this in a regional context;
- Map the potential occurrence of palaeontological resources in the area;
- Identify and assess potential impacts on the palaeontological resources as a result of the proposed development, using the prescribed impacts assessment methodology;
- Recommend practicable management measures to mitigate and/or optimise impacts; and
- Recommend and draft a monitoring campaign to ensure the correct implementation and adequacy of recommenced mitigation measures, if applicable.

6.8.2 Assessment of Impacts: Construction Phase

Two potential direct construction phase impacts on the archaeology and palaeontology of the area were identified, and are assessed separately for separate project components:

- H1: Disturbance and Loss of Archaeological Material;
- H2: Disturbance and Loss of Heritage Structures; and
- H3: Disturbance and Loss of Palaeontological Material.

6.8.2.1 Potential Impact H1: Disturbance and Loss of Archaeological Material

Linear Infrastructure

Only a small number of identified archaeological sites may potentially be negatively affected by either of the route alternatives.[25]

Indications are that no archaeological sites will be affected by the construction of the proposed pipeline and power line at the Zandkopsdrift Mine. However, the coastal zone is particularly sensitive and there is a possibility that archaeological sites may occur within this zone along the route to Kotzesrus, within the first 300m of the desalination plant.

Archaeological sites are highly context sensitive and they lose value and meaning once disturbed by any form of excavation or earthmoving activity. The extent of the impact is local, as the disturbance will be limited to the construction footprint. The duration of the impact is long-term and essentially irreversible, as archaeological material would be lost.

The impact is thus assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low*** for both route alternatives (Table 6-44).

[25] These include site BFT/2013/001 (as identified in points 14-19 of Appendix C of the HIA) and site SFT2013/031 (as identified in points 111-120 of Appendix C of the HIA) (see Appendix 4D)

Table 6-44: Significance of loss of archaeological material during construction of linear infrastructure

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Alternatives 1 and 2								
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Probable	**MEDIUM**	– ve	High
Recommended mitigation measures: • Make use of existing tracks as far as possible and avoid the encroachment of construction activities into undisturbed areas; • Restrict construction activities to within the existing zone of disturbance along the archaeologically sensitive coastal route; • Design linear infrastructure in such a way as to avoid impacting on any sensitive archaeological sites along the linear infrastructure route as identified in the HIA (see Appendix 4D), where possible; • Obtain the required permits from SAHRA for the scientific excavation of archaeological material, should this be required. • Appoint a qualified archaeologist to demarcate any archaeological sites (including shell middens) that may be affected by construction activities, as identified in the HIA (see Appendix 4D) in consultation with a qualified archaeologist as No-go areas; • Conduct a scientific excavation operation in consultation with a qualified archaeologist to excavate any sensitive archaeological sites as identified in the HIA (see Appendix 4D), should these fall within the construction footprint; • Inform employees and contractors that archaeological artefacts, including human skeletal remains, might be exposed during construction activities; • Immediately report the discovery of any archaeological material or human remains to SAHRA (021 462 4502) or a qualified archaeologist); • Advise contractors and workers of the penalties associated with the unlawful removal of cultural, historical, archaeological artefacts, as set out in the NHRA, Section 51 (1); and • Cease work immediately and notify SAHRA and/or an archaeologist should any archaeological artefacts be exposed during site clearing or other site activities. Do not remove, destroy or interfere with any artefacts on the site.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Improbable	**VERY LOW**	**– ve**	High

Desalination Plant Positions A, B, D and E

A large number of archaeological sites (coastal shell middens) are located at the desalination plant site. It is therefore likely that construction will impact on archaeological sites in this area: the extent of the impact will depend on the position of the desalination plant.

Desalination plant positions A, B, D and E contain sensitive archaeological material that could be destroyed during construction. The intensity of the loss of this archaeological material is considered to be medium and will be extend over the long term, although limited to the local area.

The impact is thus assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low*** for desalination plant positions A, B, D and E (Table 6-45).

Table 6-45: Significance of loss of archaeological material during construction of the desalination plant positions A, B, D and E

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Probable	**MEDIUM**	– ve	High
Key mitigation measures: • See Table 6-44; and • Report the discovery of any shipwreck material to the SAHRA maritime unit or the maritime archaeologist at Iziko Museums of Cape Town.								
With mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Possible	**LOW**	**Neutral**	High

Desalination Plant Position C

Only desalination plant position C is clear of any surface evidence of archaeological material. This position is therefore the preferred alternative from an archaeological perspective and it is unlikely that any archaeological material will be destroyed during construction.

The impact is thus assessed to be of ***very low*** significance with and without the implementation of mitigation for desalination plant position C (Table 6-45).

Table 6-46: Significance of loss of archaeological material during construction of the desalination plant position C

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Possible	**VERY LOW**	– ve	High
Key mitigation measures: • See Table 6-45.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Improbable	**VERY LOW**	**Neutral**	High

6.8.2.2 Potential Impact H2: Disturbance and Loss of Heritage Structures

No structures of heritage significance occur along the *Amended Bypass Route*. However, a number of buildings of heritage value occur in the town of Kotzesrus. It is possible that these structures may be damaged or affected by construction of the *Kotzesrus Route*, either through physical disturbance or blasting. Some of the buildings in the town are more than 100 years old and are structurally fragile. Blasting may compromise their structural integrity and lead to crumbling or fracturing. Should construction activities occur in close proximity to heritage structures, it is possible that these structures may be damaged during construction.

A memorial structure (the Burden Memorial) is located near the proposed brine discharge point. The structure is less than 60 years old and is not protected in terms of the NHRA. However, it does have sentimental value to the family members of the deceased. The construction of the brine discharge infrastructure may impact on the memorial and the relocation of the structure may be required.

Heritage structures in Kotzesrus and are protected in terms of the NHRA and form an important component of the overall sense of place of the town. The impact is therefore considered to be of medium intensity, and of local extent. The duration of the impact is long-term, should heritage structure be destroyed.

The impact is thus assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***very low*** (Table 6-47).

Table 6-47: Significance of loss of heritage structures during construction of the Kotzesrus Route

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Alternatives 1 and 2								
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Probable	**MEDIUM**	– ve	High
Recommended mitigation measures: • Avoid construction near (within 5 m) of any heritage structures in the town of Kotzesrus; • Ensure that buildings of heritage significance are clearly demarcated and protected, where necessary; • Ensure that blasting does not impact on the structural integrity of heritage structures and ensure that heritage structures are re-enforced where necessary; • Should heritage structure be damaged, repair these structures using the appropriate building techniques in consultation with a qualified architect; and								

• Negotiate the relocation of the Burden memorial with the relevant family members, if required.								
With mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Possible	**VERY LOW**	**– ve**	High

6.8.2.3 Potential Impact H3: Disturbance or Loss of Palaeontological Material

Shallow excavation during construction may affect palaeontological material. In general coastal plain formations are sensitive as they are known to contain rare, well-preserved fossil materials important to on-going palaeoclimatic, palaeobiological and/or evolutionary studies. Potential fossil finds (fossil bones) have high palaeontological importance and their loss is irreversible.

Construction activities may disturb or destroy valuable palaeontological material. Conversely, construction activities often lead to the discovery of valuable palaeontological material. Should this material be adequately preserved and documented, it could provide valuable scientific information that would otherwise have remained undiscovered.

Desalination plant position E

Fossiliferous Quaternary beach deposits may be displaced by construction of the intake and discharge pipelines and during construction of the desalination plant (position E).

Vertebrate fossils that may be destroyed (or uncovered) are likely to be additions to the mid to late Quaternary fauna (which is poorly known) and the extent of the impact is considered to be regional. Proposed excavations are likely to be shallow, fossil bones in Quaternary beach deposits are scarce and intensity of the impact is considered to be low and the likelihood of their discovery is improbable.

The impact is assessed to be of ***low*** (negative) significance and with the implementation of mitigation is assessed to be of ***low*** (positive) significance (Table 6-48).

Table 6-48: Significance of loss of paleontological material during construction of the desalination plant at position E

	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Without mitigation	Regional 2	Low 1	Long-term 3	**Medium** **6**	Improbable	**LOW**	– ve	Medium
Key mitigation measures: • Instruct construction personnel to be alert for rare fossil bones and to follow "Fossil Finds Procedure"; • Appoint a palaeontologist should paleontological finds be uncovered by earthworks; • Cease construction on (chance) discovery of fossils and protect fossils from further damage; • Contact appointed palaeontologist and supply palaeontologist with the relevant information and images; and • Ensure that the palaeontologist assesses the information and establishes a suitable response, such as reporting the importance of the find and providing recommendations for preservation, collection and record keeping.								
With mitigation	Regional 2	Low 1	Long-term 3	**Medium** **6**	Improbable	**LOW**	**+ ve**	Medium

Desalination plant (positions A, B, C and D) and Coastal Linear Infrastructure

Fossil bones are likely to be found at the desalination plant site and in the coastal linear infrastructure route (north of the desalination plant site). Positions A, B, C and D are underlain by terrestrial Aeolian deposits. Fossiliferous Quaternary beach deposits may be encountered along the coastal linear infrastructure route, although it is more likely that Aeolian sands of the Koekenaap formation occur. Both Pliocene and Holocene fossil bones are found in the terrestrial sands of the Koekenaap Formation. These fossil bones have high sensitivity. However, excavations will be shallow and unlikely to disturb these deposits. The impact is considered to be irreversible, of regional extent and of medium intensity.

The impact is assessed to be of ***medium*** (negative) significance and with the implementation of mitigation is assessed to be of ***medium*** (positive) significance, (Table 6-49).

Table 6-49: Significance of loss of paleontological material during construction of the desalination plant (positions A, B, C and D) and linear infrastructure at the coast

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Regional 2	Medium 2	Long-term 3	**High 7**	Possible	**MEDIUM**	– ve	High
Key mitigation measures: • See Table 6-48.								
With mitigation	Regional 2	Medium 2	Long-term 3	**High 7**	Possible	**MEDIUM**	**+ ve**	High

Inland Linear Infrastructure

It is considered less likely that fossil bones will be found in the shallow subsurface of the inland route leading towards the mine, as the route turns eastwards away from the coast. The likelihood of fossil finds is considered similar for both route alternatives.

Fossil bones (of regional importance) are scarce in the recent coversands of the terrestrial sands of the Hardevlei, Koekenaap and Panvlei formations. These coversands will only be excavated to a shallow depth, and the intensity of the impact is considered to be low.

The impact is assessed to be of ***low*** (negative) significance and with the implementation of mitigation is assessed to be of ***low*** (positive) significance (Table 6-50).

Table 6-50: Significance of loss of paleontological material during construction of the inland linear infrastructure

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Regional 2	Low 1	Long-term 3	**Medium 6**	Improbable	**LOW**	– ve	Medium
Key mitigation measures: • See Table 6-48.								
With mitigation	Regional 2	Low 1	Long-term 3	**Medium 6**	Improbable	**LOW**	**+ ve**	Medium

6.8.3 The No-Go Alternative

The No-Go alternative entails no change in the *status quo*, in other words no disturbance of archaeological and palaeontological material. Conversely, potentially scientifically valuable palaeontological material would remain undiscovered.

6.8.4 Mitigation Measures: Potential Cultural Heritage Impacts

Essential cultural heritage mitigation measures during **construction** are as follows:

- Make use of existing tracks as far as possible and avoid the encroachment of construction activities into undisturbed areas;
- Restrict construction activities to within the existing zone of disturbance along the archaeologically sensitive coastal route;
- Design linear infrastructure in such a way as to avoid impacting on any sensitive archaeological sites along the linear infrastructure route as identified in the HIA (see Appendix 4D), where possible;

- Obtain the required permits from SAHRA for the scientific excavation of archaeological material, should this be required;
- Appoint a qualified archaeologist to demarcate any archaeological sites (including shell middens) that may be affected by construction activities, as identified in the HIA (see Appendix 4D) in consultation with a qualified archaeologist as No-go areas;
- Conduct a scientific excavation operation in consultation with a qualified archaeologist to excavate any sensitive archaeological sites as identified in the HIA (see Appendix 4D), should these fall within the construction footprint;
- Inform employees and contractors that archaeological artefacts, including human skeletal remains, might be exposed during construction activities;
- Immediately report the discovery of any archaeological material or human remains to SAHRA (021 462 4502) or a qualified archaeologist);
- Advise contractors and workers of the penalties associated with the unlawful removal of cultural, historical, archaeological artefacts, as set out in the NHRA, Section 51 (1);
- Cease work immediately and notify SAHRA and/or an archaeologist should any archaeological artefacts be exposed during site clearing or other site activities. Do not remove, destroy or interfere with any artefacts on the site;
- Instruct construction personnel to be alert for rare fossil bones and to follow “Fossil Finds Procedure”;
- Report the discovery of any shipwreck material to the SAHRA maritime unit or the maritime archaeologist at Iziko Museums of Cape Town;
- Avoid construction near (within 5 m) of any heritage structures in the town of Kotzesrus;
- Ensure that buildings of heritage significance are clearly demarcated and protected, where necessary;
- Ensure that blasting does not impact on the structural integrity of heritage structures and ensure that heritage structures are re-enforced where necessary;
- Should heritage structure be damaged, repair these structures using the appropriate building techniques in consultation with a qualified architect; and
- Relocate Burden memorial as per wishes of family;
- Appoint a palaeontologist should paleontological finds be uncovered by earthworks;
- Cease construction on (chance) discovery of fossils and protect fossils from further damage;
- Contact appointed palaeontologist and supply palaeontologist with the relevant information and images; and
- Ensure that the palaeontologist assesses the information and establishes a suitable response, such as reporting the importance of the find and providing recommendations for preservation, collection and record keeping.

Best practice cultural heritage mitigation measures during **construction** are as follows:

- Appoint a qualified archaeologist to sample any archaeological material that will be affected by the project; and
- Appoint an archaeologist to monitor any excavations that takes place within 300 m of the HWM.

6.9 Potential Visual and Sense of Place Impacts

Impacts on landscape and heritage setting are assessed in the HIA which was completed by Tim Hart (2014) (see Appendix 4D). Impacts on visual qualities and sense of place were assessed by SRK visual specialists, taking the information contained in the HIA into consideration.

6.9.1 Assessment of Impacts: Construction Phase

One direct construction phase impact on visual quality and sense of place was identified:

- V1: Visual intrusion of construction equipment and activities.

Although there are slight variations in the landscape setting, construction phase impacts are expected to remain largely similar and the visual intrusion of construction equipment and activities for the route alternatives and at the desalination plant are jointly assessed.

6.9.1.1 Potential Impact V1: Visual Intrusion of Construction Equipment and Activities

The project is located in a rural landscape characterised by low intensity agricultural activity, and the landscape setting invokes a sense of inhospitability and 'wilderness', particularly at the coast. The landscape has a strong sense of remoteness: there is little infrastructure or development, though Kotzesrus has a definite sense of place due to its unique, isolated rural setting and historical buildings in the town. Homesteads, power and phone lines, fences and some low intensity agricultural infrastructure are somewhat visually intrusive. There are few receptors in the area, particularly outside of towns.

Visual impacts will be generated by construction activities such as earthworks, which can cause scarring and from construction infrastructure, plant and materials on site (e.g. site camp, cranes and stockpiles). Visual intrusion resulting in a loss of sense of place is likely to occur since construction effects are incongruent with the rural or wilderness nature of the area. The extent of the visual intrusion is expected to be local and of low intensity over the short term during the construction phase.

The significance of the impact is assessed to be of ***very low*** significance and with the implementation of mitigation is reduced to ***insignificant*** (Table 6-51).

Table 6-51: Significance of visual intrusion of construction equipment and activities

<table>
<tr><th></th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th></tr>
<tr><td>Without mitigation</td><td>Local
1</td><td>Low
1</td><td>Short-term
1</td><td>Very Low
3</td><td>Probable</td><td>VERY LOW</td><td>– ve</td><td>High</td></tr>
<tr><td colspan="9">Essential mitigation measures:
• Limit outdoor security lighting and ensure that it is as unobtrusive as possible;
• Attach signs to structures to avoid free standing signs in the landscape during the construction period;
• Control litter and keep construction site as clean and neat as possible;
• Avoid construction in the vicinity of heritage structures in Kotzesrus and do not damage these structures during construction; and
• Use unobtrusive screening and avoid large expanses of bland security walls and unshielded delivery areas adjacent to or visible from scenic coastal road.</td></tr>
<tr><td>With mitigation</td><td>Local
1</td><td>Low
1</td><td>Short-term
1</td><td>Very Low
3</td><td>Possible</td><td>INSIGNIFICANT</td><td>– ve</td><td>High</td></tr>
</table>

6.9.2 Assessment of Impacts: Operation Phase

Two potential direct operation phase impacts on the visual environmental were identified:

- V2: Altered Visual Character and Sense of Place; and

- V3: Discolouration and Increased Turbidity of Coastal Waters.

6.9.2.1 Potential Impact V2: Altered Visual Character and Sense of Place

Kotzesrus Route

Linear infrastructure including pipelines and power lines is likely to be visually intrusive, as these elements are not currently present in the landscape and conflict somewhat with the rural and wilderness character of the area. Although low wire fences and some power lines currently traverse the area, the pipeline in particular may be intrusive as a pronounced industrial linear element through the landscape, along the entire length of the route. However, most visual impacts associated with the Kotzesrus route will be in Kotzesrus.

Kotzesrus is a very small and isolated village, and its ability to absorb physical changes without impacting its unique sense of place is limited. The town is relatively free of infrastructural clutter and the construction of linear infrastructure will alter the aesthetic character of the town. The road through Kotzesrus will likely require widening, which could further impact on the rural character of the town. The formalisation (and sealing) of the road would be out of keeping with character and texture of Kotzesrus, which has developed organically and has no formal grid structure.

Although the town is nestled between granite koppies and is somewhat screened from view from surrounding areas, a scenic route leads into the town which is visible from a number of vantage points along the scenic route. The town is therefore considered to have a low Visual Absorption Capacity (VAC), i.e. capacity to conceal visual impacts. The impact will be local and of medium intensity, and long term.

The impact is thus assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low*** (see Table 6-52).

Table 6-52: Significance of alteration of visual character and sense of place for the Kotzesrus Route

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Probable	**MEDIUM**	– ve	High
Essential mitigation measures: • Ensure that changes to the existing road through Kotzesrus are done as conservatively as possible and that the organic qualities of the village are respected (i.e. the road re-alignment must not be too formal or have overly strong geometry), should the re-alignment of the road through Kotzesrus be required, • Avoid formal concrete kerbs to ensure the visual integration of the road with the landscape; and • Ensure that the design of the linear infrastructure causes minimal visual intrusion through using, for example, non-reflective materials as far as possible and using rural construction techniques.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Improbable	**LOW**	– ve	High

Amended Bypass Route

Linear infrastructure along the route would have largely similar impacts to the *Kotzesrus Route,* with the exception of Kotzesrus where no visual impacts will occur.

Although portions of the bypass route will be constructed in previously undisturbed areas, there is limited number of receptors in the area. The VAC of the portion of the route that will bypass Kotzesrus is considered to be relatively high, as the landscape is somewhat undulating and this portion of the route will be largely screened from sensitive receptors in the town of Kotzesrus. and the impact is considered to be of low intensity.

The significance of the impact is thus assessed to be of ***low*** significance and with the implementation of mitigation is reduced to ***very low*** (see Table 6-53).

Table 6-53: Significance of alteration of visual character and sense for the Amended Bypass Route

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Probable	**LOW**	– ve	High
Essential mitigation measures: • Ensure that the design of the linear infrastructure causes minimal visual intrusion through using, for example, non-reflective materials as far as possible and using rural construction techniques.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Improbable	**VERY LOW**	– ve	High

Desalination Plant Site and Coastal Linear Infrastructure

The coastal environment at Volwaterbaai is considered to be visually sensitive. It has high scenic value and exhibits distinct visual - spatial qualities. The desalination plant site is located in a stark, open setting in a predominantly natural landscape with little evidence of human influence. Views over the Atlantic Ocean contribute to a sense of 'openness'. An existing gravel route along the coast provides scenic views across the undulating coastal plain and the dynamic coastline of rocky outcrops and sandy beaches increases the visual quality of the coastal strip.

The low-growing succulent vegetation and relatively flat profile of the coastal plain provide little opportunity for screening and the construction of the desalination plant will result in visual intrusion at the coast since the coastal landscape is considered to have low VAC. The desalination plant will be industrial in nature and seemingly incongruent with the pristine coastal environment compromising the sense of place and the sense of 'wilderness' in the area.

Lighting at the desalination plant may cause light pollution or increase skyglow[26] and alter night-time sense of place. Skyglow cannot easily be prevented and is always more noticeable in a previously unlit area, but is compounded by poor external lighting design and lighting fixtures that spread light upward into the atmosphere. Pipeline infrastructure crossing the coastal zone will be placed underground, considerably reducing the visual impact.

The impact on the sense of place will be localised over the long-term. Since there are few receptors in the area, the visual impact is considered to be of medium intensity due to the incongruent nature of the desalination plant[27].

Desalination plant positions A, C and D, to the west of the coastal road, are preferred from a visual perspective. Positions B and E are less preferred, as these will obstruct coastal vistas from the coastal route and will be more visible to receptors.

The impact is thus assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low*** for the desalination plant site and coastal linear infrastructure (Table 6-54).

[26] Skyglow is a form of light pollution and refers to the brightening of the sky above populated areas. This phenomenon diminishes the clarity of the nightscapes and constellations which are so often an amenity of a rural landscape (SEF, 2007).

[27] A set of visual guidelines was prepared by SRK consulting in July 2013 to guide the design of the desalination plant in the coastal environment to reduce potential visual impacts (see Appendix 6A).

Table 6-54: Significance of alteration of visual character and sense for the Desalination Plant Location

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Probable	**MEDIUM**	– ve	High
Essential mitigation measures: • Install the seawater intake and brine discharge pipelines below ground in the coastal zone (to the west of the coastal road); • Appoint an architect to oversee the design of the desalination plant building and infrastructure within the coastal environment; • Consult visual guidelines prepared by SRK in July 2013 (Appendix 6A) in the design of the desalination plant.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Possible	**LOW**	– ve	High

6.9.2.2 Potential Impact V3: Discolouration and Increased Turbidity of Coastal Waters

The co-discharge of $FeCl_3$ (with brine discharge – see Section 3.7.1) may discolour receiving coastal waters. Discharge of sludge may also increase turbidity, while suspended matter in the brine discharge may have blanketing effects. This may have a visual impact on the coastal environment and further discolour coastal waters.

The colour of the brine depends on the pre-treatment process used. $FeCl_3$ (which has a brown tinge) would only be present in very low volumes and concentrations, and would be drip fed over time into the brine stream. Brine will be discharged into the high energy surf zone, where turbidity levels are already high. Discharge of brine is therefore unlikely to result in discernible discolouration or turbidity. There are few receptors in the area and the intensity of the impact is considered to be low, local in extent and long term.

The impact is thus assessed to be of ***very low*** significance with and without the implementation of mitigation (Table 6-55).

Table 6-55: Significance of discolouration of coastal waters

	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Possible	**VERY LOW**	– ve	High
Essential mitigation measures: • Design the pre-treatment system to ensure that $FeCl_3$ levels are kept to minimum to avoid discolouration of the brine; • Monitor brine colour and implement appropriate measures to reduce discolouration, where necessary.								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Improbable	**VERY LOW**	– ve	High

6.9.3 The No-Go Alternative

The No-Go alternative entails no change in the *status quo*. Kotzesrus would retain its rural character and the coastal environment would retain its desolate 'wilderness' sense of place.

Without investment, there is a risk that Kotzesrus will eventually lose its sense of place over time. However, this risk is considered to be low and the No-Go alternative is assessed to have very low visual impacts. The No-Go alternative is therefore considered to be beneficial in terms of preserving the visual character of the town of Kotzesrus as well as the coastal environment.

6.9.4 Mitigation Measures: Potential Visual Impacts

Essential visual mitigation measures during **construction** are as follows:

- Limit outdoor security lighting and ensure that it is as unobtrusive as possible;

- Attach signs to structures to avoid free standing signs in the landscape during the construction period;
- Control litter and keep construction site as clean and neat as possible;
- Avoid construction in the vicinity of heritage structures in Kotzesrus and do not damage these structure during construction; and
- Use unobtrusive screening and avoid large expanses of bland security walls and unshielded delivery areas adjacent to or visible from scenic coastal road.

Essential visual mitigation measures to address **operation** impacts are as follows:

- Ensure that changes to the existing road through Kotzesrus are done as conservatively as possible and that the organic qualities of the village are respected (i.e. the road re-alignment must not be too formal or have overly strong geometry), should the re-alignment of the road through Kotzesrus be required;
- Avoid formal concrete kerbs to ensure the visual integration of the road with the landscape;
- Ensure that the design of the linear infrastructure causes minimal visual intrusion through using, for example, non-reflective materials as far as possible and using rural construction techniques;
- Install the seawater intake and brine discharge pipelines below ground in the coastal zone (to the west of the coastal road);
- Appoint an architect to oversee the design of the desalination plant building and infrastructure within the coastal environment;
- Consult visual guidelines prepared by SRK in July 2013 (Appendix 6A) in the design of the desalination plant.

Best Practice visual mitigation measures to address **operation** impacts are as follows**:**

- Appoint a landscape architect to assist with design of visually appropriate structures within the coastal environment, the design of green roofs and the rehabilitation of the landscape using indigenous vegetation.

6.10 Cumulative Impacts

6.10.1 Introduction

Anthropogenic activities can result in numerous and complex effects on the natural and social environment. While many of these are direct and immediate, the environmental effects of individual activities (or projects) can combine and interact with other activities in time and space to cause incremental or aggregate effects. Effects from disparate activities may accumulate or interact to cause **additional** effects that may not be apparent when assessing the individual activities one at a time (Canadian Environmental Protection Agency, no date). Cumulative effects can also be defined as the total impact that a series of developments, either present, past or future, will have on the environment within a specific region over a particular period of time (DEAT IEM Guideline 7, Cumulative effects assessment, 2004).

The International Finance Corporation (IFC) states that environmental assessment should include consideration of *"… cumulative impacts of existing projects, the proposed project and anticipated future projects".* For the purposes of this report, cumulative impacts are defined as 'direct and indirect impacts that act together with current or future potential impacts of other activities or proposed activities in the area/region that affect the same resources and/or receptors'.

To define the level of cumulative impact, it is critical to look beyond the geographical boundaries and environmental impacts of a single development on the environment and consider the area of influence of the specific project as well as other developments currently in or proposed in the area and their understood impacts and area of influence. It may be that impacts experienced as a result of a single development are not considered to be significant, but when considered as part of a cumulative impact assessment, these require mitigation.

Key considerations for the assessment of cumulative impacts as part of the environmental impact assessment are:

- The cumulative impact assessment will need to give consideration to developments that may have contributed to cumulative effects in the past, may be contributing or are anticipated to contribute in the foreseeable future. This needs to be relevant to the timeframe within which impacts are to be experienced as a result of the project itself (i.e. all phases for which the project specific impact assessment is being undertaken). Given that the baseline environment will already be impacted on by the historical and current contributors to the cumulative impact, it is only necessary when undertaking the cumulative impact assessment to place an emphasis on an identified future cumulative baseline environment;
- Cumulative impacts may not be applicable to all aspects, as project related impacts may be confined to the project area and not subject to or contributing to impacts in the broader area of influence as a whole. For example, if the project area is confined to a water catchment which is not anticipated to be impacted on by other developments (past, present or foreseeable future) then a cumulative impact assessment need not be considered for this environmental aspect;
- A cumulative impact assessment will consider a specific area of influence which will be determined by the impact itself and the baseline environment in which it is proposed; e.g. where one or more projects affect the same ecosystem, the whole area in which the ecosystem is found may be considered the area of influence for the cumulative assessment. This will vary across project aspects and therefore a single area of influence for the cumulative impact assessment cannot be set; and
- The cumulative impact assessment can only be undertaken where information is readily available and as such will only be an initial assessment of the likely cumulative impact in terms of knowledge available at the time of the assessment. It is critical to understand the information sources and limitations that exist.

For the most part, cumulative effects or aspects thereof are too uncertain to be quantifiable, due mainly to a lack of data availability and accuracy. This is particularly true of cumulative effects arising from potential or future projects, the design or details of which may not be finalised or available and the direct and indirect impacts of which have not yet been assessed. Given the limited detail available regarding such future developments, the analysis will be of a more generic nature and focus on key issues and sensitivities for the project and how these might be influenced by cumulative impacts with other activities.

6.10.2 Scope of the Analysis

For cumulative effects analysis to be a useful tool to decision makers and stakeholders, it must be limited to effects that can be meaningfully evaluated, rather than expanded to the point where the resource or receptors are no longer significantly affected or the effects are no longer of interest to stakeholders. To this end, two important aspects require consideration prior to the evaluation of cumulative effects:

- The determination of an appropriate spatial and temporal boundaries for evaluation of cumulative effects of the project; and
- The evaluation of relevant projects for consideration in the cumulative effects analysis.

6.10.2.1 Spatial and Temporal Boundaries of the Analysis

Spatial and temporal boundaries for analysis of cumulative effects are dependent on a number of factors, including:

- The size and nature of the project and its potential effects;
- The size, nature and location of past and (known) future projects and activities in the area, and the significance of their adverse or beneficial environmental effects;
- Relevant ecological boundaries, including landform, vegetation, land use, habitat, soil and surface materials and climate;
- Relevant aquatic boundaries, including catchments, sub-catchments and hydrogeological discontinuities;
- The aspect of the environment impacted by the cumulative effect (boundaries selected for cumulative environmental effects on, for example, air quality might be different from those relevant to the effects on a particular species of plant or animal); and
- The period of occurrence of effects (temporal boundaries may extend beyond the timing of construction and operation) (Canadian Environmental Protection Agency, no date).

The project area is very remote and generates impacts that are mostly of local extent. The spatial scope of this analysis is generally aligned with the zone of influence of the project and potential projects (if any) in the vicinity that may have impacts overlapping with the proposed project.

The temporal scale of the contribution of project's impacts is likely to be long term, although of limited intensity.

6.10.2.2 Projects for Consideration in the Analysis

Cumulative impacts can be distinguished as follows:

- **Cumulative impacts of existing activities:** It is reasonably straightforward to identify significant past and present projects and activities that may interact with the project to produce cumulative impacts, and in many respects, these are taken into account in the descriptions of the biophysical and socio-economic baseline, especially since there are almost no other development in the region (see respective sections in Section 4);
- **Potential cumulative impacts of future activities:** Relevant future projects that will be included in the assessment are defined as those that are 'reasonably foreseeable', i.e. those that have a high probability of implementation in the foreseeable future; speculation is not sufficient reason for inclusion. Such projects may include those for which authorisations have already been granted, that are currently subject to environmental assessment processes or that have been identified in planning documents. Again, very few projects, aside from the Zandkopsdrift Mine, are proposed

Projects that fall in the above categories and that may result in cumulative impacts with the proposed development and therefore have been considered in the cumulative impact analysis are listed below:

- **Past and present projects / activities:**

  The proposed desalination plant and associated infrastructure is located in a remote, arid and sparsely populated area, and few other developments or activities are present in the region. Farming, particularly livestock (sheep) farming, is the main land use in the region at present, while some limited seasonal tourism activities take place in the vicinity of Kotzesrus and the coast.

- **Future projects / activities:**

  Relevant future projects that are included in the assessment are those that are 'reasonably foreseeable', i.e. those that have a high probability of being implemented in the foreseeable future. For the purposes of this analysis the projects and activities that are considered are listed below:

  - *Future prospecting/ mining activities:* TransHex has been granted diamond prospecting rights on Farm Strandfontein 559. However, no prospecting (or mining) activities are currently taking place on the property and although possible, are considered relatively unlikely in the future. Although this EIA focusses on the Volwaterbaai desalination plant and associated infrastructure, the development of the Zandkopsdrift Mine relies on the development of the desalination plant. The development of the mine is the only significant development in the project area that may contribute to cumulative impacts of the Volwaterbaai desalination plant and associated infrastructure ; and

  - *Future desalination plant development:* Forest Oil previously proposed to develop gas supply infrastructure and a desalination plant on the northern portion of Farm Strandfontein 559. However, this proposal has been withdrawn and it is considered unlikely that additional desalination plants will be developed in the vicinity of the project area in future.

6.10.3 Cumulative Impacts Analysis

For the most part, cumulative impacts or aspects are too uncertain to be quantifiable, mainly due to lack of (accurate) data. This is particularly true of cumulative impacts arising from potential or future projects. As such, the analysis that follows is of a generic nature and also touches on key issues and sensitivities for the Volwaterbaai desalination plant and associated infrastructure and how these might be influenced by cumulative impacts with other activities. Only qualitative assessment of cumulative impacts was possible, i.e. they are not formally rated.

6.10.4 Cumulative Botanical Impacts

6.10.4.1 Terrestrial Habitat Units

The project area has remained largely free from urban development with the exception of Kotzesrus. Lack of water within the region has also restricted activities that might have damaged or destroyed floral and faunal habitats. As a result, floral and faunal habitat within the project area is reasonably intact, with isolated areas impacted by farming and road development. Although some SCC occur, the vegetation types in the area are not considered to be *Threatened*.

The development of the Zandkopsdrift Mine will transform a considerable area of vegetation and will likely contribute to floral and faunal habitat loss. However, the majority of linear infrastructure associated with the Volwaterbaai desalination plant will largely follow existing routes and the footprint of vegetation that will be lost is small in comparison to that which will be lost at the Zandkopsdrift Mine. The project is not expected to significantly contribute to cumulative floral and faunal habitat loss in the area. Consequently the cumulative botanical impacts of development in this area will probably be very low.

6.10.4.2 Cumulative Faunal Impacts

Increased anthropogenic activities associated with the construction and operation of the Zandkopsdrift Mine and the Volwaterbaai project are likely to impact cumulatively on fauna in the region. However, the extent of faunal habitat that will be transformed by the project is limited and the impacts on RDL / protected species and not expected to significantly contribute to faunal impacts caused by the Zandkopsdrift Mine.

There are a number of fence lines in the project area and these may contribute to the disruption of faunal migratory routes. The development of linear infrastructure for the project is not expected to add to impacts of existing fences in the area, with the implementation of the appropriate mitigation measures. The overall cumulative impact on fauna is expected to be very low.

6.10.4.3 Wetland/Riparian Habitat

Due to the limited grazing value of the vegetation, farms in the project area tend to extend over large areas, with very little evidence of overgrazing or trampling evident near wetland and riparian resources. As a result, wetland and riparian features in the project area have remained largely intact.

Mining and agricultural activities are considered the main threat to wetland resources within the region. Due to the limited extent of wetland/ riparian habitat affected by the project, the cumulative impact on wetland/riparian habitat loss in the region is not expected to be significant.

6.10.4.4 Cumulative Groundwater Impacts

Groundwater is abstracted by farmers in the area. The project will not abstract groundwater and will not contribute to the cumulative depletion of groundwater resources, nor groundwater contamination and is not expected to impact cumulatively on groundwater resources.

6.10.4.5 Cumulative Marine and Coastal Impacts

The coastline of the project area has in the past been targeted by shore-based, diver-assisted diamond mining operations. As sea conditions control where safe operations can be conducted, these are typically limited to small bays and gullies with some shelter from waves. In mining target areas, intertidal and subtidal organisms are damaged or destroyed by mining equipment, removal of boulders from subtidal gullies into the intertidal zone or into rock piles, tailings and other generalised mining activities. This disturbance is very localised, being limited to a scale of tens of metres around each individual operation. While recovery of the intertidal and subtidal communities occurs within 2-5 years, physical alteration of the shoreline in ways that cannot be remediated by swell action, such as deposition of large piles of pebbles and boulders, can be more or less permanent.

As the intake and discharge pipelines for the proposed desalination plant are located in relatively sheltered gullies, there is a strong possibility that these have in the past been targeted by diamond divers. At face value, however, the selected locations for pipeline installation do not appear significantly different from other similar habitats in the general area, suggesting that if they had indeed been targeted by shore-based divers in the past, impacts to the intertidal area were temporary only. Cumulative effects with the proposed development are thus highly unlikely.

The proposed development by Forest Oil of gas infrastructure and a desalination plant on the northern portion of Farm Strandfontein 559 has been withdrawn and is, therefore, not considered further. Given the current lack of past and future proposed development along the coastline in the project area, cumulative impacts as well as disturbances to marine or coastal systems or features are expected to be limited.

6.10.5 Cumulative Socio-Economic Impacts

The development of the Zandkopsdrift Mine will increase employment, income and skills in the area and may boost business and tourism in the region and in Kotzesrus. Zandkopsdrift Mine is considered to create a significantly larger number of employment opportunities than the project. However, the projects are interdependent and are likely to impact cumulatively on employment, skills development and tourism and business opportunities in the area. The project area is characterised by high levels of unemployment and the cumulative impact (benefit) is considered to be of medium significance.

6.10.5.1 Cumulative Cultural Heritage Impacts

Archaeological material that could potentially be disturbed by the project is considered to be well represented in the Namaqualand region and is not considered to be threatened by development activities in the area, including farming and mining. Appropriate mitigation measures are expected to be adopted to prevent / mitigate potential impacts on archaeological resources by the Zandkopsdrift Mine. It is therefore unlikely that the loss of archaeological material associated with the project will contribute significantly to the loss of archaeological material in the area.

Excavation associated with the project may uncover palaeontological resources of scientific value. Through diligent and successful mitigation, fossils can be preserved and accumulated for scientific study. This is particularly the case with large mining operations, and may be of significance during the development of the Zandkopsdrift Mine.

Development of the project requires excavations (particularly for linear infrastructure) which are mostly narrow and shallow and, for the most part, in areas of low palaeontological sensitivity. The project is therefore considered to have a very low cumulative impact on palaeontological resources in the region.

6.10.5.2 Cumulative Visual Impacts

The area is isolated and remote and the closest structure along the shoreline is the Namakwa Sands pumpstation some 30 km to the south. It is also considered unlikely that any additional large structures will be constructed at the coastline in the foreseeable future. As such, the cumulative impact of the project is considered negligible.

The Zandkopsdrift Mine is not likely affect visual quality or sense of place in Kotzesrus and cumulative impacts in Kotzesrus are not anticipated.

7 Conclusions and Recommendations

This chapter evaluates the impact of the proposed Volwaterbaai Desalination Plant and associated infrastructure in the Northern Cape Province. The principal findings are presented in this chapter, followed by a discussion of the key factors NCDENC will have to consider in order to take a decision in the interests of sustainable development.

As is to be expected, the Volwaterbaai Desalination Plant and associated infrastructure has the potential to cause impacts, both negative and positive. However, since the development is of low intensity and confined in extent, very few project impacts are predicted to be of major concern.

The EIA has examined the available project layout information and drawn on both available (secondary) and specifically collected (primary) baseline data to identify and evaluate environmental (biophysical and socio-economic) impacts of the proposed project. The EIA Report aims to inform decision-makers of the key considerations by providing an objective and comprehensive analysis of the potential impacts and benefits of the project and has created a platform for the formulation of mitigation measures to manage these impacts, presented in the EMP provided in Appendix A1.

This chapter presents the general conclusions that have been drawn from the S&EIR process and which should be considered in evaluating the project. It should be viewed as a supplement to the detailed assessment of individual impacts presented in Chapter 6.

7.1 Environmental Impact Statement

The EIA Regulations, 2010 prescribe the required content of an EIA Report, including, *inter alia*, an EIS, which is presented in the section below.

