PROPOSED DEVELOPMENT OF THE IBHUBESI GAS PROJECT

DRAFT ENVIRONMENTAL IMPACT REPORT

VOLUME 1: MAIN REPORT

Prepared for:
Department of Environmental Affairs

On behalf of:
Sunbird Energy (Ibhubesi) Pty Ltd

Prepared by:
CCA Environmental (Pty) Ltd

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Prepared for:
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DRAFT ENVIRONMENTAL IMPACT REPORT

VOLUME 1: MAIN REPORT

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PROJECT INFORMATION

TITLE	Draft Environmental Impact Report for proposed development of the Ibhubesi Gas Project
APPLICANT	Sunbird Energy (Ibhubesi) Pty Ltd
ENVIRONMENTAL CONSULTANT	CCA Environmental (Pty) Ltd
REPORT REFERENCE	SE01IPP/DEIR/Rev.0
DEA REFERENCE	14/12/16/3/3/2/587
REPORT DATE	28 September 2014

REPORT COMPILED BY: Jeremy Blood

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Jeremy Blood (Pr.Sci.Nat.; CEAPSA)
Associate

REPORT REVIEWED BY: Jonathan Crowther

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Jonathan Crowther (Pr.Sci.Nat.; CEAPSA)
Managing Director

EXPERTISE OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

NAME	Jonathan Crowther
RESPONSIBILITY ON PROJECT	Project leader and quality control
DEGREE	B.Sc. Hons (Geol.), M.Sc. (Env. Sci.)
PROFESSIONAL REGISTRATION	Pr.Sci.Nat., CEAPSA
EXPERIENCE IN YEARS	27
EXPERIENCE	Jonathan Crowther has been involved in environmental consulting since 1988 and is currently the Managing Director of CCA Environmental (Pty) Ltd. He has expertise in a wide range of environmental disciplines, including Environmental Impact Assessments (EIA), Environmental Management Plans/Programmes, Environmental Planning & Review, Environmental Auditing & Monitoring, Environmental Control Officer services, and Public Consultation & Facilitation. He has project managed a number of offshore oil and gas EIAs for various exploration and production activities in South Africa and Namibia. He also has extensive experience in projects related to roads, property developments and landfill sites.

NAME	Jeremy Blood
RESPONSIBILITY ON PROJECT	Project management, report writing and specialist study review
DEGREE	B.Sc. Hons (Bot.), M.Sc. (Cons. Ecol.)
PROFESSIONAL REGISTRATION	Pr.Sci.Nat., CEAPSA
EXPERIENCE IN YEARS	16
EXPERIENCE	Jeremy Blood has been working as an environmental assessment practitioner since 1999 and has project managed a number of large-scale projects covering a range of environmental disciplines, including Environmental Impact Assessments, Environmental Management Plans/Programmes, Environmental Auditing & Monitoring and Environmental Control Officer related work in South Africa, Namibia, Mozambique and Kenya. He has expertise in a wide range of projects relating to mining (oil/gas, heavy mineral mining and borrowpits), housing/industrial developments and infrastructure projects (e.g. roads, railway line, power lines and pipelines).

EXECUTIVE SUMMARY

1. INTRODUCTION

1.1 OPPORTUNITY TO COMMENT

This Executive Summary provides a comprehensive synopsis of the Draft Environmental Impact Report (EIR) prepared as part of the Scoping and Environmental Impact Assessment (hereafter referred to as "S&EIA") process that is being undertaken for the proposed development of the Ibhubesi Gas Project.

The Draft EIR has been distributed for a 40-day comment period from **2 October to 11 November 2015** in order to provide Interested and Affected Parties (I&APs) with an opportunity to comment on any aspect of the proposed project and the findings of the S&EIA process. Copies of the full report have been made available on the CCA Environmental (Pty) Ltd (CCA) website (www.ccaenvironmental.co.za) and at the following locations:

Name of Facility	Physical Address
Cape Town Central Library	Drill Hall, Darling Street, Cape Town
Vredenburg Library	2 Akademie Street, Louwville, Vredenburg
Saldanha Library	Berg Street, Saldanha
Langebaan Library	Cnr Oostewal & Bree Street, Langebaan
Cape West Coast Biosphere Reserve offices	Cnr R27 & R315, West Coast Farmstall, Yzerfontein
Koeberg Library	Merchant Walk, Duynefontein, Melkbosstrand
Wesfleur Library	Wesfleur Circle, Atlantis
Avondale Library	Grosvenor Avenue, Avondale, Atlantis

Any comments on the Draft EIR should be forwarded to CCA at the address, telephone/fax numbers or e-mail address shown below. For comments to be included in the Final EIR, comments should reach CCA **no later than 11 November 2015**.

CCA Environmental (Pty) Ltd
Contact person: Jeremy Blood

Unit 39 Roeland Square, 30 Drury Lane, Cape Town, 8001
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1.2 PROJECT BACKGROUND

Sunbird Energy (Ibhubesi) Pty Ltd (Sunbird) and its partner, the Petroleum Oil and Gas Corporation of South Africa (Pty) Ltd (PetroSA), currently have in place an Environmental Authorisation and hold a Production Right to develop the Ibhubesi Gas Field. Sunbird is now, however, considering various additional and alternative project components, from what was originally approved, in order to supply indigenous gas feedstock to the Ankerlig Power Station near Atlantis (ongoing referred to as Ankerlig) and potential end users on the Saldanha Peninsula. The key additions / alternatives include the following:

- The installation of either a floating production, storage and offloading unit (FPSO) or a semi-submersible production platform in the licence area;

- An approximately 400 km offshore pipeline from the production facility to a shore-crossing site located between Grotto Bay and Duynefontein (i.e. the southern pipeline alternatives) and one on the Saldanha Peninsula (i.e. the northern pipeline alternatives), in the Western Cape;
- An onshore pipeline between the shore-crossing site and Ankerlig and potential end users on the Saldanha Peninsula; and
- An onshore gas receiving facility, at a location adjacent to Ankerlig or adjacent to the Silwerstroom Strand Water Treatment Plant.

This revised project is now referred to as the "Ibhubesi Gas Project" (see Figure 1).

1.3 KEY AUTHORISATION REQUIREMENTS

The proposed Ibhubesi Gas Project requires authorisation in terms of, inter alia, both the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA), as amended, and the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002) (MPRDA), as amended.

The Environmental Impact Assessment (EIA) Regulations 2010[1], promulgated in terms of Chapter 5 of NEMA, require that Environmental Authorisation is obtained from the competent authority, the Department of Environmental Affairs (DEA), to carry out the proposed development of the Ibhubesi Gas Project. In order for DEA to consider the application for authorisation a S&EIA process must be undertaken.

In terms of Section 102 of the MPRDA, Sunbird is required to amend its approved Environmental Management Programme (EMPr) to take account of any changes in the project scope on which the current Production Right is based, and submit it to the Petroleum Agency of South Africa (PASA) for consideration and subsequent approval by the Minister of Mineral Resources (or the delegated authority).

CCA has been appointed by Sunbird to undertake the S&EIA process and compile the EMPr Addendum.

2. S&EIA PROCESS

2.1 SCOPING PHASE

The Scoping Phase complied with the requirements of NEMA and the EIA Regulations 2010, as set out in GN No. R543. This involved a process of notifying I&APs of the proposed project and S&EIA / EMPr Addendum process in order to ensure that all potential key environmental impacts, including those requiring further investigation, were identified.

The Final Scoping Report (FSR), which was prepared in compliance with Section 28(1) of the EIA Regulations 2010, was accepted by DEA on 27 November 2014. The DEA acceptance stated that the next phase of the S&EIA may proceed in accordance with the tasks outlined in the Plan of Study for EIA, which was included in the FSR.

[1] Note: The EIA Regulations 2010 have subsequently been replaced by the EIA Regulations 2014. The EIA Regulations 2014, however, make provision for transitional arrangements in order to accommodate applications submitted in terms of the previous regulations. Further details of the transitional arrangements are presented in Section 2.1.2.

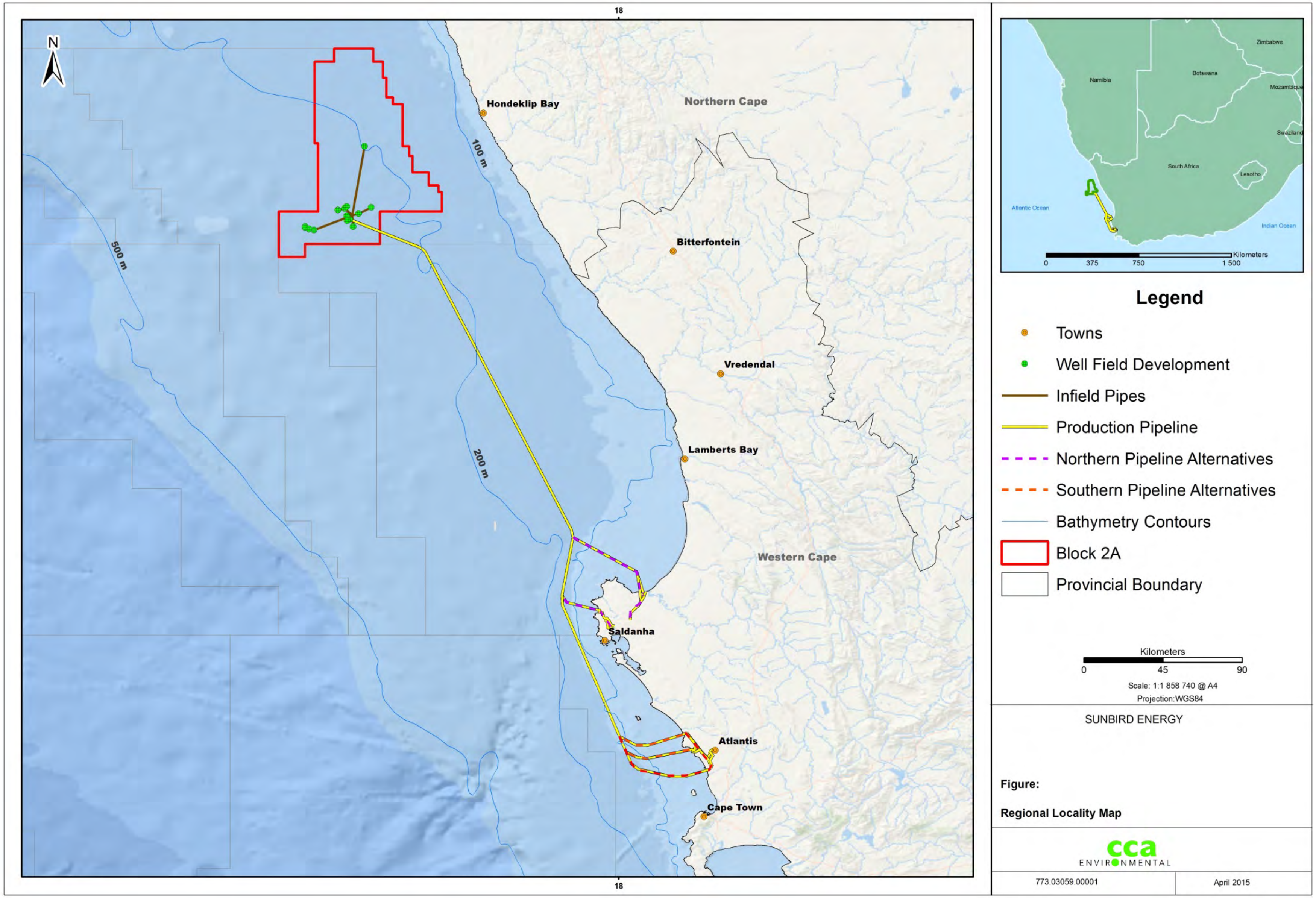

Figure 1: Locality of Licence Block 2A off the West Coast of South Africa and the proposed Ibhubesi Gas Project.

2.2 EIA PHASE

The first step in this phase was to undertake specialist studies in order to address the key issues that required investigation and detailed assessment. The 12 studies undertaken included:

1. Vegetation;
2. Freshwater;
3. Terrestrial fauna;
4. Marine fauna;
5. Heritage;
6. Oil spill assessment;
7. Air quality;
8. Risk;
9. Visual;
10. Fisheries;
11. Social; and
12. Economic.

The specialist studies and other relevant information / assessments was then integrated into the Draft EIR. The Draft EIR presents all information in a clear and understandable format suitable for easy interpretation by I&APs and authorities and provides an opportunity for them to comment on the proposed project and findings of the S&EIA process (see Section 1.1 for details of the comment period).

The following steps are envisaged for the remainder of the S&EIA process:

- After closure of the Draft EIR comment period, all comments received on the draft report will be incorporated and responded to in an updated Comments and Responses Report. The draft report will then be updated into a Final EIR, to which the Comments and Responses Report will be appended;
- The Final EIR will be released for a further 30-day comment period. All I&APs on the project database will be notified when the Final EIR is available for comment;
- The Final EIR, including any comments received from I&APs on the Final EIR, will be submitted to DEA for consideration and decision-making;
- After DEA has reached a decision, all I&APs on the project database will be notified of the outcome of the application and the reasons for the decision; and
- A statutory appeal period in terms of the National Appeal Regulations will follow the issuing of the decision.

3. PROJECT OVERVIEW

3.1 NEED AND DESIRABILITY

The proposed development of the Ibhubesi Gas Project provides an opportunity to develop South African indigenous gas reserves off the West Coast and supply indigenous feedstock to Eskom's Ankerlig power station. Ankerlig currently operates by heating diesel to gas, which passes through turbines to generate electricity. This is widely acknowledged as being both an expensive and inefficient use of fuel. Based on finding a solution to reduce these costs, Eskom is seeking to convert Ankerlig to gas. Sunbird has signed a memorandum of understanding with Eskom to investigate the feasibility of supplying gas from the Ibhubesi Gas Field to Ankerlig. The use of gas from the Ibhubesi Gas Field is supported on a national level by a number of policies and plans.

The South African Government adopted a National Infrastructure Plan in 2012 that intends to transform the economic landscape while simultaneously creating significant numbers of new jobs, strengthening the delivery of basic services, and supporting the integration of African economies. As part of this plan, eighteen Strategic Integrated Projects (SIPs) were identified to address the country's needs. The proposed Ibhubesi Gas Project falls under the following SIPs:

- SIP 5 (Saldanha-Northern Cape development corridor);
- SIP 8 (Green energy in support of the South African economy); and
- SIP 9 (Electricity generation to support socio- economic development).

The National Development Plan (2030) prioritises certain infrastructure investments, including the construction of infrastructure to import liquefied natural gas and increasing exploration to find domestic gas feedstock in order to diversify the energy mix, reduce greenhouse gas emissions and improve energy efficiency. The development of the Ibhubesi Gas Field and the proposed Ibhubesi Gas Project would meet a number of the objectives in the National Development Plan (2030).

3.2 HISTORY OF THE IBHUBESI GAS FIELD (THE APPROVED PROJECT)

Forest Exploration International (South Africa) (Pty) Ltd (Forest) and its partners (PetroSA and Anschutz Overseas Corporation Limited) commenced with exploration activities off the West Coast of South Africa in 1998. Gas reserves were confirmed by undertaking seismic surveys and drilling eight exploration wells between 2001 and 2003 in what is referred to as the Ibhubesi Gas Field (Block 2A). Based on the 2P (P50) proven reserves of 540 billion cubic feet (Bcf), Forest then applied for Environmental Authorisation in terms of NEMA and for a Production Right in term of the MPRDA. Environmental Authorisation and the Production Right for the proposed development of the Ibhubesi Gas Field Development Project were obtained in 2008 and 2009, respectively.

The existing approvals, which will remain in place, issued for the development of the Ibhubesi Gas Field includes, *inter alia*, the following:

- Resource development, including three-dimensional (3D) seismic surveys and the drilling of 99 development wells over four development phases totalling 20 years;
- A subsea production system, including subsea wellhead, production trees, manifolds and subsea pipelines (flow lines, umbilicals, Mono-Ethylene Glycol (MEG) lines and risers that would connect the wellhead structures to the manifolds and production platforms);
- The installation of three production platforms or tension leg platforms (TLPs) for the controlling of the subsea infrastructure, and initial well fluid processing and compression;
- Two approximately 108 km long production pipelines (12-inch) from the southern TLP to a landing point approximately 20 km south of the Groen River mouth in the Northern Cape; and
- An onshore gas processing facility near the landing point for the further processing of gas and condensate.

3.3 PROPOSED IBHUBESI GAS PROJECT (THE CURRENT PROJECT)

3.3.1 OFFSHORE INFRASTRUCTURE

3.3.1.1 Subsea production system

The production wells for this project would be part of the 99 approved wells. Thus no additional wells are proposed. It is anticipated that the first phase of the Ibhubesi Gas Project would include the drilling of up to 10 of these production wells with a further 10 wells drilled as part of a second development phase.

The subsea production system would be similar to that of the approved Ibhubesi Project, except that the actual layout would differ depending on final well locations.