7.1.1 Evaluation and Assessment

The evaluation is undertaken in the context of:

- The project information provided by the proponent;
- The assumptions made for this EIA Report;
- The assumption that the recommended (essential) mitigation measures will be effectively implemented; and
- The assessments provided by specialists.

This evaluation aims to provide answers to a series of key questions posed as objectives at the outset of this report, which are repeated here:

- Assess in detail the environmental and socio-economic impacts that may result from the project;
- Identify environmental and social mitigation measures to address the impacts assessed; and
- Produce an EIA Report that will assist NCDENC to decide whether (and under what conditions) to authorise the proposed development.

The evaluation and the basis for the subsequent discussion are represented concisely in Table 7-1, which summarises the potentially significant impacts and their significance ratings before and after application of mitigation and/or optimisation measures.

Table 7-1: Summary of potential impacts of the Volwaterbaai Desalination Plant and Associated Infrastructure

*Potential negative impacts are shaded in reds, benefits are shaded in greens. Insignificant impacts have not been shaded. Only **key** mitigation/optimisation measures are presented.*

<table>
<tr><th rowspan="2">ID #</th><th rowspan="2">Impact</th><th colspan="2">Significance rating</th><th rowspan="2">Preferred Layout Alternative</th><th rowspan="2">Key mitigation/optimisation measures</th></tr>
<tr><th>Before mitigation/ optimisation</th><th>After mitigation/ optimisation</th></tr>
<tr><td colspan="6">CONSTRUCTION PHASE IMPACTS</td></tr>
<tr><td>A</td><td colspan="5">Impacts on Air Quality</td></tr>
<tr><td>A1</td><td>Changes in air quality due to project related emissions</td><td>Insignificant</td><td>Insignificant</td><td></td><td>• Maintain all vehicles and equipment in good working order to minimise exhaust fumes;
• Avoid clearing of vegetation until absolutely necessary;
• Stabilise exposed surfaces as soon as is practically possible;
• Avoid excavation and handling and transport of materials which may generate dust under high wind conditions or when a visible dust plume is present;
• Limit construction vehicle speeds to 40 km/hr on gravel roads, 30 km/h on the gravel road though Kotzesrus and 20 km/h on unconsolidated and non-vegetated areas; and
• Apply dust suppression measures where required.</td></tr>
<tr><td>N</td><td colspan="5">Noise Impacts</td></tr>
<tr><td rowspan="4">N1</td><td rowspan="4">Increased noise levels and vibration due to project activities</td><td colspan="2">Kotzesrus Route</td><td rowspan="4">Amended Bypass Route</td><td rowspan="4">• Limit noisy construction activities to daylight hours form Monday to Saturday;
• Comply with the applicable municipal and / or industry noise regulations;
• Notify adjacent residents or business premises before particularly noisy construction activities, including blasting;
• Maintain all vehicles and equipment in good working order;
• Restrict the use of radios, televisions etc by workers;
• Enclose diesel generators used on site for power supply; and
• Investigate potential noise reduction measures if complaints are received.</td></tr>
<tr><td>Low</td><td>Very low</td></tr>
<tr><td colspan="2">Amended Bypass Route</td></tr>
<tr><td>Insignificant</td><td>Insignificant</td></tr>
<tr><td>T</td><td colspan="5">Traffic Impacts</td></tr>
<tr><td>T1</td><td>Impact of project related traffic on existing road users and surrounding residents</td><td>Very Low</td><td>Insignificant</td><td>Amended Bypass Route</td><td>• Use appropriate signage to warn other road users of construction activities on roads;
• Maintain and repair roads damaged by construction vehicles;
• Ensure that drivers of construction vehicles comply with the rules of the road;
• Implement the necessary measures to maintain roads and road surface integrity;
• Ensure that vehicle axle loads do not exceed the technical design capacity of roads; and
• Limit the speed of construction vehicles to 30 km/h through Kotzesrus and any other villages or towns along gravel roads.</td></tr>
</table>

ID #	Impact	Significance rating: Before mitigation/ optimisation	Significance rating: After mitigation/ optimisation	Preferred Layout Alternative	Key mitigation/optimisation measures
AE	**Impacts on Aquatic Ecology**				
AE1	Loss of Wetland Habitat and Ecological Structure	*Kotzesrus Route*: High	*Kotzesrus Route*: Low	*Amended Bypass Route*	• Demarcate all sensitive wetland zones outside of construction footprint and designate as no-go areas; • Align pipelines and power lines to cross wetlands and drainage features, perpendicularly to limit the area of disturbance within the wetland or drainage feature; • Install pipelines and power lines to span over the wetland/drainage feature and the associated 32m buffer zone; • Permit only essential construction personnel within the wetland habitat; • Obtain the relevant approvals from DWS for any activities within wetland areas; • Prevent potentially contaminated run-off from work areas from entering wetland habitats; • Incorporate adequate erosion and stormwater management measures in road design and for construction activities in order to prevent erosion and the associated sedimentation of wetland areas; • Upgrade inadequate bridges and culverts, where these upgrades are required for the project; • Rehabilitate all wetlands impacted by construction to re-instate wetland function.
		Amended Bypass Route: Medium	*Amended Bypass Route*: Low		
B	**Botanical Impacts**				
B1	Loss of Floral Habitat, Biodiversity and SCC	*Kotzesrus Route*: High	*Kotzesrus Route*: Low	*Amended Bypass Route*	• Limit construction footprint and vegetation removal to what is absolutely essential; • Strictly control edge effects of construction activities e.g. erosion and alien vegetation proliferation; • Limit the removal of vegetation from the road reserve and servitude; • Install pipelines and power lines above the ground on support structures (plinths); • Construct the pipeline within the road reserve, or as close as possible to the road / road reserve edge; • Place all infrastructure outside of rocky outcrop areas as far as possible; • Compile and implement a detailed rescue and relocation plan for SCC; • Appoint/designate a suitably experienced person to oversee the removal and rescue and relocation of all SCC; • Obtain special authorisation from the NCDENC for SCC or protected plant species to be cut, disturbed,
		Amended Bypass Route			

ID #	Impact	Significance rating: Before mitigation/ optimisation	Significance rating: After mitigation/ optimisation	Preferred Layout Alternative	Key mitigation/optimisation measures
		Low	Very Low		damaged or destroyed; • Remove alien and weed species encountered within the study; ensure no additional impact and loss of indigenous plant species due to the herbicide used; • Minimise disturbance footprints when removing alien plant species; • Dispose of removed alien plant material at a registered waste disposal site;
		Quartzite and Clay Exposure Areas			**In Quartzite and Clay Exposure Areas:** • Demarcate the construction footprint (final route of power lines and pipelines) for the duration of the construction period and prevent disturbance outside the demarcated area; • Locate power lines and pipelines in quartzite and clay exposure areas to the west of the existing road; • Ideally construct the pipeline within the road reserve or as close as possible to the road reserve edge; • Install pipelines and power lines above ground on support structures (plinths) with minimal footprints; • Install pipes by crane from the road edge, to minimise disturbance; • Demarcate and cordon off individuals of *Bulbine bruynsii* within the construction footprint, with a 2 m buffer around each individual or group of individuals. Position support structures to avoid encroachment on cordoned off areas; • Remove and translocate the affected individuals of *Bulbine bruynsii* immediately to a suitable area outside the development footprint, if it is unavoidable that they will be disturbed; • Identify plinth positions between June – September when *Bulbine bruynsii* plants are visible; • Obtain authorisation from the NCDENC and translocate any plants in the construction footprint; • Undertake excavations for power line and pipeline support structures manually; • Limit the number of construction personnel allowed into the sensitive habitat areas; • Submit method statements for all construction activities for review by a suitably qualified ecologist; • Appoint an Environmental Control Officer (ECO) to supervise all construction activities; • Restrict footprint of material and equipment storage areas, which should be outside of road reserve adjacent to quartzite and clay exposure areas; and • Do not store material removed during excavations for power line and pipeline support structures within the road reserve adjacent to quartzite and clay exposure areas. Temporarily remove construction related material to a designated area offsite and permanently remove construction related waste and refuse from site.
		Very High	Low		
		Desalination plant site			
		Medium	Low		
F	**Impacts on Fauna**				
F1	Altered faunal habitat, diversity	*Kotzesrus Route*		*Amended Bypass*	• Strictly control edge effects of construction activities e.g. erosion and alien vegetation proliferation particularly in very high sensitivity areas;
		High	Low		

ID #	Impact	Significance rating Before mitigation/ optimisation	 After mitigation/ optimisation	Preferred Layout Alternative	Key mitigation/optimisation measures
	and RDL/protected species	*Amended Bypass Route*		*Route*	• Minimise removal of vegetation and associated faunal habitat from the road reserve; • Place infrastructure outside rocky outcrop areas as far as possible; • Reduce noise in close proximity to the Brak River crossing avoid the disturbance of the *Aquila verreauxii* (Verreauxs Eagle) breeding pair; • Rescue and relocate fauna encountered within the construction footprint; • Strictly prohibit the trapping and hunting of fauna by construction personnel; • Enforce a speed limit for construction vehicles of 40 km/h to reduce collisions with fauna; • Where possible, install seawater intake and discharge pipelines within existing road reserves; • Rescue and relocate fauna occurring within the construction footprint, particularly slower moving species such as tortoises; and • Strictly prohibit the trapping and hunting of fauna by construction personnel
		Low	Very Low		
		Desalination plant: A,C and D		*Desalination plant position A, C and D*	
		Low	Very Low		
		Desalination plant: B and E			
		Medium	Low		
M	**Impacts on Marine Ecology**				
M1	Disturbance of coastal ecology	Medium	Low		• Minimise disturbance of the intertidal and subtidal areas; • Lay pipeline in such a way that required rock blasting is minimised; • Minimise traffic on upper shore; and • Restrict traffic to clearly demarcated access routes and construction areas only.
M2	Impacts of Contamination on Marine Biota	Low	Insignificant		• Conduct a comprehensive environmental awareness programme amongst construction personnel; • Ensure that oils and lubricants used for maintenance of equipment in the field are correctly contained; • Maintain vehicles and equipment to prevent oils, diesel, fuel or hydraulic fluids spills; • Ensure that all construction vehicles in the coastal zone have a spill kit; • Prohibit mixing of concrete in the intertidal zone; • Regularly clean up concrete spilled during construction; • Prohibit dumping of excess concrete or mortar on the sea bed, or in the coastal zone; and • Ensure regular collection and removal of refuse and litter from intertidal areas.
M3	Impacts of turbidity and smothering through redeposition of suspended sediment	Very Low	Very Low		• Prohibit dumping of construction materials in the intertidal and subtidal zones.
M4	Disturbance and	Low	Very Low		• Restrict blasting to the absolute minimum required and a maximum of one blast per day;

ID #	Impact	Significance rating: Before mitigation/ optimisation	Significance rating: After mitigation/ optimisation	Preferred Layout Alternative	Key mitigation/optimisation measures
	injury of shore birds and marine biota through noise and blasting				• Use blasting methods which minimise the environmental effects of shock waves through the use of smaller, quick succession blasts directed into the rock; • Avoid onshore blasting during the breeding season of shore-birds; • Ensure there are no marine mammals and turtles in the immediate vicinity (2 km) before blasting.
M5	Elimination of benthic communities through loss of substratum	Very Low	Very Low		• No mitigation possible
M6	Impacts of temporary desalination plant on the marine environment	Insignificant	Insignificant		• Minimise the footprint of the temporary desalination plant in the coastal zone; and • Ensure that brine and co-pollutants are discharged into the surf-zone below the low water mark.
SE	**Socio-Economic Impacts**				
SE1	Increased employment, income and skills development	Insignificant	Very Low		• Survey local skills levels, and employ local people based on the availability of skills; and • Promote skills development as opposed to the importation of skills, where possible.
SE2	Increased business and tourism opportunities	Very Low	Very Low		• No optimisation possible.
SE3	Increased incidence of crime	Insignificant	Insignificant		• None.
H1	**Heritage Impacts**				
H1	Disturbance and loss of archaeological material	*Linear infrastructure*			• Use existing tracks where possible and avoid encroachment of construction activities into undisturbed areas; • Restrict construction activities to the existing disturbance zone along the coastal route; • Design linear infrastructure to avoid sensitive archaeological sites; • Obtain the required permits from SAHRA for excavation of archaeological material, where required; • Demarcate archaeological sites (including shell middens) that may be affected by construction activities
		Medium	Very Low		
		Desalination plant: A, B, D and E		*Desalination*	

ID #	Impact	Significance rating: Before mitigation/ optimisation	Significance rating: After mitigation/ optimisation	Preferred Layout Alternative	Key mitigation/optimisation measures
		Medium	Low	*plant position C*	as no-go areas, in consultation with a qualified archaeologist; • Excavate sensitive archaeological sites within the construction footprint in consultation with a qualified archaeologist; • Inform employees and contractors that archaeological artefacts, including human skeletal remains, might be exposed during construction activities as well as procedures to be followed; • Immediately cease work and report the discovery of any archaeological material or human remains to SAHRA. Do not remove, destroy or interfere with any artefacts on the site; and • Report the discovery of any shipwreck material to the SAHRA maritime unit or the maritime archaeologist at Iziko Museums of Cape Town.
		Desalination plant: C			
		Very Low	Very Low		
H2	Disturbance and loss of heritage structures	Medium	Very Low		• Avoid construction near (within 5 m) of any heritage structures in the town of Kotzesrus; • Clearly demarcate and protect buildings of heritage significance; • Reinforce heritage structures where required and ensure that blasting does not impact on the structural integrity of heritage structures; • Repair any damage to heritage structures in consultation with a qualified architect; and • Negotiate the relocation of the Burden memorial with the relevant family members, if required.
H3	Disturbance and loss of palaeontological material	*Desalination plant: E*			• Instruct construction personnel to be alert for rare fossil bones and to follow “Fossil Finds Procedure”; • Appoint a palaeontologist should paleontological finds be uncovered by earthworks; • Cease construction on (chance) discovery of fossils and protect fossils from further damage; • Contact appointed palaeontologist and supply palaeontologist with the relevant information and images; and • Ensure that the palaeontologist assesses the information and establishes a suitable response, such as reporting the importance of the find and providing recommendations for preservation, collection and record keeping.
		Low	Low		
		Desalination plant: A, B, C and D			
		Medium	Medium		
		Linear infrastructure			
		Medium	Medium		
V	**Visual Impacts**				
V1	Visual intrusion of construction equipment and activities	Very Low	Insignificant		• Limit outdoor security lighting and ensure that it is as unobtrusive as possible; • Attach signs to structures to avoid free standing signs in the landscape during the construction period; • Control litter and keep construction site as clean and neat as possible; • Avoid construction in the vicinity of heritage structures in Kotzesrus and do not damage these structures during construction; and • Use unobtrusive screening and avoid large expanses of bland security walls and unshielded delivery areas adjacent to or visible from scenic coastal road.

ID #	Impact	Significance rating: Before mitigation/ optimisation	Significance rating: After mitigation/ optimisation	Preferred Layout Alternative	Key mitigation/optimisation measures
OPERATIONAL PHASE IMPACTS					
A	**Impacts on Air Quality**				
A1	Changes in Air Quality	*Kotzesrus Route* Insignificant *Amended Bypass Route* Insignificant	*Kotzesrus Route* Insignificant *Amended Bypass Route* Insignificant	*Amended Bypass Route*	• No mitigation required.
N	**Noise Impacts**				
N1	Noise Impacts during Operation	Insignificant	Insignificant		• No mitigation required.
T	**Traffic Impacts**				
T1	Impacts of Operational Traffic	Insignificant	Insignificant		• No mitigation required.
AE	**Impacts on Aquatic Ecology**				
AE2	Loss of Wetland Habitat and Ecological Structure	Very Low	Insignificant		• Permit only essential personnel within wetland habitats for unavoidable maintenance; • Disallow heavy machinery or vehicles in wetland areas; • Keep all demarcated sensitive wetland zones outside of the maintenance areas off limits; • Prevent run-off from work areas entering wetland habitats; • Incorporate adequate erosion and stormwater management measures in order to prevent erosion and the associated sedimentation of wetland areas; and • Monitor water pipelines for leaks and repair any leaks immediately.
B	**Botanical Impacts**				
B2	Loss of Floral Habitat, Biodiversity and SCC	*Linear infrastructure* Very Low	*Linear infrastructure* Insignificant		• Remove alien and weed species encountered within the study area; • Undertake maintenance activities within very high sensitivity habitats (including quartzite and clay exposure areas) manually; • Do not permit heavy machinery into very high sensitivity habitat units; • Restrict the number of personnel entering very high sensitivity habitats during maintenance activities; • Restrict maintenance activities to the road reserve, with surrounding open veld areas strictly off-limits to maintenance vehicles and personnel; • Strictly prohibit maintenance personnel from collecting plant material from surrounding natural areas;

ID #	Impact	Significance rating: Before mitigation/ optimisation	Significance rating: After mitigation/ optimisation	Preferred Layout Alternative	Key mitigation/optimisation measures
		Desalination plant			• Monitor water pipelines for leaks (specifically in very high sensitivity habitats where a change in water availability may alter habitat characteristics) and repair any leaks immediately; • Monitor sea water intake and brine pipelines for leaks and repair any leaks immediately.
		Very Low	Insignificant		
F	**Impacts on Fauna**				
F2	Impacts on faunal habitat, diversity and RDL/protected species	*Linear infrastructure*			• Restrict maintenance activities to the road reserve, with surrounding open veld areas strictly off-limits to maintenance vehicles and personnel; • Strictly prohibit the trapping and hunting of fauna by maintenance personnel; • Enforce a speed limit for operational and maintenance vehicles of 40 km/h to reduce collisions with fauna; • Rescue and relocate faunal species encountered;
		Very Low	Very Low		
		Desalination plant			
		Very Low	Insignificant		
F3	Disruption of faunal migratory corridors	Medium	Medium		• Design gravel roads in such a way to allow for either a gradual kerb or regular ‘exits’ from the road in order to allow faunal species such as tortoises to safely cross. Regularly inspect gravel roads to ensure this.
M	**Impacts on Marine Ecology**				
M7	Loss of marine species through impingement and entrainment	Low	Low		• Adjust seawater intake velocities to <0.15 m/s; and • Ensure installation of screens on the end of the intake pipes, or the use of a screen box or shroud.
M8	Reduced physiological functioning of marine organisms due to elevated salinity	Medium	Low		• Ensure engineering designs at the seaward end of the discharge pipe achieve the highest required dilution of brine (29x), thereby limiting increased salinities to the minimum achievable mixing zone only.
M9	Reduced physiological functioning of marine organisms due to elevated temperature	Very Low	Very Low		• Ensure engineering designs at the seaward end of the discharge pipe achieve the highest required dilution of brine (29x), thereby limiting potential thermal footprints to the mixing zone only.
M10	Chronic effects on marine organisms	Low	Low		• No mitigation possible

ID #	Impact	Significance rating: Before mitigation/ optimisation	Significance rating: After mitigation/ optimisation	Preferred Layout Alternative	Key mitigation/optimisation measures
	due to halogenated by-products				
M11	Detrimental effects on marine organisms through discharge of co-pollutants in backwash water	Medium	Low		• Use low-toxicity chemicals as far as practicable; • Limit the use of scale-control additives to minimum practicable quantities; • Avoid antiscalants that increase nutrient levels (e.g. polyphosphate antiscalants); • Select an antiscalant that has relevant eco-toxicological testing; • Conduct Whole Effluent Toxicity (WET) testing of the brine effluent; and • Collect residual cleaning solutions and membrane filter washes and neutralize and remove solids before discharge.
M12	Detrimental effects on marine organisms due to residual biocides and chemicals in brine	Medium	Insignificant		• Implement shock dosing of biocide in preference to continual dosing; • Dechlorinate effluent prior to discharge with sodium metabisulphite (SMBS); • Undertake 'pigging' of intake and discharge pipelines to reduce the need for and costs of biocides.
M13	Detrimental effects on marine organisms due to heavy metals from corrosion processes	Medium	Very Low		• Design the plant to reduce corrosion to a minimum by ensuring that dead spots and threaded connections are eliminated. Corrosion resistance is considered good when the corrosion rate is <0.1 mm/a (UNEP 2008).
SE	**Socio-Economic Impacts**				
SE4	Increased employment, income and skills development	Low	Low		• Award installation, customisation and maintenance contracts to South African companies in instances where plant, material or goods must be procured abroad; • Survey skills levels in local communities, and employ people based on the availability of local skill; and • Promote skills development as opposed to the importation of skills, where possible.
SE5	Increased business and tourism opportunities	*Kotzesrus Route*			• Divert heavy vehicles around Kotzesrus; and • Encourage light vehicles and personnel to drive through Kotzesrus.
		Very Low	Very Low		
		Amended Bypass Route			
		Very Low	Very Low		
SE6	Improved service	Very Low	Very Low		• Investigate the opportunity of providing water to villages in close proximity to the project infrastructure.

ID #	Impact	Significance rating: Before mitigation/ optimisation	Significance rating: After mitigation/ optimisation	Preferred Layout Alternative	Key mitigation/optimisation measures
	provision				
V	**Visual Impacts**				
V2	Altered visual character and sense of place	*Kotzesrus Route*		*Amended Bypass Route*	• Ensure that changes to the existing road through Kotzesrus are done as conservatively as possible and that the organic qualities of the village are respected (i.e. the road re-alignment must not be too formal or have overly strong geometry), should the re-alignment of the road through Kotzesrus be required, • Avoid formal concrete kerbs to ensure the visual integration of the road with the landscape; and • Ensure that the design of the linear infrastructure causes minimal visual intrusion through using, for example, non-reflective materials as far as possible and using rural construction techniques. • Install the seawater intake and brine discharge pipelines below ground in the coastal zone; • Appoint an architect to oversee the design of the desalination plant building and infrastructure; • Consult visual guidelines prepared by SRK in July 2013 in the design of the desalination plant.
		Medium	Low		
		Amended Bypass Route			
		Low	Very Low		
		Desalination plant site and coastal linear infrastructure			
		Medium	Low		
V3	Discoloration and increased turbidity of coastal waters	Very Low	Very Low		• Design the pre-treatment system to ensure that $FeCl_3$ levels are kept to minimum to avoid discolouration of the brine; • Monitor brine colour and implement appropriate measures to reduce discolouration, where necessary

Relevant observations with regard to the overall impact ratings, assuming mitigation measures are effectively implemented, are:

- The predicted *air quality* impacts, mainly associated with the creation of dust and resulting nuisance effects, notably on the community of Kotzesrus are rated as *insignificant*. Surfacing the road through Kotzesrus or making use of the Amended Bypass Route rather than the *Kotzesrus Route* would both further minimise this impact.
- The predicted *noise* impacts are rated as *very low* for the *Kotzesrus Route* and *insignificant* for the *Amended Bypass Route* during construction, and insignificant for either route during operations. Noise impacts associated with the desalination plant are insignificant due to the absence of sensitive receptors in the area.
- The predicted *traffic* impacts are rated as *insignificant* for either route alternative; however the impact on the Kotzesrus community will be marginally lower for the *Amended Bypass Route*.
- The predicted impacts on *aquatic ecology* are rated as *low* for either route alternative; however the *Kotzesrus Route* crosses the Brak River and will have higher impacts on wetland function than the *Amended Bypass Route*.
- The predicted *botanical* impacts associated with the *Kotzesrus Route* are rated as *low*, and for the *Amended Bypass Route, very low*. Within the extremely sensitive quartzite and clay exposure areas, it is assumed that the disturbance footprint will be minimised to prevent loss of individuals of *Bulbine bruynsii,* reducing the potentially very high significance impact to *low*. Botanical impacts at the desalination plant site are also rated as *low*. During operations, botanical impacts will be *insignificant*.
- The predicted impacts on *fauna* are generally rated as *low* to *very low*, with reduced impacts for the *Amended Bypass Route*, and construction of the desalination plant to the *east of the coastal road* (i.e. desalination plant positions A, C or D). Impacts for positions B and E are rated as *low*. The impact of the barrier to faunal migration created by the pipeline is however rated as *medium*.
- The predicted impacts on *marine ecology* are generally rated as *very low* during construction, and *very low to low* during operation, since the position of the brine discharge outfall in a high energy surf zone, together with the design of the discharge infrastructure will expedite adequate mixing of the high salinity brine within a relatively short time and confined footprint.
- The predicted *socio-economic benefits* are rated as *very low* during construction and *low* during operation (although marginally lower for the *Amended Bypass Route* which would divert traffic around Kotzesrus, limiting benefits to businesses). Adverse socio-economic impacts are negligible.
- The predicted *heritage* impacts are rated as *very low*, but slightly elevated (to *low*) at the desalination plant.
- The predicted *visual* impact is rated as *low* for the *Kotzesrus Route* and coastal infrastructure, and is rated as *very low* for the *Amended Bypass Route*.

Cumulative impacts in the region may derive from existing agricultural activities and the proposed development of the Zandkopsdrift Mine and associated infrastructure. Cumulative biophysical impacts are of relatively low significance given the very limited scale of existing and planned development and associated anthropogenic activity in the area. Cumulative socio-economic benefits are considered more significant. The contribution of the Volwaterbaai Desalination Plant Project to cumulative impacts is relatively limited at a regional scale.

7.1.2 Principal Findings

The proposed Volwaterbaai Desalination Plant will entail so-called triple bottom line costs, i.e. social, environmental and economic costs. The triple bottom line concerns itself with environmental (taken to mean biophysical) sustainability, social equity and economic efficiency and is typically employed by companies seeking to report on their performance. The concept serves as a useful construct to frame the evaluation of environmental impacts of the project.

The challenge for NCDENC is to take a decision which is sustainable in the long term and which will probably entail trade-offs between social, environmental and economic costs and benefits. The trade-offs are documented in the report, which assesses environmental impacts and benefits and compares these to the No-Go alternative. SRK believes it will be instructive to reduce the decision factors to the key points which the authorities should consider. These points constitute the principal findings of the EIA:

1. Sedex Minerals (Pty) Ltd (Sedex Minerals) intends to mine a Rare Earth Element deposit and beneficiate the ore to produce a mixed rare earth salt at the Zandkopsdrift Mine, 30 km south of the town of Garies in the Northern Cape Province.
2. Due to the lack of available water sources in the area, Sedex Desalination (Pty) Ltd (Sedex Desalination), a subsidiary of Sedex Minerals was established to construct a 8 million m^3/annum (Mm^3/a) seawater desalination plant on the Farm Strandfontein 559 in the Northern Cape, to supply mineralised water to the Zandkopsdrift Mine.
3. In addition to the construction and operation of the desalination plant, the project includes an access road between the Zandkopsdrift Mine and the desalination plant, pipelines to convey water from the desalination plant to the mine, as well as overhead power lines from the mine to supply power to the desalination plant. Pipelines will be placed above the ground on plinths to minimise disturbance, apart from the pipeline between the ocean and the desalination plant, which will be installed below ground. A small, temporary desalination plant will provide water during the construction phase.
4. From the desalination plant, linear infrastructure will be routed along what is currently a combination of 4 x 4 tracks and dirt roads to the Zandkopsdrift Mine, a distance of approximately 49 km. Pipeline and power lines will be positioned in the road reserve if acceptable to the relevant authorities, failing which a servitude directly adjacent to the road reserve will be registered.
5. The project area is typical of the sparsely inhabited Namaqualand region and the desalination plant is in a remote location. The area around the desalination plant and linear infrastructure is mostly used for agricultural purposes and livestock (sheep) grazing is the dominant form of agricultural activity in the area. Dryland crop farming occurs closer to the Zandkopsdrift Mine. There is very little commercial activity in the area, although a small shop (the Kotzesrus Cash Store) is located in the centre of the town, mainly serving the local residents, tourists and Lepelsfontein residents.
6. Farm Strandfontein 559 is owned by Sedex Minerals, measures approximately 12 259 ha and is zoned for Agriculture. The property contains relatively pristine indigenous coastal vegetation which is intermittently used as pasture by a farmer in the area. The small portion(s) of the property required for the desalination plant will be rezoned and subdivided from the remainder of the Farm, with the option to sell unutilised portions in future.
7. Two alternative routes for the linear infrastructure were assessed: the Kotzesrus Route follows the existing roads and tracks, and routes through Kotzesrus. The *Amended Bypass Route* largely follows the same alignment as the *Kotzesrus Route*, but bypasses the Kotzesrus.

8. Five potential positions for the desalination plant (in what is effectively a single site envelope) have been identified and were assessed. Three of these, i.e. positons A, C and D are situated to the east (landward) of the road, while positions D and E are situated to the west (seaward).
9. The potential environmental impacts associated with the proposed Volwaterbaai Desalination Plant and associated infrastructure considered in the S&EIR process include air quality, noise, traffic, aquatic ecology, botanical, faunal, marine ecology, socio-economic, heritage and visual impacts. Assuming that the recommended mitigation measures will be effectively implemented, the proposed development is not projected to have unacceptably significant adverse impacts, while socio-economic benefits are also fairly modest. Impacts of the temporary desalination plant are negligible.
10. The impacts associated with the development of the *Kotzesrus Route* or *Amended Bypass Route* are considered to be acceptable. The *Amended Bypass Route* is preferred from an environmental perspective, as residents of Kotzesrus will be exposed to fewer and less significant noise, traffic and visual impacts, in addition to the reduced loss of wetland, floral and faunal habitat.
11. The impacts associated with the development and operation of the desalination plant are also considered acceptable, with the desalination plant positions situated to the east of the road (*positions A, C or D*) only marginally preferred to those to the west of the road (*positions B or D*).
12. The predicted impacts associated with discharge of brine in the surf zone are considered acceptable.
13. The No-Go alternative implies no change to the *status quo* and thus no additional impacts on terrestrial or marine ecology. It is unlikely that an alternative sustainable source of water for the Zandkopsdrift Mine would be available, and that the cumulative socio-economic benefits of the mine and the desalination plant would not materialise.
14. A number of mitigation and monitoring measures have been identified to avoid, minimise and manage potential environmental impacts associated with the proposed development. These are further laid out in the EMP.

7.2 Recommendations

The specific recommended mitigation and optimisation measures are presented in Chapter 6 and the EMP (Appendix 1A) and key measures are summarised in Table 7-1 above. Sedex Desalination would need to implement these mitigation measures to demonstrate compliance and adherence to best practice. Although it is in theory possible that the potential impacts (or unintended consequences) of implementing mitigation and optimisation measures could offset their intended effect, the majority of the recommendations made in this EIA Report are procedural and/or can be implemented without resulting in any physical effects. The potential for such unintended consequences in the case of the Volwaterbaai desalination plant and associated infrastructure is therefore considered negligible.

Key recommendations, which are considered essential, are:

1. Implement the EMP to guide construction and operations activities and to provide a framework for the ongoing assessment of environmental performance;
2. Appoint an Environmental Control Officer (ECO) to oversee the implementation of the EMP and supervise any construction activities in particularly sensitive habitats;
3. Minimise the physical footprint of the development and areas disturbed by construction activities, particularly in sensitive habitats and habitats supporting species of conservation concern;

4. Rehabilitate all areas disturbed by construction activities;
5. Obtain other permits and authorisations as may be required, including, but not limited to
    a. Water Use Authorisations;
    b. A Coastal Waters Discharge Permit;
    c. Permits for the disturbance or translocation of species of conservation concern; and
    d. A permit for construction vehicles in the coastal zone.
6. Investigate the possibility of reaching an arrangement to making water from the desalination plant available to the villages in the vicinity of the project; and
7. Develop and implement the Monitoring Plan to monitor the quality of the brine discharged from the desalination plant and the predicted dilution of brine within the surf zone. If required water quality and predicted dilution levels are not achieved, implement additional mitigation measures.

7.3 Conclusion and Authorisation Opinion

This Draft EIA Report has identified and assessed the potential biophysical and socio-economic impacts associated with the proposed Volwaterbaai desalination plant and associated infrastructure in the Northern Cape.

In terms of Section 31 (n) of NEMA, the environmental practitioner is required to provide an opinion as to whether the activity should or should not be authorised. In this section, a qualified opinion is ventured, and in this regard SRK believes that sufficient information is available for NCDENC to take a decision.

The Volwaterbaai desalination plant and associated infrastructure will result in unavoidable adverse environmental impacts, although these are of relatively limited extent, given the limited footprint of the project infrastructure which largely follows the alignment of the existing road and tracks. Consequently, none of these adverse impacts are considered unacceptably significant and all can be managed to tolerable levels through the effective implementation of the recommended mitigation measures. In addition, the project will indirectly benefit the local and regional economy by facilitating development of the Zandkopsdrift Mine.

Working on the assumption that Sedex Desalination is committed to ensuring that the desalination plant and associated infrastructure is operated and constructed to high standards, achieved through implementation of the recommended mitigation measures and ongoing monitoring of performance, SRK believes and the EIA Report demonstrates that through effective implementation of the stipulated mitigation measures, the adverse impacts can be reduced to levels compliant with national (and international) standards or guidelines

The fundamental decision is whether to allow the development, which brings economic benefits and is generally consistent with development policies for the area, but which may have limited biophysical impacts.

SRK believes that the specialist studies have shown that the development of the Volwaterbaai desalination plant and associated infrastructure is generally acceptable. The EIA has also assisted in the identification of essential mitigation measures that will mitigate the impacts associated with these components to within tolerable limits.

In conclusion SRK is of the opinion that on purely ‘environmental’ grounds (i.e. the project’s potential socio-economic and biophysical implications) the application as it is currently articulated should **be approved,** provided the essential mitigation measures are implemented. Though the *Amended Bypass Route is* preferred, the *Kotzesrus Route* could also be approved, allowing the proponent to consider technical and financial factors when selecting the final route. Ultimately, however, the NCDENC will need to consider whether the project benefits outweigh the potential impacts.

7.4 Way Forward

This EIA Report is now available for public comment and we invite stakeholders to review the report and to participate in the final phase of the public consultation process. An Executive Summary (in Afrikaans and English) of this report has been distributed to registered stakeholders and is available from SRK on request (details below). Electronic copies of the full EIA Report and Executive Summary are available on the SRK website: www.srk.co.za (via the 'public documents' link on the 'library' menu).

Comments on the EIA Report can be submitted to:

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This EIA Report may be amended based on comments received from stakeholders. Stakeholders' comments on the EIA Report will assist NCDENC in making a decision regarding the application. The public is therefore urged to submit comment. If you require assistance in compiling and submitting comments, please contact us and we will ensure that you receive appropriate support.

Comments must be submitted by 4 December to be incorporated into the Final EIA Report.

If significant amendments are made to the EIA Report, the report will be rereleased to IAPs for a 21 day review period. Once stakeholders have commented on the information presented in the EIA Report, the Final EIA Report will be prepared and submitted to NCDENC for approval. Once a decision is taken by authorities, this decision will be communicated to registered IAPs.

Prepared by

Sharon Jones

Principal Consultant

Reviewed by

Chris Dalgliesh

Partner

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

8 References

ACRM (2013). Heritage Impact Assessment for Proposed Mining on the Remainder of the Farm Dikdoorn no 535 near Garies, Northern Cape. Prepared for Site Plan on behalf of Group Five Civil Engineering (Pty) Ltd. Prepared by Agency for Cultural Resource Management (ACRM), March 2013. Available online: http://www.sahra.org.za/sites/default/files/heritagereports/Report%20Site%20Plan%20Dikdoorn%20quarry%20-%20HIA.pdf, accessed June 2013.

AGES (2013). Zandkopsdrift Rare Earth Element Mine: Determination of Regional Groundwater Potential for Purposes of Supplementary Mine Water Supply. Technical Report AS-R-2013-01-11.

African EPA (2007). Ubuntu Local Municipality Integrated Environmental Management Programme. Available online: http://www.ubuntu.gov.za/index.php/component/docman/doc_download/188-15-ubuntu-m-integrated-environmental-management-plan?Itemid=31, accessed November 2013.

Awad, A.A., Griffiths, C.L. and Turpie, J.K. (2002). Distribution of South African benthic invertebrates applied to the selection of priority conservation areas. Diversity and Distributions 8:129-145.

Bamber, R.N., (1995). The influence of rising background temperature on the effects of marine thermal effluents. Journal of Thermal Biology 20(1/2): 105-110.

Burger L. (2011). South Western Karoo Basin Gas Exploration Application Project: Central Precinct Appendix 6: Air Quality Technical Assessment. Available online: http://www.golder.com/af/en/modules.php?name=Pages&sp_id=1236, accessed November 2013.

Canadian Environmental Protection Agency (no date). Reference Guide: Addressing Cumulative Environmental Effects. Available on-line: [http://www.ceaa-acee.gc.ca/013/0001/0008/guide1_e.htm#6.2]. Accessed August 2007.

Chidley, C., Le Roux, R., and Holton, E. (2011). Environmental Management Framework and Strategic Environmental Management Plan for the Namakwa District Municipality. Prepared by Nemani Consulting CC. Prepared for the Department of Environment and Nature Conservation. Available online: http://nc.spisys.gov.za/docs.html, accessed May 2013.

CNdV (2012). Namakwa District Municipal Spatial Development Framework: Settlement and Infrastructure Development and Management Plan. Prepared for Namakwa District Municipality and Department of Rural Development and Land Reform. Prepared by CNdV Africa Planning and Design CC. Available online: http://nc.spisys.gov.za/docs.html, accessed May 2013.

Creative Harvest (not dated). Ubuntu Tourism Strategy - A Ten Year Plan 2010 – 2020. Available online: http://www.ubuntu.gov.za/index.php/component/docman/doc_download/109-ubuntu-tourism-strategy?Itemid=31, accessed November 2013.

CSIR, (2006). The development of a common set of water and sediment quality guidelines for the coastal zone of the BCLME. CSIR Report No CSIR/NRE/ECO/ER/2006/0011/C, prepared for the Benguela Current Large Marine Ecosystem Programme, January 2006.

DEA (2010). Companion to the EIA Regulations 2010, Integrated Environmental Management Guideline Series 5, Department of Environmental Affairs. Department of Environmental Affairs and Tourism (DEAT), Pretoria.

DEA&DP (2011). Information Document of the Interpretation of the Listed Activities, EIA Guideline and Information Document Series. Western Cape Department of Environmental Affairs & Development Planning (DEA&DP).

DEA (Department of Environmental Affairs) (2010). Companion to the EIA Regulations 2010, Integrated Environmental Management Guideline Series 5, Department of Environmental Affairs

DEA&DP (2013). EIA Guideline and Information Document Series. Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) Available online: http://www.capegateway.gov.za/eadp, accessed June 2013.

DEA&DP (2011). Guideline on the Interpretation of the Listed Activities. Western Cape Department of Environmental Affairs and Development Planning (DEA&DP).

DEAT (2004). Integrated Environmental Management Information Series. Department of Environmental Affairs and Tourism (DEAT).

DOH (Department of Health) (2012). The 2011 National Antenatal Sentinel HIV & Syphilis Prevalence Survey in South Africa. Available online: http://www.doh.gov.za/docs/presentations/2013/Antenatal_Sentinel_survey_Report2012_final.pdf, accessed November 2013.

Dreyer and Loock (2012). Desktop Archaeological, Palaeontological and Heritage Assessment of the Farm Elands Kloof 121 (Schanskraal), Richmond, Northern Cape Province.

DWA (2012). Aquifer Classification of South Africa.

DWAF (2005). National Groundwater Resource Assessment Phase 2 (GRAII). Reports 2C and 3E. Pretoria.

DWS (1999). Department of Water Affairs and Forestry, South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999.