3.3.1.2 Offshore production facility

Two production facility alternatives are being considered, namely:

- FPSO: Generally the FPSO would be a converted oil tanker or purpose-built vessel designed specifically for the project; or

- A semi-submersible platform: A semi-submersible platform is a floating structure comprised of three to six (or more) hollow steel legs that are typically connected by horizontal pontoons.

The production facility would contain the equipment for controlling the subsea infrastructure, the initial processing of well fluids, handling waste streams, compression facilities required to enable transport of the produced gas via the production pipeline, storage of condensate in on-board tanks and an accommodation area with living quarters and associated utilities.

3.3.1.3 Offshore production pipeline

Produced gas would be transferred from the production facility via a rigid subsea production pipeline (14- to 18-inch in diameter) to the shore-crossing locations. The pipeline would be approximately 400 km in length (depending on the selected shore-crossing location) and would run roughly parallel to the coast between the 100 m and 250 m contour line (see Figure 2). In order to provide some protection and help to reduce buoyancy and improve stability, the pipeline (or sections thereof) may be concrete coated or be provided with concrete mattress protection.

Figure 2: Proposed production pipeline route alternatives.

3.3.2 ONSHORE INFRASTRUCTURE

3.3.2.1 Southern shore-crossings between Grotto Bay and Duynefontein and onshore production pipeline

The specific destination for the southern shore-crossing and associated onshore pipeline is the Ankerlig power station near Atlantis. Thirteen potential shore-crossing alternatives were originally identified between Yzerfontein and Duynefontein. These alternatives were screened via a detailed multi-criteria analysis that considered:

- Technical engineering aspects (e.g. physical characteristics and length of shore-crossing, complexity of installation, relative angle of wave attack, rate of sediment transport and available services);
- Environmental sensitivity (e.g. topography, vegetation and freshwater); and
- Social considerations (e.g. proximity to residential areas, existing services and visibility).

The screening of alternatives identified three shore-crossings as the preferred alternatives for assessment in the S&EIA (see Figure 3). These include:

- <u>Grotto Bay:</u> This shore-crossing location is situated immediately south of the Grotto Bay Private Nature Reserve and residential area. The onshore route is proposed to follow the Grotto Drive road reserve fence line and associated fire break to the south of the existing road until just east of the R27.
- <u>Silwerstroom Strand:</u> This shore-crossing location is situated on the northern boundary of the Silwerstroom Strand resort. The onshore routing between the shore-crossing and the R27 could follow one of three alternatives, namely:
  - Alternative 1 (Northern Route): Via the existing Silwerstroom Water Treatment Plant to the existing Silwerstroom Road.
  - Alternative 2 (Central Route): The alignment of the existing Silwerstroom Strand Road; and
  - Alternative 3 (Southern Route): Via a private farm road and fence line on farm Groote Springfontein to the south of the resort.
- <u>Duynefontein:</u> The Duynefontein shore-crossing location is situated within the Koeberg nuclear power station property of Eskom, approximately 200 m north of the Duynefontein residential area. The onshore route would follow an existing track through the Koeberg Power Station property to the R27.

The following options are being considered for the north-south corridor:

- A new pipeline servitude parallel and adjacent to the existing Chevron pipeline servitude; and
- A new pipeline servitude to the east of R27 road reserve. This option was identified following input from the City of Cape Town: Environmental Resource Department. As the area through which the pipeline would pass is expected to form part of a new conservation area (the Dassenberg Coastal Catchment Partnership (DCCP), which will extend from Koeberg to Grotto Bay), it was suggested that the alignment should follow the edge of a future management block and associated fire break, which would run adjacent to and east of the R27.

The east link to Ankerlig would follow the southern side of Dassenberg Road reserve. It should be noted that another alternative was considered for the Duynefontein shore-crossing, which followed the existing power transmission line servitude directly from the Koeberg Power Station to Ankerlig. However, this alternative was dropped during the Scoping Phase due to concerns raised by Eskom that the proposed pipeline could result in electromagnetic coupling and the corrosion of the power line infrastructure.

The approximate total pipeline lengths from the shore-crossing locations to Ankerlig are presented below.

Alternative		Estimated total pipeline length
Grotto Bay to Ankerlig		26.0 km
Silwerstroom Stand to Ankerlig	Alt 1	18.6 km
	Alt 2	19.4 km
	Alt 3	17.3 km
Duynefontein to Ankerlig		13.9 km

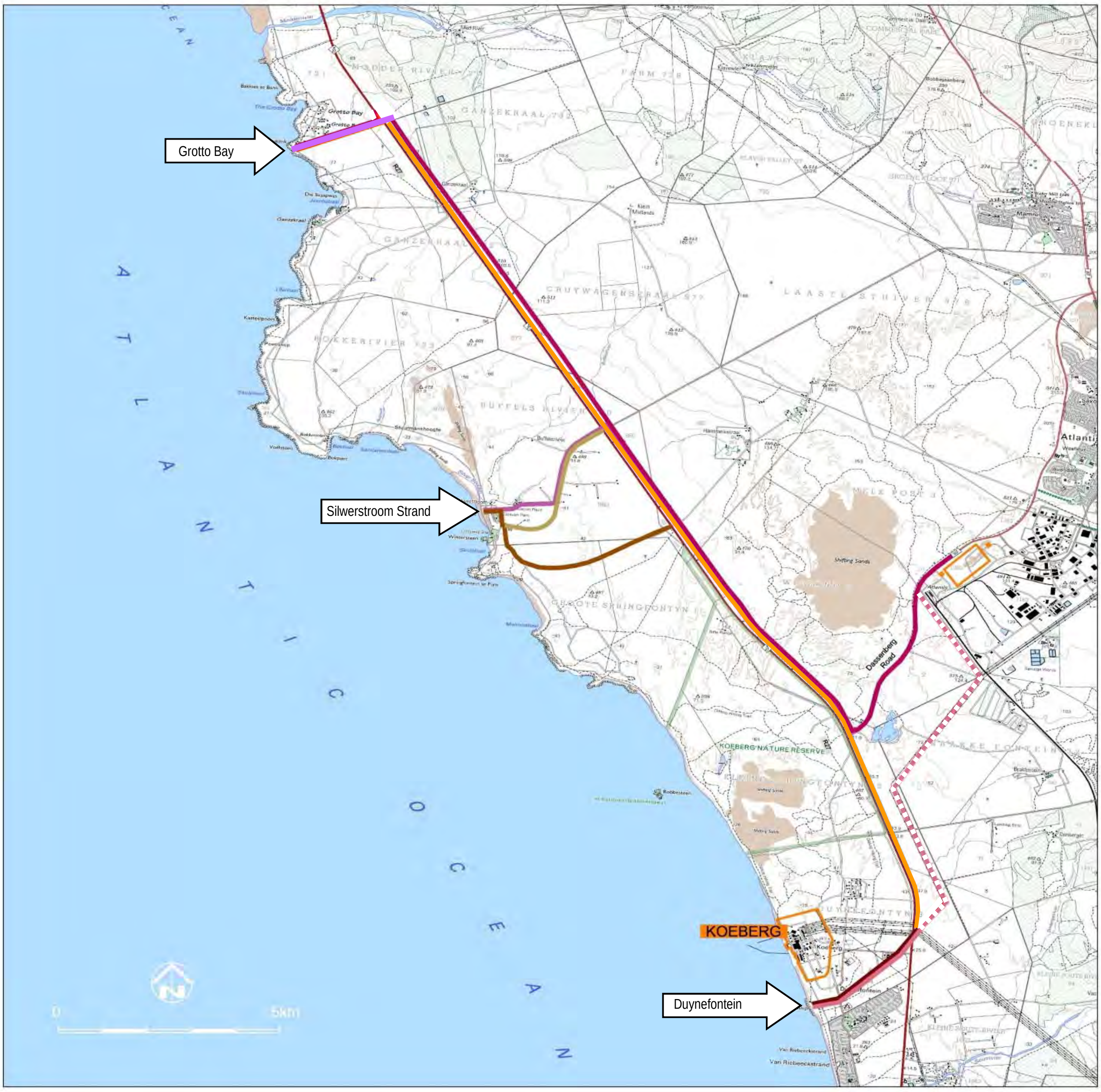

Figure 3: **Location of southern shore-crossings and onshore pipeline route alternatives between Grotto Bay and Duynefontein. Note: the alternative shown as a stippled line was dropped during the Scoping Phase and is no longer being considered.**

3.3.2.2 Northern shore-crossings on the Saldanha Peninsula and onshore production pipeline

The specific target for an end point has not yet been established, as no specific customer exists at this stage. Thus end points have been selected adjacent to major roads, from which an extended future pipeline could easily link into a future customer. Six potential shore-crossing alternatives were considered on the Saldanha Peninsula. Screening of these alternatives, via a detailed multi-criteria analysis that considered technical engineering aspects, potential environmental impacts and potential social implications, identified three shore-crossings for assessment in the S&EIA (see Figure 4). These include:

- St Helena West: This shore-crossing location is positioned on the southern side of St Helena Bay, west-southwest of the mouth of the Berg River;
- St Helena East: This shore-crossing is located approximately 2.5 km east of the St. Helena West shore-crossing location. During the Scoping Phase this shore-crossing alternative and pipeline were repositioned approximately 1.2 km to the west in order to avoid the Berg River Ecosystem Priority Area; or
- Noordwesbaai: Noordwesbaai is located approximately 20 km south of Shelley Point and 10 km west of the town of Vredenburg. During the Scoping Phase a portion of this pipeline alternative was repositioned to the west in order to avoid the Bok River Ecosystem Priority Area and a proposed residential development (Solar City).

All routes cross mainly farmland. The St Helena East and West alternatives largely share the same onshore routing, apart from a short section, between the coast and the R45 main road. The Noordwesbaai shore-crossing route follows a south-easterly direction to the R399 between Saldanha and Vredenburg. Initially the route follows an existing dirt track through a Critical Biodiversity Area (CBA). In order to minimise the length within the CBA two alternatives are proposed, namely Noordwesbaai West and Noordwesbaai East. After exiting the CBA, the Noordwesbaai East route would largely follow existing fence lines in a south-easterly direction, avoiding other CBAs, and intersect the Jacobsbaai Road, after which it continues in a south-easterly before turning east towards the R399.

The approximate total pipeline lengths are presented below.

Alternative		Estimated total pipeline length
St Helena West		17.5 km
St Helena East		17.8 km
Noordwesbaai	West	15.3 km
	East	15.1 km

3.3.2.3 Onshore gas receiving facility

An onshore gas receiving facility would be required to reduce gas pressure in the production pipeline and measure the gas flow rate before it is fed through to the end user. The facility would require an area of approximately 1.85 ha and would be located at one of two sites adjacent to the Ankerlig power station (see Figure 5) or at one of two sites adjacent to the Silwerstroom Strand Water Treatment Plant (see Figure 6). For the northern pipeline alternatives, no onshore facility is being considered, as no specific customer exists at this stage.

The onshore facility would essentially consist of a process area (including water bath heathers, flues and vent stacks), a utilities area (including an electrical substation, emergency power generators, workshop, warehouse, control room, ablutions, etc.) and parking. The tallest part of the gas processing facility would be the flues and cold vent stacks, which would be 10 m high, and the water bath heaters, which would be 5 m high. All other buildings would be single storey in height.

Power and potable water would be obtained from the local municipal grid / supply.

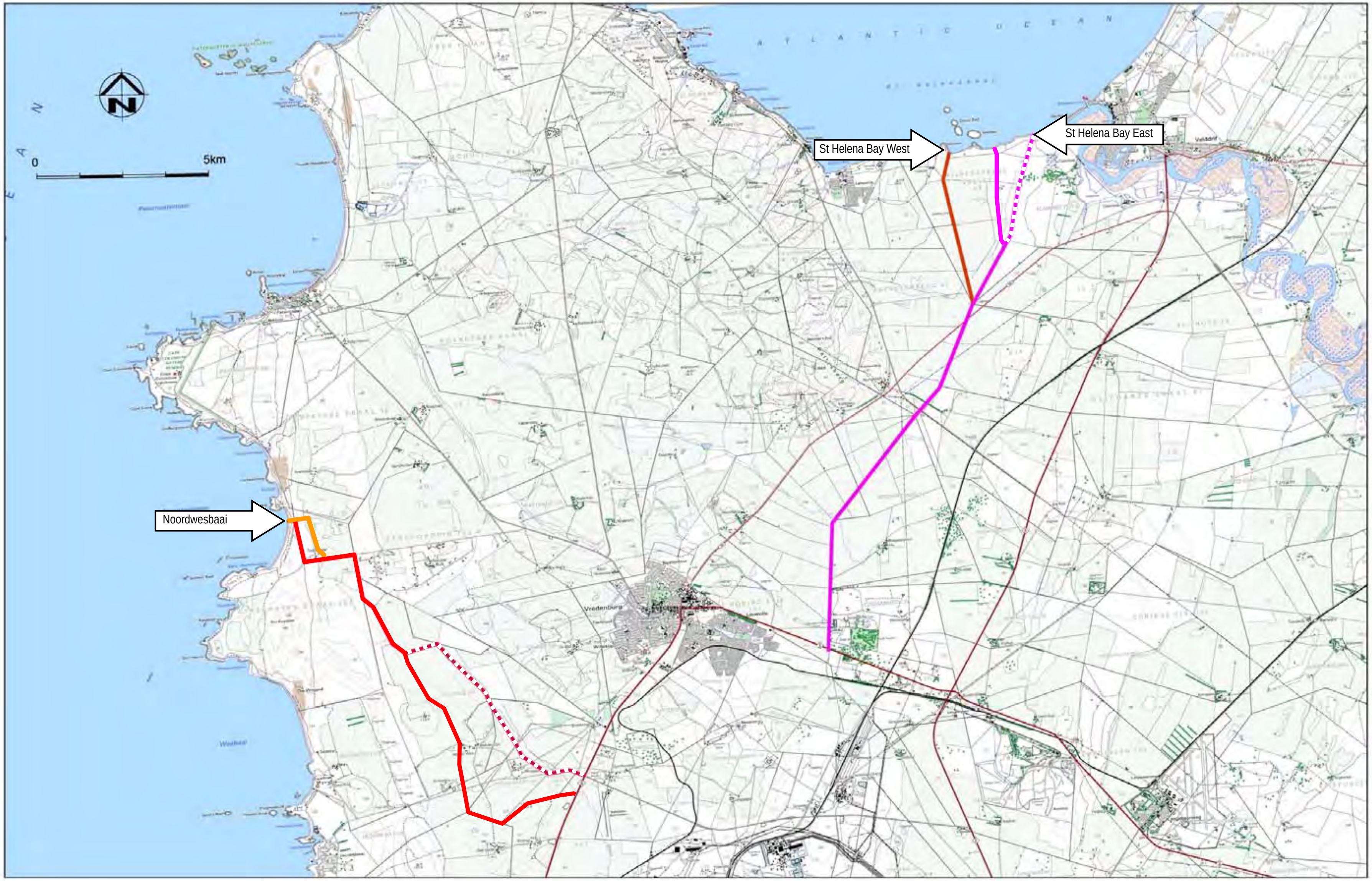

Figure 4: **Location of northern shore-crossings and pipeline route alternatives on the Saldanha Peninsula. Note: the alternatives shown as stippled lines were dropped during the Scoping Phase and are no longer being considered.**

Figure 5: **Location alternatives (Alternative 1a and 1b) for the proposed onshore gas receiving facility near the Ankerlig Peaking Power Plant (after GoogleEarth 2015).**

Figure 6: **Location alternatives (Alternative 2a and 2b) for the proposed onshore gas receiving facility near the existing Silwerstroom Strand Water Treatment Plant (after GoogleEarth 2015). The proposed onshore pipeline alternatives associated with the Silwerstroom Strand shore-crossing are also shown.**

3.3.3 ESTABLISHMENT

3.3.3.1 Offshore

The offshore production facility would be constructed at a shipyard and barged to location. The necessary activities would then be undertaken to fix the facility on site.

Installation of the production pipeline would most likely be undertaken using a pipe-lay vessel. Pipe sections would be supplied from an onshore logistics base at the Cape Town and / or Saldanha Bay harbours. The traditional method for installing offshore pipelines in relatively shallow water, and most likely to be used, is commonly referred to as the S-Lay method. In extremely deep water the angle of the pipe becomes so steep that the required stinger length may not be feasible. A comparatively new method for installing offshore pipelines in deeper water is the J-lay method.

In order to check for leaks along the production pipeline a System Leak Test or hydrotest would be undertaken using chemically treated seawater to prevent pipeline corrosion. It is envisaged that the volume of treated seawater that would be discharged (into an overflow pond on the beach) during the hydrotesting phase would be small relative to the total volume in the pipeline (in the order of 50 m^3).

Pipeline dewatering operations would be performed after successful leak testing of the pipeline. Dewatering would likely be performed from onshore to offshore to simplify the discharge of the hydrotest water. The volume of treated seawater that would be discharged during the dewatering phase would be in the order of 34 000 m^3 depending upon the final pipeline diameter and wall thickness.