DWAF (2004). Revision of General Authorisations in Terms of Section 39 of the National Water Act, 1998. Government Gazette no. 26187, Government Notice No. 399, 26 March 2004.

Emanuel, B.P., Bustamante, R.H., Branch, G.M., Eekhout, S. and F.J. Odendaal, (1992). A zoogeographic and functional approach to the selection of marine reserves on the west coast of South Africa. South African Journal of Marine Science 12: 341-354.

Energy Blog (2014). Available online: http://energy.org.za/knowledge-tools/project-database?art_title=&programme=&province=&project_type=&town=&cck=project&boxchecked=0&search=project_lookup&task=search, accessed February 2014.

Golder Associates (2011). South Western Karoo Basin Gas Exploration Application Project: Central Precinct Appendix 9: Social Technical Assessment. Available online: http://www.golder.com/af/en/modules.php?name=Pages&sp_id=1236, accessed November 2013.

Golder Associates (2011a). South Western Karoo Basin Gas Exploration Application Project: Central Precinct Appendix 5: Ecology Technical Report. Available online: http://www.golder.com/af/en/modules.php?name=Pages&sp_id=1236, accessed November 2013.

Golder Associates (2011b). South Western Karoo Basin Gas Exploration Application Project: Central Precinct Appendix 4: Soil Technical Report. Available online: http://www.golder.com/af/en/modules.php?name=Pages&sp_id=1236, accessed November 2013.

Hart, T. (2006). Initial Heritage Scoping Assessment of a Proposed Eskom Transmission Line Route from Gariep River to Vredendal (Eskom Kudu Integration Project). Prepared for SEF (Pty) Ltd (as part of a scoping EIA). Prepared by Archaeology Contracts Office, February 2006. Available at http://eskom.ensight-cdn.com/content/Heritagereport.pdf, accessed June 2013.

Helme, N. 2014. Specialist Botanical Input to Routing of Proposed Pipeline in area north of Kotzesrus. Prepared for SRK on behalf of Sedex Desalination, August 2014.

Heugens, E.H.W., Hendriks, A.J, Dekker, T., Van Straalen N.M. and W. Admiraal, (2001). A review of the effects of multiple stressors on aquatic organisms and analysis of uncertainty factors for use in risk assessment. Crit. Rev. Toxicol. 31(3): 247-284.

Higgs, M. Francke, E and Kotze, P. (2010). Kamiesberg Local Municipality Spatial Development Framework: Land Development Plan 2010 – 2015. Prepared by Aurecon and Koplan Consultants CC. Prepared for Kamiesberg Local Municipality. Available online: http://nc.spisys.gov.za/docs.html, accessed June 2013.

International Finance Corporation (1998). Procedure for Environmental and Social Review of Projects. IFC, Washington, USA.

Kotze D.C., Marneweck G.C., Batchelor A.L., Lindley D.S., Collins. N.B., 2008. Wet Eco-Services. A Technique For Rapidly Assessing Ecosystem Services Supplied By Wetlands. WRC Report No. TT 339/08. Water Research Commission, Pretoria

KLM IDP (2013). Kamiesberg Local Municipality Integrated Development Plan, 2013-2014. Unpublished report, available from Kamiesberg Municipality, July 2013.

Lombard, A.T., Strauss, T., Harris, J., Sink, K., Attwood, C. and Hutchings, L. (2004). South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 4: Marine Component. Pretoria: South African National Biodiversity Institute. (www.sanbi.org).

Macfarlane D.M., Kotze D.C., Ellery W.N., Walters D., Koopman V., Goodman P. and Goge C. 2009. WET-Health: A technique for rapidly assessing wetland health. WRC Report No. TT 340/09. Water Research Commission, Pretoria.

McPherson V.P. (not dated). Ubuntu Spatial Development Framework. Available online: http://www.ubuntu.gov.za/index.php?Itemid=56, accessed November 2013.

Northern Cape Provincial Government (2012). Northern Cape Provincial Spatial Development Framework. Available online: http://northerncapepsdf.co.za/wp-content/uploads/Northern_Cape_PSDF_22_August_2012.pdf, accessed October 2013.

Northern Cape Provincial Government (2011). Northern Cape Provincial Growth and Development Strategy. Available online: http://www.francesbaard.gov.za/documents/2011/NCPGDS%20FINAL.pdf, accessed November 2013.

Ollis, DJ; Snaddon, CD; Job, NM & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African Biodiversity Institute, Pretoria.

Pether, J., 2014. Proposed Volwaterbaai Desalination Plant and Associated Infrastructure, for Zandkopsdrift Mine, Namaqualand, Northern Cape Province. Prepared for SRK on behalf of Sedex Desalination. Report version 2, dated 25 July 2014.

Pixley Ka Seme District Municipality (2011). Integrated Development Plan for 2011 – 2016. Available online: http://mfma.treasury.gov.za/Documents/01.%20Integrated%20Development%20Plans/2011-12/03.%20District%20Municipalities/DC7%20Pixley%20Ka%20Seme%20(Nc)/DC7%20Pixley%20ka%20Seme%20-%20IDP%20-%202012.pdf, accessed November 2013.

Prins (2011). South Western Karoo Basin Gas Exploration Application Project: Central Precinct Appendix 8: Cultural Heritage. Available online: http://www.golder.com/af/en/modules.php?name=Pages&sp_id=1236, accessed November 2013.

Pulfrich, A and Steffani, N., 2014. Marine Environmental Impact Assessment for the Seawater Intake Structure and Brine Disposal System of the Proposed Desalination Plant at Volwaterbaai. Prepared for SRK on behalf of Sedex Desalination. Prepared in July, 2014.

Royal Haskoning DHV (2013). Volwaterbaai seawater desalination plant and associated infrastructure: Preliminary feasibility study. Final Draft. Prepared by McGhie, J. Turner, K., Lombard, P., Kotze, B.,van Heerden, J. Prepared for Sedex Desalination, August 2013. Reference number: WCPT138_VWB PFS Report_25%.

StatsSA (2011). Census 2011 Municipal fact sheets. Available online: http://www.statssa.gov.za/Census2011/Products/Census_2011_Municipal_fact_sheet.pdf, accessed June 2013

StatsSA (2013). Information on the Ubuntu Local Municipality. Available online: http://beta2.statssa.gov.za/?page_id=993&id=ubuntu-municipality, accessed November 2013.

StatsSA (2013). National and provincial labour market trends. 2003-2013. Available online: http://beta2.statssa.gov.za/publications/P02114/P021142013.pdf, accessed November 2013.

Ubuntu Local Municipality (not dated). Integrated Development Plan 2013 – 2014. Available online: http://www.ubuntu.gov.za/index.php?Itemid=31, accessed November 2013.

Ubuntu Local Municipality (2002). Ubuntu HIV/AIDS Strategy 20-21 February 2002. Available online: https://www.google.co.za/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&cad=rja&ved=0CEAQFjAD&url=http%3A%2F%2Fwww.ubuntu.gov.za%2Findex.php%2Fcomponent%2Fdocman%2Fdoc_download%2F193-12-ubuntu-j-aids-program%3FItemid%3D31&ei=hlWYUpPdFMa47QaQl4DgCg&usg=AFQjCNH1NgkWI99n57lX14eRnVniWy_MKg&bvm=bv.57155469,d.ZGU, accessed November 2013.

UNEP, (2008). Desalination Resource and Guidance Manual for Environmental Impact Assessments. United Nations Environment Programme, Regional Office for West Asia, Manama, and World Health Organization, Regional Office for the Eastern Mediterranean, Cairo.

Van der Ryst, M. And Küsel, S. (2012). Phase 2 Specialist Study of Middle Stone Age Localities on the Farm Zandkopsdrif 357, Garies District, Northern Cape Province. Prepared for Sedex Minerals (Pty) Ltd, and AGES (Pty) Ltd (Gauteng). Prepared by Habitat Landscape Architects, May 2012. Available online: http://www.sahra.org.za/sites/default/files/additionaldocs/PHASE%202%20REPORT_SAHRA%20PERMIT%2080%2011%2012%20003%2051_MMVANDERRYST_ZANDKOPSDRIFT_17%20MAY%202012.pdf, accessed June 2013.

Van Staden, S., van der Haar, N. and Zdanow, L. (2013). Ecological Sand and Route Sensitivity Report: Volwaterbaai Desalination Plant near Abraham Villiers Bay, Northern Cape Province. Prepared for SRK Consulting, April 2013.

WeatherSA (2011). WeatherSA Climatic Records for the town: DeAar. Available online: http://old.weathersa.co.za/Climat/Climstats/DeAarStats.jsp, accessed July 2011.

Webley, L. (2012). Desktop Heritage Impact Assessment: Proposed 1.5 ha gravel mine, portion 4 of the farm Brakfontein 431, Namaqualand Magisterial District, Northern Cape Province. Prepared for Greenmined Environmental. Prepared by Lita Webley, ACO Associates, December 2012. Available online:http://www.sahra.org.za/sites/default/files/heritagereports/HIA%20Brakfontein%20Garies%20%20gravel%20mining.pdf, accessed June 2013.

Webley, L. and Halkett, D. (2010). Archaeological (including Heritage) Impact Assessment: Proposed Prospecting on Portion 2 and Remainder Portion of the Farm Zandkopsdrift 537, Garies, Northern Cape. Prepared for Sedex Minerals (Pty) Ltd. Prepared by Archaeology Contracts Office, October 2010. Available online: http://www.sahra.org.za/sites/default/files/heritagereports/AIA_Zandkopsdrift_537_Garies_Webley_LE_Oct10_0.pdf, accessed June 2013.

WSP Africa Coastal Engineers (2012a). Marine Intake Site Selection Report – Draft. Report No. 14830/1. October 2012.

Zdanow, Z., van Staden, S. and van de Haar, (2014). Terrestrial and Freshwater Ecological Assessment as part of the Environmental Assessment and Authorisation process for the proposed construction of a desalination plant, including associated infrastructure and services at Volwaterbaai, near Abrahams Villiers Bay in the Northern Cape Province. Prepared by SAS. Prepared for SRK Consulting in August 2014.

Appendix 1A Environmental Management Programme

Volwaterbaai Desalination Plant and Associated Infrastructure, Northern Cape

Environmental Management Programme

Report Prepared for

Sedex Desalination (Pty) Ltd

Report Number 451101/04

NCDENC Reference Numbers: NC/EIA/07/NAM/KAM/KOT1/2013

NCP/EIA/0000225/2013

DEA: O&C CWDP Reference Number: 2014/017/NC/Volwaterbaai Desalination Plant

Report Prepared by

srk consulting

October 2014

Volwaterbaai Desalination Plant and Associated Infrastructure, Northern Cape

Environmental Management Programme

Sedex Desalination (Pty) Ltd

NCDENC Reference Numbers: NC/EIA/07/NAM/KAM/KOT1/2013

NCP/EIA/0000225/2013

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SRK Project Number 451101

October 2014

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Profile and Expertise of EAPs

SRK Consulting (South Africa) Pty Ltd (SRK) has been appointed by Sedex Desalination (Pty) Ltd (Sedex Desalination) as the independent consultants to undertake the Environmental Impact Assessment (EIA) process required in terms of the National Environmental Management Act 107 of 1998 (NEMA).

SRK Consulting comprises over 1 600 professional staff worldwide, offering expertise in a wide range of environmental and engineering disciplines. SRK's Cape Town environmental department has a distinguished track record of managing large environmental and engineering projects and has been practisng in the Western Cape since 1979. SRK has rigorous quality assurance standards and is ISO 9001 accredited.

As required by NEMA, the qualifications and experience of the key individual practitioners responsible for this project are detailed below.

Project Director and Reviewer: Christopher Dalgliesh, BBusSc (Hons); MPhil (EnvSci)
Certified with the Interim Board for Environmental Assessment Practitioners South Africa (CEAPSA)
Chris Dalgliesh is a Partner at SRK and the Head of the Environmental Department in Cape Town. He has over 19 years of experience as an environmental consultant working on a broad range of EIA, auditing, environmental planning and management, stakeholder engagement and environmental management system projects. Chris's experience includes managing and co-ordinating major EIAs throughout Southern Africa and South America in the mining, energy, land-use planning and development, water and waste management, and industrial sectors.

Project Manager: Sharon Jones, BSc Hons (Env. Sci); MPhil (EnviroMan)
Certified with the Interim Board for Environmental Assessment Practitioners South Africa (CEAPSA)
Sharon Jones is a Principal Environmental Consultant with over 16 years of experience, primarily in South Africa, Southern Africa (Mozambique, Angola and Namibia) and South America (Suriname). Sharon has managed EIAs across a number of sectors, provided input into due diligence studies, compiled numerous construction and operations phase EMPs for a range of projects, and has audited compliance with EMPs on a number of sites. She is also involved with the development of Environmental Management Frameworks. Sharon is a registered Professional Natural Scientist (Environmental Science) with SACNASP and a Certified Environmental Practitioner of South Africa (CEAPSA).

Statement of SRK Independence

Neither SRK nor any of the authors of this Report have any material present or contingent interest in the outcome of this Report, nor do they have any pecuniary or other interest that could be reasonably regarded as being capable of affecting their independence or that of SRK.

SRK has no beneficial interest in the outcome of the assessment which is capable of affecting its independence.

Disclaimer

The opinions expressed in this report have been based on the information supplied to SRK by Sedex Desalination. SRK has exercised all due care in reviewing the supplied information, but conclusions from the review are reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

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Acronyms and Abbreviations

AGES	Africa Geo-Environmental Services Gauteng (Pty) Ltd
BBBEE	Broad Based Black Economic Empowerment
CARA	Conservation of Agricultural Resources Act 43 of 1983
CIP	Cleaning in Place
CR	Contractors Representative
DEA: O&C	Department of Environmental Affairs: Oceans and Coasts
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
HIA	Heritage Impact Assessment
HWM	High Water Mark
KLM	Kamiesberg Local Municipality
NCDENC	Northern Cape Department of Environment and Nature Conservation
NCNCA	Northern Cape Nature Conservation Act 9 of 2009
NDM	Namakwa District Municipality
NEM: ICMA	National Environmental Management: Integrated Coastal Management Act 24 of 2008
NEMA	National Environmental Management Act 107 of 1998 as amended
NGOs	Non-Governmental Organisations
NHRA	National Heritage Resources Act 25 of 1999
NOEC	No Observed Effect Concentration
NWA	National Water Act 36 of 1998
PNEC	Predicted No Effect Concentration
PPE	Personal Protective Equipment
RE	Resident Engineer
RO	Reverse osmosis
S&EIR	Scoping and Environmental Impact Reporting
SAHRA	South African Heritage Resources Agency
SCC	Species of Conservation Concern
SMBS	Sodium metabisulphite
SRK	SRK Consulting (South Africa) (Pty) Ltd
WET	Whole Effluent Toxicity

Glossary

Activity	An activity or operation carried out as part of the construction or operation of the desalination plant and associated infrastructure
Aspect	An action, event, product or service, occurring as a component or result of an activity, which interacts with the existing environment (or which results in impacts to it)
Community	Those people who may be impacted upon by the construction and operation of the project. This includes neighbouring landowners, local communities and other occasional users of the area.
Contractor	Any company appointed by the Proponent to undertake construction or related activities on site, and will include the main Contractor, as well as any sub-contractors.
Construction phase	The stage of project development comprising site preparation as well as all construction activities associated with the development.
Contaminated water	Water contaminated by activities on site, e.g. concrete water and run-off from plant / personnel wash areas.
Design phase	The stage during which detailed layout and development plans are prepared, including the drafting of contract documents for construction.
Environment	The external circumstances, conditions and influences that surround and affect the existence and development of an individual, organism or group. These circumstances include biophysical, social, economic, historical and cultural aspects.
Environmental Authorisation	The authorisation by a competent authority of a listed activity or specified activity in terms of NEMA.
Environmental Impact Assessment	A process of evaluating the environmental and socio-economic consequences of a proposed course of action or project
Environmental Management Measures	Requirements or specifications for environmental management, as presented in the EMP, some of which are based on the mitigation measures identified in the EIA Report (in this case the EIA).
Hazardous substance	A substance (including materials and waste) that can have a deleterious (harmful) effect on the environment and those substances declared hazardous substances in terms of the Hazardous Substances Act 15 of 1973.
Impact	A change to the existing environment, either adverse or beneficial, that is directly or indirectly due to the development of the project and its associated activities.
Method Statement	A mandatory written submission by the Contractor to the ECO setting out the plant, materials, labour and method the Contractor proposes using to carry out an activity.
Mitigation Measures	Actions identified in the EIA to manage (avoid, minimise or optimise) potential environmental impacts which may result from the development.
Operations phase	The stage of the works following the construction phase, during which the development will function or be used as anticipated in the Environmental Authorisation.

Performance indicator	A measurable indicator of the outcome of environmental management, used to assess the success with which mitigation measures have been implemented. Often captures the results of several different monitoring activities.
Phase	A defined period during the life of the power plant project, e.g. the *construction* and *operations* phases.
Proponent	The person or organisation implementing the project.
Resources	The personnel, financial, equipment and technical requirements necessary for the successful completion of mitigation measures and for monitoring activities.
Schedule	The schedule or deadline for completion of each mitigation measure, which are recorded to ensure that mitigation measures are implemented in good time and in the correct sequence.
Solid waste	All solid waste including construction debris, chemical waste, broken / redundant equipment, oil filters, wrapping materials, timber, tins and cans, drums, wire, nails, food and domestic waste (e.g. plastic packets and wrappers).
Sub-Contractors	A sub-contractor is any individual or contractor appointed by the main Contractor, to undertake a specific task on site.

1 Introduction

1.1 Background

Sedex Minerals (Pty) Ltd (Sedex Minerals) intends to mine a Rare Earth Element deposit and beneficiate the ore to produce a mixed rare earth salt at the Zandkopsdrift Mine, 30 km south of the town of Garies in the Northern Cape Province. Sedex Desalination (Pty) Ltd (Sedex Desalination), a subsidiary of Sedex Minerals proposes to construct a 8 million m3/annum (Mm3/a) seawater desalination plant, including associated infrastructure and services at Volwaterbaai, on the Farm Strandfontein 559 in the Northern Cape, (see Figure 1-1) to supply mineralised water via a transfer pipeline to the Zandkopsdrift Mine.

SRK Consulting (South Africa) (Pty) Ltd (SRK) undertook the Scoping and Environmental Impact Reporting (S&EIR) process required in terms of the National Environmental Management Act 107 of 1998, as amended (NEMA) and the Environmental Impact Assessment (EIA) Regulations, 2010 (promulgated in terms of NEMA). The EIA Report contains a detailed description of the project and its impacts.

NEMA requires that an Environmental Management Programme (EMP) be submitted along with the EIA Report to demonstrate how environmental management and mitigation measures will be implemented. The mitigation measures, which were identified during the S&EIR process, apply to the following phases of the development process:

- ***The Design Phase***: These measures relate to the detailed layout, planning and design of the seawater desalination plant and associated infrastructure, and will largely be implemented by the planning and development team, prior to the commencement of any physical on site activities. These mitigation measures are presented in Section 2.
- ***The Construction Phase*****:** These mitigation measures are applicable during site preparation and construction on the site of the seawater desalination plant and linear infrastructure and must be implemented by the relevant contractors and sub-contractors. These mitigation measures are presented in Section 3.
- ***The Operational Phase:*** These mitigation measures are applicable during the long-term operation of the seawater desalination plant and must be implemented by the plant management. These mitigation measures are presented in Section 4.

As it is expected that the seawater desalination plant and linear infrastructure will be maintained in the long-term and not be decommissioned in the foreseeable future, measures related to decommissioning and post-closure rehabilitation of the desalination plant are not included in the EMP.

The management measures listed for the various phases are either:

- **Essential**: best practice measures which must be implemented and are non-negotiable; or
- **Best Practice**: recommended to comply with best practice, with adoption dependent on the proponent’s risk profile and commitment to adhere to best practice, and which must be shown to have been considered and sound reasons provided by the proponent if not implemented. *These measures have been italicized for ease of reference.*

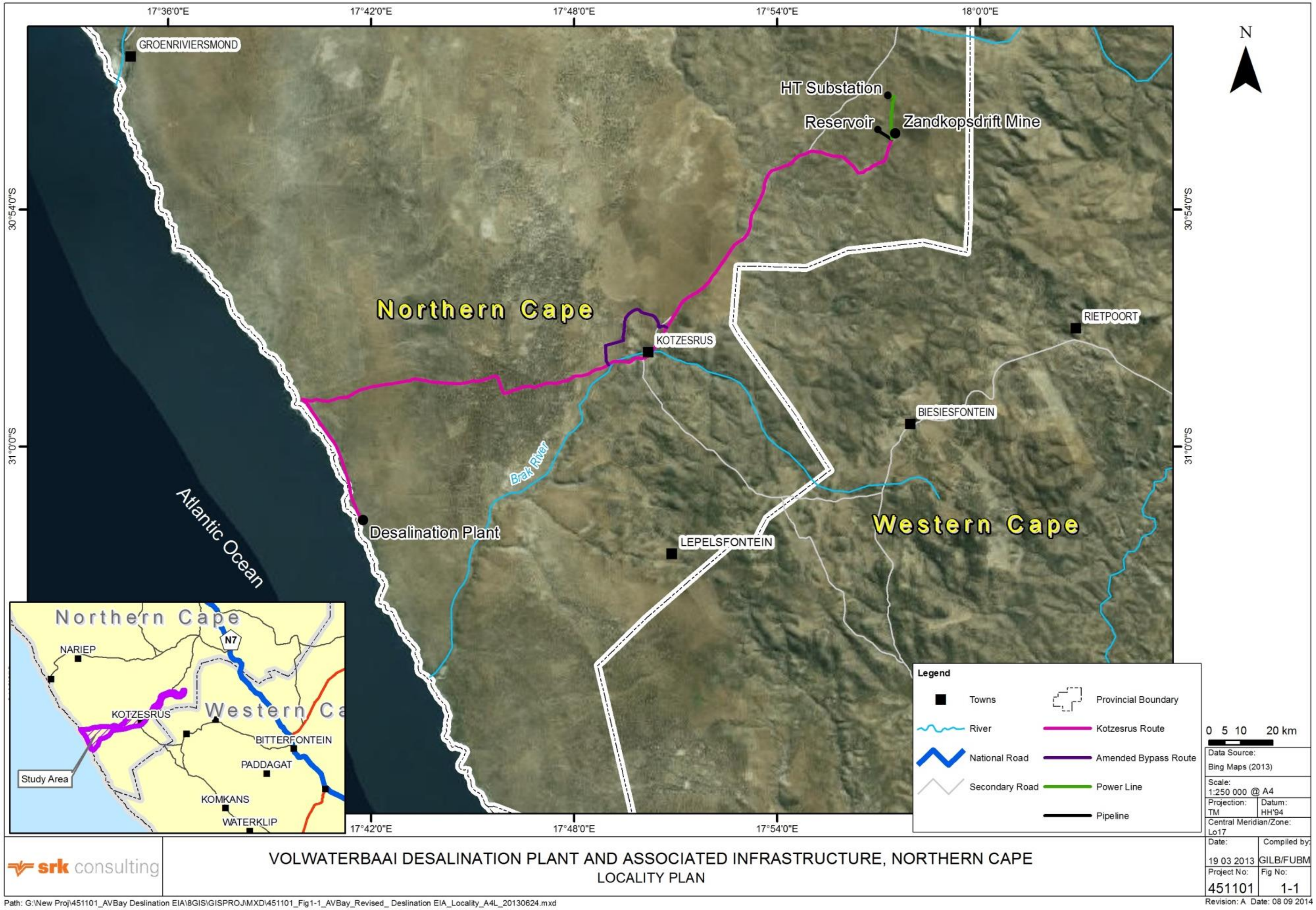

Figure 1-1: Locality Map

***Note**: The EMP will be submitted to the Northern Cape Department of Environment and Nature Conservation (NCDENC) for approval along with the EIA Report. Once an environmental authorisation (EA) has been issued by NCDENC, this document may need to be updated to ensure that all relevant conditions of authorisation are adequately captured.*

1.2 Content of the EMP

The EIA Regulations, 2010 (Government Notice (GN) 543, Chapter 3, Part 3, Section 33) prescribe the required content in an EMP. These requirements and the sections of this EMP in which they are addressed, are summarised in Table 1-1.

Table 1-1: Content of the EMP as per EIA Regulations, 2010

GN 543, S33 Ref.:	Item	Section Ref.:
(a) (i)	Details of the person who prepared the EMP	i
(a) (ii)	Expertise of that person to prepare an EMP	i
(b)	Information on any proposed management or mitigation measures to address the environmental impacts identified in the EIA in respect of:	
(b) (i)	Planning and design	2
(b) (ii)	Pre-construction and construction activities	3
(b) (iii)	Operation or undertaking of the activity	4
(b) (iv)	Rehabilitation of the environment	3
(b) (v)	Closure, where relevant	n/a
(c)	A detailed description of the aspects covered by the draft EMP	1.2
(d)	An identification of the persons responsible for implementation of the mitigation measures	2-4
(e)	Proposed mechanisms for monitoring compliance with and performance of the EMP	2-4
(f)	Where practicable, measures to rehabilitate the environment affected by the activity	3
(g)	Description of the manner in which it intends to:	
(g) (i)	Modify, remedy, control or stop any action, activity or process that cause pollution or environmental degradation	2-4
(g) (ii)	Remedy the cause of pollution or degradation	3, 4
(g) (iii)	Comply with any prescribed environmental management standards	3, 4
(g) (iv)	Comply, if applicable, with provisions of NEMA regarding closure	n/a
(g) (v)	Comply, if applicable, with provisions of NEMA regarding financial provisions for rehabilitation	n/a
(h)	Time periods within which the measures in the EMP must be implemented	2-4
(i)	Process for managing any environmental damage, pollution etc	3, 4
(j)	Environmental awareness plan describing the manner in which:	3
(j) (i)	The applicant intends to inform his or her employees of environmental risks	3
(j) (ii)	Risks must be dealt with to avoid pollution/degradation of environment	3
(k)	Closure plans, where appropriate	n/a

1.3 Site and Project Description

Sedex Minerals propose to develop the Zandkopsdrift Rare Earth Element Mine on the remainder of Farm Zandkopsdrift 537, and Portion 2 of the Farm Zandkopsdrift 537, in the Northern Cape Province. The development of the Mine is subject to a separate EIA process, being conducted by Africa Geo-Environmental Services Gauteng (Pty) Ltd (AGES) (NCDENC Ref: NC/EIA/NAM/KAM/ZAN/2012).

Due to the shortage of water resources in the area, a seawater desalination plant is proposed at Volwaterbaai on the Farm Strandfontein 559, Namaqualand (the property - see Figure 1-2) to supply water to the mine. The property is owned by Sedex Minerals and measures approximately 12 259 ha and is zoned for Agriculture.

Sedex Desalination, a subsidiary of Sedex Minerals, was established specifically to develop a desalination plant and linear infrastructure for this purpose. The water will be pumped via pipeline from the desalination plant to the Mine, with a take-off and reservoir located at Kotzesrus. An access/maintenance road and power lines will also be established between the mine and the desalination plant. Two linear infrastructure route alternatives were considered in the EIA, the *Kotzesrus Route* and the *Amended Bypass Route,* the latter identified as the preferred alternative.

The Volwaterbaai property is located approximately 55km southwest of Bitterfontein (in the Western Cape Province); approximately 15km west of the town of Kotzesrus and approximately 29km southwest of Garies (both in the Northern Cape Province) (see Figure 1-1). The property contains relatively pristine indigenous coastal vegetation that is used for grazing purposes on an intermittent basis by a farmer in the area. It is proposed that the small portion(s) of the property that will be required for the desalination plant will be rezoned and subdivided from the remainder of the Farm, with the possibility to sell the unutilised portions in future.

The current design of the desalination plant and associated infrastructure is for the provision of a maximum of 8 Mm^3/a of product water. The desalination plant will be located at the property approximately 6km north of the Brak River mouth on a typical stretch of the Namaqualand coastline, comprising rocky coastal outcrops interspersed with sandy beaches. From the desalination plant, water supply pipelines, overhead power lines and an access road servicing the plant (hereafter linear infrastructure or linear routes) will be routed along what is currently a combination of 4 x 4 tracks and dirt roads to the Zandkopsdrift Mine, a distance of approximately 48.9km (see Figure 1-2).

The project is located in the Succulent Karoo Region of Endemism which is considered to be of high vulnerability in terms of biodiversity sensitivity. Botanically sensitive quartzite and clay exposure areas, containing rare species such as the Vulnerable *Bulbine bruynsii* are located to the east of Kotzesrus (see Figure 1-3 and Figure 1-4). Specific mitigation measures to reduce potential impacts on quartzite and clay exposure areas are included in the EMP (Sections 3 and 4).

A number of ephemeral drainage features and wetland features (including the *Brak River*, *tributaries to the Groen River*, *natural ephemeral pans* and *artificial depressions*) also occur within the vicinity of the project footprint (see Figure 1-5). Specific mitigation measures to reduce potential impacts on drainage features and wetland areas are included in the EMP (Sections 3 and 4).

A more detailed project description and description of the affected environment is provided in Sections 3 and 4 of the EIA Report (SRK Report No: 451101/03; September 2014: *Volwaterbaai Desalination Plant and Associated Infrastructure, Northern Cape: Environmental Impact Assessment Report*).

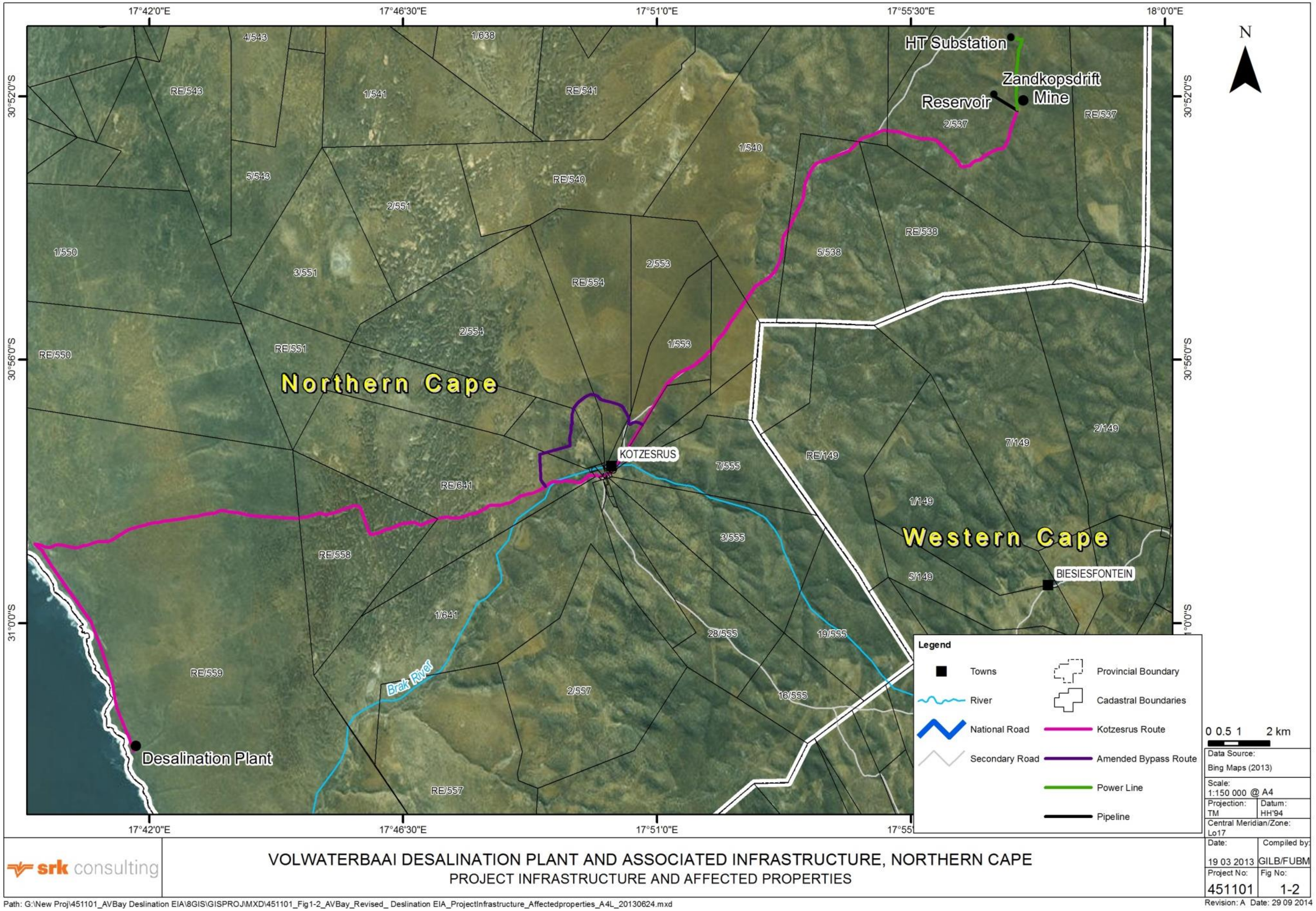

Figure 1-2: Project Infrastructure and Affected Properties

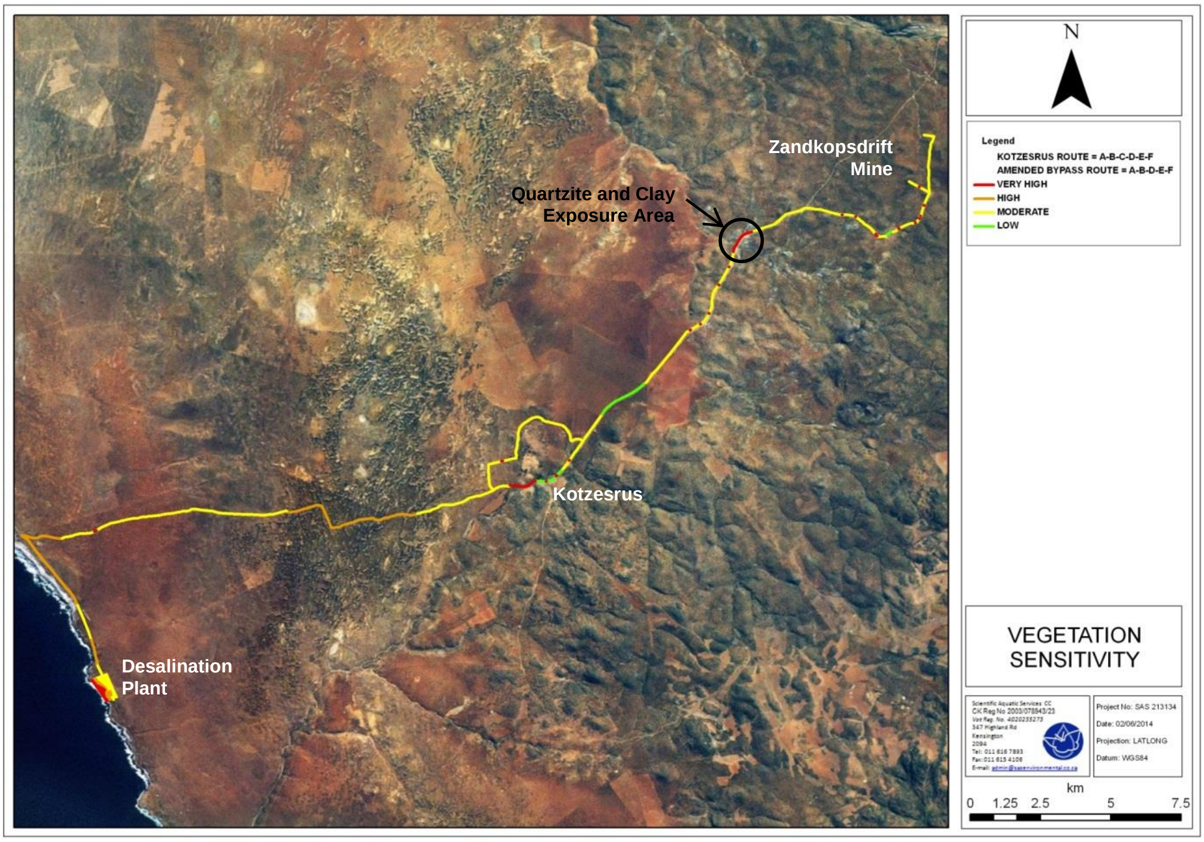

Figure 1-3: Vegetation Sensitivity and Quartzite and Clay Exposure Areas

Source: Zdanow et al., 2014

srk consulting	**Volwaterbaai Desalination Plant and Associated Infrastructure** Quartzite and Clay Exposure Areas containing *Bulbine Bruynsii*	Project No. 451101

Figure 1-4: Quartzite and Clay Exposure Areas along Kotzesrus Route

Source: Helme, 2014.

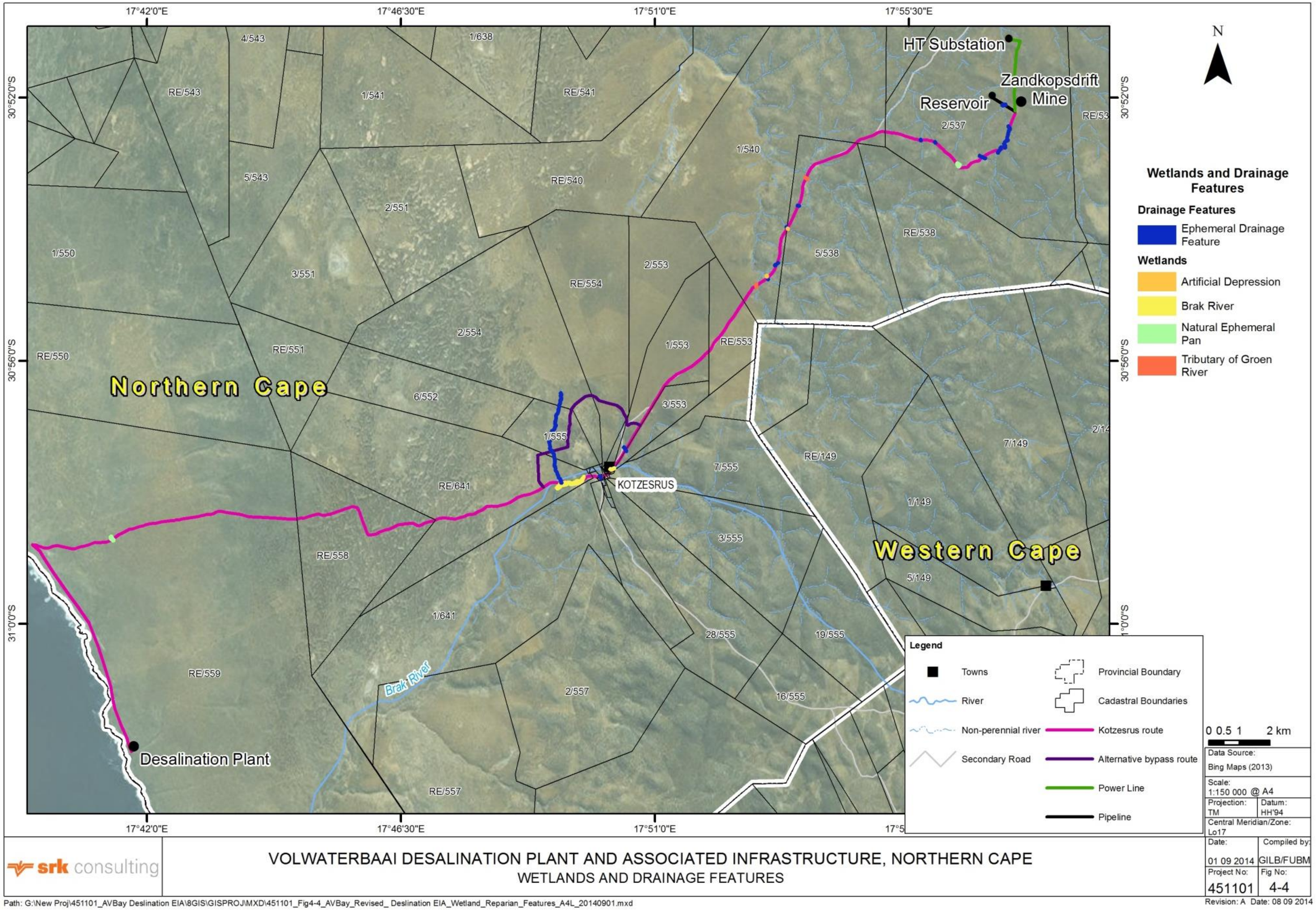

Figure 1-5: Wetlands and Drainage Features

1.4 Potential Impacts

A summary of the potential impacts of the proposed development identified and assessed in the EIA Report is presented in Table 1-2. Additional details on the nature of these impacts are provided in the EIA Report.

Table 1-2: Potential impacts of the proposed Project

Impact	Description	Impact Status
Construction Phase		
Air Quality	Changes in air quality due to project related emissions	Negative
Noise	Increased noise levels and vibration due to project activities	Negative
Traffic	Impacts of project related traffic on existing road users and surrounding residents	Negative
Aquatic Ecology	Loss of wetland habitat and ecological structure	Negative
Botany	Loss of floral habitat, biodiversity and Species of Conservation Concern (SCC)	Negative
Fauna	Altered faunal habitat, diversity and RDL/protected species	Negative
Marine Ecology	Disturbance of coastal ecology	Negative
	Impacts of contamination on marine biota	Negative
	Impacts of increased turbidity and smothering through redeposition of suspended sediment	Negative
	Disturbance of shore birds and marine biota through noise and blasting	Negative
	Elimination of benthic communities through loss of substratum	Negative
	Impacts of temporary desalination plant on the marine environment	Negative
Socio- economic	Increased employment, income and skills development	Positive
	Increased business and tourism opportunities	Positive
	Increased incidence of crime	Positive
Heritage	Disturbance and loss of archaeological material	Negative
	Disturbance and loss of heritage structures	Negative
	Disturbance and loss of palaeontological material	Negative
Visual	Visual intrusion of construction equipment and activities	Negative
Operations Phase		
Air Quality	Changes in air quality	Negative
Noise	Noise Impacts during operation	Negative
Traffic	Impacts of operational traffic	Negative
Aquatic Ecology	Loss of wetland habitat and ecological structure	Negative
Botanical Impacts	Loss of floral habitat, biodiversity and SCC	Negative
Fauna	Impacts on faunal habitat, diversity and RDL/protected species	Negative
	Disruption of faunal migratory corridors	Negative
Marine Ecology	Loss of marine species through impingement and entrainment	Negative
	Reduced physiological functioning of marine organisms due to elevated salinity	Negative
	Reduced physiological functioning of marine organisms due to elevated temperature	Negative
	Chronic effects on marine organisms due to formation of halogenated by-products	Negative
	Detrimental effects on marine organisms through discharge of co-pollutants in	Negative

Impact	Description	Impact Status
	backwash water	
	Detrimental effects on marine organisms due to residual biocides and chemicals	Negative
	Detrimental effects on marine organisms due to heavy metals from corrosion processes	Negative
Socio- economic	Increased employment, income and skills development	Positive
	Increased business and tourism opportunities	Positive
	Improved service provision	Positive
Visual	Altered visual character and sense of place	Negative
	Discoloration and increased turbidity of coastal waters	Negative

2 Measures Applicable to the Detailed Design Phase

2.1 Roles and Responsibilities

The key role players during the design phase of the project are:

- Sedex Desalination (the proponent); and
- Engineering consultants responsible for the design of the seawater desalination plant and linear infrastructure.

Their roles and responsibilities during the detailed design phase with respect to the implementation of the EMP are outlined below.

Sedex Desalination:

- Ensure that all members of the engineering consultant team are aware of and take into consideration all relevant measures in the EMP; and
- Confirm that all relevant environmental management measures in the EMP have been incorporated into the project design on completion of the Design Phase.

Engineering Consultants:

- Take cognisance of all relevant measures in the EMP and ensure integration thereof in the detailed design; and
- Reference the environmental management measures applicable to the construction (Section 3) and operation (Section 4) phases of the project in all documents that will be applicable to future phases of the Project (e.g. tender documents).

2.2 Environmental Management Measures

The environmental management and mitigation measures that must be implemented during the design phase, as well as responsibilities and timelines for the implementation of these measures and monitoring thereof, are laid out in Table 2-1 below.

Table 2-1: Environmental management and mitigation measures that must be implemented during the design phase

Design Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[1]**	**Performance Indicators**
Authorisations	1.	Ensure that all required licences and permits have been obtained before the start of construction, including *inter alia*: • The relevant approvals from the Department of Water and Sanitation (DWS) for any activities within wetland areas and their associated buffers particularly in terms of Section 21 (c) and (i) of the National Water Act 36 of 1998 (NWA); • Authorisation from the Northern Cape Department of Environment and Nature Conservation (NCDENC) for SCC, protected and indigenous species to be cut, disturbed, damaged or destroyed • A permit for driving on the beach in terms of the the National Environmental Management: Integrated Coastal Management Act 24 of 2008 (NEM: ICMA); and • A Coastal Water Discharges Permit in terms of NEM: ICMA; and • Coastal use permits for construction in the coastal zone and the abstraction of seawater in terms of NEM: ICMA, if applicable.	• Sedex Desalination	• Before construction commences	• Keep record of all permits, licences and authorisations	• Licences and permits are available
Project Planning	2.	Appoint an independent ECO to oversee construction activities.	Sedex Desalination/ Engineering consultants	Before construction activities commence	• Review appointment documentation • Review rehabilitation plan and financial provisions	• ECO appointment documents • Rehabilitation plan and financial provisions
	3.	Plan and make adequate financial provision for rehabilitation and restoration activities and clearly allocate timing and responsibility for environmental rehabilitation.				
Linear Infrastructure design	4.	Install pipelines and power lines above ground support structures (plinths) with minimal footprints.	Engineering consultants	During design phase	• Review detailed layout plans	• Safe crossing of faunal species • Erosion and stormwater control • Disturbance of sensitive archaeological sites
	5.	Ensure that as far as possible all infrastructure is placed outside rocky outcrop areas.				
	6.	Design gravel roads in such a way to allow for either a gradual kerb or regular 'exits' from the road in order to allow faunal species such as tortoises to safely cross. Construction and maintenance of access roads should allow for the movement of faunal species, particularly tortoises that struggle to cross gravel roads with continuous heaps of sand on either side				
	7.	Incorporate adequate erosion and stormwater management measures in road design in order to prevent erosion and the associated sedimentation of wetland areas.				

[1] Unless otherwise indicated, monitoring will be undertaken by Sedex Desalination, supported by the authorities where the requirement is specifically stipulated in a licence or permit.

Design Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[1]**	**Performance Indicators**
	8.	Ensure that the construction footprint of power line footing structures does not fall within any riparian or wetland features as identified in Figure 1-5.				
	9.	Provide gates with sufficient locking mechanisms where private camp fences/ gates are crossed, if necessary.				
	10.	Design linear infrastructure in such a way as to avoid impacting on any sensitive archaeological sites along the linear infrastructure route as identified in the Heritage Impact Assessment (HIA) (see Appendix A), where possible.				
	11.	*Investigate the possibility of installing pipelines at a minimum height of 30 cm above the ground to allow small faunal species may move naturally under this unnatural barrier.*				
Bridges, culverts and wetland crossings	12.	Upgrade bridges/culverts to comply with the requirements listed below, where these upgrades are required for the project: • Bridges and culverts must span the entire width of wetland and drainage features; • Bridge structures must not alter seasonal stream flow patterns; • Habitat connectivity must be maintained beneath bridge structures and culverts, by e.g. constructing underpasses so that they are sufficiently high to allow for the movement of local fauna, including small antelope, and (where possible) sufficiently wide to include a buffer along the margins of the wetland habitat; • Bridges and culverts must not result in the incision and canalisation of the wetland and drainage areas, but must allow for sufficient dispersion of water through wetland and drainage areas to prevent the concentration of flow which could lead to scouring and incision of the system.	Engineering consultants	During design phase	• Review detailed layout plans	• Extent to which measures are reflected/ addressed in plans.
	13.	Align pipelines and power lines to cross wetlands and drainage features, perpendicularly (or as close as possible to perpendicular) to limit the area of disturbance within the wetland or drainage feature.				
	14.	Install pipelines and power lines to span over the wetland/drainage feature and the associated 32m buffer zone, where these features cannot be avoided. Where this is not possible, pipeline and power line support structures must be placed in the buffer zone rather than inside the feature.				
Linear infrastructure design through	15.	Locate power lines and pipelines in close proximity to quartzite and clay exposure areas to the west of the existing gravel road (see Figure 1-4).	Engineering consultants	During design phase	• Review detailed layout plans	• Location of pipelines near quartzite and clay

Design Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[1]**	**Performance Indicators**
quartz and clay exposure areas	16.	Ideally design and construct the pipeline within the road reserve or alternatively as close as possible to the road / road reserve edge.				exposure areas • Disturbance of sensitive areas • Translocation of sensitive species
	17.	Design pipelines and power lines to be installed on support structures above the ground. These support structures (plinths) must have as small a footprint as possible.				
	18.	Identify plinth positions between June and September (the year before construction if necessary), since *Bulbine bruynsii* plants are only evident above ground from at this time of year. Do so in conjunction with someone capable of identifying these plants in the field and translocate any plants potentially in the plinth footprint.				
Desalination plant	19.	Design the plant to reduce corrosion to a minimum by ensuring that dead spots and threaded connections are eliminated. Corrosion resistance is considered good when the corrosion rate is <0.1 mm/a.	Engineering consultants	During design phase	• Review detailed design parameters	• Corrosion rate
Seawater intake and discharge pipelines	20.	Where possible, install seawater intake and discharge pipelines within existing gravel road reserves in order to reduce impact on surrounding natural habitat.	Engineering consultants	During design phase	• Review detailed layout plans	• Placement of seawater intake and discharge pipelines
	21.	Install the seawater intake and brine discharge pipelines below ground in the coastal zone (to the west of the coastal road).				
	22.	Design pipeline in such a way that required rock blasting is kept to a minimum.				
Seawater intake	23.	Ensure that intake velocities are kept below ~0.15 m/s to enable fish and other organisms to escape the intake current.	Engineering consultants	During design phase	• Review detailed design layout and parameters	• Intake velocities • Screens at intake structures; • Raw water study.
	24.	Include screens as part of the designs for the intake structure and ensure installation of screens on the end of the intake pipes, or the use of a screen box or shroud.				
	25.	Conduct a study on the chemical, microbial and physical properties of the raw water. This should include an evaluation of meteorological and oceanographic data, and aquatic biology and take seasonal variations into account.				
Pre-treatment system	26.	Design the pre-treatment system to ensure that $FeCl_3$ levels are kept to minimum to avoid discolouration of the brine.	Engineering consultants	During design phase	• Review design parameters	• $FeCl_3$ levels
Design of brine discharge	27.	Ensure adequate design at the outfall site to facilitate rapid dilution of the brine effluent.	Engineering consultants	During design phase	• Review design parameters	• Highest required dilution of brine
	28.	Ensure that a nozzle is provided at the end of the brine discharge pipe to generate a minimum discharge of ~4 m/s to improve the mixing between the brine and the seawater.				

Design Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**[1]	**Performance Indicators**
	29.	Ensure engineering designs at the seaward end of the discharge pipe achieve the highest required dilution of brine (29x), thereby limiting increased salinities to the minimum achievable mixing zone only.				
	30.	Utilise the jet stream from the pipe end to accelerate the brine directly into the oncoming rolling waves, thereby ensuring rapid mixing with the surrounding seawater.				
	31.	*Increase the number of ports at the discharge outlet to improve the mixing between the brine and the seawater.*				
	32.	*Design outlet velocities so as to minimise the potential for flow distortion.*				
Visual aspects	33.	Ensure that changes to the existing road through Kotzesrus are done as conservatively as possible and that the organic qualities of the village are respected (i.e. the road re-alignment must not be too formal or have overly strong geometry), should the re-alignment of the road through Kotzesrus be required.	Engineering consultants	During design phase	• Review detailed layout plans	• Appointment documents of the relevant professionals • Extent to which measures are addressed in plans
	34.	Avoid formal concrete kerbs to ensure the visual integration of the road with the landscape.				
	35.	Ensure that the design of the linear infrastructure causes minimal visual intrusion through using, for example, non-reflective materials as far as possible and using rural construction techniques.				
	36.	Appoint an architect to oversee the design of the desalination plant building and infrastructure within the coastal environment.				

Design Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[1]**	**Performance Indicators**
	37.	Consult visual guidelines prepared by SRK in July 2013 (Appendix B) in the design of the desalination plant, taking the following into consideration: • Integrate design with natural topography; • Limit height of buildings; • Limit the construction footprint; • Reduce building bulk as far as possible; • Limit infrastructure on the coastal side of the coastal road; • Make use of local construction techniques as far as possible; • Make appropriate use of materials; • Carefully consider screening options; • Carefully consider fencing options; • Make use of “green” roofs where possible; • Rehabilitate disturbed areas and employ indigenous landscaping appropriately; • Carefully consider the use of shade structures; and Carefully consider and limit the use of lighting.				
	38.	*Appoint a landscape architect to assist with design of visually appropriate structures within the coastal environment, the design of green roofs and the rehabilitation of the landscape using indigenous vegetation.*				

3 Measures Applicable to the Construction Phase

3.1 Roles and Responsibilities

The key role players during the construction phase of the project are anticipated as follows:

- Sedex Desalination (the proponent);
- Resident Engineer, who will oversee activities and Contractors on site;
- Contractors responsible for the construction of the seawater desalination plant and linear infrastructure; and
- Any sub-contractors hired by the Contractor.

The anticipated construction phase organogram is presented in Figure 3-1 below and shows the proposed lines of communication during this phase. All instructions relating to the EMP will be given to the Contractor via the Resident Engineer (RE). In an emergency situation, the Environmental Control Officer (ECO) may give an instruction directly to the Contractor. Both the Contractor and ECO will report issues of concern to the RE, who in turn will report on progress to the proponent. Sedex Desalination will retain responsibility for ensuring that the Contractor fully implements the provisions of the EMP.

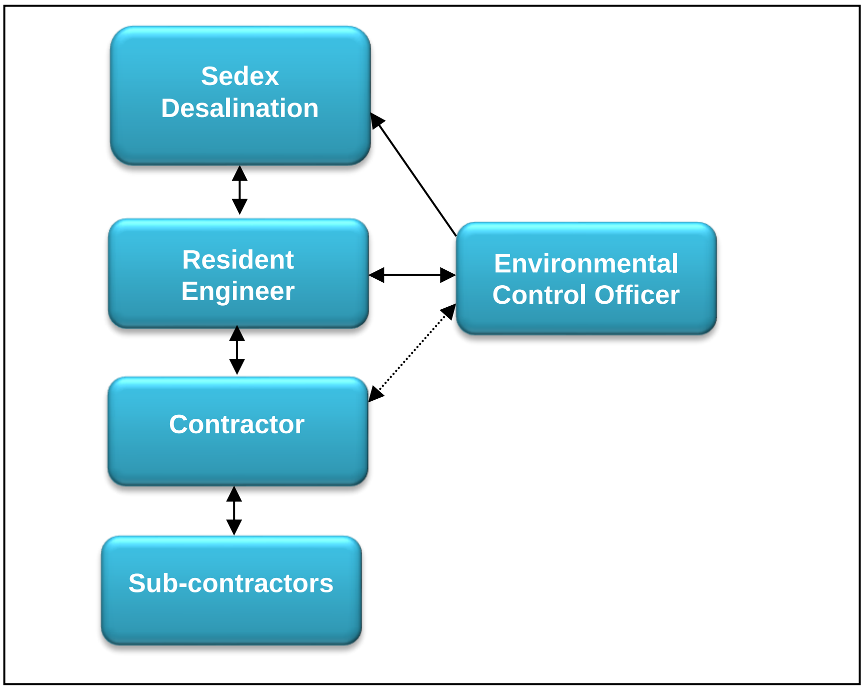

Figure 3-1: Construction phase reporting structure

Key roles and responsibilities during the construction phase with respect to the implementation of the EMP are outlined below.

Sedex Desalination:

Sedex Desalination has overall responsibility for management of the Project. In terms of environmental management, the proponent will:

- Appoint suitably experienced Engineers who will be responsible for the overall management of activities on site during the construction phase;
- Appoint an independent and suitably qualified ECO to monitor compliance with the EMP for the duration of the Construction Phase;
- Ensure that the Engineers are aware of the requirements of the EMP, implement the EMP and monitor the Contractor's activities on site;
- Ensure that the Contractor is aware of and contractually bound to the provisions of this EMP by including the relevant environmental management requirements in the tender and contract documents, as appropriate;
- Ensure that the Contractor remedies environmental problems timeously and to the satisfaction of the ECO and authorities (when necessary); and
- Notify the authorities should problems not be remedied timeously.

Resident Engineer:

Sedex Desalination will appoint suitably qualified Engineers, who in turn will designate a suitable RE who will be responsible for overseeing activities of the Contractor during the Construction Phase. The RE shall:

- Ensure that the Contractor is duly informed of the EMP and associated responsibilities and implications of this EMP prior to commencement of construction;
- Monitor the Contractor's activities (together with the ECO) with regard to the requirements outlined in the EMP;
- Relay all instructions from the ECO to the Contractor and ensure that these are fully understood and implemented;
- Report any environmental emergencies/concerns to the ECO immediately;
- Act as a point of contact for local residents and community members; and
- Ensure that non-compliance is remedied timeously and to the satisfaction of the relevant authorities.

Contractor:

The Contractor will be required to appoint or designate a Contractor's Environmental Representative (CR) who will assume responsibility for the Contractor's environmental management requirements on site and be the point of contact between the Contractor and the ECO. The CR shall:

- Ensure that all activities on site are undertaken in accordance with the EMP;
- Monitor the Contractor's activities (together with the ECO) with regard to the requirements outlined in the EMP;
- Ensure that all employees and sub-contractors comply with the EMP;
- Compile a weekly checklist reflecting the level of compliance (for submission to the ECO);
- Immediately notify the ECO of any non-compliance with the EMP, or any other issues of environmental concern; and
- Ensure that non-compliance is remedied timeously and to the satisfaction of the ECO.

The Contractor has a duty to demonstrate respect and care for the environment. The Contractor will be responsible for the cost of rehabilitation of any environmental damage that may result from non-compliance with the EMP, environmental regulations and relevant legislation.

Sub-contractors:

All sub-contractors will be required to:

- Ensure that all employees are duly informed of the EMP and associated responsibilities and implications of this EMP prior to commencement of construction;
- Ensure that all activities on site are undertaken in accordance with the EMP;
- Monitor employees' activities (together with the ECO) with regard to the requirements outlined in the EMP;
- Immediately notify the ECO of any non-compliance with the EMP, or any other issues of environmental concern; and
- Ensure that non-compliance is remedied timeously and to the satisfaction of the ECO.

The sub-contractor has a duty to demonstrate respect and care for the environment. The sub-contractor will be responsible for the cost of rehabilitation of any environmental damage that may result from non-compliance with the EMP, environmental regulations and relevant legislation, resulting from their presence on site.

Environmental Control Officer:

The ECO shall be a suitably qualified/experienced environmental professional or professional firm, appointed by the proponent, for the duration of the construction phase. The ECO should be appointed at least two weeks prior to the start of any activities on site, to allow the ECO to become familiar with his/her responsibilities and the requirements of the EMP. The ECO shall:

- Request Method Statements from the Contractor prior to the start of relevant construction activities, where required, and approve these (as appropriate) without causing undue delay;
- Monitor, review and verify compliance with the EMP by the main Contractor, as well as any sub-contractors and specialist contractors;
- Undertake site inspections at least once a month to determine compliance with the EMP;
- Identify areas of non-compliance and recommend corrective action (measures) to rectify them in consultation with Sedex Desalination, the RE and the Contractor, as required;
- Compile a checklist highlighting areas of non-compliance following each ECO inspection;
- Ensure follow-up and resolution of all non-compliances;
- Provide feedback for continual improvement in environmental performance;
- Respond to changes in project implementation or unanticipated site activities which are not addressed in the EMP, and which could potentially have environmental impacts, and advise Sedex Desalination, the RE and Contractor as required; and
- Undertake a site closure inspection, which may result in recommendations for additional clean-up and rehabilitation measures.

3.2 Compliance and Monitoring

3.2.1 Method Statements

A Method Statement is a document setting out specific details regarding the plant, materials, labour and method the Contractor proposes using to carry out certain activities, usually activities that may have a detrimental effect on the environment. It is submitted by the Contractor to the ECO.

The purpose of a Method Statement is for the Contractor to provide additional details regarding the proposed methodology for certain activities, and for the ECO to confirm that these meet the requirements of the EMP and acceptable environmental practice. This allows the EMP to be less prescriptive and affords the Contractor a certain amount of flexibility or to amend stipulations in the EMP, if approved by the ECO. It also provides a reference point to detect deviations from the agreed approach to an activity.

Each Method Statement will address environmental management aspects relevant to the activity and will typically provide detailed descriptions of items including, but not necessarily limited to:

- Nature, timing and location of activities;
- Procedural requirements and steps;

- Management responsibilities;
- Material and equipment requirements;
- Transportation of equipment to and from site;
- Method for moving equipment/material while on site;
- How and where material will be stored;
- Emergency response approaches, particularly related to spill containment and clean-up;
- Response to compliance/non-conformance with the requirements of the EMP; and
- Any other information deemed necessary by the ECO.

The following list provides examples of Method Statements that may be requested from the Contractor:

- Environmental awareness course preparation;
- Material and equipment storage and delivery;
- Fuel storage, dispensing and fuel spills;
- Waste management;
- Management of contaminated water;
- Erosion and stormwater control;
- Cement batching;
- Work in sensitive environments; and
- Any others requested by the ECO.

The Method Statements will be submitted by the Contractor to the ECO not less than **5 days** prior to the intended date of commencement of an activity (or as otherwise agreed with the ECO). The ECO shall approve / reject the Method Statement within **2 days**. An activity covered by a Method Statement shall not commence until the ECO has approved of such method and once approved, the Contractor shall abide by these Method Statements. A pro forma Method Statement is attached in Appendix C, although a suitable Method Statement format can be agreed between the ECO and Contractor.

3.2.2 Environmental Records and Reports

Environmental records and reports required during the construction phase are listed in Table 3-1.

Table 3-1: Reports required during construction

Report	Frequency	From	To
Environmental Checklist	Weekly	CR	ECO
Environmental Compliance Report	Monthly	ECO	RE and Sedex Desalination
Site Closure Audit	End of Contract	ECO	RE and Sedex Desalination

Environmental Checklist

The CR will undertake weekly site inspections to check on the implementation of the EMP by the Contractor and complete a brief report/checklist after the inspection. The completed checklists shall be submitted to the ECO at the end of each inspection. This checklist should be discussed between the CR and the ECO during the initial site inspection, and agreement reached on the preferred format and content.

Environmental Compliance Report

The ECO will prepare monthly Environmental Compliance Reports, detailing any environmental issues, non-compliance and corrective actions to be implemented. These reports will be based on the ECO's observations and the weekly Environmental Checklists. Environmental Compliance Reports will be submitted to Sedex Desalination and a full record will be kept by the ECO, for submission to the Local Authority and/or NCDENC on request.

When more frequent site visit are undertaken by the ECO[2], the frequency of progress reports will increase accordingly to allow for timeous reporting of environmental issues and actions required.

Photographic Records

If the ECO identifies any areas of concern, the ECO will request photographic records.

Site Closure Audit

The ECO will undertake a final site closure audit on completion of the construction phase. The purpose of this is to confirm compliance with all site closure requirements identified by the ECO, and that the site has been left in an environmentally suitable condition. If outstanding environmental requirements are observed during this inspection, a further inspection must be carried out to confirm compliance. The site closure audit report will be submitted to Sedex Desalination for record purposes, and to NCDENC if requested.

3.2.3 Corrective Action

Corrective action is a critical component of the plan-do-check-act implementation cycle and it is through corrective action that continuous improvement can be achieved. Where repeated non-compliance is recorded, procedures may need to be altered accordingly to avoid the need for repeated corrective action.

If environmental compliance monitoring by the CR and ECO indicates non-conformance with the EMP or approved Method Statements, the RE will formally notify the Contractor through a Corrective Action Request. The Corrective Action Request documents:

- The nature of the non-conformance/environmental damage;
- The actions or outcomes required to correct the situation; and
- The date by which each corrective or preventive action must be completed.

Upon receipt of the Corrective Action Request, the Contractor will be required to produce a Corrective Action Plan (or similar plan), which will detail how the required actions will be implemented. The Corrective Action Plan must be submitted to the ECO for approval prior to implementation. Once it has been approved, the corrective action must be carried out within the time limits stipulated in the Corrective Action Request. Additional monitoring by the CR and ECO will then be required to confirm the success or failure of the corrective action.

[2] More frequent site visits may be required as certain times during the contract e.g. at site establishment and closure, during activities which may have significant environmental impacts, or while activities are being undertaken close to environmentally sensitive portions of the site.

3.3 Environmental Management Measures

The environmental management and mitigation measures that must be implemented during the construction phase, as well as responsibilities and timelines for the implementation of these measures and monitoring thereof, are laid out in Table 3-2 below.

Table 3-2: Environmental management and mitigation measures that must be implemented during the construction phase

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[3]**	**Performance Indicators**
Site camp	1.	Submit a method statement for Site Camp establishment for approval by the ECO at least two weeks prior to the start of construction activities.	All Contractors (including main Contractors and sub-contractors)	Start of construction	• Visual inspection	• Method statements approved by ECO • Position of Site Camp approved by ECO • Security and access to Site Camp controlled • Area outside Site Camp designated as No-go area
	2.	Establish a suitably fenced Site Camp at the start of the contract, which will allow for site offices, vehicle, equipment, material and waste storage areas to be consolidated as much as possible. Locate the Site Camp at a position approved by the ECO. Provide water and / or washing facilities at the Site Camp for personnel.				
	3.	Do not locate the site camp within the 1:100 year flood line or within 100 meters, whichever is the greatest, from any water resource.				
	4.	Demarcate construction site boundaries upon establishment. Control security and access to the site. Fence off site boundaries to the satisfaction of the ECO and ensure that plant, labour and materials remain within site boundaries.				
	5.	Designate the area beyond the boundary of the site as No-go areas for all personnel on site. No vehicles, machinery, materials or people shall be permitted in the No-go area at any time without the express permission of the CR in consultation with the ECO.				
Establishment of parking and storage areas	6.	Limit vehicle and heavy machinery parking and storage areas to the absolute minimum required, in size and number.	All Contractors	Throughout construction	• Visual inspection	• Location of parking and storage areas • Disturbance outside parking and storage areas and construction footprint.
	7.	Locate vehicle and heavy machinery parking and storage areas to previously disturbed, unvegetated areas as far as possible.				
	8.	Clearly demarcate and strictly adhere to vehicle and heavy machinery parking and storage areas.				
Housekeeping	9.	Ensure that the appointed ECO undertakes the required site visits and submits the required monthly ECO Reports.	Sedex Desalination	Throughout construction	• ECO to send inspection reports to Sedex Desalination	• Regular ECO site visits and reports
	10.	Maintain equipment to ensure that no oils, diesel, fuel or hydraulic fluids are spilled.	All Contractors		• Visually inspect construction areas pollution.	• Incidence of contamination
	11.	Regularly inspect all construction machinery and holding tanks for leaks or damages.				
	12.	Repair any defects as soon as possible. In the case of leaks,				

[3] Unless otherwise indicated, monitoring will be undertaken by the ECO, supported by the authorities where the requirement is specifically stipulated in a licence or permit.

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[3]**	**Performance Indicators**
		ensure that the leaking water or effluent is captured and not released into the environment.				
	13.	Control litter and keep construction areas as clean and neat as possible				
	14.	Ensure regular collection and removal of refuse and litter from intertidal areas.				
Environmental Awareness Training	15.	Provide environmental awareness training to all personnel on site. Training should include discussion of: • Potential impact of construction waste activities on the environment; • Suitable disposal of construction waste and litter; • Key measures in the EMP relevant to worker's activities; • How incidences and suggestions for improvement can be reported. Ensure that all attendees remain for the duration of the training and on completion sign an attendance register that clearly indicates participants' names.	All Contractors	Before workers start working on-site Before new activities are undertaken	• Check training attendance register • Observe whether activities are executed in line with EMP requirements	• Proportion of workers that completed environmental training • Compliance of workers with EMP
	16.	Inform employees and Contractors that archaeological artefacts, including human skeletal remains, might be exposed during construction activities.				
	17.	Advise Contractors and workers of the penalties associated with the unlawful removal of cultural, historical, archaeological artefacts, as set out in the National Heritage Resources Act 25 of 1999 (NHRA), Section 51 (1).				
	18.	Instruct construction personnel to be alert for rare fossil bones and to follow "Fossil Finds Procedure".				
	19.	Train all staff in the effects of debris and litter in the marine environment and surrounding areas and appropriate disposal procedures.				
	20.	*Inform staff about dominant faunal species, associated habitat and importance of their conservation in the region.*				
Security	21.	*Ensure that workers are kept within construction areas and are not allowed to move around freely in surrounding areas.*	All Contractors	Throughout construction	• Inspect complaints register; • Visual inspection	• Number of incidents of crime • Incidence of farm gates left open
	22.	Ensure that Contractors and workers are restricted to areas under construction.				
	23.	*Ensure adequate supervision of workers within construction areas.*				
	24.	Ensure that farm access and public road gates are closed immediately following their use for thoroughfare.				
Complaints	25.	Maintain a complaints register for all complaints. The register	Contractor (main	Throughout	• Inspect complaints	• Availability of register

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[3]**	**Performance Indicators**
		must list: • Complainant name and contact details; • Date complaint was lodged; • Person who recorded the complaint; • Nature of the complaint; • Actions taken to investigate the complaint and outcome of the investigation; • Action taken to remedy the situation; Date on which feedback was provided to complainant.	Contractor)	construction	register.	on site • Designated person to maintain register • Complaints logged • Complaints followed up and closed out.
Vegetation clearing	26.	Limit the construction footprint to what is absolutely essential, in order to minimise environmental damage.	All Contractors	Before construction activities commence	• Visual inspection	• Relocation of SCC • Size of area cleared relative to development footprint • Size of area disturbed outside of construction site boundary
	27.	Designate areas outside the development footprint as No-go areas.				
	28.	Compile a detailed search and relocation plan and attempt to relocate SCC to a suitable habitat outside of the construction footprint area if it is unavoidable that SCC such as *Babiana hirsuta* will be disturbed.				
	29.	Appoint/designate a suitably experienced person to oversee the removal and rescue and relocation of all SCC.				
	30.	Obtain authorisation from the NCDENC for SCC, protected and indigenous species to be cut, disturbed, damaged or destroyed.				
	31.	Limit the removal of vegetation and associated faunal habitat from the road reserve and servitude to that which is essential.		During vegetation clearing		
	32.	Pick, uproot, fell or damage any plant growing in the coastal area without a permit – other than according to the approved EMP which will provide necessary mitigation measures.				
	33.	*Restrict vegetation clearing for construction to the dry dormancy period within the region (November to April) as far as possible to minimise damage in more sensitive habitat units such as rocky outcrops, Sand Fynbos and Coastal areas.*				
Disturbance of fauna	34.	Rescue and relocate fauna encountered within the construction footprint, particularly slower moving species such as tortoises.	All Contractors	During construction	• Visual inspection	• Number of animals harmed • *Number of visible tags*
	35.	Do not harm, catch or kill birds or animals by any means, including poisoning, trapping, shooting or setting of snares.				
	36.	Do not disturb, catch, remove, injure, kill or feed, any wild animal or bird which occurs in the coastal area and do not break, damage, destroy, disturb or remove any birds' egg or nest.				

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[3]**	**Performance Indicators**
	37.	Do not wilfully disturb any sea bird, seal or marine mammal.				
	38.	*Attach visible tags to power lines, cables and infrastructure in order to limit potential deadly avifaunal collisions.*				
Installation of linear infrastructure near wetland areas	39.	Demarcate all sensitive wetland zones outside of the construction footprint and designate these as No-go areas.	All Contractors	Before construction activities commence	• Visual inspection • Review method statements	• Wetland areas designated as No-go areas • Availability of method statements
	40.	Permit only essential construction personnel within the wetland habitat and undertake excavations for support structures by hand where placing pipeline and power line support structures within wetland habitat is unavoidable.				
	41.	Do not allow operation and storage of equipment within the riparian zone.				
	42.	Prepare method statements for construction activities in wetland areas.				
	43.	*Restrict clearing and earthworks for construction through wetland and drainage areas to the drier summer months, if possible, to avoid erosion of exposed soils and sedimentation of wetland habitats associated with the route alternative.*				
Installation of linear infrastructure near quartzite and clay exposure areas	44.	Demarcate the construction footprint (final route of power lines and pipelines) for the duration of construction. No disturbance may take place outside the demarcated area, and access should be from the existing road.	All Contractors	Before construction commences	• Visual inspection • Review of method statements	• Construction footprint demarcated • Method Statements approved • ECO appointed
	45.	Remove (the plants must be dug up (roots are usually only 2-3 cm deep) and translocate the affected individuals of *Bulbine bruynsii* immediately to a suitable area outside the development footprint, if it is unavoidable that they will be disturbed.				
	46.	Obtain special authorisation from the NCDENC (*Bulbine bruynsii* falls within the family Asphodelaceae which is protected under the Northern Cape Nature Conservation Act 9 of 2009 [NCNCA]), if individuals are to be translocated.				
	47.	Ideally place the pipe onto the plinths by crane from the road edge, in order to minimise disturbance (trampling, temporary storage of pipe, etc.) to sensitive areas between the plinths.		During construction		
	48.	Demarcate and cordon off individuals of *Bulbine bruynsii* within the construction footprint, with a 2 m buffer around each individual or group of individuals. Position support structures for pipelines and power lines (and associated construction disturbance areas) so that they do not encroach on any such cordoned off areas. Note: this may require that support structures are unevenly spaced in these areas.				
	49.	Undertake excavations for power line and pipeline support				

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[3]**	**Performance Indicators**
		structures traversing quartzite and clay exposure areas manually, where possible.				
	50.	Limit the number of construction personnel allowed into the sensitive habitat areas where pipelines traverse quartzite and clay exposure areas.				
	51.	Submit method statements for all construction activities in quartzite and clay exposure areas, for review by a suitably qualified professional.				
	52.	Appoint an ECO to supervise all construction activities in quartzite and clay exposure areas throughout the construction period, to ensure compliance with all mitigation requirements.				
	53.	Restrict material and equipment storage areas to areas falling outside of sensitive quartzite and clay exposure areas.				
	54.	Do not store material removed during excavations for power line and pipeline support structures within the road reserve adjacent to quartzite and clay exposure areas. Temporarily remove construction related material to a designated area offsite and permanently remove construction related waste and refuse from site.				
	55.	In order to minimise damage, clearing of vegetation for construction within quartz and clay exposure areas should be restricted to the dry dormancy period within the region (November to April) as far as possible.				
Topsoil storage	56.	Limit construction and lay down areas to areas within the development footprint.	All Contractors	Before construction commences	• Visual inspection	• Incidence of erosion • Incidence of incorrect storage and harvesting of topsoil
	57.	Remove topsoil (up to a maximum of 30 cm depth)		During vegetation clearing		
	58.	Stockpile topsoil prior to the commencement of construction activities (stockpile no higher than 2m)				
	59.	Locate topsoil stockpiles in an area protected from the wind, and agreed to with the ECO.				
	60.	Ensure suitable control of run-off during the construction phase to prevent erosion of topsoil on adjacent land and undeveloped portions of the site.		During construction		
	61.	Replace harvested topsoil in areas that are to be rehabilitated as soon as sections of the works are completed (i.e. not only following the completion of all works)		During rehabilitation		• Time to rehabilitation • Size of disturbed areas
Protection of archaeological and heritage resources	62.	Make use of existing tracks as far as possible and avoid the encroachment of construction activities into undisturbed areas.	All Contractors	Before construction commences	• Visual inspection	• Discovery of possible archaeological material • Rescue and reporting
	63.	Restrict construction activities to within the existing zone of disturbance along the archaeologically sensitive coastal route.				

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[3]**	**Performance Indicators**
	64.	Appoint a qualified archaeologist to demarcate any archaeological sites (including shell middens) that may be affected by construction activities, as identified in the HIA (see Appendix A) in consultation with a qualified archaeologist as No-go areas.				of identified material when discovered • Extent of damage to buildings in Kotzesrus
	65.	Conduct a scientific excavation operation in consultation with a qualified archaeologist to excavate any sensitive archaeological sites as identified in the HIA (see Appendix A), should these fall within the construction footprint.				
	66.	*Appoint a qualified archaeologist to sample any archaeological material that will be affected by the project.*				
	67.	Obtain the required permits from South African Heritage Resources Agency (SAHRA) in terms of the NHRA for the scientific excavation of archaeological material, should this be required.		Before removal of archaeological material		
	68.	Do not destroy, damage, alter, excavate or remove shell middens or any archaeological sites without the required permit in terms of the NHRA.		During earthworks		
	69.	Immediately report the discovery of any archaeological material or human remains to SAHRA or a qualified archaeologist.				
	70.	Cease work immediately and notify SAHRA and/or an archaeologist should any archaeological artefacts be exposed during site clearing or other site activities. Do not remove, destroy or interfere with any artefacts on the site.				
	71.	Report the discovery of any shipwreck material to the SAHRA maritime unit or the maritime archaeologist at Iziko Museums of Cape Town.				
	72.	Avoid construction near (within 5m) of any heritage structures in the town of Kotzesrus.		Before construction commences near Kotzesrus		
	73.	Ensure that buildings of heritage significance are clearly demarcated and protected, where necessary.				
	74.	Avoid construction in the vicinity of heritage structures in Kotzesrus and do not damage these structures during construction.				
	75.	Ensure that blasting does not impact on the structural integrity of heritage structures and ensure that heritage structures are re-enforced where necessary.		During construction near Kotzesrus		
	76.	Should heritage structure be damaged, repair these structures using the appropriate building techniques in consultation with a qualified architect.				