3.3.3.2 Onshore

The pipeline would be buried through the surf zone and along its full onshore length to a depth of approximately 1 m to 1.5 m below ground until it reaches the proposed onshore gas receiving facility.

Two primary installation methods would be used for the shore-crossing, namely:

- Trenching and bottom tow: The preferred option would be to assemble the pipeline onshore and then pull it out to sea from an anchored barge. An alternative is for the pipe to be assembled and launched from a pipe-laying vessel and then to be pulled ashore using a winch mounted on the beach. Through the beach and surf zone the pipeline would need to be burial to protect it from waves and to ensure that during the seasonal variation of the beach levels, the pipeline is not exposed or undermined. To enable a trench to be excavated through the surf zone, a temporary sheet piled cofferdam (including temporary jetty or groin) may need to be constructed. A lay-down area for the construction operation of approximately 2 ha would be needed in close proximity to the shore-crossing site; and
- Horizontal directional drilling (HDD): Directional drilling would entail drilling a hole under the shoreline and then pulling a pipeline through the hole using an anchored barge. This method would require a lined sump or containment dam for the recycling of drilling fluids. Directional drilling would require a construction area of approximately 0.3 ha.

A summary of the most likely installation methods that would be needed for each shore-crossing alternative is provided below.

Alternative	Trenching and bottom-tow	Horizontal directional drilling (HDD)	Blasting in coastal zone	Cofferdam and jetty / groin
Southern shore-crossings				
Grotto Bay	X	✓	Possible blasting on landward side of HDD operation - depends on depth of bedrock	X
Silwerstroom Strand	✓	Unlikely	Unlikely - depends on the presence of offshore reefs and if these cannot be avoided	✓
Duynefontein	✓	X	X	✓
Northern shore-crossings				
St Helena West	✓	Unlikely due to fractured nature of the rock	✓	✓
St Helena East	✓		✓	✓
Noordwesbaai	✓	X	Unlikely - depends on depth of bedrock	✓

The onshore pipeline would be laid by normal pipe-laying methods after the route is cleared of vegetation and any other obstacles. The area of disturbance along the onshore pipeline route would ultimately be determined by the geotechnical characteristics of the proposed route, e.g. sandy soils would require a wider trench and would thus have a greater area of disturbance. It is estimated that the width of the construction servitude (including access road) would be approximately 15 to 20 m along the entire length of the pipeline route. Depending on the underlying geotechnical conditions some blasting may be required. Disturbed areas along the pipeline route would be rehabilitated after construction with the aim of restoring the area back to near its original state.

3.3.4 OPERATION

3.3.4.1 Offshore

Gas and well fluids extracted from the wells would pass through the flow lines to the production facility. Initial processing on the production facility would consist mainly of the separation of liquids, in the form of condensate and any produced water, from the gas. The condensate would be stored on-board for later offloading to a shuttle tanker for export to market. The produced water would be treated to acceptable standards before being discharged overboard (as per the existing Environmental Authorisation and Production Right). The separated gas would be compressed to an export pressure and transferred via the offshore production pipeline to shore.

Supply vessels and helicopters would be used to transport personnel and supplies between the offshore development and an onshore logistics support base, which would be based in either Cape Town or Saldanha Bay (approved as part of the original project). Transportation of personnel to and from the production facility would be provided by helicopter operations from an existing airport on the West Coast, e.g. Kleinzee.

3.3.4.2 Onshore

The onshore gas receiving facility would reduce gas pressure in the production pipeline and measure the gas flow rate before it is fed through to the end user at Ankerlig. In addition, the operation at the gas receiving facility would include heating to ensure the gas is delivered to Ankerlig with sufficient heat.

Maintenance, regular testing and frequent inspection of the proposed onshore pipeline would be undertaken to minimise the potential for leaks in the pipeline. An access track (one vehicle width) within the pipeline servitude would be provided where the pipeline route does not follow existing road servitudes.

3.3.5 Decommissioning and abandonment

At the end of the economic life of the Ibhubesi Gas Field, the production facility would be decommissioned and removed from location. The offshore production pipeline would be thoroughly flushed, plugged off, and left on the seabed. The remaining subsea infrastructure (including the wellheads, production trees, umbilicals, flow lines, etc.) would be decommissioned as per the existing Environmental Authorisation and Production Right.

The onshore gas receiving facility would be decommissioned and removed from site and the area rehabilitated. The onshore pipeline would be thoroughly flushed, plugged off, and left underground. Decommissioned equipment would either be sold for reuse or scrap.

4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

4.1 MARINE ENVIRONMENT

4.1.1 PHYSICAL ENVIRONMENT

The study area lies within the southern zone of the Benguela Current region and is characterised by the cool Benguela upwelling system. The dominant southerly and south-easterly winds in summer drive the massive offshore movement of surface water, resulting in strong upwelling of nutrient-rich bottom waters. Nutrient-rich upwelled water enhances primary production, and the West Coast region consequently supports substantial pelagic fisheries.

The wave regime along the West Coast shows only moderate seasonal variation in direction, with virtually all swells throughout the year coming from the south and south-south-west direction.

4.1.2 BIOLOGICAL OCEANOGRAPHY

The proposed pipeline route would pass through Namaqua and the South-western Cape bioregions. The biotas of the nearshore marine habitats off the West Coast are relatively robust, being naturally adapted to an extremely dynamic environment where biophysical disturbances are commonplace. Communities within this region are largely ubiquitous, particular to substrate type (i.e. hard vs. soft bottom), exposure to wave action, or water depth. Habitats specific to the study area include: sandy intertidal and subtidal substrates; and intertidal rocky shores and subtidal reefs.

The proposed offshore production pipeline route would largely coincide with benthic habitats mapped largely as ‘least threatened’. It would traverse an area of ‘vulnerable’ habitat to the south-east of Child’s Bank and 'endangered' habitat in the nearshore areas on the innershelf south of Cape Columbine. Of the southern shore-crossing alternatives, the Duynefontein and Silwerstroom Strand alternatives pass through areas considered to be "critically endangered" marine habitats, whereas the Grotto Bay alternative passes through "vulnerable" and "endangered" marine habitats. The northern shore-crossing alternatives at Noordwesbaai and St Helena (West and East) all pass through areas considered to be "critically endangered" marine habitats near the coast.

4.1.3 HUMAN UTILISATION

Seven fisheries are active off the West Coast, including demersal trawl, small pelagic purse-seine, demersal long-line (hake and shark), large pelagic long-line, tuna pole, traditional line fish and West Coast rock lobster. The proposed offshore pipeline route largely avoids the areas targeted by the demersal trawl sector.

The majority of shipping traffic is located on the outer edge of the continental shelf with traffic inshore of the continental shelf along the South-West Coast largely comprising fishing vessels, especially between Kleinsee and Oranjemund. The majority of the shipping traffic *en route* to and from Cape Town would pass offshore of the proposed production pipeline route.

Exploration for oil and gas is currently undertaken in a number of licence blocks off the West Coast. There is no current development or production from the South African West Coast offshore. The licence block and offshore pipeline overlap with a number of other prospecting and mining areas (diamonds, heavy minerals and phosphate).

There are no accounts of shipwrecks on the South African National Maritime database for the Grotto Bay, Silwerstroom Strand, Duynefontein and Noordwesbaai shore-crossings. There are, however, two references to shipwrecks in the St Helena Bay area.

Numerous conservation areas and Marine Protected Areas (MPAs) exist along the coastline of the Western Cape, none of which would be traversed by the proposed pipeline route. Nine focus areas have been identified for protection on the West Coast. The Ibhubesi Gas Field is located on the eastern extent of the proposed "Childs Bank" area, while the proposed production pipeline passes through the proposed "West Coast Consolidation" area. It should be noted that Sunbird has been in consultation with the South African National Biodiversity Institute (SANBI) on the implications of the proposed MPAs.

4.2 ONSHORE ENVIRONMENT

4.2.1 SOUTHERN SHORE-CROSSING ROUTE (GROTTO BAY TO DUYNEFONTEIN)

The proposed landing points for the southern pipeline routes fall under the jurisdiction of the Swartland Local Municipality and the City of Cape Town Metropolitan Municipality.

The study area falls within several protection zones of the Atlantis Aquifer. This aquifer forms an important component of the water supply system for the City of Cape Town. Groundwater levels are between 2 - 12 m below natural ground level, although there are significant seasonal fluctuations.

The southern area lies at the boundary of the Swartland and Sandveld bioregions. The natural vegetation in the study area is recorded as Cape Seashore Vegetation (Least Threatened), Cape Flats Dune Strandveld (Endangered D1), Atlantis Sand Fynbos (Critically Endangered D1), Langebaan Dune Strandveld (Vulnerable) and Swartland Shale Renosterveld (Critically Endangered A1 & D1). Much of the area around

Ankerlig and along the R27 has been mapped as a Critical Biodiversity Area (CBA). Similarly, much of the area within the Swartland Municipality through which the pipeline routes pass is mapped as an 'Endangered' ecosystem.

The only rivers of note within the southern study area are the Buffels and Silverstroom Rivers, which are relatively small coastal rivers. The larger catchment of these rivers has been mapped as a Freshwater Ecosystem Priority Area (FEPA) river catchment, with the management implication being that it should not be allowed to degrade but rather be rehabilitated where possible. A number of small seeps and valley-floor depressions occur within the study area.

Although no archaeological material was noted along any of the onshore pipeline routes and onshore facility sites, previous observations on the West Coast indicate that the coastline, especially headlands, is littered with Late Stone Age shell midden material. This is supported by the identification of shell midden material in the vicinity of the Grotto Bay parking area. Due to the presence of pleistocene fossils in relatively shallow calcretised sands and the Springfontein Formation within the Koeberg Nature Reserve, it is anticipated that palaeontological material could be encountered along all routes and at the onshore facility sites.

4.2.2 NORTHERN SHORE-CROSSING ROUTE (SALDANHA PENINSULA)

The proposed landing points for the northern pipeline routes fall under the jurisdiction of the West Coast District Municipality.

The natural vegetation in the study area is mapped as Cape Seashore Vegetation (Least Threatened), Langebaan Dune Strandveld (Vulnerable), Saldanha Limestone Strandveld (Endangered) and Saldanha Flats Strandveld (Endangered). Although large sections of these pipeline routes pass through transformed agricultural lands, the Noordwesbaai alternatives would pass through short sections mapped as CBAs.

The only rivers of note within the northern study area are the Berg and Bok Rivers. Although the proposed onshore pipeline alternatives avoid these rivers, they do pass through some valley bottom wetlands associated with watercourses.

Immediately west of the mouth of the Berg River are a series of at least nine early fish traps built into the shallow waters of the bay. The proposed St Helena West shore-crossing would pass through such a fish trap, which has a heritage grading of Grade IIIA. All northern onshore pipeline alternatives avoid any surface manifestations of archaeological material.

5. IMPACT ASSESSMENT CONCLUSIONS

A summary of the assessment of potential environmental impacts associated with the proposed project is provided in Tables 1 (biophysical), 2 (socio-economic) and 3 (human health).

Table 1: Summary of the significance of the potential biophysical impacts associated with the proposed Ibhubesi Gas Project (Note: * indicates that no mitigation is possible and / or considered necessary, thus significance rating does not change).

Potential impact		Alternative (where applicable)	Significance: Without mitigation	Significance: With mitigation
1. Offshore biophysical impacts:				
1.1 Production pipeline				
Physical damage to and disturbance of benthic communities due to installation of pipeline on the seabed	Unconsolidated sediments	All pipeline routes	M	**L**
	Hard grounds		H	**L**
Physical damage to and disturbance of benthic communities due to installation of pipeline through the intertidal and shallow subtidal zone		Grotto Bay	INSIG	**INSIG**
		Other shore-crossing alternatives	L	**VL**
Construction noise, vibrations and blasting		Grotto Bay	INSIG	**INSIG**
		Other shore-crossing alternatives	L-M	**VL**
Effects on benthic species diversity and numbers due to physical presence of the pipeline		All pipeline routes	M (+ve)	**M (+ve)**
Normal discharges from the pipe-lay vessel and discharge of hydrotest water		All pipeline routes	VL	**VL**
Spills and pollution in the coastal zone during construction		All pipeline routes	L	**VL**
1.2 Production facility				
Physical damage to and disturbance of benthic communities due to anchoring	Unconsolidated sediments	Both production facility alternatives	VL	**VL**
	Hard grounds		L	**VL**
Noise from production facility			VL	**VL***
Lighting from production facility			VL-M	**VL-L**
Normal discharges from production facility			VL	**VL**
Accidental condensate and diesel spill during operation			M	**L**
2. Onshore biophysical impacts:				
2.1 Southern shore-crossing route (Grotto Bay to Duynefontein)				
Loss of vegetation due to clearing		Grotto Bay	L	**VL**
		Silwerstroom Strand and Duynefontein	M	**L**
		North-south corridor and east link to Ankerlig	M	**L**
Direct mortality of faunal species		All pipeline routes	VL	**VL**
Loss of faunal habitats			L	**VL**
Barrier effect of pipeline	Trench		INSIG-VL	**INSIG-VL**
	Pipeline		INSIG	**INSIG**

Potential impact		Alternative (where applicable)	Significance Without mitigation	Significance With mitigation
Loss of wetland and riparian habitat, temporary impedance of low and increased sedimentation		Grotto Bay	VL	**INSIG**
		Silwerstroom Strand	M	**L-M**
		Duynefontein	VL	**INSIG-VL**
		East link to Ankerlig	L	**VL**
2.2 Northern shore-crossing route (Saldanha Peninsula)				
Loss of vegetation due to clearing		St Helena West and Noordwesbaai East	L	**VL**
		St Helena East	L-M	**L**
		Noordwesbaai West	H	**M**
Direct mortality of faunal species		All pipeline routes	VL	**VL**
Loss of faunal habitats			L	**VL**
Barrier effect of pipeline	Trench		INSIG-VL	**INSIG-VL**
	Pipeline		INSIG	**INSIG**
Loss of wetland and riparian habitat, temporary impedance of low and increased sedimentation		St Helena West	L	**VL**
		St Helena East	VL	**INSIG**
		Noordwesbaai	L	**VL**
2.3 Onshore gas receiving facility				
Loss of vegetation due to clearing		Ankerlig facility	M	**M**
		Silwerstroom Strand facility	H	**H**
Loss of wetland and riparian habitat, temporary impedance of low and increased sedimentation		Ankerlig facility	L	**VL**
		Silwerstroom Strand facility	M	**L-M**
Direct mortality of faunal species		All alternatives	VL	**VL**
Loss of faunal habitats			L	**VL**

VH=Very High	H=High	M=Medium	L=Low	VL=Very low	Insig = insignificant	N/A = Not applicable

Table 2: Summary of the significance of the <u>potential socio-economic impacts</u> associated with the proposed Ibhubesi Gas Project (Note: * indicates that no mitigation is possible and / or considered necessary, thus significance rating does not change).

Potential impact	Alternative (where applicable)	Significance Without mitigation	Significance With mitigation
1. Cultural impacts:			
1.1 Offshore pipeline			
Disturbance of historical shipwrecks	Southern shore-crossing routes	L	**L**
	Northern shore-crossing routes	L	**L**

Potential impact		Alternative (where applicable)	Significance	
			Without mitigation	With mitigation
1.2 Southern shore-crossing route (Grotto Bay to Duynefontein)				
Disturbance of cultural heritage material, including fossils, shell middens and other archaeological material		Grotto Bay	M	**L**
		Other pipeline routes	L	**L**
1.3 Northern shore-crossing route (Saldanha Peninsula)				
Disturbance of cultural heritage material, including early fish traps, fossils, shell middens and other archaeological material		St Helena West	M	**L**
		St Helena East and Noordwesbaai	L	**L**
2. Visual impacts:				
2.1 Southern shore-crossing route (Grotto Bay to Duynefontein)				
Visual impact due to pipeline		All pipeline routes	L	**L**
2.2 Northern shore-crossing route (Saldanha Peninsula)				
Visual impact due to pipeline		St Helena West and East	VL	**VL**
		Noordwesbaai	L	**L**
2.3 Onshore gas receiving facility				
Visual impact due to onshore facility		Silwerstroom Strand facility	M-H	**M**
		Ankerlig facility	L-M	**L**
3. Fishing industry impacts:				
Disruption to fishing activities due to 500 m safety zone around pipe-lay vessel	Small pelagic purse-seine and West Coast rock lobster	All pipeline routes	VL	**VL**
	Other fishing sectors		INSIG	**INSIG**
Disruption to fishing activities and increased fishing effort and loss-of-access to fishing grounds due to presence of production facility and subsea pipeline	Demersal trawl	All pipeline routes	VL	**VL**
	Small pelagic purse-seine		**NO IMPACT**	
	Hake-directed demersal long-line		VL	**VL**
	Shark -directed demersal long-line		VL	**VL**
	Large pelagic long-line		INSIG	**INSIG**
	Tuna pole		INSIG	**INSIG**
	Traditional line-fish		INSIG	**INSIG**
	West Coast rock lobster	Noordwesbaai, Silwerstroom Strand and Duynefontein	VL	**VL**
		Grotto Bay and St Helena Bay	L	**L**
	Fisheries research	All pipeline routes	VL	**VL**
Accidental condensate and diesel spill during operation	All sectors	All pipeline routes	INSIG-VL	**INSIG-VL**

Potential impact		Alternative (where applicable)	Significance	
			Without mitigation	With mitigation
3. Social impacts:				
Creation of employment, empowerment and local expenditure	Construction	All pipeline routes and facility sites	VL (+ve)	**L (+ve)**
	Operation		L (+ve)	**M (+ve)**
	Decommissioning		VL (+ve)	**L (+ve)**
Skills and SMME development			L (neutral)	**M (+ve)**
Income and related economic dependency			M (+ve)	**H (+ve)**
Gender balance			L (neutral)	**L (+ve)**
Cultural impact due to in-migration	Construction		L	**VL (neutral)**
	Operation		L	**L (neutral)**
	Decommissioning		VL	**VL (neutral)**
4 Economic impacts:				
4.1 General				
Macro-economic impacts		All pipeline routes and facility sites	L (unkown)	**L (unkown)***
Compliance with planning frameworks for the region and the development of the gas industry			L (+ve)	**L (+ve)***
Energy security and diversification of the country's energy mix			L (+ve)	**L (+ve)***
Generation of "clean" energy			H (+ve)	**H (+ve)***
Impact on industry and mining			L	**L**
4.2 Southern shore-crossing route (Grotto Bay to Duynefontein)				
Impact on tourism		Grotto Bay and Silwerstroom	L	**VL**
		Duynefontein	INSIG	**INSIG***
Impact on farming		All pipeline routes	INSIG	**INSIG***
Impact on future land use options		Grotto Bay and Silwerstroom Strand (Alt 3)	L	**L***
		Silwerstroom Strand (Alt 1 & 2) and Duynefontein	INSIG	**INSIG***
		Ankerlig facility	INSIG	**INSIG***
		Silwerstroom Stand facility	L	**L***
4.3 Northern shore-crossing route (Saldanha Peninsula)				
Impact on tourism		St Helena West and East	VL	**VL***
		Noordwesbaai	L	**VL**
Impact on farming		All pipeline routes	L	**VL**
Impact on future land use options		All pipeline routes	M	**L-M**

VH=Very High	H=High	M=Medium	L=Low	VL=Very low	Insig = insignificant	N/A = Not applicable

Table 3: Summary of the significance of the potential human health impacts associated with the proposed Ibhubesi Gas Project (Note: * indicates that no mitigation is possible and / or considered necessary, thus significance rating does not change).

Potential impact	Alternative (where applicable)	Significance	
		Without mitigation	With mitigation
1. Air quality impacts:			
1.1 Offshore operational activities			
Emissions from the offshore stacks arise mainly from the flare, power generation, the inert gas system/boilers and an incinerator	Both production facility alternatives	VL	**VL***
1.2 Onshore construction activities			
Fugitive dust may also be emitted during material loading and hauling, and stockpiling	All pipeline routes	L	**VL**
1.3 Onshore operational activities			
Emissions from the onshore stacks arise mainly from the water bath heaters.	Both onshore facility alternatives	L	**L**
2. Risk impacts:			
2.1 Southern shore-crossing route (Grotto Bay to Duynefontein)			
Thermal radiation from jet or flash fires and overpressure from Vapour Cloud Explosions	Duynefontein	L	**L**
	Grotto Bay and Silwerstroom Strand	M	**L**
	North-south corridor and east link to Ankerlig	L	**L**
	Both onshore facility alternatives	L	**L**
2.2 Northern shore-crossing route (Saldanha Peninsula)			
Thermal radiation from jet or flash fires and overpressure from Vapour Cloud Explosions	All pipeline routes	L	**L**

VH=Very High	H=High	M=Medium	L=Low	VL=Very low	Insig = insignificant	N/A = Not applicable

5.1 BIOPHYSICAL ENVIRONMENT

5.1.1 OFFSHORE MARINE ENVIRONMENT

Offshore production pipeline

The majority of the impacts associated with the operation of the pipe-lay vessel and pipeline installation would be highly localised, of very short-term duration (3 - 4 months) and of low intensity, and are considered to be of **VERY LOW** significance after mitigation. These short-term impacts are mitigated by ensuring that vessels comply with MARPOL 73/78 standards and providing prior notification (including navigation warnings) to key stakeholders.

One of the key issues associated with pipeline installation relates to the physical damage and disturbance of vulnerable or sensitive benthic communities. Although the majority of the proposed offshore production pipeline route coincides with benthic habitats mapped as 'least threatened', it would traverse more sensitive habitats nearer the coast. Deep reefs and other hard ground habitats in particular, which potentially occur along the pipeline route, may support fragile, structurally complex species (e.g. cold water corals, black corals, gorgonians and sponges). These species are generally long-lived and slow-growing, and as such have slow recovery times after disturbance. With careful routing of the pipeline and the avoidance of any sensitive habitats identified during a pre-construction subsea route survey (using a Remotely Operated Vehicle (ROV) or similar device), the significance could be reduced to **LOW** for all pipeline route alternatives.

The extent of disturbance through the coastal zone would ultimately depend on which installation method is used to install the pipeline, namely trenching and bottom tow or horizontal directional drilling. The horizontal directional drilling method would have minimal effect on intertidal and shallow subtidal habitats, as the pipeline would pass below the seabed, and as such would have an **INSIGNIFICANT** impact. This method, would however, require a lined sump or containment dam onshore for returned drilling muds. In contrast to the horizontal directional drilling method, the installation of the pipeline via a trench through the surf zone would involve considerable disturbance of the high shore, intertidal and shallow subtidal beach habitats. In addition, this installation method may also require blasting and the construction of a temporary sheet piled cofferdam and temporary jetty (or groin) to provide a working platform from which the work through the beach zone can be carried out. Although trenching would involve considerable disturbance to the coastal zone, recolonisation would commence rapidly after cessation of trenching in unconsolidated sediments. This is due to the fact that communities within the wave-influenced zone being adapted to a high wave energy environment and frequent natural disturbances. Research studies following completion of coastal mining have shown that biological 'recovery' of disturbed areas can occur within two to five years. The impact associated with the trenching and bottom tow installation method is considered to be of **VERY LOW** significance with mitigation. Although the initial engineering site assessment indicated that the Grotto Bay alternative is the only alternative that appears suitable for the horizontal directional drilling method, it is recommended that a detailed geotechnical site investigation be undertaken to determine the possibility of using the horizontal directional drilling installation method, specifically at St Helena Bay and Silwerstroom Strand where there is a rocky intertidal zone or potentially shallow bedrock beneath the sand.

The **INSIGNIFICANT** to **LOW** impacts associated with pipeline installation should be weighed up against the potential biophysical benefits that may result from the presence of the pipeline on the seabed. Once the pipeline has been laid, the affected seabed areas around the pipeline would with time be recolonised by benthic macrofauna. The pipeline itself would provide an alternative substratum for colonising communities. Thus the proposed pipeline could effectively increase the amount of hard substrate that is available for the colonisation of vulnerable / sensitive benthic species, which potentially occur along the pipeline route. The potential increase in biodiversity and biomass, especially of vulnerable / sensitive species, associated with the abandonment of the pipeline on the seabed is deemed to be of **MEDIUM (positive)** significance.

Production facility

The majority of the impacts associated with the operation of the production facility (e.g. anchoring, lighting and normal discharges) would be localised, of medium term duration (15 years) and of low intensity, and are considered to be of **VERY LOW to LOW** significance after mitigation. It should be noted that these impacts are no different to those associated with the operation of a Tension Leg Platform (a vertically moored floating structure), which was approved as part of the original project proposal.

Operational spills

This is considered to be an abnormal operation and relates to the unlikely event of a hydrocarbon spillage (e.g. during fuel bunkering or during the transfer of condensate from the production facility to the tanker). A small instantaneous spill of diesel (12 m^3) would be relatively short-lived on the water surface (1.5 -

4 days) before dissipating and is predicted to travel in a north-westerly direction away from the coast during both the summer and winter. A small diesel spill is not predicted to reach the coast located approximately 85 km away. A medium instantaneous spill of condensate (160 m^3) could remain on the water surface for up to 16 days depending on the weather conditions. The section of coast most at risk to shoreline oiling extends from approximately Hondeklipbaai to Strandfontein. During summer the strong south-easterly winds would reduce the risk of shoreline oiling. The impact of a small to medium-sized operational spill on marine fauna and fishing is considered to range from **INSIGNIFICANT** and **LOW** significance with implementation of project-specific oil spill contingency plan.

5.1.2 ONSHORE TERRESTRIAL ENVIRONMENT

Onshore production pipeline

The key impacts on the onshore biophysical environment relate to the clearing of vegetation within the construction servitude (15 - 20 m wide) and trench excavation (1 - 1.5 m deep). These activities would have potential impacts on the vegetation, terrestrial fauna and freshwater resources. Many of these impacts are considered to be of short duration (8 to 10 months), as the pipeline would be backfilled and rehabilitated as the construction operation progresses. The duration of the impact on the vegetation would be longer as it is anticipated that successful revegetation would only be achieve over the medium-term, based the success of the revegetation of Atlantis Sand Fynbos vegetation along the existing Chevron pipeline.

The majority of the indigenous vegetation in the southern study area is Endangered or Critically Endangered, and as such much of the area around Ankerlig and along the R27 has been mapped as a CBA. The estimated extent of indigenous vegetation that would be cleared per alternative is presented in the table below. The vegetation impact ranges from **VERY LOW** to **LOW** significance with mitigation depending on which shore-crossing alternative is selected, and of **LOW** significance with mitigation for impact associated with the north-south corridor and east link to Ankerlig. Obviously the shorter the route the less vegetation would be affected.

Alternative	Estimated indigenous vegetation cleared	Main vegetation types
Grotto Bay to Ankerlig	47 ha	Cape Flats Dune Strandveld and Atlantis Sand Fynbos
Silwerstroom Stand to Ankerlig (three alternatives)	34 – 38 ha	
Duynefontein to Ankerlig	28 ha	Cape Flats Dune Strandveld

All the northern routes cross mainly farmland, although portions of the Noordwesbaai alternative pass through areas mapped as CBAs. In order to avoid the CBA area near the coast, the Noordwesbaai East alternative was proposed. The estimated extent of indigenous vegetation that would be cleared per alternative is presented in the table below. The vegetation impact ranges from **VERY LOW** (Noordwesbaai East and St Helena Bay West) to **LOW** (St Helena East) to **MEDIUM** (Noordwesbaai West) significance with mitigation depending on which pipeline route alternative is selected.

Alternative	Estimated indigenous vegetation loss	Main vegetation types
St Helena West	3 ha	Saldanha Flats Strandveld
St Helena East	4 ha	
Noordwesbaai (two alternatives)	11 – 14 ha	Langebaan Dune Strandveld and Saldanha Limestone Strandveld

Potential impacts on freshwater resources include the loss of wetland and riparian habitat, bed modifications, temporary impedance or diversion of flow, and increased sedimentation and turbidity of freshwater. The key aquatic features in the southern study area include the Silwerstroom / Buffels River System and its associated valley bottom wetlands, and in the northern study area the Bok River and the associated valley bottom wetlands, and the wider floodplain area of the Berg River Estuary. Due to the fact that much of the surrounding landscape has been developed either for agriculture or for urban activities, most of the freshwater features in the study area are already in a largely modified state. With regard to the southern pipeline routes, the Silwerstroom Strand alternatives are located in a relatively sensitive area in terms of ground and surface water interaction and as such the impact is considered to be of **LOW to MEDIUM** significance with mitigation. The impact associated with the Grotto Bay and Duynefontein alternatives are considered to be **INSIGNIFICANT to VERY LOW** with mitigation. With regard to the northern pipeline routes, the potential freshwater impact ranges from **INSIGNIFICANT** (St Helena East) to **VERY LOW** (St Helena West and Noordwesbaai) depending on which pipeline route alternative is selected.

The impact on terrestrial fauna is assessed to be of similar significance for all pipeline route alternatives (**INSIGNIFICANT to VERY LOW** significance with mitigation).

Onshore gas receiving facility

The onshore facility would occupy an area of approximately 1.85 ha. The potential impacts related to the onshore gas receiving facility are considered to range from medium- to long-term duration based on an anticipated field life of 15 years.

In general, the sites located adjacent to Ankerlig within the Atlantis Industrial Area are deemed to be less sensitive than the sites adjacent to the Silwerstroom Strand Water Treatment Plant. The vegetation impact ranges from **MEDIUM** significance for the Ankerlig sites (located in highly disturbed Cape Flats Dune Strandveld) to **HIGH** significance for the Silwerstroom Strand sites (located in Atlantis Sand Fynbos).

The onshore facility sites adjacent to the Silwerstroom Strand Water Treatment Plant are located in a relatively sensitive area in terms of ground and surface water interaction. The potential impact on freshwater resources in this area is thus considered to be of **LOW to MEDIUM** significance with mitigation, compared to the impact of **VERY LOW** significance for the site adjacent to Ankerlig.

The impact on terrestrial fauna is assessed to be of similar significance for all site alternatives (**INSIGNIFICANT to VERY LOW** significance with mitigation).

5.2 SOCIO-ECONOMIC ENVIRONMENT

Overall project

There is no reason to believe that the proposed project would have any macro-economic consequences for the economy or engender any marked benefits. The project is not of a size that would have an impact on the exchange rate or on the interest rate. There is also too little information to determine whether the project would generate a net inflow of foreign funds, as it is not known if funds would be sourced locally or internationally. If obtained within South Africa the stimulatory effects of the spending would merely be displacing the stimulatory effects of any alternative project, which those funds could have financed. On the other hand if the funding was to be sourced internationally this would constitute a positive financial injection into the economy. Although the capacity to manufacture and lay pipes, similar to those proposed, exists in South Africa, it is not known whether a local or foreign contractor would be used. The cost of the pipeline may, therefore, be an injection or a withdrawal from the national income. The macro-economic impact is, therefore, considered to be of **LOW (positive, negative or neutral)** significance depending of where the finds are sourced and local content. On a regional level the proposed project is line with the planning frameworks for the region and the development of the gas industry in the Western Cape, and as such is expected to have positive impact of **LOW (positive)** significance.

The proposed project could also have a positive impact on energy security and diversification of the country's energy mix, with added benefit to Eskom in the form of lower energy costs and reduced carbon emissions. This impact is assessed to be **LOW (positive)** significance. An external benefit of using gas at Ankerlig would be reduced carbon emissions. Currently South Africa is one of the most carbon intensive economies in the world relying on coal-powered energy to meet almost 90% of its energy needs. The conversion of Ankerlig from diesel to gas would reduce carbon emissions. The impact associated with the generation of "clean" energy is assessed to be **HIGH (positive)**.

The proposed development would stimulate direct and indirect employment opportunities over the duration of the proposed project, as well as result in skills and SMMEs being developed in the study area. Although the proposed project would be a relatively small employer, any job opportunities would undoubtedly have a positive impact in the project area. Direct employment associated with the proposed project is projected as follows:

- 665 - 772 jobs during the design and construction phase (**LOW positive** significance with mitigation);
- 100 - 141 jobs during the operational phase (**MEDIUM positive** significance with mitigation); and
- 60 - 80 jobs during the decommissioning phase (**LOW positive** significance with mitigation).

Since the proposed project constitutes a new economic activity for the study area and beyond, all salary and related revenue generated by the proposed project would be additional. The impact of income and related economic dependency is considered to be of **HIGH (positive)** significance with mitigation.

Offshore production pipeline

The impact on the various fishing sectors active along the proposed pipeline route during installation would be limited to the 500 m safety zone around the pipe-lay vessel, which would be highly localised and of very short-term duration (3 - 4 months). This potential impact ranges from **INSIGNIFICANT** (demersal trawl, demersal long-line, large pelagic long-line, tuna pole, traditional line-fish) to **VERY LOW** (small pelagic purse-seine, West Coast rock lobster). Key mitigation includes ensuring that prior notification is provided to the fishing industry and that Radio Navigation Warnings and Notices to Mariners are released throughout the installation period.

The installation of the proposed production pipeline on the seabed from the production platform to the shore-crossing sites could disturb historical shipwrecks. However, since all known shipwrecks off the coast occur in waters shallower than 100 m and within 50 km of the coast, it is unlikely that the majority of the offshore pipeline would encounter any historical shipwrecks. Offshore of the southern pipeline shore-crossing sites there are no accounts of any historical shipwrecks on the South African National Maritime database. In the northern study area, there are two references to shipwrecks in the St Helena Bay area, although the exact positions of these shipwrecks are not known. With careful routing of the pipeline and the avoidance of any identified shipwrecks during a pre-construction geotechnical survey, the significance is considered to be **LOW** for all pipeline route alternatives.