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**[3]	**Performance Indicators**
	77.	Negotiate the relocation of the Burden memorial with the relevant family members, if required.		Before construction in the coastal zone		
	78.	*Appoint an archaeologist to monitor any excavations that takes place within 300 m of the High Water Mark (HWM).*				
	79.	Do not disturb in any way a shipwreck older than 60 years without a permit from the national heritage authorities. On finding shipwreck material: • Immediately inform the national heritage authorities if likely shipwreck material is found, • Contract a marine archaeologist to survey the site, • Avoid excavations within 200 m from the centre of the site until the area has been surveyed and clearance, or a permit to continue activities, has been obtained. Retain permits and copies of correspondence.		During construction in the marine environment		
Protection of paleontological resources	80.	Appoint a palaeontologist should paleontological finds be uncovered by earthworks.	All Contractors	Prior to construction	• Visual inspection	• Discovery of possible palaeontological material • Rescue and reporting of identified material when discovered
	81.	Cease construction on (chance) discovery of fossils and protect fossils from further damage.		During earthworks		
	82.	Contact appointed palaeontologist and supply palaeontologist with the relevant information and images.				
	83.	Ensure that the palaeontologist assesses the information and establishes a suitable response, such as reporting the importance of the find and providing recommendations for preservation, collection and record keeping.				
Temporary desalination plant	84.	Keep the footprint of the temporary desalination plant in the coastal zone to the absolute minimum required.	All Contractors	During construction	• Visual inspection; and • Confirmation of chemical use.	• Footprint of desalination plant • *Use of chemicals*
	85.	Ensure that brine and co-pollutants are discharged into the surf-zone below the low water mark.				
	86.	*Use low-toxicity chemicals in the temporary desalination plant as far as practicable.*				
Construction in coastal environment	87.	Restrict disturbance of the intertidal and subtidal areas to the smallest area possible.	All Contractors Sedex Desalination	Before construction activities commence	• Visual inspection	• Disturbance of coastal zone • Number of tracks in the coastal zone • Location of laydown areas and stockpiles
	88.	Use existing roads and tracks wherever possible. Restrict access to the construction sites in the coastal zone to a single clearly demarcated track only.		During construction in the marine environment		
	89.	Ensure tracks have acceptable surfaces, are free from erosion, and have effective drainage. Maintain tracks so that post-construction rehabilitation requirements are minimised.				
	90.	Where resurfacing of access tracks/roads is required, use only local sediments as surfacing material. Should these materials				

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[3]**	**Performance Indicators**
		either not be suitable or available, then only under the advice of a vegetation scientist should materials sourced from terrestrial areas above the HWM be introduced to the high-shore environment.				
	91.	No construction materials sourced from terrestrial areas above the HWM may be introduced to the intertidal environment.				
	92.	Keep the laydown areas for construction of the intake sump (sand trap) and the pipeline in the coastal environment to the absolute minimum required.				
	93.	Locate laydown area for the intake sump at the desalination plant in an already disturbed area so as to cause least disturbance to the vegetation and natural environment.				
	94.	Confine stockpiles of sediments excavated from the sump construction area to a specific controlled, previously disturbed area.				
	95.	Ensure that the edge effects of construction related activities do not impact on very high sensitivity coastal rocky outcrop areas.				
Excavation of pipeline trench in marine environment	96.	Ensure that excavated sediments are only discharged down-current of the construction site.	All Contractors	During excavation	• Visual inspection	• Deposition of excavated sediments • Extent and timing of excavation activities
	97.	Deposit sediments from excavations as far down the shore as possible to ensure their rapid removal by wave action.				
	98.	Do not deposit sediments above the HWM.				
	99.	Keep excavation operations to a minimum wherever possible by careful planning and scheduling of trenching activities (e.g. during low tide periods only).				
Pipeline launching and installation of intake structures	100.	Ensure that the vessel contractor has taken out adequate protection and indemnity insurance cover for oil pollution incidents at sea, and that an oil spill contingency plan and acceptable onboard environmental management systems are in place for the vessel. These should incorporate plans for emergencies.	Sedex Desalination and Contractor	During installation of marine infrastructure	• Review of insurance policies and contingency plans; • Compliance with health and safety protocols.	• Records of insurance policies and contingency plans
	101.	Ensure Contractors adhere to all applicable diving regulations. Ensure high levels of safety and operational health.				
Blasting in the coastal zone	102.	*Develop and implement a responsible blasting schedule, which allows seals and other scavengers feeding on dead fish to have left the area before the next blasting event.*	All Contractors	Prior to blasting	• *Proof of notification of nearby residents;* • Records of blasting; and • Visual Inspection.	• Number and timing of blasting incidents • Compliance with SANS public safety requirements • Disturbance to coastal
	103.	*Ensure that an effective public notification programme is in place to inform nearby residents of the planned blasting schedules.*				

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**[3]	**Performance Indicators**
	104.	Ensure that all blasting activities are conducted in accordance with South African National Standards (SANS) standards, with adherence to all public safety requirements.				flora and fauna, including marine mammals, turtles and nesting shore-birds
	105.	Lay pipeline in such a way that required rock blasting is kept to a minimum.		During construction		
	106.	Restrict blasting to the absolute minimum required and a maximum of one blast per day.		During blasting		
	107.	Use blasting methods which minimise the environmental effects of shock waves through the use of smaller, quick succession blasts directed into the rock.				
	108.	*Visually search the area around the blasting site for marine mammals, sea turtles or flocks of swimming and diving birds. Postpone blasting if any are observed within a 2 km radius of the blasting site.*		Prior to blasting		
	109.	Avoid onshore blasting during the breeding season of shore-birds and of feasible, limit blasting to the non-breeding season of shorebirds that nest in the coastal zone.				
	110.	Limit blasting to the seasons when migratory whales are absent from the area (i.e. summer months).				
	111.	*Implement observational controls in that blasting be prohibited when whales, dolphins, seals and/or turtles are within the area.* *Observations should be made for a minimum of 30 minutes before each scheduled blast. If marine mammals are observed within the specified range blasting should be delayed until the animals have clearly moved out of the area.*				
	112.	*All fish and mammal specimens that are killed during blasting should be collected, with data on their positions relative to the blast location, and submitted to researchers at the MFMR who may have use for them for scientific purposes.*		Following blasting		
Stormwater and erosion	113.	Divert stormwater from construction works and manage roads is such a manner as to disperse runoff and to prevent the concentration of stormwater flow.	All Contractors	Throughout construction	• Visual inspection	• Incidence of stormwater contamination
	114.	Prevent potentially contaminated run-off from work areas from entering wetland habitats.				
	115.	Construct works to attenuate the velocity of stormwater discharge and to protect the banks of water resources.				
	116.	Construct, operate and maintain stormwater control works in a suitable manner throughout construction.				
	117.	Ensure that stormwater is not contaminated by any substance: solid, liquid, vapour or gas or a combination thereof, which is				

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[3]**	**Performance Indicators**
		produced, used, stored, dumped or spilled on site.				
	118.	Prevent erosion and the associated sedimentation of wetland areas, through use of the following (as appropriate): berms, silt fences, hessian curtains, stormwater diversion away from areas susceptible to erosion and stormwater attenuation.				
	119.	Manage increased runoff due to vegetation clearing and/or soil compaction and ensure that stormwater does not cause bank stability and excessive levels of silt entering watercourses.				
	120.	Immediately stabilize slopes that are disturbed / cleared for construction with geofabric or another appropriate erosion stabilisation technique to prevent erosion.				
Invasive species	121.	Strictly control alien vegetation proliferation.	Contractor	Throughout construction	• Visual inspection	• Alien vegetation proliferation
	122.	Remove alien and weed species encountered the desalination plant property in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act 43 of 1983 (CARA) and Section 28 of the National Environmental Management Act 107 of 1998 (NEMA). In this regard: • Take care with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used; • Keep footprint areas as small as possible when removing alien plant species; • Dispose of removed alien plant material at a registered waste disposal site.				
Waste management	123.	Develop a waste management plan, laying out: • Expected type and amount of waste; • Measures to reduce waste; • Type and expected volume of recyclable waste; • Recycling facilities that will collect / receive waste; • Type of storage for different waste types; • Waste Contractors that will collect waste; and • Monitoring procedures to ensure the waste management plan is implemented.	Sedex Desalination	Before start of activities on site	• Inspection of plan	• Availability of plan
	124.	Aim to minimise waste through reducing and re-using (packaging) material.	Contractor	Throughout construction	• Visual inspection of waste collection and disposal areas • Visual inspection of construction areas	• Presence of litter • Availability of rubbish bins and skips • Degree to which rubbish bins and skips
	125.	Collect all waste in bins and/or skips at the construction site.				
	126.	Collect recyclables separately and deliver these to suitable facilities or arrange for collection.				

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[3]**	**Performance Indicators**
	127.	Prevent littering by construction staff at work sites by providing bins or waste bags in sufficient locations.			(litter) • Check waste disposal slips • Monitor activity against method statement	are filled • Total volume of general and hazardous waste storage capacity • Total volume of general and hazardous waste stored on site • Degree to which different waste is separated • Frequency of waste collection
	128.	Provide separate bins for hazardous / polluting materials and mark these clearly.				
	129.	Store hazardous / polluting materials on impermeable ground until it is disposed of / collected.				
	130.	Prohibit the dumping of construction materials or waste in the intertidal and subtidal zones.				
	131.	Prohibit the discharge of oily or waxy effluents into the sea.				
	132.	Do not allow any burning or burying of waste on site.				
	133.	Dispose of rubble and other waste construction materials at the nearest designated landfill site.				
	134.	Dispose of non-recyclable metal objects at the nearest appropriate waste site.				
	135.	Dispose of oils and other potential pollutants at an appropriate licensed site, with the necessary agreements in place.				
Ablution facilities	136.	Provide ablution facilities (i.e. chemical toilets) for all site staff at a ratio of 1 toilet per 15 workers (absolute minimum 1:25).	Contractor	Throughout construction	• Visual inspections • Records of waste disposal	• Incidence of staff not using facilities • Incidence of pollution
	137.	Sewage must not be disposed of into the sea under any circumstances.				
	138.	Secure all temporary / portable toilets to the ground within the Site Camp to the satisfaction of the CR to prevent them toppling due to wind or any other cause.				
	139.	Maintain toilets in a hygienic state (i.e. toilet dispensers to be provided, toilets to be cleaned and serviced regularly (at least "twice- monthly" by an appropriate waste contractor), and toilets to be emptied before long weekends and builders' holidays).				
	140.	Remove / appoint an appropriate sub-contractor to remove accumulations of chemicals and treated sewage from the site and dispose of at an approved waste disposal site or sewage plant.				
	141.	Ensure that no spillages occur when the toilets are cleaned or emptied. Repeated incidents of spillage of chemicals and or waste (i.e. more than one incident), will require toilets to be placed on a solid base with a sump.				
Concrete/Cement Work	142.	Use Ready-Mix concrete rather than batching where possible.	All Contractors	Throughout construction	• Visual inspection and approval by CR and ECO.	• Incidence of batching outside works footprint • Contamination of
	143.	Ensure that no cement truck delivery chutes are cleaned on site. Cleaning operations are to take place off site at a location				

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**[3]	**Performance Indicators**
		where wastewater can be disposed of in the correct manner. If this is not possible a suitable washing facility is to be developed on site in consultation with the ECO				water and soil • Visible concrete on site
	144.	No Batching or mixing activities may occur on or near the shore.				
	145.	No mixing of concrete may be allowed in the intertidal zone.				
	146.	Batch cement in a bunded area within the boundaries of the development footprint only (where unavoidable)				
	147.	Ensure that cement is mixed on mortar boards and not directly on the ground (where unavoidable).				
	148.	Regularly clean up concrete spilled during construction.				
	149.	Physically remove any remains of concrete, either solid, or liquid, immediately and dispose of as waste.				
	150.	Place cement bags in bins and dispose of bags as waste to a licensed waste disposal facility.				
	151.	Sweep / rake / stack excess aggregate / stone chip / gravel / pavers into piles and dispose at a licensed waste disposal facility.				
	152.	During construction of the jetty pylons, do not dump concrete or mortar onto the sea bed.				
	153.	No dumping of excess concrete or mortar may be allowed on the sea bed, or in the coastal zone.				
Hazardous materials	154.	Design and construct hazardous material storage facilities, especially fuel storage, with suitable impermeable materials and a minimum bund containment capacity equal to 110% of the largest container.	Contractor	Throughout construction	• Visual inspection of hazardous materials handling and storage areas	• Incidence of non-compliance with safety procedures concerning hazardous materials, including waste materials • Incidence of spills of hazardous materials, including waste materials • Availability of spill kits • Cost of cleaning up spills • Evidence of contamination and leaks
	155.	Locate hazardous material storage facilities, especially fuel storage, as far as practically possible from the marine environment or any water resources. Prohibit the storage of hazardous substances on the shore.				
	156.	Ensure that contaminants (including cement) are not placed directly on the ground (e.g. mix cement on plastic sheeting) to prevent runoff reaching the marine environment or water resources.	All Contractors			
	157.	Develop (or adapt and implement) procedures for the safe transport, handling and storage of potential pollutants.				
	158.	Avoid unnecessary use and transport of hazardous substances.				
	159.	Keep Material Safety Data Sheets for all hazardous materials on site and ensure that they are available for reference by staff	Contractor			

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[3]**	**Performance Indicators**
		responsible for handling and storage of materials.				
	160.	Ensure that all construction vehicles used in the coastal zone have a spill kit (peatsorb/ drip trays) on-board to be used in the event of a spill.	All Contractors			
Transportation and refuelling	161.	Undertake regular maintenance of vehicles and machinery to identify and repair minor leaks and prevent equipment failures.	All Contractors	Throughout construction	• Visual inspection of vehicles, barges, machinery and refuelling/maintenance areas	• Incidence of non-compliance • Incidence of leaks and spills • Cost of cleaning up spills
	162.	Vehicles and other machinery must be serviced well above the 1:100 year flood line or within a horizontal distance of 100 meters from any watercourse.				
	163.	Undertake any on-site refuelling and maintenance of vehicles/machinery in designated areas. Line these areas with an impermeable surface and install oil traps.				
	164.	Ensure that oils and lubricants used for maintenance of equipment in the field are correctly contained.				
	165.	No vehicle maintenance or refuelling to be undertaken in the coastal zone, except in emergencies.				
	166.	Use appropriately sized drip trays for all refuelling and/or repairs done on machinery – ensure these are strategically placed to capture any spillage of fuel, oil, etc.				
	167.	Use drip trays under all equipment and plant that is parked overnight or for long periods.				
	168.	Ensure that boats and barges do not release pollutants into the water and have adequate mooring or anchoring facilities.				
	169.	Clean up any spills immediately, through containment and removal of free product and appropriate disposal of contaminated soils				
	170.	Keep spill containment and clean-up equipment at all work sites and for all polluting materials used at the site.				
Response to environmental pollution	171.	In the event of environmental pollution, e.g. through spillages, immediately stop the activity causing the problem.	All Contractors	Throughout construction	• Maintain register of pollution events and response • Following resumption of activities, frequently inspect repaired equipment to ensure proper functioning	• Number of incidents • Time activities stopped • Number of recurring incidents • Availability and completeness of register
	172.	Only resume activity once the problem has been stopped or (in the case of spillages) the pollutant can be captured without reaching the marine environment.				
	173.	Repair faulty equipment as soon as possible.				
	174.	Install additional bunding / containment structures around the equipment that was the source of the leak / spillage to prevent pollution from reaching the marine environment in future.				
	175.	Clean up spills in the construction area immediately.				
	176.	Treat hydrocarbon spills, e.g. during refuelling, with adequate				

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**[3]	**Performance Indicators**
		absorbent material, which then needs to be disposed of at a suitable landfill.				
	177.	Sediments contaminated with oils must be collected and disposed of at a bio-remediation plant, or be bio-remediated.				
	178.	In the event of equipment, litter and debris entering the sea, remove these as soon as possible and before they leave Small Bay (in the case of floating litter).				
	179.	Notify the relevant authorities within one day of an environmental pollution event. Inform at least the following: • Department of Environmental Affairs: Ocean and Coast (DEA: O&C) in the case of marine pollution.	Contractor Sedex Desalination			
Noise management	180.	Limit noisy construction activities in Kotzesrus to day-time from Monday to Saturday or in accordance with relevant municipal bylaws, if applicable.	All Contractors operating machinery	Throughout construction	• Random noise measurements	• Results of random noise measurements • Number of registered complaints
	181.	Comply with the applicable municipal and / or industry noise regulations.				
	182.	Notify adjacent residents or business premises before particularly noisy construction activities will take place.				
	183.	Notify adjacent landowners before any blasting takes place and implement the appropriate measures to reduce noise levels and limit the amount of vibration.				
	184.	Maintain all generators, vehicles, vessels and other equipment in good working order to minimise exhaust fumes and excess noise.				
	185.	Subject all mobile equipment, vehicles and power generation equipment to commissioning tests at handover by the supplier, and measure noise emissions against the manufacturer's specifications to confirm compliance.				
	186.	Subject noise emissions from mobile and fixed equipment to periodic checks as part of regular maintenance programmes or though ambient noise measurements.				
	187.	Restrict the use of radios, television sets and other such equipment near receptors so as to not disturb neighbouring residents/tenants.				
	188.	Enclose diesel generators used for power supply at Kotzesrus to reduce unnecessary noise.				
	189.	Investigate potential noise reduction measures such as mufflers on equipment if complaints regarding construction noise are received.				
	190.	Reduce noise levels in areas in close proximity to the Brak				

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[3]**	**Performance Indicators**
		River crossing in order to avoid the disturbance of the *Aquila verreauxii* (Verreauxs Eagle) breeding pair.				
Dust management	191.	Avoid clearing of vegetation until absolutely necessary (i.e. just before excavations).	All Contractors	Throughout construction	• Visual assessment of dust plumes • Visual assessment of dust control measures	• Visibility of dust coming off construction site • Dust mitigation measures in place • Number of days that dust plumes are visible • Number of registered complaints • Size of disturbed areas
	192.	Stabilise exposed surfaces as soon as is practically possible.				
	193.	Avoid excavation and handling and transport of materials which may generate dust under high wind conditions or when a visible dust plume is present.				
	194.	Locate soil stockpiles in sheltered areas where they are not exposed to the erosive effects of wind. Where erosion of stockpiles becomes a problem, implement erosion control measures at stockpiles.				
	195.	Limit construction vehicle speeds to 40 km/hr on gravel roads, 30 km/h on the gravel road though Kotzesrus and 20 km/h on unconsolidated and non-vegetated areas.				
	196.	Reduce airborne dust at construction sites through e.g.: • Damping dust-generating areas/roads with freshwater; and • Covering dumps or stockpiles of lose material with plastic sheeting or netting, especially during windy conditions.				
Visual aspects	197.	Limit outdoor security lighting and ensure that it is as unobtrusive as possible	All Contractors	• Throughout construction	• Visual inspection	• Number of complaints
	198.	Attach signs to structures to avoid free standing signs in the landscape during the construction period				
	199.	Use unobtrusive screening and avoid large expanses of bland security walls and unshielded delivery areas adjacent to or visible from scenic coastal road.				
Traffic Management	200.	Manage construction sites and activities so as to minimise impacts on road traffic as far as possible, e.g. minimise the unnecessary movement of construction vehicles.	All Contractors operating vehicles	Throughout construction	• Keep record of vehicles entering the site and time they enter • Keep record of incidents and complaints • Visually inspect vehicles for any obvious faults or overloading	• Number of incidents and complaints • Number of vehicles travelling to site each day • Condition of vehicles
	201.	Use appropriate road signage, in accordance with the South African Traffic Safety Manual, providing flagmen, barriers etc at the various access points when necessary.				
	202.	Maintain and repair roads damaged by construction vehicles.				
	203.	Implement the necessary measures to maintain roads and road surface integrity.				
	204.	Ensure that large construction vehicles are suitably marked to be visible to other road users and pedestrians.				
	205.	Ensure that all safety measures are observed and that drivers comply with the rules of the road.				

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[3]**	**Performance Indicators**
	206.	Ensure that vehicle axle loads do not exceed the technical design capacity of roads.				
	207.	Investigate and respond to complaints about traffic.				
	208.	Limit construction vehicle speeds to 40 km/hr on gravel roads, 30 km/h on the gravel road though Kotzesrus and other villages and 20 km/h on unconsolidated and non-vegetated areas.				
	209.	Restrict traffic to clearly demarcated access routes and construction areas only and restrict traffic on upper shore to the minimum required.				
Fire Management	210.	Ensure that no fires are permitted on or adjacent to site.	Contractor	Throughout construction	• Inspect attendance register for training sessions • Inspect fire extinguishers and certificates	• Number of fire incidents • Certified extinguishers in appropriate locations
	211.	Ensure that no smoking is permitted on the site except for within a designated area in the Site Camp (to be included in the Site Camp Method Statement). Suitable firefighting equipment must be readily available in this area.				
	212.	Ensure that sufficient fire-fighting equipment is available on site.				
	213.	Equip all fuel stores and waste storage areas with fire extinguishers.				
	214.	Ensure that all personnel on site are aware of the location of firefighting equipment on the site and how the equipment is operated.				
	215.	Suitably maintain firefighting equipment.				
Employment	216.	Survey skills levels in local communities, and employ people based on the availability of local skill.	Contractor Sedex Desalination	Throughout construction	• Keep record of how targets were determined • Keep record of staff by origin • Keep record of training provided	• Percentage of local staff • Percentage of BBBEE staff
	217.	Promote skills development as opposed to the importation of skills, where possible.				
	218.	Train new staff where skill shortages exist.				
	219.	*Ensure that workers are sourced from local communities as far as possible.*				
	220.	Award installation, customisation and maintenance contracts to South African companies in instances where plant, material or goods must be procured abroad.				
	221.	Prioritise procurement of goods and services from local suppliers during construction, especially from suitably accredited Broad Based Black Economic Empowerment (BBBEE) suppliers.				
	222.	Commit to local procurement targets based on information on local availability, giving preference to suitably accredited				

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[3]**	**Performance Indicators**
		BBBEE suppliers.				
	223.	Determine which goods can be realistically sourced within the Kamiesberg Local Municipality (KLM) through partnership with local government, the local business chamber and Non-Governmental Organisations (NGOs).				
	224.	Determine areas of potential supplier development to encourage local supply and train/enable suppliers accordingly.				
	225.	Encourage and support life skills education programmes which focus on responsible personal financial management.				
	226.	Ensure maximum procurement of goods and services from suppliers located in the KLM and Namakwa District Municipality (NDM).				
	227.	Maximise opportunities for the training of unskilled and skilled workers from local communities and use local sub-contractors where possible.				
	228.	Develop workforce skills that will promote local economic integration and entrepreneurship.				
	229.	Implement a grievance mechanism.				
Closure and Rehabilitation	230.	Remove all construction equipment, vehicles, equipment, waste and surplus materials, site office facilities, temporary fencing and other items from the site.	Contractor	Once construction is complete; or Throughout construction if it takes place in phases / different areas sequentially	• Visual inspection of site • Keep record of rehabilitation measures	• Rehabilitation forms an integral part of operations from start-up • Construction sites fully rehabilitated within five years
	231.	Clean up and remove any spills and contaminated soil in the appropriate manner.				
	232.	Do no bury discarded materials on site or on any other land not designated for this purpose.				
	233.	Rehabilitate affected areas on the site.				
	234.	Rehabilitate areas adjacent to the site (if disturbance is unavoidable) to at least the same condition as was present prior to construction.				
	235.	Use harvested topsoil for rehabilitation and landscaping.				
	236.	Use indigenous (preferably endemic) vegetation for landscaping and rehabilitation.				
	237.	Ensure that rehabilitation is effective by using the appropriate methods, including the loosening of soil and the prevention of erosion.				
	238.	Rehabilitate all wetland areas impacted by construction related activities to ensure that wetland functions are re-instated after construction.				

Construction Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[3]**	**Performance Indicators**
Rehabilitation above the HWM in the coastal zone	239.	Ensure the rehabilitation of any dune/coastal vegetation disturbed during construction.	Contractor	Once construction is complete	• Visual inspection of site • Keep record of rehabilitation measures	• Rehabilitation forms an integral part of operations from start-up • Construction sites fully rehabilitated within five years
	240.	Rehabilitate all roads and tracks developed as part of the construction activities as follows: • Place barriers (e.g. large rocks, fences) across the entrances of non-essential informal tracks and signpost intention to rehabilitate. • Remove foreign road-construction materials which may hamper vegetation regrowth and dispose of in an approved manner prior to rehabilitation. Where the surface of tracks has become compacted, plough or rip the surface and temporarily stabilise with mulch until suitable vegetation establishes itself.				
	241.	Where necessary, level the disturbed area used for vehicle and equipment storage to a condition resembling its natural profile.				
	242.	Where the surface has become compacted, plough or rip the surface leaving bumpy rather than flat to maximise potential for collection of fog, for moisture, and windblown seed in pockets to serve as regeneration and dispersal nodes.				
	243.	Use all excess excavated sediments from sump construction to level suitable depression areas at the same height on the shore in the vicinity.				
	244.	Level the disturbed area to a condition resembling its natural profile.				
Rehabilitation below the HWM	245.	Backfill all excavations above mean sea level with the excavated material as trenching progresses, in such a way as to maintain the original shore profile as far as possible.	Contractor	Once construction is complete	• Visual inspection of site.	• Backfill of excavations

4 Measures Applicable to the Operations Phase

4.1 Roles and Responsibilities

The key role players during the operations phase of the project are:

- Sedex Desalination (the proponent);
- The plant manager;
- Employees; and
- Contractors providing services to the seawater desalination plant and linear infrastructure (if any are required).

The anticipated operations phase management structure is presented in Figure 4-1 below and shows the proposed lines of communication during this phase. The site manager retains overall responsibility for operations at the seawater desalination plant and linear infrastructure and the implementation of the EMP.

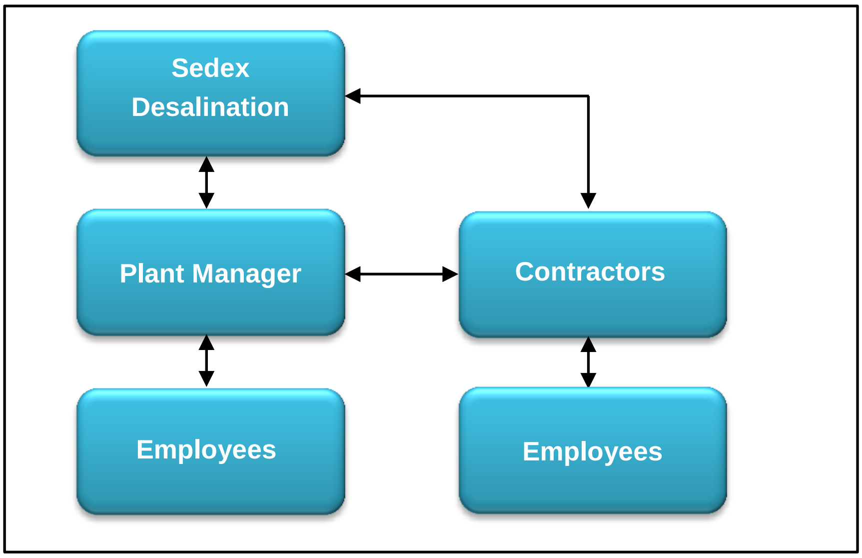

Figure 4-1: Operations phase plant management structure

Key roles and responsibilities during the operations phase with respect to the implementation of the EMP are outlined below.

Sedex Desalination:

- Ensure that copies of the EMP are available at Sedex Desalination's offices and on site;
- Review monthly reports by the plant manager on environmental performance of their operations;
- Implement and manage of a programme of environmental inspection, monitoring and reporting;
- Implement of a programme for follow-up and analysis of all environmental incidents or accidents; and
- Liaise with the authorities and other stakeholders regarding the plant's environmental performance.

Plant Manager (Sedex Desalination):

- Ensure that all employees are aware of the requirements of the EMP;
- Comply with the applicable environmental commitments, procedures, restrictions and guidance specified in the EMP;
- Ensure that all supervisors and employees are familiar with and understand the requirements of the EMP that are relevant to their activities;
- Ensure that all supervisors regularly discuss environmental topics with workers, e.g. during toolbox talks;
- Conduct environmental inspections, monitoring and reporting, as stipulated by the EMP;
- Ensure that all environmental incidents or accidents are investigated and analysed, and that measures are implemented to prevent similar events from happening in the future;
- Review the environmental performance of employees and contractors; and
- Compile monthly reports on the environmental performance of their operations for submission to Sedex Desalination.

Employees:

- Comply with the applicable environmental commitments, procedures, restrictions and guidance specified in the EMP; and
- Co-operate fully in implementing applicable environmental procedures.

Contractors (if any are required):

- Comply with the applicable environmental commitments, procedures, restrictions and guidance specified in the EMP;
- Co-operate fully in implementing applicable environmental procedures;
- Ensure that copies of the EMP are available on site;
- Ensure that all its personnel on site, (including any sub-contractors and their staff) are familiar with and understand the requirements of the EMP that are relevant to their activities; and
- Ensure that any problems and non-conformances are remedied in a timely manner, to the satisfaction of the relevant Sedex Desalination management personnel.

4.2 Environmental Management Measures

The environmental management and mitigation measures that must be implemented during the operations phase, as well as responsibilities and timelines for the implementation of these measures and monitoring thereof, are laid out in Table 4-1 below.

Table 4-1: Environmental management and mitigation measures that must be implemented during the operations phase

Operational Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**[4]	**Performance Indicators**
Housekeeping	1.	Clean up spills inside and outside of the plant immediately.	Plant manager Contractors	Throughout operations	• Visually inspect areas inside and outside the plant for pollution	• Incidence of contamination on site
	2.	Keep the area outside of the plant clean, especially during the rainy season when pollutants can wash into the sea with the stormwater.				
	3.	Prevent spillages from coming into contact with the marine environment.			• Visually inspect the water for pollution	
	4.	Regularly inspect all machinery and holding tanks for leaks or damages.			• Visually inspect equipment and vehicles for obvious faults • Review maintenance log	• Frequency of equipment failure • Cost of equipment repair • Equipment downtime
	5.	Regularly inspect all vehicles for leaks.				
	6.	Repair any defects as soon as possible. In the case of leaks, ensure that the leaking substance or effluent is captured and not released into the environment.	Technical support			
	7.	Limit lighting outside of buildings to essential activities and facilities.	Plant manager		• Visually assess light pollution from outside of plant area	• Degree to which light from the plant is visible from surrounding area
Complaints	8.	Maintain a complaints register for all complaints. The register must list: • Complainant name and contact details; • Date complaint was lodged; • Person who recorded the complaint; • Nature of the complaint; • Actions taken to investigate the complaint and outcome of the investigation; • Action taken to remedy the situation; • Date on which feedback was provided to complainant.	Plant manager	Throughout operations	• Inspect complaints register	• Availability of register on site • Designated person to maintain register • Complaints logged • Complaints followed up and closed out
Environmental awareness training	9.	Provide environmental awareness training to all personnel on site. Training should include discussion of: • Potential impact of desalination process, e.g. on the marine environment; • The need to minimise such impacts to retain a 'social licence to operate'; • Key measures in the EMP relevant to worker's activities; • How incidences and suggestions for improvement can be	Plant manager Contractors	Before new workers start for the first time Before new activities are undertaken	• Check training attendance register • Observe whether activities are executed in line with EMP requirements	• Proportion of workers that completed environmental training • Compliance of workers with EMP

[4] Unless otherwise indicated, monitoring will be undertaken by the seawater desalination plant Site Manager, supported by the authorities where the requirement is specifically stipulated in a licence or permit and periodic external audits.

Operational Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**[4]	**Performance Indicators**
		reported. Ensure that all attendees remain for the duration of the training and on completion sign an attendance register that clearly indicates participants' names.				
Employment and business opportunities	10.	Award installation, customisation and maintenance contracts to South African companies in instances where plant, material or goods must be procured abroad.	Plant manager	Throughout operations	• Keep record of customisation and maintenance contracts • Keep record of staff by origin • Keep records of vehicle movement through and around Kotzesrus	• Percentage of goods procured locally; • Percentage of local staff; and • Number of vehicles travelling through the town of Kotzesrus.
	11.	Survey skills levels in local communities, and employ people based on the availability of local skills.				
	12.	Promote skills development as opposed to the importation of skills, where possible.				
	13.	Divert heavy vehicles around Kotzesrus (with the use of the *Amended Bypass Route*).				
	14.	Encourage light vehicles and personnel to drive through Kotzesrus (with the use of the *Amended Bypass Route*).				
	15.	Investigate the opportunity of providing water to villages in close proximity to the project infrastructure.				
Waste management	16.	Develop a waste management plan, laying out: • Expected type and amount of waste; • Measures to reduce waste; • Type and expected volume of recyclable waste; • Recycling facilities that will collect / receive waste; • Type of storage for different waste types; • Waste contractors that will collect waste; and • Monitoring procedures to ensure the waste management plan is implemented.	Contractor Plant manager	Before start of operations	• Regular audits against plan	• Waste Management Plan • Extent to which plant is complied with
	17.	Ensure that no material used at the seawater desalination plant (e.g. bagging) enters the marine environment.		Throughout operations	• Visual inspection of waste collection and disposal areas • Visual inspection of construction areas (litter) • Check waste disposal slips	• Presence of litter • Available rubbish bins and skips • Degree to which rubbish bins and skips are filled • Total volume of general and hazardous waste storage capacity and hazardous waste stored on site • Degree to which different waste is
	18.	Aim to minimise waste through reducing and re-using (e.g. packaging) material.				
	19.	Collect recyclables separately and deliver these to suitable facilities or arrange for collection.				
	20.	Collect all waste in bins and/or skips. Prevent littering by staff at work sites by providing bins or waste bags in sufficient locations.				
	21.	Provide separate bins for hazardous / polluting materials and mark these clearly.				
	22.	Store hazardous / polluting materials on impermeable ground until it				

Operational Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[4]**	**Performance Indicators**
		is disposed of / collected.				separated • Frequency of waste collection
	23.	Dispose of waste appropriately to prevent pollution of soil and groundwater.				
	24.	Do not allow any burning or burying of waste on site.				
Stormwater management	25.	Install stormwater drains that route stormwater around potentially polluting areas, such as the seawater desalination plant.	Contractors Plant manager	Before start of operations	• Visually inspect stormwater runoff and drains	• Visible pollution of stormwater entering the sea • Extent to which stormwater is captured in drains • Extent to which stormwater avoids polluting areas
	26.	Bund hazardous material storage areas and install a roof if possible to prevent stormwater contamination from these areas.				
	27.	Capture stormwater that might be contaminated, e.g. from storage area or seawater desalination plant, separately and route to a settling pond where suspended matter can settle out. Dispose of such matter appropriately, e.g. to an approved landfill, and not into the marine environment.		Throughout operations		
	28.	Keep outside areas clean to minimise the potential of polluting stormwater.				
	29.	Incorporate adequate erosion and stormwater management measures in order to prevent erosion and the associated sedimentation of wetland areas. Management measures may include berms, silt fences, hessian curtains, stormwater diversion away from areas susceptible to erosion and stormwater attenuation. Care should however be taken so as to avoid additional disturbance during the implementation of these measures.				
	30.	Prevent run-off from work areas entering wetland habitats during maintenance.				
Hazardous materials	31.	Design and construct hazardous material storage facilities, especially fuel storage, with suitable impermeable materials and a minimum bund containment capacity equal to 110% of the largest container.	Contractors Plant manager	Throughout operation	• Visual inspection of hazardous materials handling and storage areas	• Incidence of non-compliance with safety procedures concerning hazardous materials, including waste materials • Number of spills of hazardous materials, including waste materials • Cost of cleaning up spills • Evidence of contamination and leaks
	32.	Locate hazardous material storage facilities, especially fuel storage, as far as practically possible from the water's edge.				
	33.	Ensure that contaminants are not placed directly on the ground to prevent runoff reaching the marine environment.				
	34.	Develop (or adapt and implement) procedures for the safe transport, handling and storage of potential pollutants.				
	35.	Avoid unnecessary use and transport of hazardous substances.				
	36.	Keep Material Safety Data Sheets for all hazardous materials on site and ensure that they are available for reference by staff responsible for handling and storage of materials.				
Transportation and refuelling	37.	Undertake regular maintenance of vehicles and machinery to identify and repair minor leaks and prevent equipment failures.	Contractors operating vehicles and vessels	Throughout operation	• Visual inspection of	• Incidence of non-

Operational Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**[4]	**Performance Indicators**
	38.	Undertake any on-site refuelling and maintenance of vehicles/machinery in designated areas with an impermeable surface.	Plant manager		vehicles and vessels	compliance • Incidence of leaks and spills • Cost of cleaning up spills
	39.	Ensure that boats do not release pollutants into the water.				
	40.	Ensure compliance with national safety standards in vessel operations.				
	41.	Clean up any spills immediately, through containment and removal of free product and appropriate disposal of contaminated soils.				
	42.	Keep spill containment and clean-up equipment at all work sites and for all polluting materials used at the site.				
Traffic management	43.	Schedule deliveries after daylight hours if possible.	Plant manager Contractors providing deliveries to the plant	Throughout operation	• Keep record of vehicles entering the site and time they enter • Keep record of incidents and complaints • Visually inspect vehicles for any obvious faults or overloading	• Number of incidents and complaints • Number of vehicles travelling to site each day • Condition of vehicles
	44.	Stagger deliveries if possible rather than concentrating them during “rush” hours.				
	45.	Ascertain and ensure that vehicle axle loads do not exceed the technical design capacity of roads utilised by the project.				
	46.	Investigate and respond to complaints about traffic.				
	47.	Provide sufficient parking space at the seawater desalination plant.				
Air emissions	48.	Maintain all generators, vehicles, vessels and other equipment in good working order to minimise exhaust fumes.	Plant manager Contractors	Throughout operation	• Inspect maintenance records • Visually inspect exhaust fumes	• No noticeable exhaust fumes • Regular maintenance
Noise	49.	Maintain all sound proofing, generators, vehicles, and other equipment in good working order to minimise excess noise.	Plant manager Contractors	Throughout operation	• Maintenance log of equipment	• Frequency of required repairs
Maintenance activities	50.	If maintenance activities within very high sensitivity habitats (including quartzite and clay exposure areas –see Figure 1-4) are unavoidable, undertake these activities manually.	Contractors	During periodic maintenance activities	• Visually inspect maintenance activities • Keep record of maintenance activities	• Incidence of disturbance of sensitive habitats; • Incidence of disturbance of fauna; • Incidence of disturbance of wetland habitat; and • Enforcement of speed limits.
	51.	Do not permit heavy machinery into very high sensitivity habitat units (including quartzite and clay exposure areas).				
	52.	Restrict the number of personnel entering into very high sensitivity habitats (including quartzite and clay exposure areas) during maintenance activities.				
	53.	Ensure that maintenance activities are restricted to the road reserve and do not encroach into surrounding open veld areas and that these open veld areas are strictly off-limits to maintenance vehicles and				

Operational Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**[4]	**Performance Indicators**
		personnel.				
	54.	Strictly prohibit maintenance personnel from collecting plant material from surrounding natural areas.				
	55.	Strictly prohibit the trapping and hunting of fauna by maintenance personnel.				
	56.	Enforce a speed limit for operational and maintenance vehicles of 40km/h in order to reduce collision of maintenance vehicles with fauna.				
	57.	Rescue and relocate any faunal species encountered particularly slower moving species such as tortoise.				
	58.	Regularly inspect gravel roads to ensure that faunal species such as tortoises are able to cross safely.				
	59.	Permit only essential personnel within the wetland habitat if maintenance activities within wetland areas are unavoidable.				
	60.	Disallow heavy machinery and vehicles in wetland areas.				
	61.	Keep all demarcated sensitive wetland zones outside of the maintenance areas off limits.				
	62.	Maintain all infrastructure relating to seawater intake and effluent discharge at the desalination plant, including monitoring devices.				
Invasive species	63.	Remove alien and weed species within areas used by the project in order to comply with the relevant legislation.	Contractors	During operation	• Visual inspection	• Number of invasive species.
Intake structures and pipelines	64.	Regularly undertake ‘pigging’ of intake and discharge pipelines to reduce the need for and costs of biocides.	Plant manager	During operation	• Review of entrainment study	• Entrainment study completed
	65.	*Although an entrainment and impingement study is typically recommended for large desalination plants, the comparatively low volumes of feed-water to be extracted from the surf-zone for this project would not justify such a study*				
Pre-treatment of intake water and cleaning of Reverse Osmosis (RO) membranes	66.	Implement shock dosing of biocide in preference to continual dosing to avoid bacterial resistance to the biocide.	Plant manager	Throughout operations	• Inspection of pre-treatment and RO membrane cleaning processes	• Chemical use; and • Quality of brine effluent.
	67.	Use low-toxicity chemicals as far as practicable.				
	68.	Limit the use of scale-control additives to minimum practicable quantities.				
	69.	Avoid antiscalants that increase nutrient levels (e.g. polyphosphate antiscalants).				
	70.	*Ensure efficient Cleaning in Place (CIP) process and adequate maintenance of plant.*				
Brine discharge	71.	Dechlorinate effluent prior to discharge with sodium metabisulphite (SMBS).	Plant manager	Prior to effluent discharge	• Inspection of brine	• Level of chlorine in

Operational Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**[4]	**Performance Indicators**
	72.	Avoid over-dosing of SMBS.			discharge processes • Monitoring of brine effluent	brine effluent.
	73.	Aerate the effluent prior to discharge.				
	74.	Ensure that biocide and co-pollutant concentration comply with Coastal Waters Discharges Permit conditions and that they do not exceed the No Observed Effect Concentration (NOEC) or Predicted No Effect Concentration (PNEC) by active minimisation of chlorine effects through de-chlorination prior to discharge.		Throughout operations	• Monitoring of brine effluent	• Quality of brine effluent.
	75.	Actively neutralise and/or remove other co-pollutants from the effluent, and dispose of at an authorized disposal site.		Prior to brine discharge	• Inspection of brine discharge processes.	• Available waste disposal slips; and • Constituents and quality of brine.
	76.	Collect residual cleaning solutions and membrane filter washes and neutralize and remove solids before discharge.				
	77.	*Investigate new technologies and ways to minimise wastewater into the coastal waters.*				
Response to environmental pollution	78.	Compile and implement a contingency plan for emergency incidence such as malfunctions and abnormal conditions, specifically related to the control of effluent stream. The contingency plan must examine the risk of contamination, and considers procedures that must be implemented to mitigate any unanticipated impacts (e.g. mixing zone larger than expected under certain conditions). The plan must also allow for follow-up and analysis of all environmental incidents or accidents.	Plant manager	Compile before start of operations Implement throughout activities	• Authorities to confirm adequacy of programme	• Response from authorities
	79.	In the event of environmental pollution, e.g. through spillages, excessive release of air emissions or odours, immediately stop the activity causing the problem.	Plant manager	Throughout operations	• Maintain register of pollution events and response • Following resumption of activities, frequently inspect repaired equipment to ensure proper functioning	• Number of incidents • Time activities stopped • Number of recurring incidents
	80.	Only resume activity once the problem has been stopped or (in the case of spillages) the pollutant can be captured without reaching the environment.				
	81.	Repair faulty equipment as soon as possible.				
	82.	Install additional bunding / containment structures around the equipment that was the source of the leak / spillage to prevent pollution from reaching the marine environment in future.	Plant manager		• Visually inspect adequacy of bunding	
	83.	Notify the relevant authorities within one day of an environmental pollution event, at a minimum the DEA: O&C in the case of marine pollution.	Plant manager Contractors		• Maintain register of events and communication with authorities	• Time between incidence and notification
	84.	If complaints regarding noise are received: • Measure noise levels in surrounding areas attributable to the plant under various operating conditions and at various times; and • Investigate and, if required, implement noise reduction measures.		Throughout operation	• Noise measurements • Complaints register	• Results of random noise measurements • Number of registered complaints

Operational Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods[4]**	**Performance Indicators**
Decommissioning/ continued use	85.	Investigate the continued use of the desalination plant for water provision to surrounding communities following the closure of the Zandkopsdrift Mine.	Sedex Desalination Plant manager	Prior to closure of Zandkopsdrift Mine.	• Keep records of negotiations • Prepare decommissioning plan	• Decommissioning plan and sufficient funds for decommissioning (if required).
	86.	Develop a preliminary decommissioning plan for the site and pipeline (if required). *Consider leaving the marine pipeline in place post closure to prevent unnecessary disturbance of the seabed and associated communities.*				
	87.	Should decommissioning be required, calculate the estimated cost of decommissioning and rehabilitation and set aside sufficient funds during the operations period to cover these costs.				

5 Monitoring

The objective of implementing an inspection and monitoring programme is to ensure long-term compliance with mitigation measures, approved plans and permit conditions. The monitoring programme also provides transparent assurance to Sedex Desalination (and external parties) that specified standards are being set so as to reduce (negative) impacts to tolerable levels, and that target performance levels are being met.

The inspection and monitoring programme must be designed to measure environmental performance against applicable standards, guidelines and expectations, and to provide early detection of undesirable impacts to the environment. Such information is used to ensure that project standards are being met, and to demonstrate compliance with regulatory requirements. The monitoring programme is amended as and when necessary in order to ensure safe operation and optimal environmental protection.

Sedex Desalination will be responsible for the collection and monitoring of environmental data during the operations phase.

Monitoring should commence prior to the commencement operation to establish an adequate baseline against which impacts of construction activities can be monitored. Monitoring will continue throughout the operations phase, and the duration and frequency of monitoring may be modified to best characterise any affected environmental aspect. Monitoring Plans / Programmes required during the operations phase are indicated in Table 5-1.

Table 5-1: Monitoring

Operations Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**	**Performance Indicators**
Operations Phase						
Environmental monitoring	1.	Compile, implement and manage a programme of environmental inspection, monitoring and reporting, based on requirements of the Coastal Water Discharge Permit issued to the desalination plant.	Plant manager Sedex desalination	Compile programme before start of operations Refine and implement programme throughout operations Reporting suggested quarterly (depending on licence conditions)	• Site manager to provide feedback on monitoring and environmental performance to authorities (and potentially key public stakeholders) • Authorities to review monitoring results for adequacy	• Inspection, monitoring and reporting programme • Frequency of monitoring and reporting • Compliance with standards and licence conditions • Response from authorities
	2.	Liaise with the authorities and potentially other key public stakeholders regarding the plant's environmental performance.				
	3.	Implement regular monitoring of the environmental performance at the plant in line with the monitoring programme.		Monthly throughout operations	• Review reports for adequacy of monitoring and results	• Frequency of monitoring and reporting • Compliance with standards and licence conditions
	4.	Submit monthly reports to the Site Manager, reporting on the environmental performance of the desalination plant.				
	5.	Appoint external auditors to audit compliance with the EMP.		At least every 2 years	• External auditor report	• Compliance with EMP
Effluent monitoring	6.	Monitoring of the effluent for residual chlorine and dissolved oxygen levels.	Plant manager Sedex desalination	Weekly during operations	• Review reports for adequacy of monitoring and results • Authorities to monitor compliance • Consider periodic independent sampling • Keep records of which remedial measures where considered and why they were or weren't implemented.	• Regular sampling, no gaps • Regular reporting • Results in line with permit and EMP requirements
	7.	Monitor extent of brine footprint to validate near-field model predictions and ensure that the diffuser is performing to the expected specifications.				
	8.	Monitor brine colour and implement appropriate measures to reduce discolouration, where necessary.				
	9.	Monitoring of bacterial numbers in the brine (biennially).		Biennially Every 6 – 12 months		
	10.	Monitor the effects of the discharged brine on the receiving environment.				
	11.	Monitored the effluent regularly (every 6-12 months) for heavy metals.				
	12.	Conduct Whole Effluent Toxicity (WET) testing of the brine effluent to more reliably assess the impact of any co-discharged constituents and to calculate the required dilution rate.		Throughout operations		
	13.	Implement the appropriate remedial measures				
	14.	Indicate the location of monitoring points in monitoring results.				
	15.	Report effluent monitoring results at a minimum to the DEA: O&C				

Operations Phase Measures						
Aspect	**ID**	**Mitigation measure / Procedure**	**Responsible**	**Implementation Timeframe**	**Monitoring Methods**	**Performance Indicators**
	16.	*Establish limits for heavy metal concentrations in the brine discharges and monitor the brine regularly to avoid exceedance of these limits.*				
	17.	*Implement a water quality monitoring programme to validate the predictions of the hydrodynamic modelling study and monitor constituents of the effluent to ensure compliance with water quality guidelines.*				
	18.	*Establish an invaluable database on brine effluent impacts for future developments of this nature.*				
Pipeline monitoring	19.	Monitor sea water intake and brine pipelines for leaks and repair any leaks immediately.	Plant manager	Weekly during operations	• Keep records of leaks detected and repaired.	• Number of leaks or defects repaired; • Corrosion levels or plant constituent parts; and • Remedial measures implemented.
	20.	Monitor pipelines for defects, structural integrity, etc.				
	21.	Check corrosion levels of plant constituent parts and the physical integrity of the intake and outlet pipes and diffuser.				
	22.	Implement the appropriate remedial measures.				

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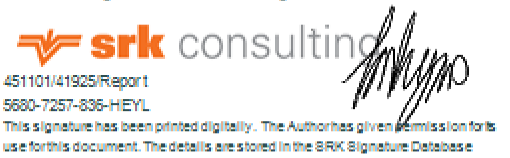
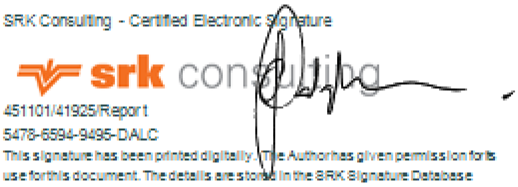


Larissa Heyns

Environmental Consultant

Reviewed by



Chris Dalgliesh

Principal Environmental Consultant

Appendix A:

Sensitive Archaeological Sites

1 APPENDIX : Heritage Sites

The table below contains a list of all heritage occurrences recorded during the survey. Site names are only allocated to definable archaeological sites while background scatters and occurrences of lesser significance are assigned single GPS co-ordinates. In the significance column an indication of the heritage significance of the site is provided. Note that mitigation would only need to be carried out for those sites that will actually be disturbed.

Abbreviations used in the table are as follows:

Burn: *Burnupena* sp. (shellfish)
CCS: cryptocrystalline silica (rock type)
C/m: *Choromytilus meridionalis* (shellfish)
FGB: fine-grained black rock (rock type)
GG / GGA / GGB / GGAB: *C. granatina, S. granularis, S. argenvillei, S. barbara* (shellfish)
OES: ostrich eggshell
QP: quartz porphyry (rock type)

GPS ID	Site name	Co-ordinates	Description	Significance
001		S30 53 02.1 E17 56 22.5	Ephemeral artefact scatter on pan.	Low
002		S30 52 59.3 E17 56 24.0	Light artefact scatter close to pan. Quartz, silcrete, CCS, other black rock.	Low
003		S30 52 57.9 E17 56 26.0	Light scatter of quartz, CCS and OES on heuweltjie.	Low
004	ZKD2013/001	S30 52 52.1 E17 56 27.1	Stone-packed grave on heuweltjie behind the house. This is the highest spot in the area. Also glass and ceramics and quite a few stone artefacts of quartz, CCS, silcrete and igneous rock.	**High** **Avoid**
005		S30 52 55.9 E17 56 23.3	Heuweltjie with a scatter of quartz artefacts on it.	Low
006	ZKD2013/002	S30 53 02.5 E17 56 23.4	Remains of a small dam built in the pan. Two fence posts and some wire remain around it.	Low
007		S30 52 49.2 E17 55 55.9	Hill with a heuweltjie on top of it and a light scatter of quartz and silcrete artefacts.	Low
008		S30 52 46.5 E17 56 07.0	Heuweltjie with a light scatter of quartz on it.	Low
009		S30 52 34.4 E17 54 55.5	Heuweltjie with a scatter of quartz and CCS on it. Lots of quartz artefacts in the area.	Low
010		S30 52 58.9 E17 53 51.1	Widespread background scatter of quartz, silcrete and CCS in eroding areas.	Low
011	KPH2013/001	S30 53 07.2 E17 53 44.8	Coarse silcrete outcrop with occasional silcrete artefacts around it. Quarrying is evident in areas where the silcrete is of better quality. Outcrop is about 40 m long and the same silcrete appears as artefacts on the surrounding heuweltjies.	Low
012	Kotzesrus	S30 57 45.9 E17 49 52.0	Kotzesrus house 12 m from road.	**High** **Avoid**
013	Kotzesr	S30 57 46.0 E17 49	Kotzesrus house 10 m from road.	**High**

	us	52.8		Avoid
014		S30 57 47.7 E17 49 45.5	Ephemeral but widespread quartz scatter with variably weathered artefacts. Also one willow pattern ceramic sherd in road.	Low
015	BFT2013/001	S30 57 50.6 E17 49 42.6	Ephemeral but widespread quartz, quartzite and silcrete scatter in an eroding area. Includes at least some diagnostic MSA artefacts.	**Medium** **Mitigate** (focused on pts 16 & 19)
016		S30 57 51.0 E17 49 41.9	Stone artefact and OES scatter which includes a complete (but very broken *in situ*) ostrich egg. OES seems mineralised and its surface is eroded in places. The site has a mix of MSA and LSA. Quartz, quartzite, silcrete, CCS, FGB, clear quartz thumbnail scraper, GGA, *Oxystele* sp. (marine shell), bone, two pot sherds.	
017		S30 57 51.0 E17 49 40.9	Artefact scatter in eroding area. Quartz, silcrete (incl. an adze), FGB, quartzite, QP, tortoise bone, water-worn and perforated (from inside) limpet shell.	
018		S30 57 51.4 E17 49 40.1	Artefact scatter in eroding area. Quartz, silcrete (incl. MSA retouched flake), FGB, CCS radial core.	
019		S30 57 52.3 E17 49 39.3	Large and very dense artefact scatter of about 20 m diameter in eroding area. Quartz, quartzite, silcrete, CCS, QP, FGB, OES. (NB: waterbakke on granite to the north contain a few cubic meters of water, some up to 50 cm deep.)	
020	BFT2013/002	S30 57 51.7 E17 49 38.3	Ruined building. Said to have been a stable. Artefacts around it include pink glass, clear glass, green glass, white glass, white ceramic, ceramic with blue patch, ceramic with blue rim, *S. argenvillei* shell. Structure is 6 x 10 m and is 5 m from the edge of the road.	**Low** **Mitigate** (record and test exc. as required)
021		S30 57 52.4 E17 49 36.4	Artefacts scatter with quartz, quartzite, silcrete and OES.	Low
022		S30 57 50.6 E17 49 28.5	No site visible but there is quartz, OES and *S. argenvillei* in the road so there is probably a site buried in the sand on the north side of the road.	**Low** (test exc.) **Mitigate**
023	BFT2013/003	S30 56 55.5 E17 49 23.3	Ephemeral quartz scatter between boulders.	**Medium** **Avoid** (or mitigate as required)
024		S30 56 56.5 E17 49 21.8	Quartz scatter SW of big boulder. Also pottery (8.5 mm thick). This seems the most likely spot to have subsurface deposits.	
025		S30 56 54.9 E17 49 20.8	Light quartz scatter between boulders.	
026		S30 56 54.3 E17 49 19.5	Widespread light quartz scatter W of boulders.	
027		S30 56 51.0 E17 49 20.0	Widespread light quartz scatter NW of boulders.	
028		S30 56 51.1 E17 49	Widespread light quartz scatter N of	

		22.0	boulders.	
029		S30 56 33.3 E17 49 19.4	A few quartz artefacts in an eroding area.	Low
030		S30 58 27.4 E17 46 58.2	MSA quartz scatter below the surficial sands at the edge of a borrow pit. Quite a lot of artefacts (*c.* 50) but would be difficult to gather a meaningful sample. Also some silcrete and quartzite. Artefacts on road must come from borrow pits.	Low
031		S30 58 20.0 E17 45 14.1	Borrow pit as above but only *c.* 7 quartz artefacts.	Low
032		S30 58 22.0 E17 44 56.4	Borrow pit as above but *c.* 20 quartz, quartzite and silcrete artefacts.	Low
033	Kotzesrus	S30 57 46.2 E17 49 57.8	Old school building, 10 m from road.	**High** **Avoid**
034		S30 57 46.0 E17 50 00.7	Structure, 35 m from road. Corrugated iron Victorian apparently built with corrugated iron imported from the UK and still all the original sheets.	
035		S30 57 45.5 E17 50 04.9	Structure, 25 m from road.	
036		S30 57 43.9 E17 50 08.9	Structure, 25 m from road.	
037-040		S30 57 37.9 E17 50 15.6 S30 57 37.1 E17 50 15.7 S30 57 37.2 E17 50 17.9 S30 57 37.7 E17 50 17.8	Graveyard. Kotze, Nieuwoudt, Van Zyl, Van Eden, Mulder, Auret, Coetzee, Van Schoor.	
041-043		S30 57 36.5 E17 50 16.6 S30 57 36.3 E17 50 18.3 S30 57 36.2 E17 50 17.4	Graveyard. Auret, Daniel, Coetzee, Zandberg, Schoeman, Cornelissen, Van Zyl, Du Toit, Nieuwoudt, Mulder.	
044		S30 57 44.3 E17 50 08.1	Monument (1916)	
045		S30 58 40.8 E17 41 22.4	Two small pans with a few quartz and quartzite artefacts visible around them and in the road. No shell, probably all MSA. On hill to the west there is one quartz flake and some fragments of *C. granatina* and *S. argenvillei* but extremely ephemeral.	Low
046-050	SFT2013/001	S30 58 50.4 E17 40 08.4 S30 58 49.7 E17 40 06.7 S30 58 49.2 E17 40 05.6 S30 58 48.8 E17 40 04.5 S30 58 48.2 E17 40 02.2	Extensive, but low density shell scatters throughout this area. GPS points taken where shell visible in road. Also points 28-37, 55-56, 59-62, 74-76 of a previous project (Orton & Hart 2011) along the coastal road.	**Low-medium** **Mitigate** (test and exc. as required)

051, 092-093	SFT2013/002	S31 01 54.9 E17 41 46.3 S31 01 55.0 E17 41 44.5 S31 01 54.6 E17 41 45.5	Shell scatter. GGA, quartz. In valley. Ephemeral but widespread.	Low
052	SFT2013/003	S31 01 54.3 E17 41 47.6	Shell scatter. GGAB, C/m. In valley. 15 m diameter.	Low
053		S31 01 52.6 E17 41 44.4	Artefact scatter. Quartz, QP. Eroding from trench. ?ESA/MSA	Low
054	SFT2013/004	S31 01 49.5 E17 41 42.0	Quartz artefact scatter with occasional shell fragments.	**Low** **Mitigate**
055-065	SFT2013/005	S31 01 49.5 E17 41 42.7 S31 01 49.8 E17 41 43.1 S31 01 50.1 E17 41 42.9 S31 01 50.4 E17 41 43.1 S31 01 50.0 E17 41 43.3 S31 01 50.5 E17 41 44.2 S31 01 49.1 E17 41 42.3 S31 01 50.5 E17 41 42.8 S31 01 50.7 E17 41 43.3 S31 01 50.1 E17 41 42.6 S31 01 50.8 E17 41 44.4	Set of light shell scatters (dumps) likely related to each other. GGA, quartz, OES.	**Low-medium** **Mitigate**
066-075	SFT2013/006	S31 01 47.6 E17 41 41.8 S31 01 46.2 E17 41 41.5 S31 01 46.4 E17 41 41.8 S31 01 46.4 E17 41 41.8 S31 01 46.7 E17 41 41.3 S31 01 46.8 E17 41 40.8 S31 01 45.8 E17 41 41.6 S31 01 46.6 E17 41 42.0 S31 01 46.9 E17 41 41.8 S31 01 46.8 E17 41 41.2	Set of light shell scatters (dumps) likely related to each other. GGA, quartz, Burn, C/m.	**Low-medium** **Mitigate**
076	SFT201	S31 01 49.6 E17 41	Shell scatter. GGB, pottery, quartz. 8 m	**Low**

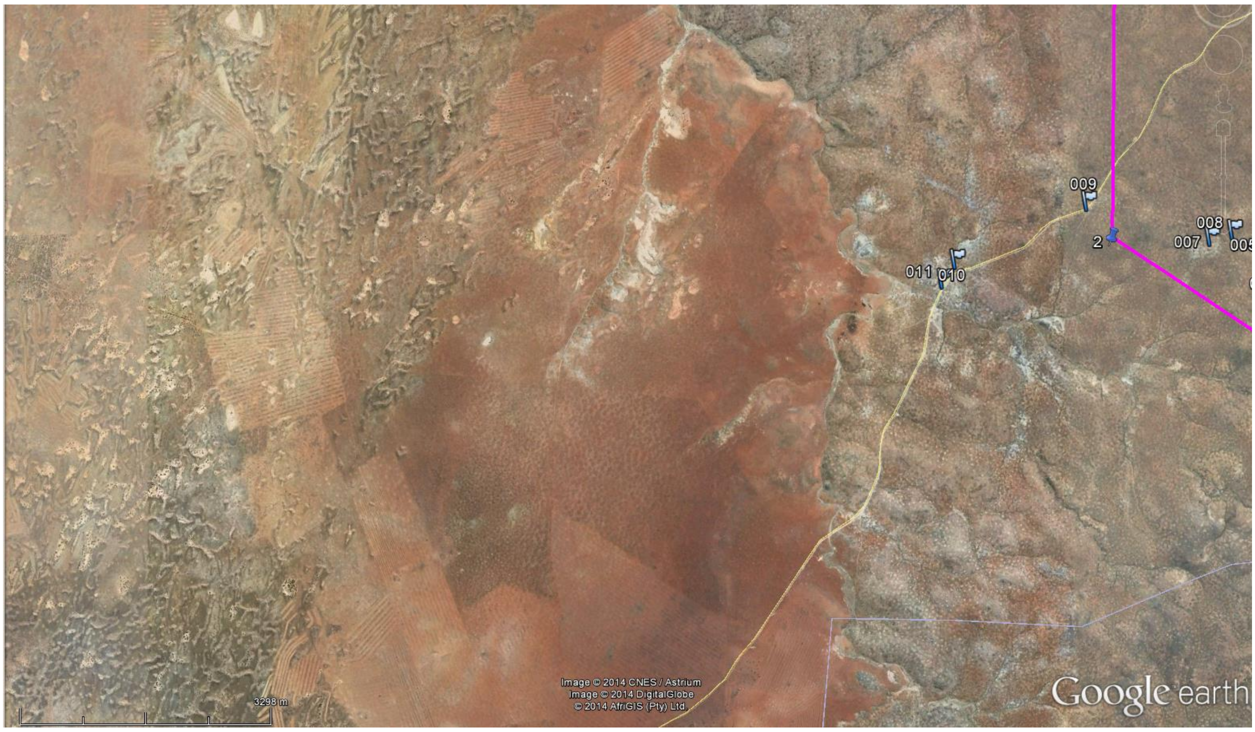
	3/007	39.4	diameter.	Mitigate
077	SFT2013/008	S31 01 50.8 E17 41 40.4	Shell scatter. GGA, quartz. 8 m diameter.	**Low** Mitigate
078-079	SFT2013/009	S31 01 52.5 E17 41 40.5 S31 01 53.4 E17 41 41.5	A very long shell scatter. GGA, quartz. 35 x 10 m.	**Low-medium** Mitigate
080	SFT2013/010	S31 01 53.1 E17 41 40.0	Shell scatter. GGA, quartz.	**Low-medium** Mitigate
081	SFT2013/011	S31 01 52.5 E17 41 38.0 S31 01 52.7 E17 41 37.6	Stone artefact scatter (quartz) with occasional shell fragments. 5 m diameter.	**Low-medium** Mitigate
082-083	SFT2013/012	S31 01 52.5 E17 41 34.3 S31 01 53.2 E17 41 35.0	Bedrock outcrop with dense shell on both the north and south sides. Good shelter from south wind. Although there is modern disturbance in the surface there is probably subsurface deposit as well. Lots of quartz. Similar scatter on south side of boulder. GGAB.	**Medium-high** Mitigate (depending on subsurface remains)
084	SFT2013/013	S31 01 53.7 E17 41 39.9	Shell scatter. GG. 5 m diameter.	**Low** Mitigate
085	SFT2013/014	S31 01 53.6 E17 41 40.3	Ephemeral shell scatter. GG, Burn. 5 m diameter.	Low
086-090	SFT2013/015	S31 01 54.7 E17 41 41.9 S31 01 55.0 E17 41 41.2 S31 01 55.2 E17 41 41.3 S31 01 55.4 E17 41 41.7 S31 01 55.2 E17 41 42.2	Set of shell scatters. GGA, quartz. 20 x 25 m area.	**Low-medium** Mitigate
091	SFT2013/016	S31 01 55.0 E17 41 43.3	Shell scatter in valley.GGA. 30 m diameter.	**Low** Mitigate
094	SFT2013/017	S31 01 55.5 E17 41 42.6	Ephemeral shell scatter. GGA 8 m diameter.	Low
095	SFT2013/018	S31 01 54.8 E17 41 35.5	Shell scatter. GGAB, quartz. 15 m diameter.	Low
096	SFT2013/019	S31 01 54.0 E17 41 35.1	Shell scatter in jeep track. GGA. 15 m diameter.	Low
097	SFT2013/020	S31 01 51.0 E17 41 34.3	Shell scatter on a bedrock outcrop. GGA, quartz.	Low
098	SFT2013/021	S31 01 48.2 E17 41 37.2	Shell scatter. GGA. 10 m diameter.	Low
099	SFT2013/022	S31 01 47.0 E17 41 37.7	Shell scatter. GGA, quartz. 10 m diameter.	**Low**
100-101	SFT2013/023	S31 01 47.9 E17 41 35.3 S31 01 50.1 E17 41 34.8	Long shell scatter. GGA, quartz. 60 x 10 m.	**Low** Mitigate

102	SFT2013/024	S31 01 37.4 E17 41 22.7	Memorial to Ellis Burden (heart attack).	**High** **Avoid**
103	SFT2013/025	S31 01 34.9 E17 41 23.2	Shell scatter. GA. 10 m diameter.	Low
104		S31 01 34.2 E17 41 26.5	Quartz artefacts in dumped sand from small excavation.	Low
105	SFT2013/026	S31 01 35.6 E17 41 26.9	Possible grave. Upright granite slab embedded in the ground on the crest of a small hill.	**High** **Avoid**
106	SFT2013/027	S31 01 34.4 E17 41 30.4	Ephemeral shell scatter. GG. 8 m diameter.	Low
107	SFT2013/028	S31 01 37.5 E17 41 34.8	Ephemeral shell scatter. GG, quartz, QP. 20 m diameter. Extends into road.	Low
108	SFT2013/029	S31 01 30.2 E17 41 37.0	Ephemeral shell scatter. GG. 5 m diameter.	Low
109		S31 01 29.8 E17 41 38.7 S31 01 31.4 E17 41 34.7	Palaeontological observation of marine shell from a prospecting drill hole. Reported on by John Pether.	See palaeontological report.
110	SFT2013/030	S31 01 29.1 E17 41 31.7	Ephemeral shell scatter. GG, quartz. 5 m diameter.	Low
111-120	SFT2013/031	S31 01 28.5 E17 41 31.1 S31 01 28.3 E17 41 31.0 S31 01 28.1 E17 41 31.5 S31 01 27.8 E17 41 31.5 S31 01 27.9 E17 41 31.8 S31 01 27.9 E17 41 30.4 S31 01 28.9 E17 41 30.9 S31 01 28.6 E17 41 30.3 S31 01 29.0 E17 41 30.2 S31 01 29.5 E17 41 30.7	Two dense shell scatters and various other lighter scatters, also extends through road. GGAB, Burn.	**Low** **Mitigate**
121	SFT2013/032	S31 01 29.7 E17 41 29.6	Shell scatter. GGA. 10 m diameter.	Low
122	SFT2013/033	S31 01 29.7 E17 41 24.9	Shell scatter. GGA, OES, quartz. 10 m diameter.	Low
123	SFT2013/034	S31 01 31.1 E17 41 29.0	Shell scatter. GGA, OES. 5 m diameter.	Low
124	SFT2013/035	S31 01 30.9 E17 41 29.9	Shell scatter. GG. 5 m diameter.	Low
125	SFT2013/036	S31 01 30.8 E17 41 30.3	Shell scatter. GG. 5 m diameter.	Low
126		S31 01 32.6 E17 41 30.3	Drill hole deposits with quartz and QP artefacts in one part suggesting all from one depth.	Low
127		S31 01 02.1 E17 41	Artefacts eroding out of a slope near a	Low

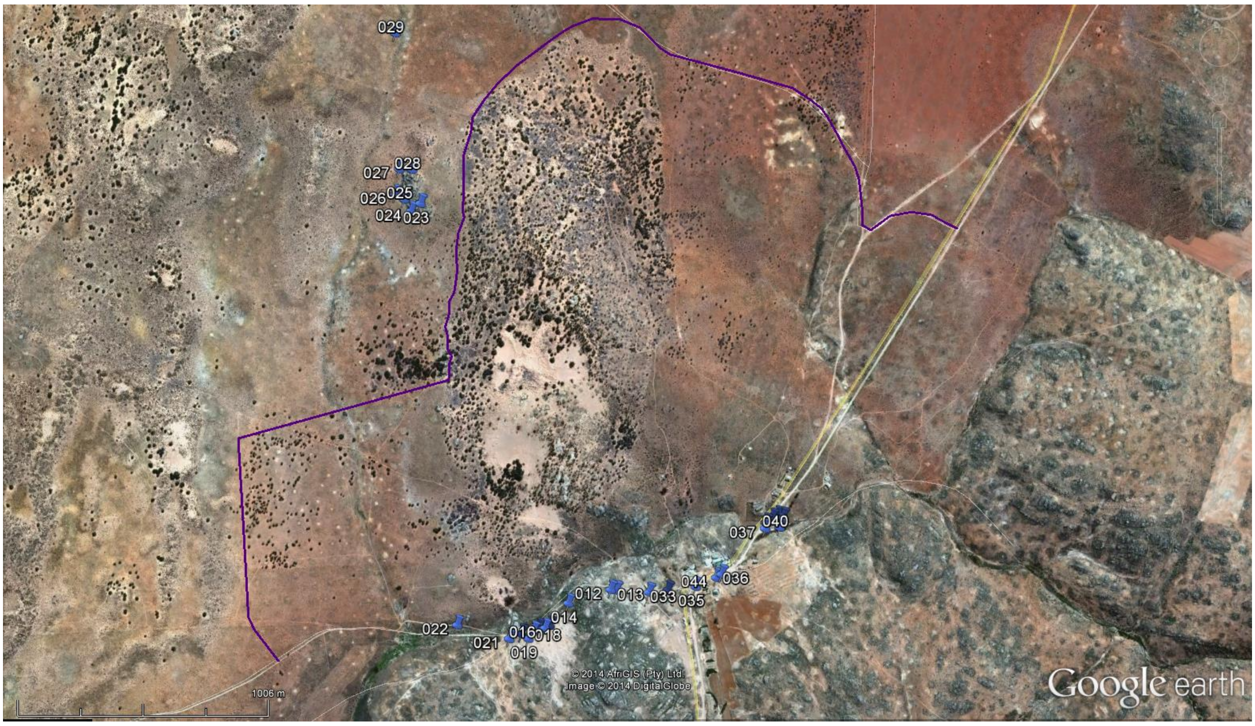
		22.3	calcrete outcrop. Quartz, QP, quartzite.	
128		S31 00 48.7 E17 41 18.4	Artefacts eroding out of a slope near a calcrete outcrop. Quartz, QP, quartzite.	Low
129	SFT201 3/037	S31 00 14.1 E17 41 04.9	Shell scatter in the road with lots of artefacts. Quartz, QP, quartzite, HS, UG. Probably good buried deposits alongside road.	**Medium** **Mitigate**
130	SFT201 3/038	S30 59 58.9 E17 40 58.0	Shell and quartz scatter in the road.	Low
131	SFT201 3/039	S30 59 44.4 E17 40 46.1	Good concentration of stone artefacts exposed on the hard surface beneath the surficial sands.	**Low-medium** **Mitigate**
132		S30 58 53.4 E17 40 15.5	Borrow pit with stone artefacts on hard layer above calcrete and below sand. Quartz, quartzite, QP.	Low
133		S30 58 21.0 E17 43 42.7	Borrow pit with quartz, silcrete, quartzite. Also some in road. About 7 artefacts seen.	Low
134		S30 58 23.3 E17 47 30.3	As above. Quartz, silcrete, quartzite, sandstone. About 20 artefacts seen.	Low
135		S30 51 55.4 E17 58 03.1	MSA artefacts with lots of retouch in the mine pit area.	Covered by earlier mitigation
136	ZKD201 3/003	S30 52 55.8 E17 56 35.0	Heuweltjie with a good artefact scatter on it. Quartz, silcrete.	**Low** **Mitigate**
137		S30 52 53.5 E17 56 34.8	Heuweltjie with a few artefacts on it. Quartz.	Low
138		S30 52 51.1 E17 56 33.8	Heuweltjie with a few artefacts on it. Quartz, quartzite.	Low
139		S30 52 50.3 E17 56 30.9	Heuweltjie with artefact scatter on it. Quartz, silcrete, quartzite. Includes one small ?quartzite hand-axe.	Low
140		S30 52 51.6 E17 56 28.8	Heuweltjie with artefacts on it. Widespread scatter with no concentrations. Quartz, quartzite, FGB, coarse porcelain.	Low
141	ZKD201 3/004	S30 53 01.6 E17 56 32.6	Water put behind cottage. 1.5 m wide, 2.5 m deep. Excavated into the granite. (low wall added recently to keep silt out.)	Low

2 APPENDIX Mapping

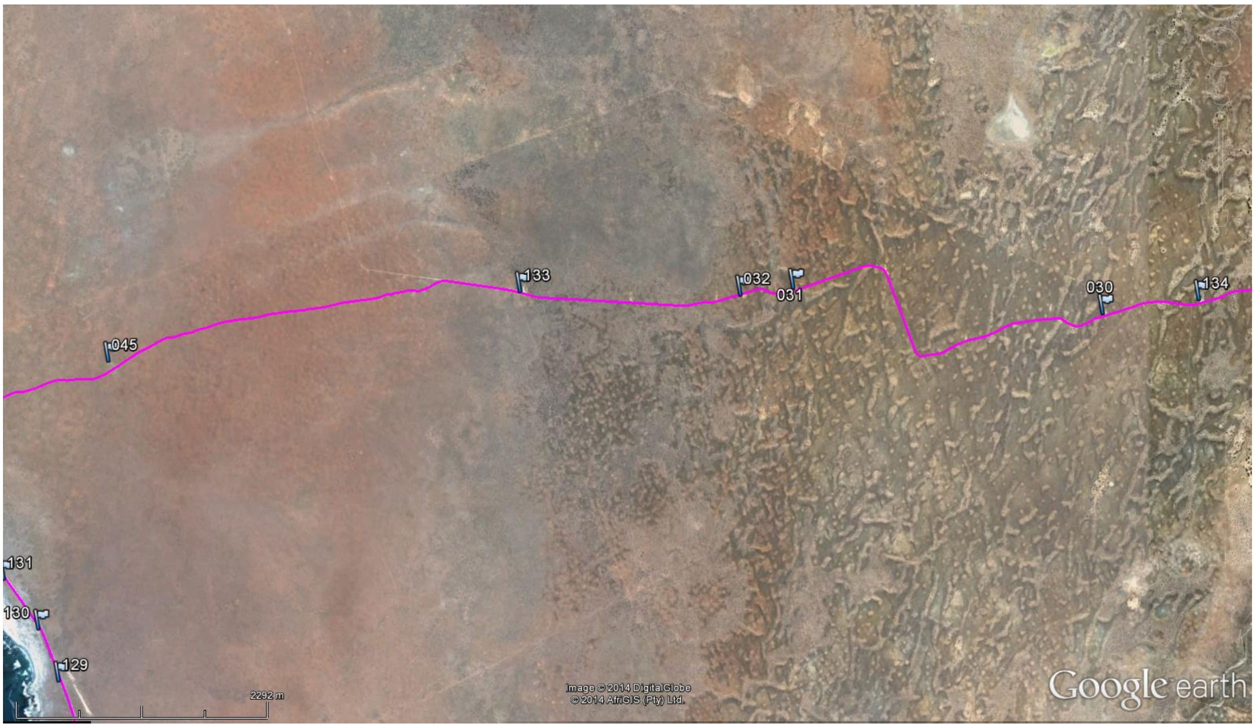
The following maps indicate the positions of the heritage resources listed in Appendix C relative to the proposed development.



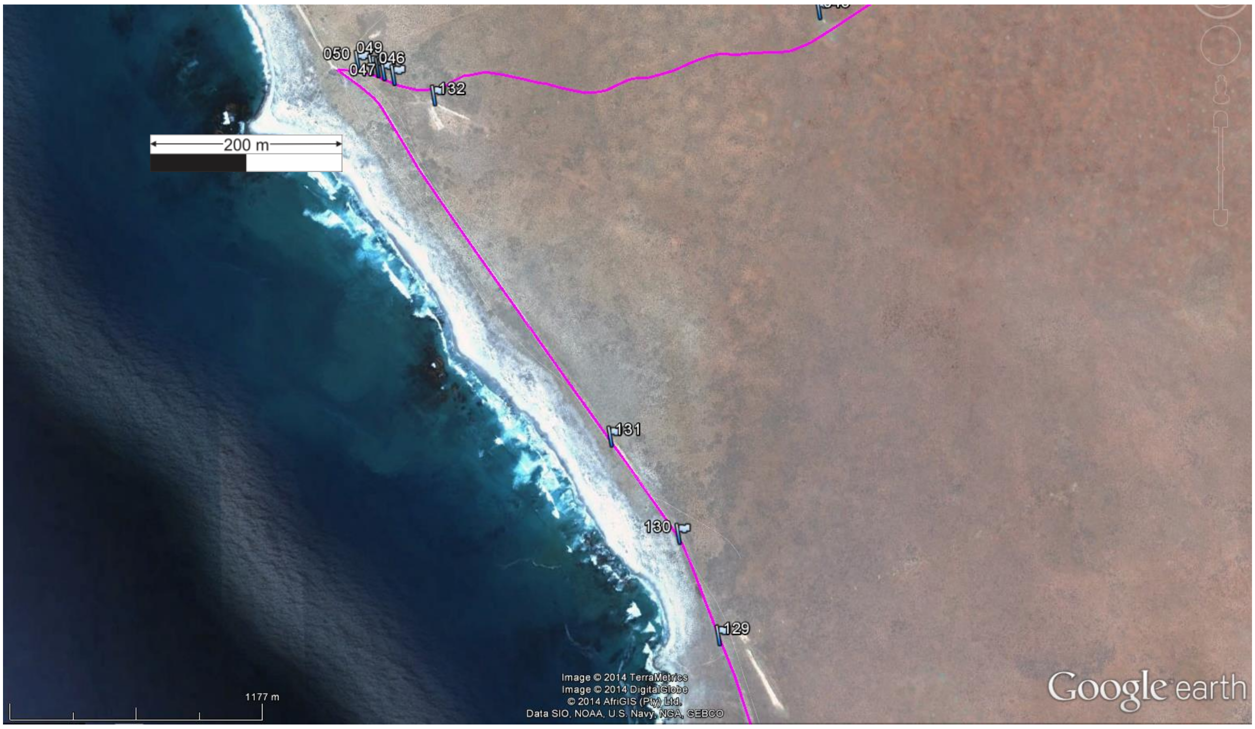
Map 1 Aerial view of the north-eastern part of the study area showing heritage sites recorded between the mine and Kotzesrus. Scale: 4 km..