Although the proposed pipeline would not be protected by a 500 m safety zone, it is afforded some protection in terms of the Marine Traffic Act, 1981 (e.g. a vessel is not permitted to drop anchor or demersal trawl within 500 m of a pipeline). Thus during the operational phase, the pipeline would only potentially affect those sectors that have gear that comes into contact with the seafloor, namely:

- Demersal trawl: The pipeline would pass through one grid block along its length (i.e. Grid Block 441 offshore of Saldanha Bay), which equates to approximately 0.02% and 0.07% of the national catch and effort, respectively. The impact is thus considered to be permanent (due to abandonment of pipeline) and of **VERY LOW** significance.

- Demersal long-line: Although anchors may not be dropped within 500 m of the pipeline, it is conceivable that a line could be set over the pipeline. During the period 2000 to 2013, some effort was recorded within grid blocks through which the pipeline would pass. The impact is considered to be of **VERY LOW** significance. The area would open up to fishing after decommissioning.
- West Coast rock lobster: Vessels could potentially set traps within 500 m of the pipeline, however, not over or in very close proximity to the pipeline. The impact is considered to be of **VERY LOW** (Noordwesbaai, Silwerstroom Strand and Duynefontein) to **LOW** (Grotto Bay and St Helena Bay) significance. The area would open up to fishing after decommissioning.

Onshore pipeline

Onshore pipeline installation could have visual, farming and tourism impacts. However, these impacts are expected to be of very short duration (8 – 10 months), as the pipeline would buried underground and farming can recommence once the pipeline has been laid. These impacts are expected to be **INSIGNIFICANT to LOW** significance with mitigation for all southern and northern pipeline routes alternatives.

The installation of the proposed pipeline through the coastal zone to the onshore facility or termination point could disturb cultural heritage material, including early fish traps, fossils, shell middens and other archaeological material. In the southern study area no archaeological material was noted along any of the pipeline routes. However, shell midden material was found at the Grotto Bay shore-crossing site. Due to the presence of pleistocene fossils within the Koeberg Nature Reserve, it is anticipated that palaeontological material could be encountered along all routes. In the northern study area, there is a historic fish trap (Grade lllA) in the vicinity of the St Helena West shore-crossing. Should the avoidance of the fish trap not be possible, localised demolition of a fish trap may be necessary, which would also require a heritage permit from the South African Heritage Resources Agency (SAHRA). The potential heritage impact associated all alternatives is considered to be of **LOW** significance with mitigation.

Onshore gas receiving facility

The proposed gas receiving facility at Silwerstroom Strand would be visible by users at the northern part of the Silwerstroom Strand resort. The potential visual impact is assessed to be of **MEDIUM** significance with mitigation. The site alternatives adjacent to Ankerlig have a moderately high visual absorption capacity due to their location adjacent to the Ankerlig Power Stations and location in the Atlantis Industrial Area, which results in an impact of lower significance (**LOW** significance with mitigation).

5.3 HUMAN HEALTH

Offshore production facility

No emission standards were exceeded for all offshore operations and all simulated “ground” level concentrations comply with National Ambient Air Quality Standards (NAAQS). There were also no offsite exceedances of the inhalation screening criteria for non-criteria pollutants (including Volatile Organic Compounds (VOCs), Hydrogen Chloride, Hydrogen Fluoride and Mercury). During operation the potential impact on employees and contractors from criteria and non-criteria pollutants is considered to be of **VERY LOW** significance with mitigation.

Onshore pipeline and facility

During construction atmospheric emissions and air quality impacts would occur as a result of land clearing, excavations grading, bulldozing, compaction, etc. The overall impact related to criteria pollutants (PM2.5 and PM10) is assessed to be of **VERY LOW** significance with mitigation for all pipeline routes and onshore facilities sites. For onshore facility operations, no emission standards were exceeded and all simulated ground level concentrations comply with NAAQS. There were also no offsite exceedances of the inhalation screening criteria for non-criteria pollutants (including VOCs). The impact during operation at the onshore gas receiving facility from criteria and non-criteria pollutants is considered to be of **LOW** significance with and without mitigation and for all proposed onshore facilities sites.

The main risk associated with the proposed onshore pipeline and gas receiving facility relate to a loss of containment of natural gas, with the main hazards being (1) the thermal radiation from jet or flash fires, and (2) overpressure from Vapour Cloud Explosions (VCEs). In terms of the maximum individual risk, the risk associated with all pipeline routes is classified as a “trivial risk” in terms of the internationally recognised ALARP triangle. In terms of societal risk, which takes into account population density, the Grotto Bay shore-crossing, passes relatively close to the Grotto Bay residential area is expected to yield a slightly higher societal risk than Silwerstroom Strand and Duynefontein. However, these risks can be reduced with the recommended engineering design. The northern shore-crossings are all considered to have the same societal risks. The impact associated with an unlikely loss of containment is considered to be of **LOW** significance with mitigation for all pipeline route alternatives.

5.4 COMPARATIVE ASSESSMENT OF PROJECTS ALTERNATIVES

5.4.1 PRODUCTION FACILITY

All potential impacts associated with the normal operation of either a FPSO or semi-submersible production platform are assessed to be of similar significance. These include:

- Disturbance to seabed;
- Emissions to the atmosphere;
- Discharge of waste to sea;
- Fauna attraction to production facility; and
- 500 m safety zone around the production facility.

There are no additional impacts or differences in impact significance relating to the choice of production facility that may be used for this proposed project.

5.4.2 PIPE-LAYING METHOD

Two offshore pipeline installation methods may be employed, namely S-Lay and J-Lay methods. Although the S-Lay method is the most likely there are no additional impacts or differences in impact significance relating to the choice of installation method.

5.4.3 OFFSHORE PIPELINE ALIGNMENT

The pipeline would be located roughly parallel to the coast between the 100 m and 250 m contour line. Although the final routing of the pipeline would ultimately be determined by a subsea route and site survey, this S&EIA takes into consideration that the proposed offshore pipeline alignment is indicative and that the final pipeline alignment may be adjusted , as needs be, in order to avoid significant topographic features and sensitive benthic habitats.

The potential impact on the marine benthic environment and significance thereof is ultimately dependent on whether any vulnerable or sensitive benthic communities occur within the selected pipeline alignment. Similarly, the potential impact on cultural heritage material (e.g. historical shipwrecks) is dependent on whether any historical shipwrecks are located nearby. Thus in order to minimise the significance of these potential impacts, it is recommended that the final pipeline alignment be adjusted , as needs be, in order to avoid any significant topographic features, vulnerable habitats / species or historical shipwrecks.

5.4.4 SOUTHERN SHORE-CROSSING AND ASSOCIATED PIPELINE ALIGNMENTS

A comparative assessment of the southern pipeline routes is presented in Table 4 below. Impacts for all these alternatives range from **INSIGNIFICANT** to **LOW – MEDIUM** with mitigation. Thus from an impact significance level perspective, all route alternatives are deemed feasible for implementation.

Table 4: Comparative assessment of the southern pipeline route impacts.

Environmental aspect		Southern pipeline routes				
		Grotto Bay	Silwerstroom Strand			Duyne-fontein
			North (Alt 1)	Central (Alt 2)	South (Alt 3)	
Biophysical	Disturbance of seabed	L	L	L	L	L
	Disturbance of coastal zone	INSIG	VL	VL	VL	VL
	Noise, vibrations and blasting	INSIG	VL	VL	VL	VL
	Vegetation	VL	L	L	L	L
	Terrestrial fauna	INSIG - VL	INSIG - VL	INSIG - VL	INSIG - VL	INSIG - VL
	Freshwater	INSIG	L - M	L - M	L - M	INSIG - VL
Socio-economic	Cultural heritage	L	L	L	L	L
	Visual	L	L	L	L	L
	Rock lobster sector	VL	INSIG	INSIG	INSIG	INSIG
	Farming	INSIG	INSIG	INSIG	INSIG	INSIG
	Tourism	VL	VL	VL	VL	INSIG
	Future land use	L	INSIG	INSIG	L	INSIG
Human health	Air quality	VL	VL	VL	VL	VL
	Risk	L	L	L	L	L

Lower significance ⇨ to ⇨ Higher significance			
INSIG	**INSIG-VL to VL**	**L**	**L-M**

There are, however, differences between the alternatives in terms of the length of the pipeline and extent of the impacts at a localised scale. Pipeline route lengths (and extent of indigenous vegetation clearance) from longest to shortest are as follows:

- Grotto Bay: ±26.0 km (47 ha)
- Silwerstroom Strand:
  - > Alt 3: 17.3 km (34 ha)
  - > Alt 1: 18.6 km (36 ha)
  - > Alt 2: 19.4 km (38 ha)
- Duynefontein: ±13.9 km (28 ha)

The Duynefontein alternative, for most criteria, is considered to be the best alternative for the following reasons:

- it is the shortest onshore route and would result in the least disturbance to indigenous vegetation;
- it is located more than 200 m away from any residential areas;
- the coastal portion occurs within a restricted area; and
- the more simple installation method (i.e. trenching and bottom tow) could be used.

However, the key criterion that could be considered as a shortcoming of this alternative is that Eskom has expressed concerns relating to risk, possible pipeline failure and the safe operation of Koeberg Power Station. The proposed pipeline may change the power station's risk profile, which may require an amendment to the Koeberg Nuclear Emergency Plan.

If Eskom does not deem the Duynefontein alternative to be acceptable from a risk perspective, the Silwerstroom Strand pipeline alternatives are considered to be the next best option, although these alternatives would potentially result in a slightly higher freshwater impact. The reasons for Silwerstroom Strand being preferred over Grotto Bay are as follows:

- The pipelines would be shorter than the Grotto Bay alternative, resulting in the disturbance of between 9 ha to 13 ha less of indigenous vegetation;
- The societal risk at Silwerstroom Strand is expected to be a slightly lower, as the resort is not permanently used and at Grotto Bay the pipeline would be located approximately 40 m from an existing residential area at it closest point; and
- The Silwerstroom Strand alternative would require the more simple installation method (i.e. trenching and bottom tow), compared to Grotto Bay which would require the more complex horizontal directional drilling method.

Of the three Silwerstroom Strand alternatives, the northern alignment is preferred as it affects a smaller portion of the resort and avoids areas identified for possible future residential development on Farm Groote Springfontein to the south.

5.4.5 NORTHERN SHORE-CROSSINGS AND ASSOCIATED PIPELINE ALIGNMENTS

A comparative assessment of the northern pipeline routes is presented in Table 5 below. Impacts for all alternatives, with the exception of the Noordwesbaai West route, range from **INSIGNIFICANT** to **LOW-MEDIUM** with mitigation. Thus from an impact significance level perspective, the St Helena West, St Helena East and Noordwesbaai East route alternatives are all deemed feasible for implementation. The Noordwesbaai West route, which passes through an additional CBA close to the coast, is not considered feasible for implementation.

The key difference between the St Helena West, St Helena East and Noordwesbaai East alternatives relates to the extent of clearance of indigenous vegetation. The estimates loss of indigenous vegetation for these alternatives is as follows:

- Noordwesbaai East: 11 ha
- St Helena East: 4 ha
- St Helena West: 3 ha

The St Helena alternatives are preferred over the Noordwesbaai East alternative for the following reasons:

- They would result in significantly less clearance of indigenous vegetation;
- There is no or limited access to the coast, resulting in few possible visitors / tourists in close proximity to the pipeline;

- Existing farming practices and a possible future wind farm could continue after pipeline installation; and
- There would be no impact on future residential development.

Of the two St Helena alternatives, the eastern alignment is preferred as it avoids the early fish trap located in the vicinity of St Helena West.

Table 5: Comparative assessment of the northern pipeline route impacts.

Environmental aspect		Northern pipeline routes			
		St Helena West	St Helena East	Noordwesbaai West	Noordwesbaai East
Biophysical	Disturbance of seabed	L	L	L	L
	Disturbance of coastal zone	VL	VL	VL	VL
	Noise, vibrations and blasting	L	L	L	L
	Vegetation	VL	L	M	VL
	Terrestrial fauna	INSIG - VL	INSIG - VL	INSIG - VL	INSIG - VL
	Freshwater	VL	INSIG	VL	VL
Socio-economic	Cultural heritage	L	L	L	L
	Visual	L	L	L	L
	Rock lobster	INSIG	INSIG	VL	VL
	Farming	VL	VL	VL	VL
	Tourism	INSIG	INSIG	INSIG - VL	INSIG - VL
	Future land use	L-M	L-M	L-M	L-M
Human health	Air quality	VL	VL	VL	VL
	Risk	L	L	L	L
Lower significance ⇨ to ⇨ Higher significance					
INSIG	**INSIG-VL to VL**	**L**	**L-M**	**M**	

5.4.6 ONSHORE GAS RECEIVING FACILITY

The alternative facility sites located adjacent to Ankerlig are in general deemed to be less sensitive than the sites adjacent to the Silwerstroom Strand Water Treatment Plant, specifically with regard to vegetation, freshwater and visual impacts (see Table 6). The Ankerlig sites are located within an existing industrial area and the vegetation has already been heavily impacted by disturbance and the invasion by alien invasive species. The Ankerlig sites also have a greater visual absorption capacity, due to their location adjacent to an existing power station, resulting in a lower visual impact. The Silwerstroom Strand sites are also located in a relatively sensitive area in terms of ground and surface water interaction.

The finding of this assessment is that the Ankerlig sites are the preferred sites. The implication of this, however, is that the onshore pipeline would operate at a higher pressure for the majority of its length. The risk assessment has, however, classified the risk associated with all pipeline routes, operating at the higher pressure, as a “trivial risk” and concluded that there are no fatal flaws that could prevent the project proceeding.

Table 6: Comparative assessment of the onshore facility site impacts.

Environmental aspect		Onshore facility			
		Ankerlig		Silwerstroom Strand	
		1a	1b	2a	2b
Biophysical	Vegetation	M	M	H	H
	Terrestrial fauna	INSIG - VL	INSIG - VL	INSIG - VL	INSIG - VL
	Freshwater	L	VL	L - M	L - M
Socio-economic	Cultural heritage	L	L	L	L
	Visual	L	L	M	M
	Future land use	INSIG	INSIG	L	L
Human health	Air quality	L	L	L	L
	Risk	L	L	L	L

Lower significance ⇨ to ⇨ Higher significance					
INSIG	INSIG-VL to VL	L	L-M	M	H

5.4.7 NO-GO ALTERNATIVE

As the original NEMA and MPRDA approvals are still in place, the no-go alternative could on one hand relate to the implementation of the original project proposal, i.e. two subsea production pipelines to an onshore gas processing facility on the Northern Cape coast. The impacts associated with this alternative were assessed as part of the original S&EIA undertaken by Forest.

Alternatively, the no-go alternative could be the option of not proceeding with the proposed gas field development project in any form. In this case, the residual impacts (i.e. impacts after implementation of mitigation measures) of the proposed activities would not occur. The implications of not going ahead with the proposed project are as follows:

- South Africa would lose the opportunity to establish the extent of indigenous oil / gas reserves on the West Coast;
- South Africa would lose the opportunity to maximise the use of its own indigenous oil and gas reserves, and create an oil and gas industry on the West Coast;
- There would be lost economic opportunities related to sunken costs (i.e. costs already incurred by Sunbird) of exploration in the licence area;
- Ankerlig would continue to operate using diesel, which is an expensive and inefficient operation. Thus there would be a lost opportunity to lower energy costs;
- There would also be a lost opportunity to improve energy security and diversify the country's energy mix; and
- South Africa would continue to rely on coal to meet almost 90% of its energy needs. Thus there would be a lost opportunity to generate a ”cleaner” energy, which could have significance benefits for the regional and South Africa as a whole.

5.5 RECOMMENDATION / OPINION OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

The key principles of sustainability, including ecological integrity, economic efficiency, and equity and social justice, are integrated below as part of the supporting rationale for recommending an opinion on whether the proposed project should be approved.

- Ecological integrity

  The disturbance of benthic communities that would result from the offshore project components is considered negligible in relation to the available area of similar habitat on and off the edge of the continental shelf in the Atlantic Offshore Bioregion, which is classified as Least Threatened. In addition, the impact is localised and short-term with recovery expected within two to five years, (assuming as recommended the avoidance of rock outcrops / reefs). The impact associated with pipeline installation should be weighed up against the potential biophysical benefits that may result from the presence of the pipeline on the seabed, which could be colonised by vulnerable / sensitive benthic species.

  Although the southern pipeline routes would result in the clearance of Endangered and Critically Endangered vegetation, which have been largely mapped as CBAs, it is not possible to avoid these sensitive areas between the coast and Ankerlig. Since the pipeline would be buried, it would allow the majority of the pipeline servitude to be rehabilitated after installation. Successful rehabilitation is deemed to be achievable based on the success of the revegetation along the existing Chevron pipeline. The northern pipeline routes have been aligned to cross mainly farmland and largely avoid indigenous vegetation.

  The conversion of Ankerlig from diesel to gas would reduce carbon emissions. Currently South Africa relies on coal to meet almost 90% of its energy needs. The generation of “clean” energy could have significance benefits for the regional and South Africa as a whole.

  In summary, the proposed project would result in the loss of some ecological integrity in the study area, which with successful rehabilitation in case of the onshore pipeline would ensure that this loss is minimal. At the same time the proposed project would have a positive contribution to air quality.