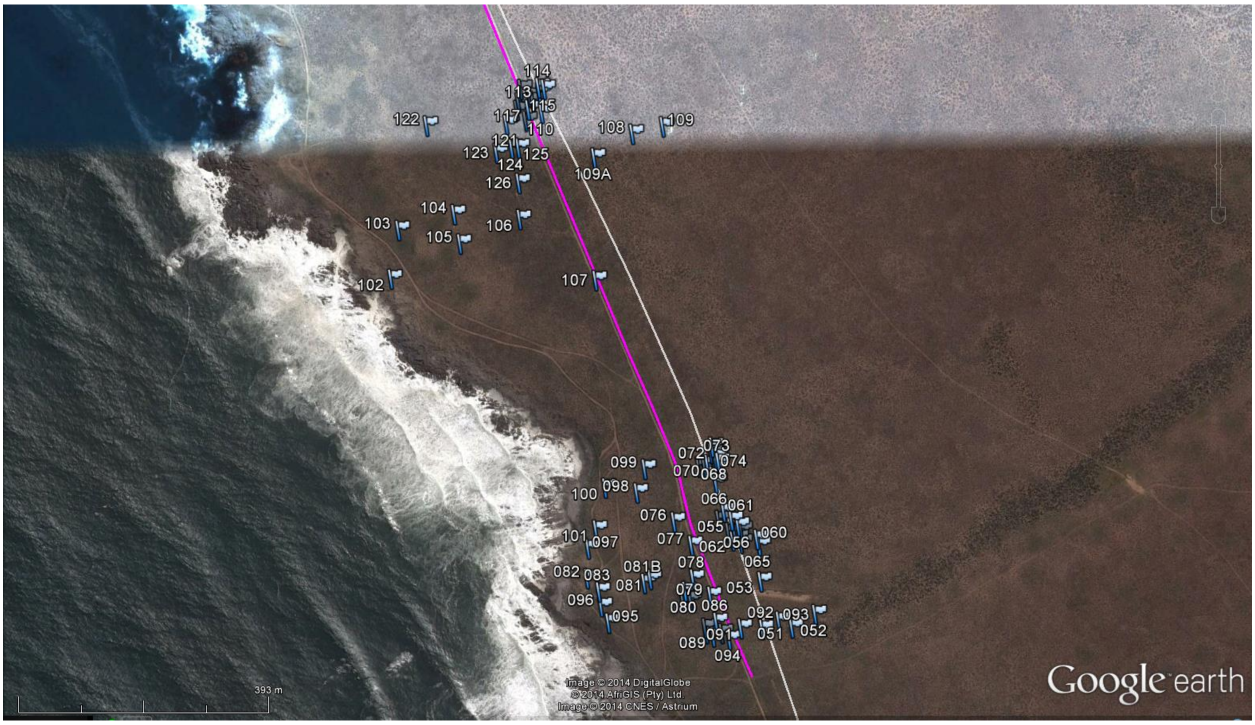
Map 2: Aerial view of the area near and around Kotzesrus (the town is in the southern part of this view) showing heritage sites recorded. The proposed bypass route (purple line) successfully avoids heritage sites.



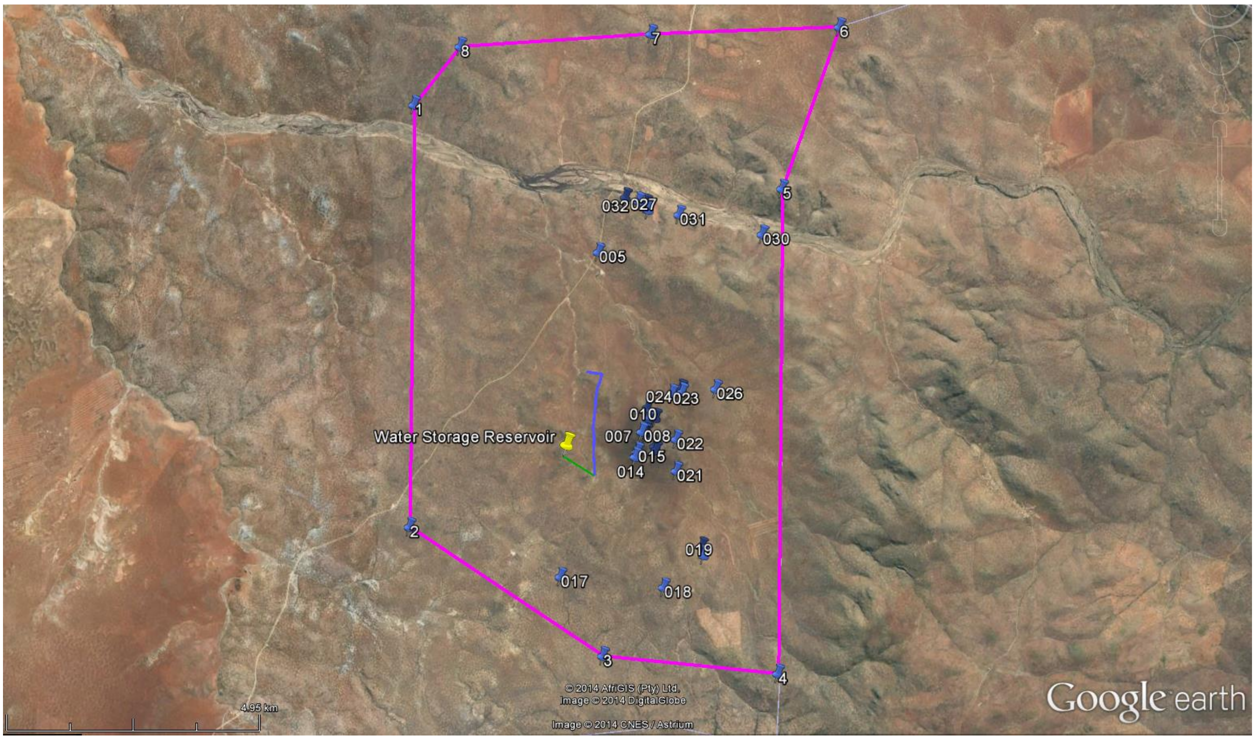
Map 3 Aerial view of route between Kotzesrus and the coast showing heritage sites recorded.



Map 4 Aerial view of the northern part of the coastal strip showing heritage sites recorded.



Map 5 Aerial view of the desalination plant area of the coastal strip showing heritage sites recorded.



Map 6. The mining area with recorded archaeological sites after Webley and Halkett (2010). The green line represents a proposed pipeline route while the blue line represents a proposed power line route. Please note that the site locations are from a different survey project and not reflected in Appendix C. Consult Webley and Halkett 2010 for details.

Map 7 White line indicates track log.

Appendix B:

Visual Guidelines

srk consulting

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18 July 2013
451101

Vice President Project Development
Frontier Rare Earths SA (Pty) Ltd
Sound Mining House
2A Fifth Avenue, Rivonia, 2128
By email: ddewit@frontierrareearths.co.za

Attention: Derick R de Wit

Dear Derick,

Visual Guidelines for the Design of the Desalination Plant at Volwaterbaai

The coastal environment at Volwaterbaai is considered to be visually sensitive. It has high scenic value and exhibits distinct visual- spatial qualities. Its stark, open setting in a predominantly natural landscape with little evidence of human influence invokes a sense of 'wilderness'. Views over the Atlantic Ocean contribute to a sense of 'openness'. An existing gravel route along the coast provides scenic views across the undulating coastal plain and the dynamic coastline of rocky outcrops and sandy beaches increases the visual quality of the coastal strip.

The low-growing succulent vegetation and relatively flat profile of the coastal plain provide little opportunity for screening and the construction of the desalination plant and associated infrastructure will result in visual intrusion. Scenic views may be obstructed in places and this may result in the loss of sense of place and the sense of 'wilderness' in the area. The desalination plant will be industrial in nature and seemingly incongruent with the pristine coastal environment. However, it can be designed in such a way as to limit potential visual intrusion through ensuring its integration with its natural surroundings.

The development of a clear design concept that focuses on the integration of the desalination plant into its natural environment will be integral to the project. The design concept should define the use of materials and construction techniques and may either include the use of industrial materials such as concrete and steel (that are in keeping with the industrial character of the desalination plant), or may focus on the use of local materials/construction techniques such as stone/mud-brick (that are in keeping with the architectural vernacular of the area). The choice of materials is dependent on structural requirements and the design philosophy and a clear statement of intent/ vision for the project should be provided along with the design concept.

The final outcome of the design will be dependent upon the design concept, structural and programmatic requirements, preferred construction techniques, materials and detailing. The following items are suggested as visual guidelines to inform the preliminary design. The use of local materials as opposed to industrial material is recommended. It should, however, be noted that these are **broad guidelines** and can be **refined** on presentation of detailed drawings by the architect/design engineers.

- **Integrate design with natural topography.** Take advantage of the opportunities presented by the topography (i.e. where the topography is slightly undulating, situate buildings into contours or make use of opportunities to screen certain elements). The design should be responsive to the topography on site and a generic layout should not be superimposed onto the site. The cut and fill ratio should be as close to zero as possible, i.e. importing fill material to create an elevated platform should be avoided. The use of low planted berms can also be used to allow the building to seem tucked into the landscape.
- **Limit height of buildings.** One storey is preferred, two storeys should be allowed as a maximum. Flat roofs are preferred over pitched roofs. Where two storeys are necessary, the profile of the building should be stepped/terraced in order to reduce building bulk (see below).
- **Limit the construction footprint.** Ensure that there is no unnecessary sprawling infrastructure (i.e. limit the extent of parking areas, pipelines and service tracks). Limit the number of isolated building structures and aim to integrate buildings as far as possible. It will be preferable to locate all infrastructure within this precinct, e.g. intake pumpstations, reservoirs etc. to limit infrastructure at the shoreline.
- **Reduce building bulk.** Aim to reduce the contrast between the relatively flat coastal environment and the visual bulk of the building. The profile of the building can be staggered/fragmented, (i.e. instead of one solid cube, the structure can be fragmented into separate, yet well integrated structural elements). Other methods to reduce the perceived bulk of the building include the use of shadow lines and articulated surfaces.
- **Limit infrastructure on the coastal side of the coastal road**. The coastal side of the road is more sensitive from a visual perspective and the placement of infrastructure here should be avoided where possible. Buried pipelines on the coastal side of the road are preferred from a visual perspective (although ecological considerations need to be taken into account, e.g. the potential for undetected seepage of brine).
- **Local construction techniques.** Local construction techniques that reflect the character of the area/vernacular architectural character of the area should be used as far as possible (these techniques include dry-packed stone walls, mud-brick/adobe structures, rough plastering).
- **Appropriate use of materials.** The use of materials should be influenced by the design concept, design requirements, feasibility of construction techniques and budget. ‘Finished’ materials should be avoided (e.g. polished concrete, glass, materials that have a shiny/reflective/glossy finish). A rough, natural, weathered finish is preferred. Local materials should be used as far as possible. For example, natural stone plinths can be constructed for the placement of pipeline infrastructure at the rocky coastline. The use of gravel surfaces/stone cobbles is preferred over the use of tar or concrete for parking and servicing areas.
- **Carefully consider screening options.** The natural vegetation in the area is low growing and won’t be entirely suitable for screening purposes. Low planted berms can be used to reduce the scale of the building, while not screening the building entirely. Walls may be used for screening purposes, where necessary. Care should be taken to ensure that the bulk and character of these screening walls do not cause visual intrusion and extensive solid, plain walls should be avoided. Stone construction techniques/cladding can be used to integrate screening walls with the natural surroundings (where appropriate). Indigenous succulents can be used for the construction of green walls, although maintenance and functional requirements will need to be taken into consideration during design.
- **Fencing.** Perimeter fencing should be avoided. Where necessary, fences will be preferred over solid walls. Fences should be black/dark green or another sympathetic colour.
- **Make use of “green” roofs where possible**. Indigenous succulents can be used as planting material for green roofs. Green roofs may help to mitigate ecological impacts associated with the disturbance of indigenous vegetation during construction. Green roofs also provide insulating functions and have been shown to reduce costs related to internal temperature regulation. Load-bearing, waterproofing and maintenance requirements will need to be taken into consideration during the design of green roof structures.
- **Landscaping.** All areas that are disturbed during construction should be rehabilitated with indigenous vegetation from the surrounding area that is suited to the particular climatic and soil conditions at the site. Low growing succulents should be utilised as far as possible. Avoid high maintenance formal landscaping (i.e. tree planting, hedges and lawn areas).
- **Shade structures.** Trees may not be suitable for the provision of shade in this area as they are unlikely to grow to a suitable height without intensive maintenance and care. The provision of shade in parking or rest areas (where necessary) should be carefully considered and the materials that are used should be in keeping with the design concept. The extensive use of shade cloth should be avoided where possible).
- **Colours.** The colour palette should be drawn from the surrounding area and be congruent with the materials that are identified in the design concept. Where paint is to be applied (if necessary), natural earth tones would be preferred and darker tones would be preferred to lighter tones. Materials and un-painted surfaces should be allowed to weather naturally (while ensuring that structural integrity is not compromised).

- **Lighting.** Avoid the installation of permanent lighting fixtures if possible. Make use of low-level lighting fixture such as bollards to avoid light spillage. Reduce the height of lighting masts (if required) to a minimum. Direct lighting inwards and downwards to avoid spillage and trespass. Install down light luminaires to vertical structures or surfaces such as signs. If the only alternative is to up-light the element, the correct luminaire must be fitted to avoid light spillage.

Many of these guidelines, suitably modified, will apply to intake, conveyance and discharge infrastructure.

Yours faithfully,

SRK Consulting (Pty) Ltd

SRK Consulting - Certified Electronic Signature
srk consulting
451101/41471/Letter Report
5939-3848-8367-HEYL
This signature has been printed digitally. The Author has given permission for its use for this document. The details are stored in the SRK Signature Database

Larissa Heyns
Professional Landscape Architect

Appendix C:

Method Statement Pro Forma

METHOD STATEMENT PRO FORMA

CONTRACT:……………………..………………………………... **DATE:**……………………………

PROPOSED ACTIVITY (give title of method statement):

WHAT WORK IS TO BE UNDERTAKEN (give a brief description of the works):

WHERE ARE THE WORKS TO BE UNDERTAKEN (where possible, provide an annotated plan and a full description of the extent of the works):

START AND END DATE OF WORKS FOR WHICH METHOD STATEMENT IS REQUIRED:

Start Date:	End Date:

HOW ARE THE WORKS TO BE UNDERTAKEN (provide as much detail as possible, including annotated maps and plans where possible):

Note: please attach extra pages if more space is required

Appendix D:

Declaration by Parties

[Proponent]

I, ____, representing [Proponent], record as follows:

I/we have read and understood this Environmental Management Programme.

I am aware of [Proponent's] responsibilities in terms of complying with, enforcing and implementing the provisions of the Environmental Management Programme and all of its constituent documents.

I undertake to comply with those requirements of the applicable environmental laws, approvals and obligations arising out of the Environmental Management Programme in the discharging of my obligations.

Signed:____________________________________ Name:_________________________________

Position:____ Date:_____________________

[Contractor]

I/we, ____ record as follows:

I/ we, the undersigned, do hereby declare that I/ we am/ are aware of the requirement by [Proponent] that construction activities will be carried out with due regard to their impact on the environment.

In view of this requirement, I/ we will, in addition to complying with the letter of the terms of the Contract dealing with protection of the environment, also take into consideration the spirit of such requirements and will, in selecting appropriate sub-contractors, employees, plant, materials and methods of construction, in-so-far as I/ we have the choice, include in the analysis not only the technical and economic (both financial and with regard to time) aspects but also the impact on the environment of the options. In this regard, I/ we recognise and accept the need to abide by the "precautionary principle" which aims to ensure the protection of the environment by the adoption of the most environmentally sensitive construction approach in the face of uncertainty with regard to the environmental implications of construction.

I/we have signed the Declaration of Understanding with respect to the Environmental Management Programme.

Signed:____ Date:_____________________

[Contractor]

SRK Report Distribution Record

Report No.	451101
Copy No.	

Name/Title	Company	Copy	Date	Authorised by
	This report is being distributed as an annexure to the Final EIA Report, and as such to the same stakeholders as that report.			

Approval Signature:

Appendix 3A Effluent Report for the Temporary Desalination Plant

PRELIMINARY EFLUENT REPORT

TEMPORARY PLANT

for

Royal HaskoningDHV / Frontier

2 JULY 2013

Table of Contents

1 INTRODUCTION

Veolia Water Solutions & Technologies South Africa (Pty) Ltd (VWS South Africa) has been approached by SSI Engineers & Environmental Consultants (PTY) LTD to provide input to the Volwaterbaai Seawater Desalination Plant for Sedex Minerals.

Sedex Minerals (Pty) Ltd a subsidiary of Frontier Rare Earths Limited is in process of developing the Zandkopsdrift Rare Earth Element mine. The proposed Zandkopsdrift mine site is located on the farm Panvlei in the Northern Cape Province, about 39 kilometres north of Bitterfontein in the Western Cape Province and about 43 kilometres south of Garies in the Northern Cape Province.

Sedex Desalination (Pty) Ltd appointed Royal HaskoningDHV (Pty) Ltd (RHDHV) previously SSI Engineers and Environmental Consultants (Pty) Ltd to provide a feasibility study design at an overall accuracy of ±15% for capital and operating cost estimates with respect to establishing the Zandkopsdrift seawater desalination scheme of approximately 5.5 Mℓ/day (2.0 Mm^3/a) product capacity, sited at Volwaterbaai on the West Coast

During the construction of the desalination plant construction water will be required but with no other sources of fresh water available it is envisaged that a containerised reverse osmosis plant to be utilised for the production of fresh water. This document relates to the effluent produced from the temporary plant.

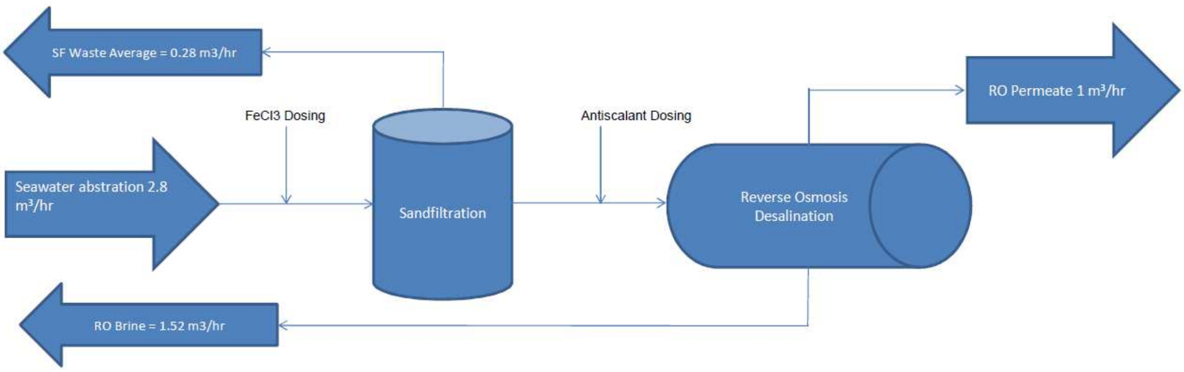
2 EFFLEUNT & CHEMICAL DETAILS FOR THE TEMPORARY PLANT

2.1 Temporary desalination plant design

Below is a summary of the process steps and key design figures of the temporary reverse osmosis desalination plant.

The process steps comprise the following:

- Seawater abstraction
- $FeCl_3$ dosing
- Sand filtration
- Antiscalant dosing
- Reverse Osmosis Desalination



2.2 Effluent details

The environmental impact assessment is performed by SRK and the potential effluents need to be considered including effluent from the temporary desalination plant. Only one effluent stream would be returned back to the ocean and the following steams will make-up this stream under normal operation.

Waste stream under normal operation:

- RO brine, this will be the bulk of the waste stream. See below an estimated composition. The RO brine will contain membrane antiscalant of maximum 3 mg/l.

	Concentrate (mg/l as Ion) Stage 1
NH4	0.00
K	790.83
Na	19077.43
Mg	2141.10
Ca	699.82
Sr	12.50
Ba	0.00
CO3	11.64
HCO3	256.10
NO3	14.58
Cl	33638.45
F	1.66
SO4	5165.79
SiO2	4.33
Boron	7.43
CO2	3.66
TDS	61856.67
pH	7.71

Brine flow = 1.52 m^3/h continuous
Antiscalant concentration = 3.0 mg/l

- Sandfilter backwash waste, this will make out a low % of the total waste volume and will consist mainly of suspended solids, organic matter, algae etc. Ferric-chloride will used in the flocculation process.

  Sand filter waste flow = 0.28 m^3/h continuous
  Ferric Chloride dosage = 5.0 mg/l as Fe in the seawater feed.
  Suspended solids backwash waste = 200 mg/l in backwash waste
  Suspended solids combined effluent = 30 mg/l in combined effluent.

  Note: The 200 mg/l is only in the sand filter waste stream during a filter backwash, the 30 mg/l concentration is blending the DMF waste continuously with the RO brine to be discharged.
  The suspended solids concentrations above are based on a feed SS concentration of 15 mg/l and it includes the ferric addition.

- CIP chemicals used for membrane cleaning. Chemicals will be stored on site in tanks and disposed of after construction as low volumes are anticipated.

Potential waste stream under abnormal operation / conditions:

- Feedwater (seawater) spillage due to tank overflow or pipe burst.
- Product water (permeate) spillage due to tank overflow or pipe burst.

2.3 Chemical details

Typically the following chemicals will be used in the plant:

- Ferric Chloride, dosed prior DAF & DMF for flocculation, see attached MSDS.
- Antisclant, dosed prior RO membranes as scale inhibitor, see attached MSDS.

Bulk storage of the above chemicals will be in bunded areas and any spillage will therefore be contained and handled on a case by case basis and will not be directed to the effluent stream returned to see.

Appendix 3B Details of RO Desalination Technology

1 MEMBRANE PROCESSES

1.1 Types of Membrane Processes

These are Microfiltration, Ultrafiltration, Nanofiltration and Reverse Osmosis, all of which use permeable membranes to achieve the desired separation between solute and solvent and are based on the principle of cross-flow, although dead-end operation may sometimes be used. The membrane may be viewed as a specialized filter, which allows the passage of solvent under pressure, while retaining solutes to different degrees, depending on the membrane type. By definition, reverse osmosis ideally allows passage only to water, while retaining all solutes. Nanofiltration and ultrafiltration, on the other hand, retain suspended solids as well as dissolved macromolecules, separating them on the basis of their physical size. Micro- and Ultrafiltration are intended to retain suspended solids in the micron and sub-micron ranges.

The membranes may be visualized to work on a “sieve filtration” mechanism. The difference in filtration characteristics is shown in Figure 1.1.1.

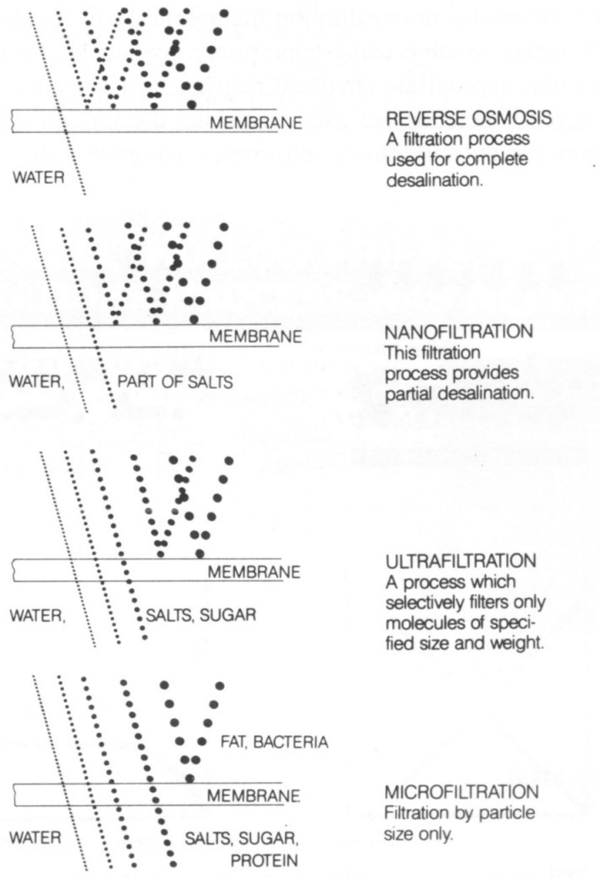


Figure 1.1.1: Difference in Filtration Characteristics between RO, NF, UF and MF

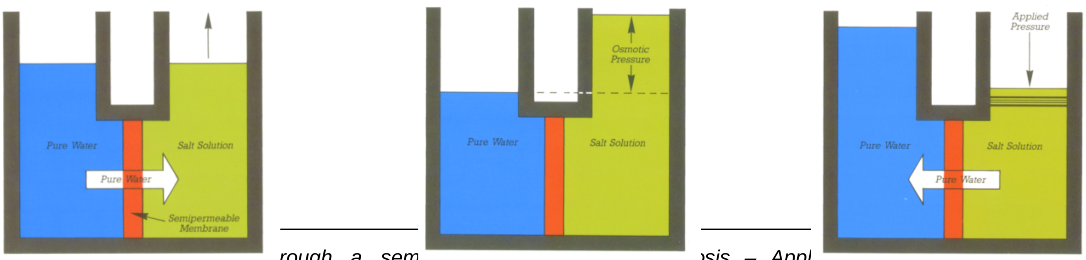
1.2 Reverse Osmosis

Reverse osmosis uses polymeric membranes in tubular, spiral and hollow-fiber configurations in the removal of dissolved ionic species from solution. As such, reverse osmosis is widely used in the desalination of brackish and seawater, as well as in the treatment of industrial effluents. Reverse osmosis is the unit operation by which the natural osmotic process is reversed to effect the removal of dissolved salts and organic compounds from an aqueous solution. This is achieved with the aid of a semi-permeable membrane and the application of a pressure, higher than the osmotic pressure, on the feed water. The membrane allows passage of pure water only, resulting in the concentration of salts and organics in the feed water. Typical operating pressures range from 15–40 bar for brackish feed waters and 60–70 bar for seawater.

1.2.1 How Reverse Osmosis Works

The phenomenon of osmosis occurs when pure water flows from a dilute saline solution through a membrane into a higher concentrated saline solution.

The phenomenon of osmosis is illustrated in Figure 1.1.4. A semi-permeable membrane is placed between two compartments. 'Semi-permeable' means that the membrane is permeable to some species and not permeable to others. Assume that this membrane is permeable to water but not to salt. Then, place a salt solution in one compartment and pure water in the other compartment. The membrane will allow water to permeate through it to either side but salt cannot pass through the membrane.



rough a sem . membrane toward a region of higher concentration to equalize solution strength. Ultimate height difference between columns is "osmotic pressure".

sis – Appl osmotic pressure reverses water flow direction. Hence the term "reverse osmosis"

Figure 1.1.4: Overview of Osmosis / Reverse Osmosis

As a fundamental rule of nature, this system will try to reach equilibrium. That is, it will try to reach the same concentration on both sides of the membrane. The only possible way to reach equilibrium is for water to pass from the pure water compartment to the salt containing compartment to dilute the salt solution.

Figure 1.1.4 also shows that osmosis can cause a rise in the height of the salt solution. This height will increase until the pressure of the column of water (salt solution) is so high that the force of this water column stops the water flow. The equilibrium point of this water column height in terms of water pressure against the membrane is called osmotic pressure.

If a force is applied to this column of water, the direction of water flow through the membrane can be reversed. This is the basis of Reverse Osmosis. Note that this reversed flow produces pure water from the salt solution, since the membrane is not permeable to salt.

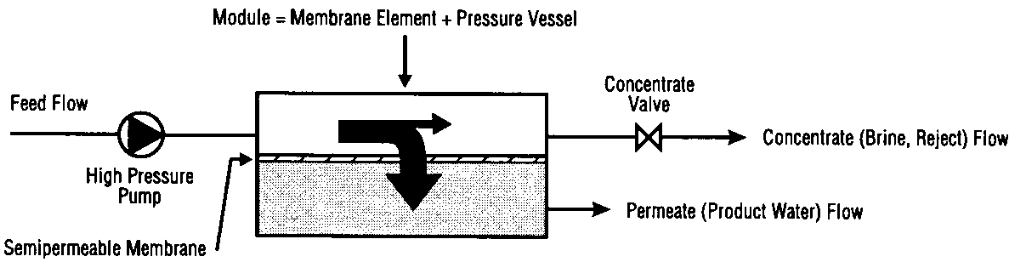
1.2.2 How to Use Reverse Osmosis In Practice

The simplified reverse osmosis process is shown in Figure 1.1.5, while Figure 1.1.6 illustrates the relationship between feed, concentrate and permeate in cross-flow operation.

With a high pressure pump, pressurized saline feed water is continuously pumped to the module system. Within the module, consisting of a pressure vessel (housing) and a membrane element, the feed water will be split in a low saline product called permeate and a high saline brine called concentrate or reject.

A flow regulating valve called concentrate valve, controls the percentage of feed water that is going to the concentrate stream and the permeate which will be obtained from the feed.

Figure 1.1.5: Reverse Osmosis Process



$$\text{Recovery (\%)} = \frac{\text{Permeate Flow} \cdot 100}{\text{Feed Flow}}$$

$$\text{Salt Passage (\%)} = \frac{\text{Permeate Salt Concentration} \cdot 100}{\text{Feed Salt Concentration}}$$

$$\text{Salt Rejection (\%)} = 100 - \text{Salt Passage}$$

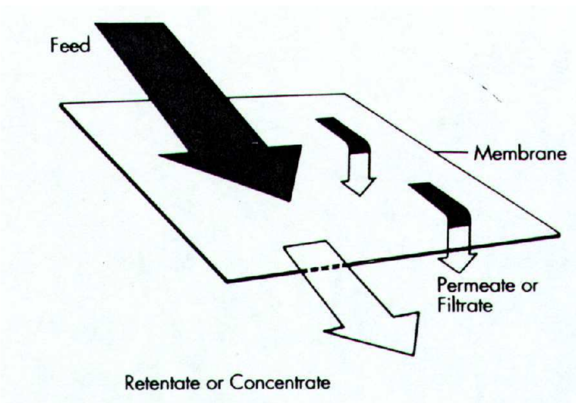


Figure 1.1.6: Principle of Cross-flow filtration showing relationship between Feed, Brine and Filtrate.

1.2.3 Spiral Wound Membrane Configuration

The spiral wound membrane assembly normally consists of several spiral membrane cartridges, which are connected together and placed in a cylindrical pressure vessel (Figure 1.1.7).

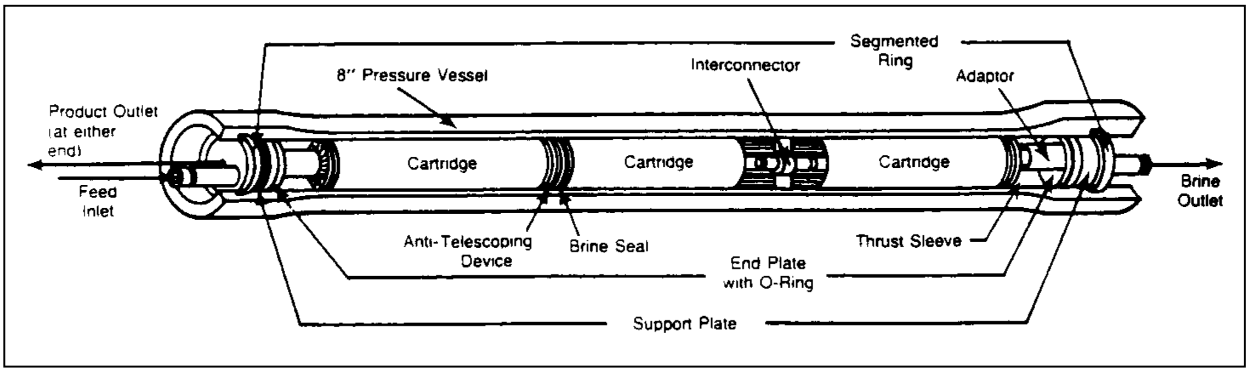


Figure 1.1.7: Spiral Wound Membrane Assembly

Each spiral cartridge is produced independently (see Figure 1.1.8). Two sheets of membranes are placed on both sides of a fabric spacer. The three pieces are then sealed on three sides to form an envelope. The remaining open side is attached to a perforated product water collection tube. A woven plastic sheet serves as a spacer and is laid on one side of the membrane envelope. The membrane envelope and spacer sheet is then rolled up into a cylindrical bundle.

Up to six membrane cartridges are connected together within a pressure vessel. Pressurized feed water enters the pressure vessel shell and flows through the channels between the spiral windings of the first cartridge. Some of the feed water permeates through the membrane and travels a spiral path to the product water collection tube at the center of the membrane cartridge. The remaining feed continues through the spiral layers, the length of the cartridge. It then encounters the next membrane in the vessel and the process is repeated. The product from each membrane cartridge exits from the common product tube in the pressure vessel. The feed water becomes more concentrated as it passes through each membrane cartridge and exits from the pressure vessel as brine.

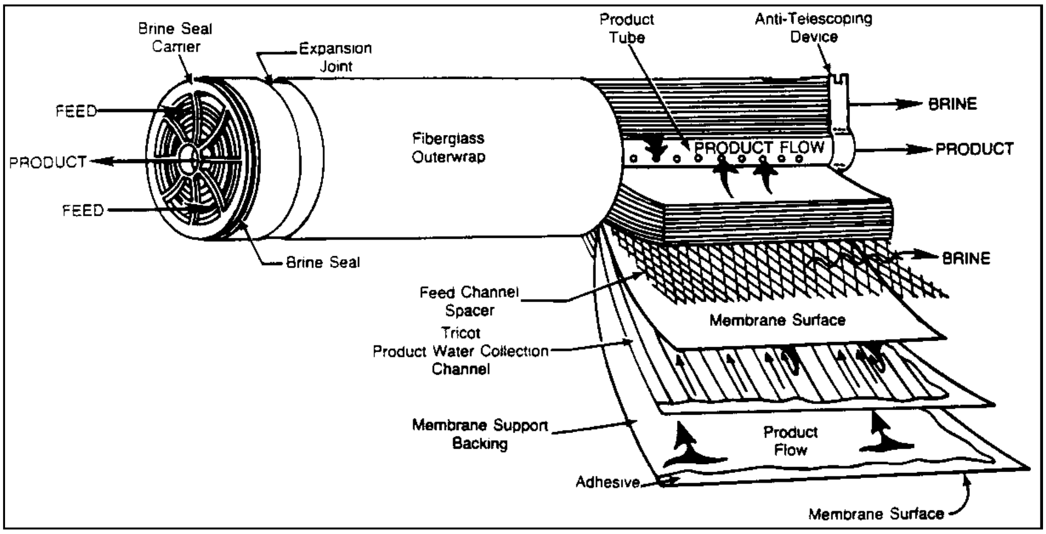


Figure 1.1.8: The Spiral Wound Membrane

Appendix 3C Confirmation that Minor Road OG155 is Proclaimed

the dr&pw

Department:
Roads and Public Works
NORTHERN CAPE PROVINCE
REPUBLIC OF SOUTH AFRICA

12 August 2013

Royal Haskoning DHV
P O Box 5195
TYGER VALLEY
7536

Attention: Daran Rogers

Minor Road OG 155

It is hereby confirmed that Road OG 155 in the Kotzesrus area is a proclaimed road.

We hereby give Frontier Rare Earths (Pty) Ltd and their associated firms authorization to start with on-site investigations as required along the proclaimed roads within the borders of the Northern Cape.

Regards

Niel Joubert
Technical Advisor-Roads
Namakwa District
Tel. 027-712 2170
Cell. 082 5566 466

Appendix 4A Terrestrial and Aquatic Ecology Impact Assessment – see Volume II

Appendix 4B Marine and Coastal Ecology Impact Assessment – see Volume II

Appendix 4C Marine Modelling Study – see Volume II

Appendix 4D Heritage Impact Assessment – see Volume II

Appendix 4E Palaeontology Impact Assessment – see Volume II

Appendix 5A Stakeholder Database

The stakeholders listed below were registered at the end of the Scoping Phase. All other stakeholders are encouraged to register to remain on / be added to the database. Authorities / Organs of State are automatically registered and will remain on the database for this project. All other stakeholders are encouraged to register to remain on / be added to the database.

	NAME	SURNAME	TYPE	ORGANISATION
Organs of State / Authorities				
1.	Razeena	Omar	National	Department of Environmental Affairs: Oceans and Coasts
2.	Nitasha	Baijnath-Pillay	National	Department of Environmental Affairs: Oceans and Coasts
3.	Thilivhali	Meregi	National	Department of Environmental Affairs: Oceans and Coasts
4.	Potlako	Khathi	National	Department of Environmental Affairs: Oceans and Coasts
5.	John	Peter	National	Department of Environmental Affairs: Oceans and Coasts
6.	Anga	Yaphi	National	Northern Cape Department of Environment and Nature Conservation
7.	Bronwyn	Cornelissen	National	Northern Cape Department of Environment and Nature Conservation
8.	Elsabe	Swart	National	Northern Cape Department of Environment and Nature Conservation
9.	Natalie	Uys	National	Northern Cape Department of Environment and Nature Conservation
10.	Mashudu	Ranwedzi	National	Department of Water Affairs
11.	Kathryn	Smuts	National	South African Heritage Resources Agency
12.	Bernard	van Lente	National	South African National Parks
13.	Tony	Robelo	National	South African National Biodiversity Institute
14.	Viljoen	Mothibi	Provincial	Department of Agriculture and Land Affairs
15.	Susanne	Erasmus	Provincial	Wildlife and Environmental Society of South Africa
16.	Jeff	Manuel	Provincial	South African National Biodiversity Institute
17.	Yolan	Friedmann	Provincial	Endangered Wildlife Trust
18.	Ntsundeni	Ravhugoni	Provincial	Department of Minerals and Energy
19.	Jasper	Nieuwoudt	Provincial	Department of Minerals and Energy
20.	Alana	Duffell-Canham	Provincial	CapeNature
21.	Madelein	Brandt	District Municipality	Namaqua District Municipality: Municipal Manager
22.	Joseph	Cloete	Local Municipality	Kamiesberg Local Municipality
Land Owners / Occupants				
23.	Braam	Nieuwoudt	Private	Owner of Portion 1 Brakfontein 555 (Nieuwefontein)
24.	Carel	Louw	Private	Owner of Portion of Hendriksvlei, Portion of Brakfontein, Portion of Varsfontein, Portion of Klipheuwel
25.	An	Cornelissen	Private	Buchuberg Exploration and Farming - Owner of Portion 6 (a portion of Porion 5) of Hendriksvlei
26.	Tilma & Fanie	Nel	Private	Owner of Remainder Farm Nuwebegin 641
27.	Adriaan (Ad)	Cornelissen	Private	Owner of Portion of Welgemeend Portion 2 of Varsfontein Consolidated
28.	Cyril	Thomas	Company	Sedex Minerals (Pty) Ltd. Owner of Portion 2 of Zandkopsdrift 573, Farm Strandfontein no 559
29.	Rob	Blake	Company	De Beers Consolidated Mines Ltd – Namaqualand Mines.

30.	William	Macdonald	Company	De Beers Consolidated Mines Ltd – Namaqualand Mines.
31.	Bertus	Cilliers	Company	Trans Hex Group Limited
32.	John	Langhus	Company	Forest Oil
33.	Richard	Jones	Company	Eskom
34.	Tielman	Nieuwoudt	Private	Owner of Portion 1 of farm Nuwe Begin no 641
35.	D. J.	du Toit	Private	Occupant of farm Langkloof
36.	J.G.S.	Roux	Private	Owner of farm: Klipheuwel
37.	I.A	du Toit	Private	Langkloof Family Trust
38.	D.J	du Toit	Private	Langkloof Family Trust
39.	Theo	Schutte	Private	Kotzesrus Resident
40.	Hendrik	van der Walt	Private	Kotzesrus Resident
41.	Jood & Venice	van Zyl.	Private	Kotzesrus Residents
42.	Dirk & Veronica	Jansen.	Private	Kotzesrus Residents
43.	Deon & Wilma	van Zyl.	Private	Kotzesrus Residents
44.	A.C.	Odendaal	Private	Kotzesrus Resident
45.	Dries	du Toit	Private	Kotzesrus Resident
46.	Albie	Poole	Private	Kotzesrus Resident
47.	Bessie	van Zyl	Private	Kotzesrus Resident
Ward Councillors/ Relevant Community Leaders				
48.	Mervin	Cloete	Local Municipality	Mayor of the town of Garies
49.	Petro	Willems	Garies and Lepelsfontein	Councillor
50.	van der Westruis	Chris	Stofkraal, Molsvlei and Rietpoort	Councillor
51.	Leon	Oewies	Stofkraal, Molsvlei and Rietpoort	Councillor
52.	Jan	Cloete	Lepelsfontein	Ward Committee Member
53.	Abraham	Gal	Lepelsfontein	Ward Committee Member
54.	Samantha	Oewies	Lepelsfontein	Ward Committee Member
Farmers Association				
55.	Tielman	Nieuwoudt	Garies Farmers Union	Chairman
Other IAPs				
56.	Wilna	Oppel	National	Department of Tourism, Environment and Conservation
57.	Adeleen	Cloete	National	Department of Tourism, Environment and Conservation
58.	Patrick	Obies	National	SANParks
59.	Ben-Jon	Dreyer	National	SANParks
60.	Majorie	Matroos	National	SANParks
61.	Marilyn	Willems	National	SANParks
62.	Johstone	Khoza	National	SANParks
63.	Ricardo	Basson	National	SANParks
64.	Ronnie	Newman	National	Conservation South Africa
65.	Chris	Fortuin	District Municipality	Namakwa District Tourism Office
66.	F.	van Heerden	Private	Kotzesrus Cash Store
67.	Pinkie	Niewoudt	Private	Soutklip Self Catering
68.	Etienne	de Jager	Private	Kotzesrus Self Catering
69.	Marika	van	Private	Veolia Water

		Noordwyk		
70.	Ralton	Pieters	Private	Attended Public Open Day
71.	Jonathan	Witbooi	Private	Attended Public Open Day
72.	Charlton	Owies	Private	Attended Public Open Day
73.	Johannes	Cloete	Private	Attended Public Open Day
74.	Susanna	Pieters	Private	Attended Public Open Day
75.	Andre	van der Westhuizen	Private	Attended Public Open Day
76.	Rachel	Cloete	Private	Attended Public Open Day
77.	Monica	Owies	Private	Attended Public Open Day
78.	Josef Marco	Owies	Private	Attended Public Open Day
79.	Willem	Stevens	Private	Attended Public Open Day
80.	Abraham	Jass	Private	Attended Public Open Day
81.	BW	Cornelissen	Private	Attended Public Open Day
82.	Anita	Lewies	Private	Attended Public Open Day
83.	Maritha	Kotze	Private	Attended Public Open Day
84.	Janco	Kotze	Private	Attended Public Open Day
85.	Kobus	Kotze	Private	Attended Public Open Day
86.	Denver	Coetzee	Private	Attended Public Open Day
87.	Tobias	Koordom	Private	Attended Public Open Day
88.	Frederik	Links	Private	Attended Public Open Day
89.	Richard	Pauls	Private	Attended Public Open Day
90.	Clive	Links	Private	Attended Public Open Day
91.	Miems	van Zyl	Private	Resident of Garies
Project Team				
92.	Derick	De Wit	Project team	Frontier
93.	Peter	Schroeder	Project team	Frontier
94.	Jesse	Strauss	Project team	Frontier
95.	Peter	Reavy	Project Manager (for Zandkopsdrift Mine)	Frontier
96.	Christine	Vivier	Director (Environmental Assessment Practitioner)	AGES

Appendix 5B Written Comments from Stakeholders

Letter

In terms of Section 38(8) of the National Heritage Resources Act (Act 25 of 1999)

Attention: Mr Cyril Thomas
Sedex Desalination (Pty) Ltd
PO Box 8399
Foreshore
Cape Town
8012

Proposed Construction of a Desalination Plant and Associated Infrastructure at Volwaterbaai for Zandkopsdrift Mine, Northern Cape Province

Thank you for your indication that development is to take place in this area.

In terms of the National Heritage Resources Act, no 25 of 1999, heritage resources, including archaeological or palaeontological sites over 100 years old, graves older than 60 years, structures older than 60 years are protected. They may not be disturbed without a permit from the relevant heritage resources authority. This means that before such sites are disturbed by development it is incumbent on the developer (or mine) to ensure that a Heritage Impact Assessment is done. This must include the archaeological component (Phase 1) and any other applicable heritage components. Approp¬riate (Phase 2) mitigation, which involves recording, sampling and dating sites that are to be destroyed, must be done as required.

In your application received by SAHRA there was no indication of such an assessment of the palaeontological/archaeological resources. The quickest way forward is to contact suitably qualified specialists to provide a Phase 1 Palaeontological/Archaeological Impact Assessment Report (see www.asapa.org.za).

The Phase 1 Impact Assessment Report will identify the archaeological sites and assess their significance. It should also make recommendations (as indicated in section 38) about the process to be followed. For example, there may need to be a mitigation phase (Phase 2) where the specialist will collect or excavate material and date the site. At the end of the process the heritage authority may give permission for destruction of the sites.

Where bedrock is to be affected, or where there are coastal sediments, or marine or river terraces and in potentially fossiliferous superficial deposits, a Palaeontological study must be undertaken to assess whether or not the development will impact upon palaeontological resources - or at least a letter of exemption from a Palaeontologist is needed to indicate that this is unnecessary. If the area is deemed sensitive, a full Phase 1 Palaeontological Impact Assessment will be required and if necessary a Phase 2 rescue operation might be necessary (see www.palaeontologicalsociety.co.za).

If the property is very small or disturbed and there is no significant site the specialist may choose to send a letter to the heritage authority to indicate that there is no necessity for any further assessment.

Any other heritage resources that may be impacted such as built structures over 60 years old, sites of cultural significance associated with oral histories, burial grounds and graves, graves of victims of conflict, and cultural landscapes or viewscapes must also be assessed.

Should you have any further queries, please contact the designated official using the case number quoted above in the case header.

Yours faithfully

Kathryn Smuts
Heritage Officer: Archaeology
South African Heritage Resources Agency

Colette Scheermeyer
SAHRA Head Archaeologist
South African Heritage Resources Agency

ADMIN:
Direct URL to case: http://www.sahra.org.za/node/118115

FAKSBOODSKAP

19 July 2013

AAN FAKSNOMMER: 021-4466050

AAN: FRONTIER RARE EARTHS SA (PTY) LTD

Vir Aandag: MNR CYRIL THOMAS

NOTA: OORHANDIG ASSEBLIEF AFSKRIFTE AAN MNRE DEREK DE WIT EN PIETER SCHRODER

Insake: ZANDKOPSDRIFT PROJEK

VAN: [redacted]

Telefoon: [redacted]

AANTAL BLADSYE: DEKBLAD PLUS VYF

19 Julie 2013

[redacted]

Mnr Cyril Thomas
Direkteur
FRONTIER RARE EARTHS SA (PTY) LTD
P.O. Box 8399
Foreshore
KAAPSTAD
8012

Geagte Meneer

ZANDKOPSDRIFT PROJEK - GARIES - NAMAKWALAND

Ek verwys na ons ontmoeting vroeër vanjaar en dank u vir die moeite wat u gedoen het om my te besoek.

Die afgelope paar maande het ek die voorreg gehad om meer tewete te kom betreffende genoemde projek en ek bedank alle amptenare van Frontier wat die moeite gedoen het om by my aan te doen om ons op hoogte tehou van verwikkelinge betreffende die infrastruktuur van genoemde projek wat moontlik ons plaaseiendom gaan deurkruis.

Soos die geval is met bykans alle boere, is ek ook maar gesteld tot watter mate ons persoonlike lewe, die omgewing en ons boerdery op die kort en langtermyn geskaad gaan word deur die verskillende fases van die skepping en inbedryfstelling van die infrastruktuur wat 'n absolute noodsaaklikheid is vir die ekonomiese sukses van die Zandkopsdrift projek.

Dit blyk onvermydelik te wees dat die bestaande ongerepte geheelbeeld van ons onmiddellike omgewing beslis drasties verander gaan word. Waar ek en my gade 'n klompie jaare gelede besluit het om hier te kom aftree om naby die ongerepte natuur te wees en lewe, blyk dit dat ons droom nou vernietig gaan word.Dit is moeilik om nie tot 'n mate meer die negatiewe as die positiewe aspekte raak te sien nie want die realiteite kan nie wegredeneer word nie.

Alhoewel ons nie in die pad van ontwikkeling wil staan nie, is dit tog moeilik om alles wat in die vooruitsig in en rondom ons eiendom gestel word, in 'n positiewe lig te sien. So is daar verskeie aangeleenthede wat ons ten opsigte van elke fase van die beplande werksaambede in en rondom ons eiendom kwel, beide op die kort en langtermyn, naamlik:

- Die humanitêre impak
- Die omgewingsimpak
- Die impak op ons persoonlike sekuriteit sowel as ons boerdery
- Die impak op die opbrengs van ons belegging (die inkomste uit die boerdery is ons lewensaar)
- Die impak op die markwaarde van ons eiendom

Genoemde kwellinge vorm in totaal 'n integrale deel van ons menswees en ons lewe hier.

BEVINDINGE TOT DATUM

Tot op hede is dit ons ondervinding dat elke aspek van alle beplanning en werksaamhede van FRONTIER in en deur ons grond, net op FRONTIER se bereiking van hul doelwitte gefokus is.

Dit is verder ook ons ondervinding dat ons maar ons lewe en besigheid by FRONTIER se beplanning en die van hul konsultante moet inpas. Alhoewel dit tot datum nie altyd maklik was nie, het ons probeer om ontvanklik en tegemoetkomend te wees. Dit sal egter nie deurgaans moontlik wees nie.

WAT HOU DIE TOEKOMS VIR ONS IN

Die pad

Waar Frontier dit in die vooruitsig stel om die ondergeskikte pad wat ons plaaseiendom deurkruis, op te gradeer ten einde alle konstruksie en ander voertuie vir die projek te akkommodeer, kan ek maar net met groot bekommernis aan die volgende dink

- Die deurlopende steurnis vir ons en ons diere oor 'n relatiewe lang periode
- Die moontlike beskadiging van ons persoonlike eiendom waarvan sommige noodsaaklike infrastruktuur vir ons is.
- Watter beskerming en gemoedsrus gaan Frontier in die vorm van versekering vir ons bied ten opsigte van die volgende:
  - Persoonlike ongevalle
  - Strukture, voertuie, implimente en infrastruktuur
  - Lewende hawe
  - Verlies aan inkomste

- Watter toename in verkeer gaan deur ons gronde ervaar word nadat die pad opgradeer en Frontier se projekte afgehandel is.
- Wat gaan die effek op ons welstand wees.
- Gaan Frontier bereid wees om saam te werk om beheer oor verkeersvloei uit te oefen.
- Sal ons dalk maar moet verhuis

Die hele padkwessie sal in meer besonderhede bespreek moet word aangesien dit volgens die pad-ingenieur van hierdie gebied van die Noord-Kaap nie 'n publieke pad is nie .

Die pypleiding en kraglyn

Skrywer begryp dat nog heelwat gedoen moet word voordat finaliteit oor hierdie aangeleenthede beskikbaar is, maar ag dit tog belangrik om nou reeds sy kwellinge onder u aandag te bring en wel soos volg:

- Sal Frontier bereid wees om die finale spesifikasie en werkstekeninge aan skrywer te openbaar
- Gaan die finale beplanning wat ons grond raak met ons bespreek word en gaan skrywer die geleentheid kry om sy insette te lewer.

ALGEMEEN

Dit is voor die handliggend dat die genoemde onderafdelings van die projekte in verskillende fases en tye uitgevoer sal moet word en oor 'n relatiewe lang periode.

Dit sal heelwaarskynlik onvermydelik wees dat sommige werksaamhede gedurende tye in en rondom skrywer se gronde sal geskied wanneer skrywer tradisioneel sy gronde moet gebruik. Waar skrywer gedurende sodanige tye nie bereid sal wees om met sy veeboerdery in sulke omstandighede voort te gaan nie en alternatiewe reëlings sal moet tref, kan dit 'n redelike negatiewe impak op my belegging hê.

OPSOMMING

Alhoewel ons nog nie in totaliteit op hoogte is van die finale besluit en beplanning van Frontier nie, het ons 'n goeie begrip van die omvang van die projek. Dit is ook vir ons duidelik dat die hele projek vir ons geen voordeel inhou nie maar slegs 'n geweldige permanente inbreuk op ons privaatheid, die omgewing en ons besigheid sal hê.

Dit bly egter ons voorneme om sover moontlik ons volle samewerking en ondersteuning te gee. Ons ag dit egter noodsaaklik om die volgende onder u aandag te bring en aan te teken ten opsigte van die volgende voorkeurroetes van Frontier soos wat dit identifiseer en aan skrywer bekendgestel is.

Geel Roete

Sou daar op hierdie as die finale hoofroete besluit word, sal daar noodwendig baie noue samewerking met skrywer moet wees betreffende die gedeelte van sy grondgebied wat geraak gaan word.

Ek neem aan dat u daarvan bewus is dat genoemde roete my plaaseiendom in twee verdeel en enige langtermyn werksaamhede op hierdie roete nie bevorderlik vir my persoonlike lewe en veral my boerdery sal wees nie.

U is blykbaar ook daarvan bewus dat ek op eie koste en met goedkeuring van die plaaaslike owerheid (afdeling paaie), noodsaaklike infrastruktuur vir die bedryf van my besigheid langs genoemde roete gevestig het. Hierdie aangeleentheid glo ek sal deur Frontier in aanmerking geneem word in die beplanning en uitvoering van die verskillende fases en dat skrywer vooraf geken sal word in alle beplanning.

Dit word dan ook hiermee aangeteken dat enige verandering aan of uitbreiding van skrywer se infrastruktuur vir die bereiking van Frontier se doelwitte vir Frontier se rekening sal wees en dat die standaard van al sodanige werk onderhewig sal wees aan skrywer se aanvaarding.

Swart en Groen roetes

Na oorweging het skrywer en sy gade besluit om slegs die swart roete te ondersteun waar dit ons grond moontlik sal deurkruis. Ons besluit is egter onderhewig aan die aanvaarding deur Frontier van ons voorwaardes en vereistes [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Waar ek intussen moet voortgaan met my besigheid en my lewe, doen ek 'n beroep op Frontier om hierdie skrywe in sy totaliteit in 'n ernstige lig te sien . Ek en my gade bevestig andermaal dat ons nie in die pad van vooruitgang of die bereiking van Frontier se doelwitte wil staan nie, maar dat ons nie bereid is om dit ten koste van onsself te doen nie en teken hiemee aan dat hierdie skrywe nie ons regte in enige opsigte sal beinvloed en/of benadeel nie.

Vriendelik die uwe,

[redacted]
namens en behoorlik daartoe gemagtig deur [redacted]

Afskrifte aan: Mnre D. De Wit : Projekbestuurder
P. Schroder : Terreinbestuurder

12 Augustus 2013

[redacted]

SRK Consulting
Privaatsak x16
Rondebosch
7701

Aandag : Larissa Heyns

FRONTIER RARE EARTHS SA (PTY) LTD
OMGEWINGSIMPAKBEPALING : VOLWATERBAAI
ONTSOUTINGSAANLEG EN GEPAARDGAANDE INFRASTRUKTUUR

Ek is deur mnr Derick de Wit van u betrokkenheid by hierdie projek ingelig en my gelukwensinge gaan hiermee aan SRK.

Ek neem kennis dat my kwellinge in hierdie verband aan u oorgedra is en meer spesifiek waar die projek my eiendom direk mag raak. Ek glo dat u van die nodige tegniese inligting van die projek voorsien is aangesien dit my mening is dat dit 'n redelike impak op verskeie aspekte sal hê wat my, my bedryf en die onmiddellike omgewing drasties kan verander, (meer negatief as positief)

Ek ontvang graag mettertyd volledige dokumente van u en onderneem om my samewerking te gee waar dit vir my moontlik mag wees.

Vriendelik die uwe

[redacted]

Nota: Sou u iets wil faks, skakel asseblief eers. Weens ons kragsituasie is die faks nie altyd aan nie. Faks en Tel nommer : [redacted]

Interim Comment

In terms of Section 38(8) of the National Heritage Resources Act (Act 25 of 1999)

Attention: Mr Cyril Thomas
Sedex Desalination (Pty) Ltd
PO Box 8399
Foreshore
Cape Town
8012

Proposed Construction of a Desalination Plant and Associated Infrastructure at Volwaterbaai for Zandkopsdrift Mine, Northern Cape Province

Thank you for the submission of the Scoping Report for the proposed Volwaterbaai Desalination Plant.

In terms of the National Heritage Resources Act, no 25 of 1999, heritage resources, including archaeological or palaeontological sites over 100 years old, graves older than 60 years, structures older than 60 years are protected. They may not be disturbed without a permit from the relevant heritage resources authority. This means that before such sites are disturbed by development it is incumbent on the developer (or mine) to ensure that a Heritage Impact Assessment is done. This must include the archaeological component (Phase 1) and any other applicable heritage components. Approp¬riate (Phase 2) mitigation, which involves recording, sampling and dating sites that are to be destroyed, must be done as required.

In your Scoping Report received by SAHRA, it is indicated that there will be an assessment of the heritage resources in the EIA phase of the project. This report should be inclusive of an Archaeological and Palaeontological Impact Assessment.

The Phase 1 Archaeological Impact Assessment Report that will identify the archaeological sites and assess their significance and make recommendations (as indicated in section 38) about the process to be followed. A Palaeontological study must be undertaken to assess whether or not the development will impact upon palaeontological resources - or at least a letter of exemption from a Palaeontologist is needed to indicate that this is unnecessary. If the area is deemed sensitive, a full Phase 1 Palaeontological Impact Assessment will be required and if necessary a Phase 2 rescue operation might be necessary.

Any other heritage resources that may be impacted such as built structures over 60 years old, sites of cultural significance associated with oral histories, burial grounds and graves, graves of victims of conflict, and cultural landscapes or viewscapes must also be assessed.

SAHRA looks forward to receiving these heritage reports and will provide comment on them before the project can commence.

Should you have any further queries, please contact the designated official using the case number quoted above in the case header.

Yours faithfully

Kathryn Smuts
Heritage Officer: Archaeology
South African Heritage Resources Agency

Colette Scheermeyer
SAHRA Head Archaeologist
South African Heritage Resources Agency

ADMIN:
Direct URL to case: http://www.sahra.org.za/node/118115

The South African Heritage Resources Agency
Street Address: 111 Harrington Street, Cape Town 8000 * Postal Address: PO Box 4637, Cape Town 8000
* Tel: +27 21 462 4502 * Fax: +27 21 462 4509 * Web: http://www.sahra.org.za

Heyns, Larissa

From: WESSA Northern Cape <wessanc@yahoo.com>
Sent: 04 September 2013 02:06 PM
To: Heyns, Larissa
Subject: Re: EIA for the Volwaterbaai Desalination Plant and Associated Infrastructure, Northern Cape: Release of draft Scoping Report

Follow Up Flag: Follow up
Flag Status: Flagged

Dear Larissa

Unlike most other Regions, the Northern Cape Region of WESSA has no staff, and is run by a group of volunteers. We currently have nobody on our Committee to handle the Conservation portfolio, and pressure of work means that **we are not able to attend meetings or participate in Environmental Impact Assessments at this time**. **Please note that a lack of response does not mean that we condone this project; it simply means that we do not have the capacity to deal with these matters.**

In the interest of saving paper, trees and costs, **please do not post any hardcopies or discs to us, unless specifically requested**. We cannot currently cope with these and they will be destroyed.

Our fax (053 842 1433) belongs to the McGregor Museum, and should only be used under exceptional circumstances, and for single pages only. This is a communal machine, so please mark all documents clearly 'WESSA', or direct them to me by name. **We prefer to communicate by e-mail.**

Suzanne Erasmus
Chairperson
WESSA (Northern Cape Region)
PO Box 316
8300 Kimberley
Tel 053 839 2717 w
Fax 053 842 1433 w
Cell 082 849 7655
wessanc@yahoo.com
http://www.wessa.org.za

From: "Heyns, Larissa" <LHeyns@srk.co.za>
To:
Sent: Thursday, 29 August 2013, 10:15
Subject: FW: EIA for the Volwaterbaai Desalination Plant and Associated Infrastructure, Northern Cape: Release of draft Scoping Report

PUBLIC PARTICIPATION PROCESS

NCDENC Ref : NC/EIA/07/NAM/KAM/KOT1/2013
NCP/EIA/OOOO225/2013

Environmental Impact Assessment for the Volwaterbaai Desalination Plant and Associated Infrastructure, Northern Cape

Notice is hereby given of a public participation process in terms of the National Environmental Management Act (107 of 1998) Environmental Impact Assessment (EIA) Regulations, 2010:

Heyns, Larissa

From: Christoffel van der westruis <christoffelvdw@matzikamamun.co.za>
Sent: 04 September 2013 10:32 AM
To: Heyns, Larissa
Cc: cjones@srk.co.za
Subject: RE: EIA for the Volwaterbaai Desalination Plant and Associated Infrastructure, Northern Cape: Release of draft Scoping Report

Follow Up Flag: Follow up
Flag Status: Flagged

Hi,thanks for keeping me updated,i've only one small concern and it is the fact that their is no such meeting scheduled for your stofkraal,molsvlei and rietpoort-communities but well for your garies community who is more then 60km from the project.I will ask friendly that you have to consider to consult those communities as well when it comes to the developing of the Zandkopsdrift-project.

May you have a nice day,god bless.
CLLR.Van der westruis

From: Heyns, Larissa [mailto:LHeyns@srk.co.za]
Sent: 29 August 2013 10:16 AM
To: Undisclosed recipients:
Subject: FW: EIA for the Volwaterbaai Desalination Plant and Associated Infrastructure, Northern Cape: Release of draft Scoping Report

PUBLIC PARTICIPATION PROCESS

NCDENC Ref : NC/EIA/07/NAM/KAM/KOT1/2013
NCP/EIA/OOOO225/2013

Environmental Impact Assessment for the Volwaterbaai Desalination Plant and Associated Infrastructure, Northern Cape

Notice is hereby given of a public participation process in terms of the National Environmental Management Act (107 of 1998) Environmental Impact Assessment (EIA) Regulations, 2010:

Project: Sedex Minerals proposes to develop the Zandkopsdrift Rare Earth Element mine on the remainder of Farm Zandkopsdrift 537, and portion 2 of Zandkopsdrift 537 in the Northern Cape Province. Due to the shortage of water in the area, Sedex Desalination, a subsidiary of Sedex Minerals, was established to develop a 4 million m^3/annum seawater desalination plant to provide water for the mine. Water will be pumped from the desalination plant via pipeline to the mine. Pipelines, overhead power lines and an access road servicing the plant will follow a combination of 4 x 4 tracks and dirt roads between the desalination plant and the Zandkopsdrift mine.

Location: The proposed desalination plant will be located at Volwaterbaai on the Farm Strandfontein 559, on the west coast of the Northern Cape Province approximately 15km west of the town of Kotzesrus. The pipeline route will extend from the desalination plant over a distance of approximately 42km in a north-easterly direction towards the mine.

Application for Environmental Authorisation to potentially undertake the following activities:

- GN R544 (9), (11), (14), (15), (16), (17), (18), (22), (23), (37), (39), (47); GN R546 (2), (4), (12), (13), (14), (16), (19), (24); and GN R545 (5) and (14).
- Exemption is being applied for from Section 10(2)(d) of GN R543.

Release of Scoping Report: The Scoping Report is available for public review and comment at the following locations from **2 September 2013**: Kotzesrus Cash Store, Municipal Service Points in Lepelsfontein, Stofkraal, Rietpoort and Molsvlei, Garies Public Library, Security Office at the Zandkopsdrift Mine and the offices of SRK Consulting in Rondebosch, Cape Town. The Scoping Report can also be accessed electronically on the SRK website www.srk.co.za (via the 'public documents' link). Please find a copy of the **Executive Summary** of the Report attached.

Opportunity to Participate: Interested and Affected Parties (IAPs) are invited to comment, and/or to register on the project database. IAPs should refer to the NCDENC reference number above, and must provide their comments together with their name, contact details (preferred

Heyns, Larissa

Subject: EIA for the Volwaterbaai Desalination Plant and Associated Infrastructure, Northern Cape: draft Scoping Report

From: Adriaan Le Roux [mailto:adriaanleroux7@gmail.com]
Sent: 05 September 2013 07:59 AM
To: Jones, Sharon
Subject: Re: FW: EIA for the Volwaterbaai Desalination Plant and Associated Infrastructure, Northern Cape: Release of draft Scoping Report

Good day,

Thank you for the information. I am just awaiting a legal opinion on an activity at the mine and will then contact you. I would encourage you to consult with the Namakwa Bioregional plan and Critical Biodiversity Area maps that guides development in the Namakwa District. The Coastal Management Unit is also in the process of establishing the coastal setback lines for the Northern Cape coastline.

I work for the same Department as Anga Yhapi. I will be responsible for the compliance monitoring of the conditions on the EA that will be issued. I am also responsible for enforcement of environmental legislation.

On Wed, Sep 4, 2013 at 1:29 PM, Jones, Sharon <SJones@srk.co.za> wrote:

Dear Adriaan

Our earlier e-mail (below) refers. I understand from the applicant, Frontier Desalination, that you have undertaken a site visit during the past week, and that you have also requested information from the applicant during this time. In order to ensure that all of your comments, concerns and requests are formally recorded as part of the EIA process for the desalination plant and associated infrastructure, and can thus be adequately addressed, I would appreciate it if you could please forward these to SRK Consulting (including any concerns or requests for information raised during your site visit).

Please also note that separate EIA processes will be undertaken for the Desalination Plant (and associated infrastructure) and for the Zandkopsdrift Mine. The EIA process for the mine, which will be managed by AGES, has however not yet commenced.

We look forward to receiving you input on this project, and will try to contact you telephonically in this regard over the next couple of days.

Kind Regards

Heyns, Larissa

From: Jones, Sharon
Sent: 11 September 2013 10:46 AM
To: Heyns, Larissa
Subject: Fw: Proposed Volwaterbaai desalinitation plant

Follow Up Flag: Follow up
Flag Status: Flagged

Sent via my BlackBerry from Vodacom - let your email find you!

From: Alana Duffell-Canham <aduffell-canham@capenature.co.za>
Date: Wed, 11 Sep 2013 10:03:28 +0200
To: Jones, Sharon<SJones@srk.co.za>
Subject: Proposed Volwaterbaai desalinitation plant

Dear Sharon

Thank you for providing CapeNature with a copy of the Scoping Report for the Volwaterbaai desalination plant and associated infrastructure.
We will not be providing comments on this application as it is located outside off the Western Cape (the Northern Cape is not within our jurisdiction).

Contacts within DENC who may be able to help are Elsabe Swart in their Conservation section. Elsabe.dtec@gmail.com
And Natalie Uys in their Environmental Policy section Nuys.denc@gmail.com

Regards,
Alana

Alana Duffell-Canham
Scientist: Land-use
CapeNature
tel +27 21 866 8029 | **fax** +27 21 866 1523 | **cell** +27 082 727 2691
email aduffell-canham@capenature.co.za | **fax2email** +27 86 529 3475
postal Private Bag x5014 Stellenbosch 7599
physical Assegaaibosch Nature Reserve Jonkershoek Road Stellenbosch
www.capenature.co.za

OMVANGSBEPALING EN OMGEWINGSIMPAK VERSLAGGEWINGSPROSES VIR DIE VOLWATERBAAI ONTSOUTINGSAANLEG EN VERWANTE INFRATRUKTUUR IN DIE NOORD KAAP

NCDENC Verwysingsnommers: NC/EIA/07/NAM/KAM/KOT1/2013
NCP/EIA/0000225/2013

BELANGHEBBENDE REGISTRASIE EN KOMMENTAAR VORM

Voltooi asseblief hierdie form en dien dit asseblief in per pos, faks of e-pos aan:
SRK Consulting
Larissa Heyns of Sharon Jones
The Administratiewe Gebou, Albion Springs, 183 Hoof Straat, Rondebosch, 7700
Postnet Suite #206, Privaatsak X18, Rondebosch, 7701
Faks: 021 685 7105 Tel: 021 659 3060,
E-pos: lheyns@srk.co.za or sjones@srk.co.za

SKRYF ASSEBLIEF DUIDELIK

OM TE REGISTREES AS 'N BELANGHEBBENDE EN GEAFFEKTEERDE PARTY

Naam: Braam Nieuwoudt **Datum:** 26-9-2013

Organisasie (indien enige):

Kapasiteit (indien van toepassing):

Posadres: Posbus 190
Lutzville

Poskode: 8165

Telefoonnommer: 027 5311066 **Faksnommer:** 0862488961

E-pos: bloukliP@nashuaisp.co.za

Verkose metode van kommunikasie (epos / faks / pos): epos

Dui asseblief enige regstreekse sake-, finansiële, persoonlike of ander belange wat u in die aansoek mag hê:

persoonlike Boerdery

Enige aanvanklike kommentaar of bekommernisse wat u oor die voorgestelde projek mag hê kan hieronder en / of op 'n aparte bladsy aangeteken word:

Pad, pyp en kraglyn wat kampe gaan Verdeel. Hoe breed gaan dit wees?
Wil graag hê dat pad vanaf Kotzesrus na see beheerde toegang moet wees.
Sal ongelukkig nie Vergadering kan bywoon nie
Verskoon ASB.

01/01 2007 00:01 FAX 0275311066 IA NIEUWOUDT 001/001

OMVANGSBEPALING EN OMGEWINGSIMPAK VERSLAGGEWINGSPROSES VIR DIE VOLWATERBAAI ONTSOUTINGSAANLEG EN VERWANTE INFRATRUKTUUR IN DIE NOORD KAAP

NCDENC Verwysingsnommers: NC/EIA/07/NAM/KAM/KOT1/2013
NCP/EIA/0000225/2013

BELANGHEBBENDE REGISTRASIE EN KOMMENTAAR VORM

Voltooi asseblief hierdie form en dien dit asseblief in per pos, faks of e-pos aan:
SRK Consulting
Larissa Heyns of Sharon Jones
The Administratiewe Gebou, Albion Springs, 183 Hoof Straat, Rondebosch, 7700
Postnet Suite #206, Privaatsak X18, Rondebosch, 7701
Faks: 021 685 7105 Tel: 021 659 3060,
E-pos: lheyns@srk.co.za or sjones@srk.co.za

SKRYF ASSEBLIEF DUIDELIK

OM TE REGISTREES AS 'N BELANGHEBBENDE EN GEAFFEKTEERDE PARTY

Naam: Maritha Kotze **Datum:**

Organisasie (indien enige): Privaat

Kapasiteit (indien van toepassing): Inwoner

Posadres: Posbus 2490
Somerset-wes

Poskode: 7129

Telefoonnommer: 0739901269 **Faksnommer:**

E-pos: maritha@consortexsa.co.za

Verkose metode van kommunikasie (epos / faks / pos): maritha@consortexsa.co.za

Dui asseblief enige regstreekse sake-, finansiële, persoonlike of ander belange wat u in die aansoek mag hê:

Enige aanvanklike kommentaar of bekommernisse wat u oor die voorgestelde projek mag hê kan hieronder en / of op 'n aparte bladsy aangeteken word:

My bekommernis oor die pad deur Kotzesrus is toenemende geraas en stof. Sowel as toename in privaat-voertuie wat sal begin om die pad te gebruik en meer irritasie veroorsaak.
• Pyp en krag - estetiese afbreuk wat aan dorp gedoen word as dit deur die dorp gaan.

OMVANGSBEPALING EN OMGEWINGSIMPAK VERSLAGGEWINGSPROSES VIR DIE VOLWATERBAAI ONTSOUTINGSAANLEG EN VERWANTE INFRATRUKTUUR IN DIE NOORD KAAP

NCDENC Verwysingsnommers: NC/EIA/07/NAM/KAM/KOT1/2013 NCP/EIA/0000225/2013

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E-pos: lheyns@srk.co.za or sjones@srk.co.za

SKRYF ASSEBLIEF DUIDELIK

OM TE REGISTREES AS 'N BELANGHEBBENDE EN GEAFFEKTEERDE PARTY

Naam: Mnr A. J. Cornelissen **Datum:** 2013-09-27

Organisasie (indien enige):

Kapasiteit (indien van toepassing):

Posadres: Welgemeend Posbus 366 GARIES

Poskode:

Telefoonnommer: 027-5311034 **Faksnommer:** NUT

E-pos: NUT

Verkose metode van kommunikasie (epos / faks / pos): Pos.

Dui asseblief enige regstreekse sake-, finansiële, persoonlike of ander belange wat u in die aansoek mag hê:

Inwoner van Kotzesrus
Plaas-eienaar.

Enige aanvanklike kommentaar of bekommernisse wat u oor die voorgestelde projek mag hê kan hieronder en / of op 'n aparte bladsy aangeteken word:

Stof en geraas sal 'n probleem wees indien pad deur dorp loop. Krag en pyp-lyn sal onooglik langs pad loop. Baie ekstra voertuie 'n probleem. Sal graag "Cellphone" ontvangs wil hê

OMVANGSBEPALING EN OMGEWINGSIMPAK VERSLAGGEWINGSPROSES VIR DIE VOLWATERBAAI ONTSOUTINGSAANLEG EN VERWANTE INFRATRUKTUUR IN DIE NOORD KAAP

NCDENC Verwysingsnommers: NC/EIA/07/NAM/KAM/KOT1/2013 NCP/EIA/0000225/2013

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E-pos: lheyns@srk.co.za or sjones@srk.co.za

SKRYF ASSEBLIEF DUIDELIK

OM TE REGISTREES AS 'N BELANGHEBBENDE EN GEAFFEKTEERDE PARTY

Naam: Ralton Pieters **Datum:** 27/09/2013

Organisasie (indien enige):

Kapasiteit (indien van toepassing):

Posadres: Lepelfontein
Posbus 97

Poskode: 8200

Telefoonnommer: 027-6325304 / 061 024 3235 **Faksnommer:**

E-pos:

Verkose metode van kommunikasie (epos / faks / pos): Faks – 027-6325303

Dui asseblief enige regstreekse sake-, finansiële, persoonlike of ander belange wat u in die aansoek mag hê:

Inwoner van Lepelfontein.

Enige aanvanklike kommentaar of bekommernisse wat u oor die voorgestelde projek mag hê kan hieronder en / of op 'n aparte bladsy aangeteken word:

Hier die projek is 'n projek wat armoede kom verlig. Ek hoop en vertrou dat dit sukses-vol gaan wees, sodat werkskepping kan plaasvind

OMVANGSBEPALING EN OMGEWINGSIMPAK VERSLAGGEWINGSPROSES VIR DIE VOLWATERBAAI ONTSOUTINGSAANLEG EN VERWANTE INFRATRUKTUUR IN DIE NOORD KAAP

NCDENC Verwysingsnommers: NC/EIA/07/NAM/KAM/KOT1/2013
NCP/EIA/0000225/2013

BELANGHEBBENDE REGISTRASIE EN KOMMENTAAR VORM

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E-pos: lheyns@srk.co.za or sjones@srk.co.za

SKRYF ASSEBLIEF DUIDELIK

OM TE REGISTREES AS 'N BELANGHEBBENDE EN GEAFFEKTEERDE PARTY

Naam: Josef Marco Owies **Datum:** 27/09/13

Organisasie (indien enige): /

Kapasiteit (indien van toepassing):

Posadres: Lepelsfontein Posbus 97

Poskode: 8200

Telefoonnommer: 0749434137 **Faksnommer:** /

E-pos: /

Verkose metode van kommunikasie (epos / faks / pos): Pos

Dui asseblief enige regstreekse sake-, finansiële, persoonlike of ander belange wat u in die aansoek mag hê:

In woner van Lepelsfontein

Enige aanvanklike kommentaar of bekommernisse wat u oor die voorgestelde projek mag hê kan hieronder en / of op 'n aparte bladsy aangeteken word:

Is not good vir die gemeenskap om werk te skep. ~~vir~~ ~~die~~ ~~g~~ Dit sal ook vir die mense 'n voorbeeld wees van die paaie.

ENVIRONMENTAL IMPACT ASSESSMENT PROCESS FOR THE VOLWATERBAAI DESALINATION PLANT AND ASSOCIATED INFRASTRUCTURE IN THE NORTHERN CAPE

NCDENC Reference Numbers: NC/EIA/07/NAM/KAM/KOT1/2013
NCP/EIA/0000225/2013

IAP REGISTRATION AND COMMENT FORM

Please complete and submit this form by hand, post, fax or email to:
SRK Consulting
Larissa Heyns or Sharon Jones
The Administrative Building, Albion Springs, 183 Main Road, Rondebosch, 7700
Postnet Suite #206, Private Bag X18, Rondebosch, 7701
Fax: 021 685 7105 Tel: 021 659 3060,
E-mail: lheyns@srk.co.za or sjones@srk.co.za

PLEASE PRINT CLEARLY

TO REGISTER AS AN INTERESTED AND AFFECTED PARTY:

Name: Jonathan Witbooi **Date:** 27/09/2013

Organisation (if any): Sokkerklub

Capacity (if applicable):

Postal address: Lepelfontein
Posbus 97

Postal code: 8200

Telephone number: 0723550673 **Fax number:**

E-mail: joncena84@gmail.com

Preferred communication method (email / fax / post): email / post.

Please indicate any direct business, financial, personal or other interest that you may have in the application:

Inwoner van Lepelfontein

Any initial comments or concerns that you may have regarding the proposed project can be indicated below and/or on a separate page:

~~My bel~~ ~~My bet~~

My bekommernis is net die verkeer. Met verkeer wat gaan toeneem en paaie wat reeds ~~in~~ ~~nie~~ in 'n goeie toestand is nie. Die toeganklikheid tot Lepelfontein is klaar 'n probleem met die toestande van paaie. Verder sien ek nie 'n probleem wat die projek op die omgewing kan hê.