- Economic efficiency

  Due to the size of the project there is no reason to believe that the proposed project would have any significant positive or negative macro-economic consequences for the economy. It is also not known whether the project would generate a net inflow of foreign funds, as it is not known if funds would be sourced locally or internationally. On a regional level the proposed project is in line with the planning frameworks for the region and the development of the gas industry in the Western Cape. It would also improve energy security and would diversify the country’s energy mix, with added benefit to Eskom in the form of lower energy costs.

  Since the onshore pipeline would be buried visual, current land use (e.g. farming) and tourism impacts would be limited. Future development would, however, need to take cognisance the pipeline location and may require an appropriate physical separation depending on the nature of any other proposed activities.

  During operation, the offshore production pipeline would only affect those sectors that have gear that comes into contact with the seafloor (namely demersal trawl, demersal long-line and West Coast rock lobster). After decommissioning, however, it is only the demersal trawl sector, which generally operates offshore of the proposed offshore pipeline route, that would be affected as the other two sectors would be able to fish over the abandoned pipeline.

The proposed development would stimulate direct and indirect employment opportunities over its duration, as well as result in skills and SMMEs being developed in the study area. Although the proposed project would be a relatively small employer, any job opportunities would undoubtedly have a positive impact in the project area.

The proposed project is considered to be economically efficient, as it fits in with the development plan for the region and the development of a gas industry, improves energy security and diversifies the country's energy mix. The proposed project would also result in the Ankerlig Power Station operating on indigenous gas rather than diesel (refined from imported crude oil), which would be more cost effective. The proposed project could also provide opportunities for other industries to use the gas for operational activities, especially in the Saldanha area.

- Equity and social justice
  The proposed project would not unfairly discriminate, directly or indirectly, against any one party nor result in an unequal distribution of negative impacts.

It is the opinion of CCA that in terms of the sustainability criteria described above there is no reason why the proposed project should not receive a favourable decision with implementation of the proposed mitigation measures.

6. RECOMMENDATIONS

6.1 RECOMMENDATIONS TO MITIGATE BIOPHYSICAL IMPACTS

6.1.1 PRODUCTION PIPELINE

(a) Pipeline alignment

- A pre-installation site survey (using a ROV or similar device) should be undertaken along the entire pipeline route in order to confirm the presence or absence of any significant topographic features (e.g. rocky outcrops) and potential vulnerable deep water habitats (e.g. deep water reefs, vulnerable sponge fields and sea pen populations). The final pipeline alignment should, as far as practically possible, be adjusted to avoid any identified sensitive benthic habitats (see Figure 4.9, 4.10 and 4.14 in the main report);
- As far as is reasonably possible, the final pipeline alignment (including associated construction area) and onshore facility should be located at least 30 m outside of the delineated edge of any significant freshwater features. Where the pipeline route crosses streams or drainage lines, it should be aligned perpendicular to the watercourse in order to minimise the area of disturbance; and
- Any measures required to protect the pipeline below the ground should, as far as possible, be designed so as not to impede any subsurface flow that may exist.

(b) Pipeline installation

- As far as practically possible and where the geology allows it, the horizontal directional drilling method should be the preferred installation option. Although this method may only be suitable at Grotto Bay, it is recommended that a detailed geotechnical site investigation be undertaken to determine the possibility of using horizontal directional drilling at either St Helena Bay or Silwerstroom Strand where there is a rocky intertidal zone or potentially shallow bedrock beneath the sand;
- Blasting recommendations:
  > The blasting programme should be scheduled so as to avoid cetacean migration periods or winter breeding concentrations (beginning of June to end of November). In addition, the

summer breeding season of shore birds (primarily oystercatchers, gulls and terns) should also, where possible, be avoided.

  - The number of blasts should be restricted to the absolute minimum required and to smaller, quick succession blasts directed into the rock using a time-delay detonation;
  - All blasting activities should be conducted in accordance with recognised standards and safety requirements;
  - Pre-blast surveys should be undertaken to ensure the impact zone is clear of marine mammals and diving seabirds (large flocks) and only once the impact zone and an associated buffer zone (i.e. within a 2-km radius of blasting point) have been declared free of marine mammals and diving seabirds should blasting commence. It is also recommended that:
    - Observer teams are stationed some distances to the north and south of the blasting point (possibly just outside the impact zones) to monitor coastal dolphin movements immediately prior to any blasting. Observers are to be positioned at suitable vantage points (at some altitude) along the coast; and
    - Observers on land should record and report all sensitive fauna, their positions, occurrence of calves and direction of movement to the Operations Manager.
  - PAM should be considered to detect the presence of small cetaceans in the impact area prior to blasting. Such acoustic monitoring would support that undertaken visually from the land, and has the advantage monitoring during periods of poor visibility; and
  - As a blasting event may attract seals and scavenging birds to stunned or dead fish, the blasting programme should be scheduled to allow seals to leave the area before the next blasts commences; and
- Excavations should be backfilled, as soon as practically possible, in order to avoid keeping long sections of trench open for extended periods.

6.1.2 PRODUCTION FACILITY

(a) Production facility location

- A ROV (or similar device) should be used to survey the seafloor prior to platform installation in order to confirm the presence or absence of any significant topographic features, vulnerable habitats and / or species within the anchor spread area. The position of the facility should, as far as practically possible, be adjusted to avoid any identified sensitive benthic habitats and species.

(b) Lighting

- Light shielding should be implemented;
- Non-essential lighting should be minimised on all platforms to reduce nocturnal attraction. However, such measure should not undermine work safety aspects or concerns; and
- A monitoring programme of faunal attraction should be implemented where all seabird mortalities are logged.

(c) Normal discharges to sea

- Develop a waste management plan using waste hierarchy;
- Ensure compliance with MARPOL 73/78 standards;
- Deck drainage should be routed to a separate drainage system (oily water catchment system) for treatment to ensure compliance with MARPOL (15 ppm);
- All process areas should be bunded to ensure drainage water flows into the closed drainage system;
- Drip trays should be used to collect run-off from equipment that is not contained within a bunded area and the contents routed to the closed drainage system;
- Low-toxicity biodegradable detergents should be used in the cleaning of all deck spillages;

- All hydraulic systems should be adequately maintained and hydraulic hoses should be frequently inspected; and
- Spill management training and awareness should be provided to crew members of the need for thorough cleaning-up of any spillages immediately after they occur in order to minimise the volume of contaminants washing off decks.

(d) Accidental release of oil

- A project-specific oil spill contingency plan must be prepared and be in place at all times during operation. The oil spill contingency plan should include or address, but not be limited to, the following:
  - > Alert procedure;
  - > Initial / immediate actions;
  - > Oil Spill Response Options / Strategies;
  - > Roles and responsibilities (including Emergency Directory);
  - > Response Actions;
  - > Response termination procedure;
  - > Oil Spill Modelling Report;
  - > Oil Spill Risk Assessment (environmental sensitivities and priorities for protection);
  - > Oil Spill Response Equipment Inventory;
  - > Response technical guidelines and limitations;
  - > Response equipment and maintenance / Inspection plan;
  - > Facilities (including specification) and products (including MSDS manual); and
  - > Drills and training.
- A Shipboard Oil Pollution Emergency Plan (SOPEP) must be prepared for all support vessels and be in place at all times during operation;
- Training and exercise programmes must be established to ensure that the response activity can be effectively executed; and
- Onboard spill equipment and spill containment materials must be in place, maintained and positioned in clearly identified locations.

6.1.3 GENERAL CONSTRUCTION-RELATED RECOMMENDATIONS

Construction activities would be managed through the effective implementation of an Environmental Management Programme (EMP) (see Appendix 5 of the main report). The EMP sets environmental targets for Sunbird and its Contractors and reasonable standards against which their performance can be measured during each of the project life cycle phases (design, construction, operation and decommissioning).

The mitigation measures provided below were specifically raised by specialists and these have been included in the project-specific EMP.

(a) Permits

- A Coastal Water Discharge Permit or a General Discharge Authorisation must be obtained from DEA (Coastal Pollution Management) prior to discharging the hydrotest water;
- A vehicle access permit must be obtained from DEA (Branch Oceans and Coasts) prior driving in the coastal zone; and
- A permit must be obtained from prior to clearing or disturbing indigenous vegetation.

(b) Construction timing

- Construction in or adjacent to freshwater features should take place during a period of low flow (summer).

(c) Environmental Awareness

- A comprehensive Environmental Awareness Programme must be conducted amongst construction personnel.

(d) Site demarcation and clearing

- The 'working zone' should be kept to a minimum and no arbitrary movement of vehicles through the coastal zone, undisturbed vegetation and wetlands should be permitted. Once the pipeline alignment is finalised and the associated construction site is determined, the area located outside of the site should be clearly demarcated and regarded as a 'no-go' area;
- Construction vehicles should be restricted to clearly demarcated access routes and construction areas within the coastal zone. These areas should be defined in consultation with a marine / coastal ecologist;
- A 'Search and Rescue' operation (mainly for geophytes) should be undertaken in the CBAs along the Noordwesbaai alternative (see Figure 5.13 in the main report);
- Topsoil management:
  - Topsoil (top 300 – 400 mm) should be removed from areas to be disturbed along the entire pipeline servitude, including temporary activities such as storage and stockpiling, and stockpiled separately from the subsoil for rehabilitation purposes to ensure there is no contamination;
  - Stockpiles should be demarcated to minimise the risk of disturbance and contamination;
  - Stockpiles should not be compacted;
  - Stockpiles should be monitored regularly to identify any alien invasive plants, which should be removed when they germinate to prevent contamination of the seed bank;
  - Stockpiling should be for as short a period as possible. Thus topsoil should be replaced as the excavation and pipeline installation work progresses; and
  - Topsoil should be replaced after the subsoil has been replaced and compacted.
- Every effort should be made to save and relocate any amphibian, reptile, bird or mammal that cannot flee of its own accord, encountered during site preparation. In addition, excavations should be inspected for trapped animals every morning. Any animal encountered that cannot safely exit by its own accord should be removed to a suitable area immediately outside the construction footprint in a similar faunal habitat.

(e) Material and handling and maintenance

- All materials near watercourses must be properly stored and contained;
- Where reasonably practical, maintenance activities shall only be undertaken in a demarcated maintenance area above the high water mark;
- All vehicles and equipment should be kept in good working order and serviced regularly to ensure no there are no oils, diesel, fuel or hydraulic fluid leaks; and
- The Contractor shall ensure that there is always a supply of absorbent material (spill kit) readily available to absorb / breakdown spills. The quantity of such materials shall be able to handle the total volume of the hydrocarbon / hazardous substance stored on site.

(f) Toilets

- Ablution facilities must be located at least 30 m away from the river systems and wetland areas.

(g Concrete batching

- No concrete should be mixed in the intertidal zone or directly on the ground.

(h) Waste management

- Good house-keeping should form an integral part of the construction operations;
- Discharges from pipe-lay vessel should comply with MARPOL 73/78 standards;

- Contaminated runoff from construction areas should, where possible, be prevented from directly entering rivers / streams. Measures may include the use of sandbags, leaving a “natural berm” between a river and the excavation for as long as possible, cut-off trenches, straw bales or geofabric siltation barriers;
- No waste should be burnt or buried on site;
- Spilled concrete should be cleaned up on a regular basis;
- All rubble associated with construction activities should be removed after construction; and
- All artificial constructions or beach modifications (e.g. cofferdam, jetty or groin) must be removed after pipeline installation.

(i) Rehabilitation

- Any substantial sediment accumulations and stockpiles should be reshaped back as close to the original profile as possible;
- Laydown areas should be scarified to a depth of 100 mm to break up any compacted soil prior to topsoil replacement. This may, however, not be necessary in very sandy areas or where hard calcrete is found at the surface; and
- Seed, collected from adjacent areas in the same vegetation type, may be used during rehabilitation. However, no ‘foreign-sourced’ seed should be introduced, e.g. during hydroseeding.

6.2 RECOMMENDATIONS TO MITIGATE SOCIO-ECONOMIC IMPACTS

6.2.1 PRODUCTION PIPELINE ALIGNMENT

- A detailed geotechnical site investigation should be undertaken. If any shipwreck material or unexplained seabed anomalies are discovered during this detailed survey, the final position of the pipeline should be adjusted to avoid such features;
- Final design should, where possible, take the following into consideration:
  - > Natural rock gullies and low points of dunes should be preferred for pipeline alignment;
  - > Damage to exposed rock outcrops and blasting should be minimised;
  - > Stream and wetland areas should be avoided; and
  - > Access and haul roads should follow existing roads and firebreaks as far as possible.
- Sunbird should engage with adjacent offshore right holders to discuss the final pipeline alignment in order to reduce the risk of interference with anticipated future prospecting / exploration or mining / production operations. Sunbird should also engage with Mainstream Renewable Power to discuss the final alignment of the St Helena West and East alternatives in order to reduce the risk of interference with their proposed renewable energy project on Farm Nooitgedacht (specifically the location of wind turbines); and
- The offshore portion of the pipeline must be surveyed and accurately recorded on the South African Navy Hydrographic charts.

6.2.2 ONSHORE GAS RECEIVING FACILITY DESIGN

- Final design of the gas receiving facility should, where possible, take the following into consideration:
  - > Silwerstroom Strand alternatives:
    - Stream and wetland areas near the waste treatment facility should be avoided;
    - A planted earth berm (approximately 6 m) should be constructed to screen the facility from the resort, based on an approved landscape plan;
    - Earthy colours should be used to blend the structures with the natural surroundings; and

    - Outdoor lighting should be minimised. Low-level lighting and fit reflectors should preferably be used to avoid light spillage.
  > Ankerlig alternatives:
    - Development should be set back from main routes to allow for planted buffer strip;
    - A planted earth berm (approximately 3 m) should be constructed along Dassenberg Road and Charel Uys Drive;
    - Appropriate colours should be used to blend structures with the existing power station; and
    - Reflectors should be fitted to avoid light spillage.
- Parking should be located under shade structures or shade trees;
- Wire mesh fencing with a dark green or black finish should be used. Palisade-type fencing with timber or metal pales, or repetitive brick piers, should be avoided; and
- External signage should be confined to the entrance gate and signs intruding on the skyline should be avoided. Signage should be grouped and limited in size (<2 m^2).

6.2.3 SOCIAL RECOMMENDATIONS

(a) Employment and skills development

- Sunbird should promote jobs that are to be made available locally in advance in order to allow educational facilities and development agencies to develop or facilitate the development of more highly skilled and technical training;
- Initiatives such as the Atlantis Industrial Initiative should be utilised to understand the skills profiles of local communities and to match them with possible employment;
- A proactive and comprehensive skills development programme should be implemented during the pre-construction phase of the proposed project and should focus on developing direct and indirect skills and capacity in the local communities, so as to ensure that a high level of local content in resources, goods and services procurement is achieved over an extended period of time;
- Sunbird should work closely with industry organisations (e.g. SAOGA) to identify relevant business development and educational institutions with which to work;
- Sunbird should promote skills development, local content and beneficiation in their project policies; and
- Skills development should focus on developing skills in previously disadvantaged groups.

(b) Income and related economic dependency

- Sunbird should aim for as high a level of local content as possible during all project phases; and
- Sunbird should develop a parallel economies programme in the development of its skills development programme, which considers alternate or replacement economic activities after gas field closure.

(c) Gender balance

- Sunbird should proceed with a gender equity programme. The previous operator established a gender-based equity target of 10% and it is recommended that Sunbird target a similar level; and
- Sunbird should work closely with industry organisations (e.g. Women in Oil and Energy South Africa) to achieve their gender equity target.

(d) In-migration

- The number of jobs available should be effectively communicated to all potential job seekers and procurement policies and procedures should be implemented in order to manage in-migration and to ensure that local cultures are not marginalised; and
- Sunbird should use reputable labour brokers.

6.2.4 ECONOMIC-RELATED RECOMMENDATIONS

- Landowners should be compensated for any lost crops, exclusion, etc. as required by law;
- Agricultural land should be rehabilitated in consultation with the landowner; and
- Damaged facilities should be reconstructed / repaired.

6.2.5 GENERAL CONSTRUCTION-RELATED RECOMMENDATIONS

As noted in Section 6.1.3, construction activities would be managed through the effective implementation of an EMP. The mitigation measures provided below were specifically raised by specialists and these have been included in the project-specific EMP.

(a) Permits

- If it is not technically feasible to avoid cultural heritage sites / material (including historical shipwrecks, early fish traps, shell middens, etc.), a heritage permit must be obtained from SAHRA (for offshore sites / material) or HWC (for onshore sites / material) in order to disturb such sites / material.

(b) Notification and communication with key stakeholders

- Sunbird should engage timeously with all affected onshore landowners to discuss the scheduling of proposed pipeline installation in order to reduce the interference with farming activities (e.g. sowing, harvesting, etc.). Where possible, pipeline installation should be scheduled at a time that least interferes with farming practices;
- Prior to offshore pipeline installation the following key stakeholders should be consulted and informed of the installation programme (including navigational co-ordinates of production facility and pipeline, timing and duration of proposed activities) and the likely implications thereof (specifically the 500 m safety / exclusion zone around the pipe-lay vessel, production platform and subsea pipeline):
  - Fishing industry / associations: South African Tuna Long-line Association, South African Deep-sea Trawling Industry Association, South African Tuna Association, Fresh Tuna Exporters Association, South African Commercial Linefish Association, West Coast and Peninsula Commercial Skiboat Association, and South African West Coast Rock Lobster Association; and
  - Other key stakeholders: Department of Agriculture, Forestry and Fisheries (DAFF), DEA, PASA, Transnet National Ports Authority (ports of Cape Town and Saldanha Bay), South African Maritime Safety Authority (SAMSA), South African Navy Hydrographic office and adjacent prospecting / exploration right holders.

  These stakeholders should again be notified when installation activities are complete and the pipe-laying vessel is off location;
- Sunbird must request, in writing, the South African Navy Hydrographic office to release Radio Navigation Warnings and Notices to Mariners throughout the pipeline installation period. The Notice to Mariners should give notice of (1) the co-ordinates of the pipeline alignment, (2) an indication of the proposed installation timeframes, and (3) an indication of the 500 m safety zone around the pipe-ley vessel. These Notices to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible;
- Any fishing vessels located at a radar range of 12 nm from the pipe-laying vessel should be called via radio and informed of the navigational safety requirements; and
- Any dispute arising with adjacent prospecting / exploration or mining / production right holders should be referred to the Department of Mineral Resources and / or PASA for resolution.

(c) Construction timing

- Construction in or adjacent to freshwater features should take place during a period of low flow (summer); and

- Construction during the peak holiday/tourism season (Dec-Jan) should be avoided, especially at Grotto Bay, Silwerstroomstrand and Noordwesbaai.

(d) Heritage sites / material

- While continuous monitoring of pipeline excavation for palaeontological and archaeological material is not considered necessary for the entire pipeline route, it is recommended that the first 500 m from the coast be monitored by an archaeologist, where after spot checks should be carried out once every two weeks; and
- Should any human remains be disturbed, exposed or uncovered during excavation, these must immediately be reported the South African Police Service and, if suspected that the remains are older than 60 years, Heritage Western Cape (HWC).

6.3 RECOMMENDATIONS TO MITIGATE HUMAN HEALTH IMPACTS

6.3.1 AIR QUALITY

(a) General construction-related recommendations

- Vegetation clearing should, where possible, take place in a phased manner in order to retain vegetation cover for as long as possible;
- A dust control programme (e.g. water sprays) should be implemented to maintain a safe working environment, minimise nuisance for surrounding residential areas / dwellings and protect damage to natural vegetation, crops, etc. Exposed areas and material stockpiles should be adequately protected against the wind (e.g. wetting exposed soil / gravel areas during windy conditions, covering of material stockpiles, etc.);
- Hauling distances should be minimised; and
- Subsoil and topsoil should be stockpiled for as short a period as possible. Thus subsoil and topsoil should be replaced as the excavation and pipeline installation work progresses forward.

(b) Air quality monitoring

- A relatively short monitoring campaign (three months) should be undertaken using passive diffusive sampling methods to establish the trend in NO_2 and SO_2 air concentrations during operation. The proposed sampler locations are shown in Figures 8.3 (Ankerlig sites) and 8.4 (Silwerstroom Strand sites) in the main report.

6.3.2 RISK

(a) Design

All designs should be in full compliance (but not necessarily limited) with the Occupational Health and Safety Act, 1993 (No. 85 of 1993) and its regulations, the National Buildings Regulations and the Buildings Standards Act, 1977 (No. 107 of 1977) as well as local bylaws. The following design considerations are recommended:

- The minimum pipeline depth should be 1.2 m (i.e. soil cover over the top of the pipeline), unless rock prevents this depth. Under these circumstances, the American Society of Mechanical Engineers (ASME) 31.8 code should be followed;
- Pipeline alternatives:
  - > The location of the pipeline adjacent to the Chevron servitude should have a minimum separation distance of 0.75 m from the servitude boundary;
  - > The portion of the Grotto Bay pipeline route adjacent to the Grotto Bay residential area should have a design factor of at least 0.5 or lower (which would require thicker pipe walls) to ensure

that the proposed pipeline would be suitable for Class 2 (design factor = 0.5) or Class 3 (design factor = 0.4), as defined by the ASME 31 code; and

> Similarly, in anticipation of possible future development at or adjacent to Silwerstroom Strand, it is recommended to implement a design factor of at least 0.5 or lower.

- Surface Markers:
  - > Conspicuous concrete surface markers (or similar) should be erected along the onshore pipeline. These markers should be within visible distance of one another or when there is a change in direction;
  - > The marker should state at least the following on a background of sharply contrasting colours:
    - The word "Warning", "Caution" or "Danger" followed by the words "Natural Gas Pipeline". All letters should be at least 30 mm high with an approximate stroke of 10 mm;
    - The name of the operator and a telephone number (including area code) where the operator can be reached at all times; and
    - All information on markers should be in English and a local language of preference.
- Since the proposed pipeline would be considered a Major Hazard Installation (MHI), it is recommended that the risk assessment be reviewed and reassessed where necessary, with “as-built” engineering information. In preparation thereof, the following provisions are made:
  - > A recognised process hazard analysis (HAZOP, FMEA, etc.) should be completed for the proposed option prior to construction;
  - > A safety document detailing safety and design features reducing the impacts from fires, explosions and flammable atmospheres should be prepared. The built facility can then be audited against the safety document to ensure compliance;
  - > The risk assessment should be verified after completion of the final designs and layout, but prior to construction; and
  - > Emergency response documentation should be finalised with input from local authorities.

(b) Operation

- Early detection and leak detection:
  - > A regular visual survey of the pipeline servitude should be implemented, so as to be aware of all activities taking place in the vicinity of this servitude. This would provide an early warning of risky activities (e.g. unauthorised excavations in servitude) and preventative risk management actions can be implemented timeously;
  - > An effective leak detection programme should be developed to ensure that leaks are identified; and
  - > The following cathodic protection monitoring procedures are recommended:
    - Monthly checks should be undertaken on the condition and performance of the transformer rectifier units supplying cathodic protection to the pipeline;
    - Every six months, 24-hour continuous electro-potential recordings should be taken at appropriate intervals along the line to ascertain the adequacy of the cathodic protection;
    - Checks on the corrosion rate using corrosion coupons and corrosometer probes at the terminal end of the line should performed on an annual basis; and
    - If and where there are indications that the cathodic protection is inadequate, continuous over line surveys should be carried out to detect any breaks in the coating and to have a closer inspection of the levels of cathodic protection over the suspect parts of the pipeline. Direct Current (DC) Voltage Gradient and Close Interval Potential survey techniques should be used.
- Operating procedures:
  - > Operating procedures should emphasise the need to eliminate gas from the pipelines after commissioning, maintenance or launcher opening. Failure to degas the lines prior to commissioning would increase the risk of gasket leak or line failure;

    - Predictive maintenance should be scheduled for the maintenance of emergency shutoff and isolation valves;
    - A formal planned maintenance programme, including pig launchers/receivers, should be adhered to;
    - Operating procedures should highlight the risks associated with pigs becoming stuck, due to incorrect line-up/incompletely opened valves. It is recommended that a pig register be implemented; and
    - Pig position indicators should be maintained in an operating condition.
- Emergency Planning:
    - The local Disaster Management Plans must be updated with the Emergency Response Plan specifically developed for the pipeline;
    - Regular exercise of the Emergency Response Plan should be implemented; and
    - The Emergency Response Plan must contain the most recent information on responsible persons and contact details.

(c) Authority awareness

- The contents of the risk assessment should be communicated with the relevant authorities to ensure awareness of, and control over, future developments near the pipeline servitude. There should be appropriate physical separation between future development and the pipeline in order to reduce the probabilities and the consequences of incidents; and
- A programme of regular (e.g. annual) communication with the local authorities should be considered to ensure an ongoing awareness of pipeline servitude risks.

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LIST OF ACRONYMS, ABBREVIATIONS AND UNITS

ALARP	As low as reasonably practicable
ASME	American Society of Mechanical Engineers
BID	Background Information Document
Bcf	Billion cubic feet
BOD	Biological oxygen demand
CBA	Critical Biodiversity Area
CCA	CCA Environmental (Pty) Ltd
CITES	Convention on International Trade in Endangered Species
cm	centimetres
cm/s	centimetres per second
CO	Carbon monoxide
CO_2	Carbon dioxide
COGSA	Carriage of Goods by Sea Act, 1986 (No. 1 of 1986)
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea
CMS	Convention on Migratory Species
DAFF	Department of Agriculture, Forestry and Fisheries
dB	Decibel
DC	Direct Current
DEA	Department of Environmental Affairs
DEA&DP	Western Cape Government: Department of Environmental Affairs and Development Planning
DEA&NC	Northern Cape Government: Department of Environment Affairs and Nature Conservation
DSR	Draft Scoping Report
DWS	Department of Water and Sanitation
E	East
EAP	Environmental Assessment Practitioner
EASSy	Eastern Africa Submarine Cable System
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMP	Environmental Management Programme (required in terms of NEMA)
EMPr	Environmental Management Programme (required in terms of the MPRDA)
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Area
FPSO	Floating Production, Storage and Offloading Unit
FSR	Final Scoping Report
g/m^2	grams per square metre
g/m^3	grams per cubic metre
GN	Government Notice
GRT	Gross Registered Tonnage
HDD	Horizontal directional drilling
HEL	Higher explosive limits
HWC	Heritage Western Cape
HWS	high water spring
IAEA	International Atomic Energy Agency
I&APs	Interested & Affected Parties
IBA	Important Bird Area
ICRP	International Commission on Radiological Protection
IDZ	Industrial Development Zone
IEM	Integrated Environmental Management
IMO	International Maritime Organisation
ISO	International Standards Organisation
IUCN	International Union for Conservation of Nature
kts	knots
LEL	Lower explosive limits
LFL	Lower Flammable Limit
LUPA	Land Use Planning Act, 2014 (No. 3 of 2014)
m	Metres
m^2	Square metres
m^3	Cubic metre
MARPOL	International Convention for the Prevention of Pollution from Ships, 1973/1978

MEG	Mono-Ethylene Glycol
mg/l	Milligrams per litre
MHI	Major Hazard Installation
mm	Millimetres
MMscf/d	Million standard cubic feet per day
MPA	Marine Protected Area
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002)
m/s	Metres per second
mT	Metric tons
N	North
NAAQS	National Ambient Air Quality Standards
NBSA	National Biodiversity Spatial Assessment Report
NEMA	National Environmental Management Act, 1998 (No. 107 of 1998)
NEM:AQA	National Environmental Management: Air Quality Act (No. 39 of 2004)
NEM:BA	National Environmental Management: Biodiversity Act (No. 10 of 2004)
NEM:ICMA	National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008)
NEM:WA	National Environmental Management: Waste Act, 2008 (No. 59 of 2008)
NHRA	National Heritage Resources Act, 1999 (No. 25 of 1999)
NNW	North-north-west
NO_X	Nitrogen oxides
NW	North-west
NWA	National Water Act, 1989 (No. 73 of 1989)
OCGT	Open Cycle Gas Turbine
OPRC	Oil Pollution Preparedness, Response and Co-operation
PASA	Petroleum Agency of South Africa
PICC	Presidential Infrastructure Co-ordinating Commission
PIM	Particulate Inorganic Matter
POM	Particulate Organic Matter
PRDW	Prestedge Retief Dresner Wijnberg Coastal Engineers
psi	Per square inch
RFI	Request for Information
ROV	Remotely Operated Vehicle
S	South
S&EIA	Scoping and Environmental Impact Assessment
SAFE	South Africa Far East
SAHRA	South African Heritage Resources Agency
SAMSA	South African Maritime Safety Authority
SAN	South African Navy
SANBI	South African National Biodiversity Institute
SAT3	South Atlantic Telecommunications cable no.3
SAWS	South African Weather Service
SHEQ	Safety, Health, Environmental management and Quality control
SIPs	Strategic Integrated Projects
SLP	Social and Labour Plan
SO_X	Sulphur oxides
SSW	South-south-west
SW	South-west
t	Tons
TAC	Total Allowable Catch
TAE	Total Applied Effort
TLP	Tension Leg Platform
TSPM	Total Suspended Particulate Matter
UNCLOS	United Nations Convention on Law of the Sea, 1982
VCEs	Vapour Cloud Explosions
VMEs	Vulnerable Marine Ecosystems
VOCs	Volatile Organic Compounds
VOS	Voluntary Observing Ships
W	West
WACS	West Africa Cable System
WASC	West African Submarine Cable
WBM	Water-based mud
WCDM	West Coast District Municipality
WSW	West-south-west

µg	Micrograms
µm	Micrometre
µg/l	Micrograms per litre
µPa	Micro Pascal
°C	Degrees Centigrade
%	Percent
‰	Parts per thousand
<	Less than
>	Greater than
"	Inch

1. INTRODUCTION

This chapter describes the purpose of this report, provides a brief description of the project background, summarises the legislative authorisation requirements, and describes the structure of the report and the opportunity for comment.

1.1 PURPOSE OF THIS REPORT AND OPPORTUNITY TO COMMENT

This Draft Environmental Impact Report (EIR) is being distributed for public review and comment as part of a Scoping and Environmental Impact Assessment (hereafter referred to as "S&EIA") process that is being undertaken for the proposed development of the Ibhubesi Gas Project.

This report summarises the process followed to date and provides a description of the proposed project and affected environment. It also presents the findings of the specialist studies and provides an assessment of the impacts of the proposed project.

Interested and Affected Parties (I&APs) are asked to comment on this Draft EIR (see Section 1.6). Comments received will be collated into a Comments and Responses Report. A Final EIR will then be compiled which will give due consideration to the comments received.

1.2 PROJECT BACKGROUND

Sunbird Energy (Ibhubesi) Pty Ltd (Sunbird) and its partner, the Petroleum Oil and Gas Corporation of South Africa (Pty) Ltd (PetroSA), currently have in place an Environmental Authorisation and hold a Production Right to develop the Ibhubesi Gas Field. Sunbird with a 76% interest in the Production Right is the operator of the block.

The Ibhubesi Gas Field is located in Licence Block 2A off the West Coast of the South Africa. The Production Right area is approximately 5 000 km^2 in extent and is located, at its closest point, approximately 60 km off the Northern Cape coast in water depths of between 200 m and 250 m (see Figure 1.1).

It was initially envisaged that the gas field would be linked via two subsea production pipelines to an onshore gas processing facility on the Northern Cape coast, where the gas would be processed before being compressed for distribution into an onshore export pipeline. The onshore export pipeline did not form part of the original project description, as this was considered to be a South African government initiative. As the onshore export pipeline did not materialise, Sunbird has re-evaluated the original development proposal in order to establish a market for the gas resources.

In October 2013 South Africa's power utility Eskom issued a request for information (RFI) for the supply and delivery of gas to its 1 350 MW Ankerlig Open Cycle Gas Turbine (OCGT) Peaking Power Station (ongoing referred to as "Ankerlig") near Atlantis, which currently operates using diesel as a fuel source. In response to this RFI, Sunbird is considering various additional and alternative project components, from what was originally approved, in order to supply indigenous gas feedstock to Ankerlig and potential end users on the Saldanha Peninsula. This revised project is now referred to as the "*Ibhubesi Gas Project*". The key additions / alternatives include the following (see Figure 1.1):

- The installation of either a floating production, storage and offloading unit (FPSO) or a semi-submersible production platform in the licence area;
- An approximately 400 km offshore pipeline (14- to 18-inch diameter) from the production facility to a shore-crossing site located between Grotto Bay and Duynefontein (i.e. the southern pipeline

alternatives) and one on the Saldanha Peninsula (i.e. the northern pipeline alternatives), in the Western Cape;

- An onshore pipeline between the shore-crossing site and Ankerlig and potential end users on the Saldanha Peninsula; and
- An onshore gas receiving facility, at a location adjacent to Ankerlig or the Silwerstroom Strand Water Treatment Plant.

1.3 KEY AUTHORISATION REQUIREMENTS

The proposed Ibhubesi Gas Project requires authorisation in terms of, *inter alia*, both the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA), as amended, and the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002) (MPRDA), as amended. These two regulatory processes are summarised briefly below and presented in more detail in Chapter 2.

The Environmental Impact Assessment (EIA) Regulations 2010[1], promulgated in terms of Chapter 5 of NEMA, require that Environmental Authorisation is obtained from the competent authority, the Department of Environmental Affairs (DEA), to carry out the proposed development of the Ibhubesi Gas Project. In order for DEA to consider the application for authorisation a S&EIA process must be undertaken.

In terms of Section 102 of the MPRDA, Sunbird is required to amend its approved Environmental Management Programme (EMPr) to take account of any changes in the project scope on which the current Production Right is based, and submit it to the Petroleum Agency of South Africa (PASA)[2] for consideration and subsequent approval by the Minister of Mineral Resources (or the delegated authority).

CCA Environmental (Pty) Ltd (CCA) has been appointed by Sunbird to undertake the S&EIA process and compile the EMPr Addendum. In order to avoid duplication, where possible, the NEMA and MPRDA processes have been combined and undertaken in parallel.

1.4 TERMS OF REFERENCE

CCA's terms of reference are as follows:

1. To undertake a S&EIA process for the proposed Ibhubesi Gas Project in accordance with the EIA Regulations 2010 promulgated in terms of Sections 24(5), 24M and 44 of NEMA focusing on the various additional project components from what was originally approved;
2. To compile an EMPr Addendum in order to meet the requirements of Section 39 and Regulation 51 of the MPRDA; and
3. To combine the NEMA and MPRDA processes, where possible, to avoid duplication but meet the legal requirements of both Acts.

[1] Note: The EIA Regulations 2010 have subsequently been replaced by the EIA Regulations 2014. The EIA Regulations 2014, however, make provision for transitional arrangements in order to accommodate applications submitted in terms of the previous regulations. Further details of the transitional arrangements are presented in Section 2.1.2.

[2] PASA is responsible for promoting, licensing, monitoring and data archiving of South Africa's petroleum exploration and production industry and is the designated agency in terms of the MPRDA.

1.5 STRUCTURE OF DRAFT EIR

The Draft EIR has been separated into three volumes:

1.5.1 VOLUME 1: MAIN REPORT

This volume consists of 10 chapters and five appendices, the contents of which are outlined below.

Section	Contents
Executive Summary	Provides a comprehensive synopsis of the Draft EIR.
Chapter 1	**Introduction** Describes the purpose of this report, provides a brief description of the project background, summarises the key legislative authorisation requirements, and describes the structure of the report and the opportunity for comment.
Chapter 2	**Legislative requirements and study process** Outlines the key environmental legislative requirements applicable to the proposed project, describes the methodology and I&AP consultation process followed in the S&EIA process.
Chapter 3	**Project description** Describes the needs and desirability for the proposed project, the history of the Ibhubesi Gas Field and the proposed Ibhubesi Gas Project (including project alternatives). The description of the proposed Ibhubesi Gas Project includes an overview of the development infrastructure both offshore and onshore, followed by a description of the proposed activities from construction through to the decommission phase of the project.
Chapter 4	**Description of the offshore marine environment** Provides a general overview of the physical and biological oceanography and human utilisation off the West Coast of South Africa and, where applicable, a detailed description of the marine environment that may be directly affected by the proposed project.
Chapter 5	**Description of the onshore terrestrial environment** Provides a general overview of the biophysical and socio-economic aspects of the environment associated with the proposed onshore pipeline routes and facility sites. A detailed description of the environment that may be directly affected by the proposed project is provided where applicable.
Chapter 6	**Impacts on the biophysical environment** Describes and assesses the potential impacts of the proposed project on the biophysical environment focusing on the offshore mainline environment and onshore terrestrial environment (vegetation, terrestrial fauna and freshwater ecology).
Chapter 7	**Impacts on the socio-economic environment** Describes and assesses the potential impacts of the proposed project on the socio-economic environment focusing on cultural heritage, aesthetics, fishing, and general social and economic aspects.
Chapter 8	**Impacts on human health** Describes and assesses the potential impacts of the proposed project on human health focusing of air quality and risk.
Chapter 9	**Conclusion and recommendations** Provides conclusions to the S&EIA and summarises the recommendations for the proposed project.
Chapter 10	**References** Provides a list of the references used in compiling this report.
Appendices	Appendix 1: DEA's acceptance of the FSR Appendix 2: Public Participation Process Appendix 2.1: I&AP database Appendix 2.2: Written comments received on the FSR Appendix 2.3: Comments and Responses Report Appendix 3: Convention for assigning significance ratings to impacts Appendix 4: Undertaking by the applicant Appendix 5: Environmental Management Programme

1.5.2 VOLUME 2: SPECIALIST STUDIES (PART 1)

This volume consists of six appendices, the contents of which are outlined below.

Section	Contents	
Appendices	Appendix 6:	Marine Ecology Assessment
	Appendix 7:	Fisheries Assessment
	Appendix 8:	Oil Spill Assessment
	Appendix 9:	Vegetation Assessment
	Appendix 10:	Freshwater Assessment
	Appendix 11:	Terrestrial Faunal Assessment

1.5.3 VOLUME 3: SPECIALIST STUDIES (PART 2)

This volume consists of six appendices, the contents of which are outlined below.

Section	Contents	
Appendices	Appendix 12:	Heritage Assessment
	Appendix 13:	Air Quality Assessment
	Appendix 14:	Risk Assessment
	Appendix 15:	Visual Assessment
	Appendix 16:	Social Assessment
	Appendix 17:	Economic Assessment

1.6 OPPORTUNITY TO COMMENT

This Draft EIR has been distributed for a 40-day comment period from **2 October to 11 November 2015** in order to provide I&APs with an opportunity to comment on any aspect of the proposed project and the findings of the S&EIA process. Copies of the full report have been made available on the CCA website (www.ccaenvironmental.co.za) and at the following locations:

Name of Facility	Physical Address
Cape Town Central Library	Drill Hall, Darling Street, Cape Town
Vredenburg Library	2 Akademie Street, Louwville, Vredenburg
Saldanha Library	Berg Street, Saldanha
Langebaan Library	Cnr Oostewal & Bree Street, Langebaan
Cape West Coast Biosphere Reserve offices	Cnr R27 & R315, West Coast Farmstall, Yzerfontein
Koeberg Library	Merchant Walk, Duynefontein, Melkbosstrand
Wesfleur Library	Wesfleur Circle, Atlantis
Avondale Library	Grosvenor Avenue, Avondale, Atlantis

Any comments on the Draft EIR should be forwarded to CCA at the address, telephone/fax numbers or e-mail address shown below. For comments to be included in the Final EIR, comments should reach CCA **no later than 11 November 2015**.

CCA Environmental (Pty) Ltd
Contact person: Jeremy Blood

Unit 39 Roeland Square, 30 Drury Lane, Cape Town, 8001
PO Box 10145, Caledon Square, 7905
Tel: (021) 461 1118/9; Fax: (021) 461 1120
E-mail: jeremy@ccaenvironmental.co.za

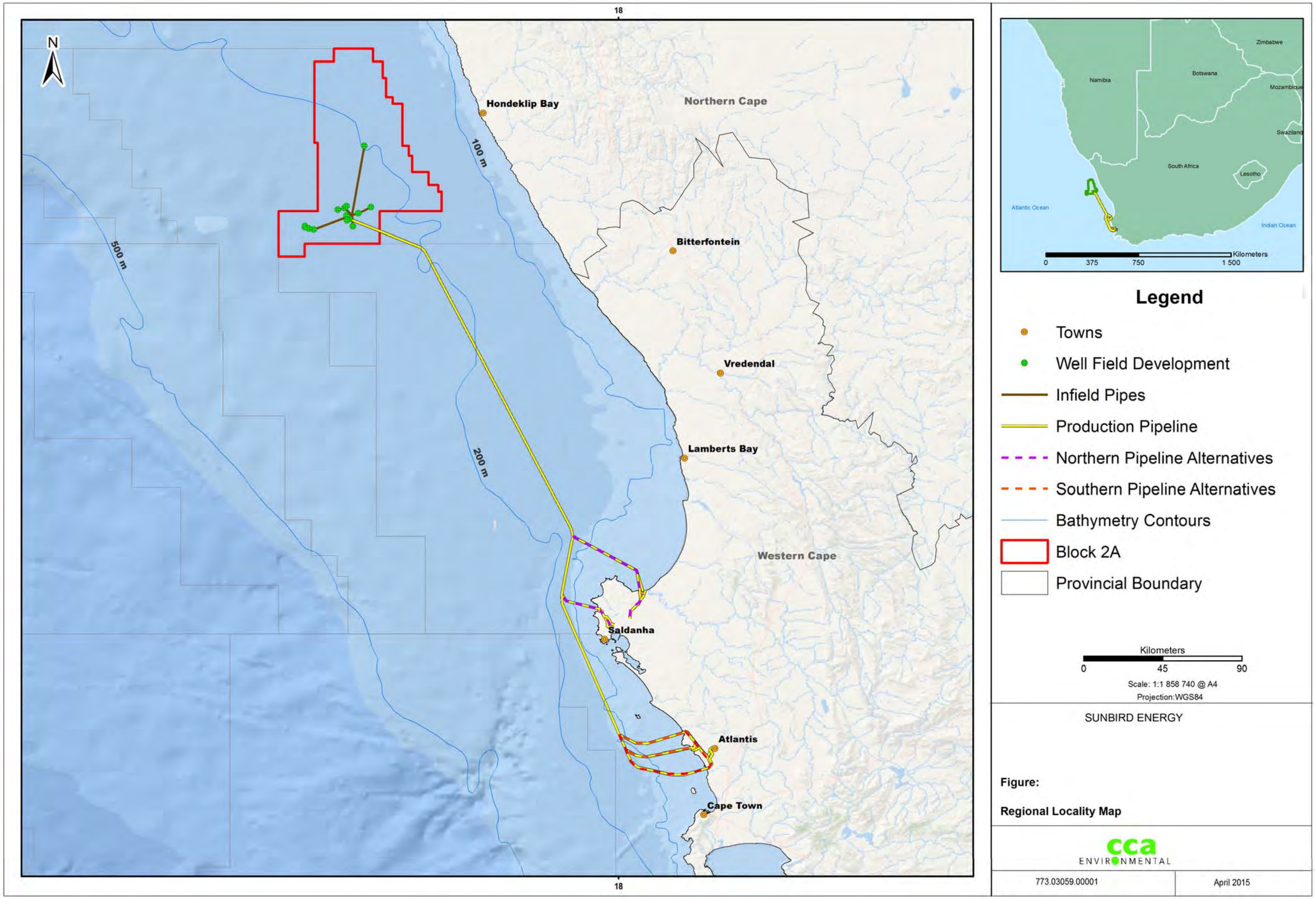


Figure 1.1: **Locality of Licence Block 2A off the West Coast of South Africa and the proposed Ibhubesi Gas Project.**

2. LEGISLATIVE REQUIREMENTS AND S&EIA PROCESS

This chapter outlines the key legislative requirements and guiding principles underpinning the S&EIA process and outlines the methodology and I&AP consultation process followed in the S&EIA.

2.1 LEGISLATIVE REQUIREMENTS

2.1.1 OVERVIEW OF THE "ONE ENVIRONMENTAL SYSTEM"

In 2007 / 2008, DEA and the Department of Mineral Resources (DMR) agreed that environmental regulation would be removed from the scope of the MPRDA and would be regulated under NEMA, which will give rise to a "One Environmental System" for the country relating to mining and related activities. The implementation of this was given effect by the National Environmental Management Amendment Act, 2008 (No. 62 of 2008) (NEMAA) and the Mineral and Petroleum Resources Development Amendment Act, 2008 (No. 49 of 2008) (MPRDAA).

In terms of Section 14(2) of the NEMAA, any provision relating to prospecting, mining, exploration and production would only come into operation on a date 18 months after the date of commencement of Section 2 of NEMAA or the MPRDAA, whichever is the later. As the MPRDAA was the later enactment coming into effect on 7 June 2013, any provision relating to prospecting, mining, exploration and production and related activities would come into effect on 8 December 2014. This meant that the requirement for both an EMPr under the MPRDA and an Environmental Authorisation under NEMA for triggered listed activities were to remain in place until 8 December 2014.

The 18 month period was, however, deleted by the promulgation of the National Environmental Management Laws Amendment Act, 2014 (No. 25 of 2014) (NEMLA 3) on 2 September 2014. Thus any provision relating to prospecting, mining, exploration and production and related activities in NEMAA also effectively came into effect on this date. However, as the effective implementation of the "One Environmental System" was dependent on various related regulations being in place, DEA issued a media statement on 3 September 2014 in which it stated that the South African Government had taken a decision to only implement the "One Environmental System" from 8 December 2014, when the whole suite of legislation and subordinate legislation necessary for the implementation of the "One Environmental System" is in effect.

The "One Environmental System" is now in place. Notwithstanding this, both NEMAA and NEMLA 3 make provision for transitional arrangements in order to accommodate applications submitted to the competent authority before 8 December 2014, such as the current S&EIA process. These provisions are as follows:

- In terms of Section 12(2) of NEMAA, an application for authorisation that is submitted in terms of Chapter 5 of NEMA and that is pending when NEMAA comes into effect must, despite the amendment of NEMA, be dispensed with in terms of Chapter 5 of NEMA as if Chapter 5 had not been amended; and
- In terms of Section 26 of NEMLA 3, an application for a Production Right in terms of the MPRDA that is pending when MPRDAA comes into effect must be dispensed with as if MPRDA had not been amended.

Thus, applications for Environmental Authorisation under NEMA and a Production Right under the MPRDA will continue as previously undertaken.

2.1.2 NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998

Section 2 of NEMA sets out a range of environmental principles that are to be applied by all organs of state when taking decisions that significantly affect the environment. Included amongst the key principles is that all development must be socially, economically and environmentally sustainable and that environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably. NEMA also provides for the participation of I&APs and stipulates that decisions must take into account the interests, needs and values of all I&APs.

Chapter 5 of NEMA outlines the general objectives and implementation of Integrated Environmental Management (IEM), which provides a framework for the integration of environmental issues into the planning, design, decision-making and implementation of plans and development proposals. Section 24 provides a framework for granting of environmental authorisations. In order to give effect to the general objectives of IEM, the potential impacts on the environment of listed activities must be considered, investigated, assessed and reported on to the competent authority. Section 24(4) provides the minimum requirements for procedures for the investigation, assessment and communication of the potential impact of activities.

2.1.2.1 EIA Regulations 2010

The EIA Regulations 2010 promulgated in terms of Chapter 5 of NEMA, and published in Government Notice (GN) No. R543, provides for the control of certain listed activities. These activities are listed in GN No. R544 (Listing Notice 1), R545 (Listing Notice 2) and R546 (Listing Notice 3) of 18 June 2010, and are prohibited until Environmental Authorisation has been obtained from the competent authority, in this case DEA[3]. Such Environmental Authorisation, which may be granted subject to conditions, will only be considered once there has been compliance with GN No. R543.

GN No. R543 sets out the procedures and documentation that need to be complied with when applying for environmental authorisation. A *Basic Assessment* process must be applied to an application if the authorisation applied for is in respect of an activity or activities listed in GN No. R544 and / or R546 and a *S&EIA* process must be applied to an application if the authorisation applied for is in respect of an activity or activities listed in GN No. R545. The proposed project includes activities listed in all three listing notices (see Table 2.1)[4], thus it is necessary that a full S&EIA process is undertaken in order for DEA to consider the application in terms of NEMA.

It should be noted that subsequent to the commencement of the S&EIA in terms of the EIA Regulations 2010, the regulations have been replaced by the EIA Regulations 2014, which were published on 4 December 2014 and came into effect on 8 December 2014. The EIA Regulations 2014, however, make provision for transitional arrangements in order to accommodate applications submitted in terms of the previous regulations and which are pending when the EIA Regulations 2014 took effect, despite the repeal of the previous regulations. Such applications must in terms of Regulation 53(1), be dispensed with in terms of the EIA Regulations 2010, as if these regulations had not been repeated. In addition, in terms of Regulation 53(3) where an application is pending and new activities are now applicable under the EIA Regulations 2014, these must be dispensed with in terms of the previous regulations on condition that all impacts associated with the newly identified activities have also been considered and adequacy assessed.

[3] DEA is the competent authority since the proposed project occurs within the Western Cape and offshore within the State-controlled Exclusive Economic Zone (EEZ). The offshore EEZ does not fall within the borders of any province of South Africa.

[4] It should be noted that the listed activities applicable to the proposed project and presented in Table 2.1 are slightly different to those presented in the Application Form, submitted to DEA in September 2013, due to subsequent information obtained from the Applicant, engineers and site visits. An amended Application Form will be submitted to DEA to address this issue.

Listed activities in terms of the EIA Regulations 2014 applicable to the proposed exploration drilling programme are presented in Table 2.2. All the potential impacts associated with the newly listed activities have been considered and adequately assessed in this S&EIA.

Table 2.1: List of applicable activities in terms of Listing Notice 1, 2 and 3 of the EIA Regulations 2010.

Activity No.	Activity Description	Description of activity in relation to the proposed project
GN No. R544		
11	*The construction of: (x) buildings exceeding 50 m^2 in size; and (xi) infrastructure or structures covering 50 m^2 or more, where such construction occurs within a watercourse or within 32 m of a watercourse, measured from the edge of the watercourse ...*	Depending on which alternative is selected the proposed onshore pipeline and gas receiving facility may be located within 32 m of a watercourse. Refer to Section 3.3.2 for a description of the proposed onshore infrastructure.
14	*The construction of structures in the coastal public property where the development footprint is bigger than 50 m^2, …*	The proposed onshore pipeline would pass through coastal public property. Refer to Section 3.3.2.1 for a description of the proposed shore-crossings and Section 3.3.3.2 for the possible installation methods.
16	*Construction or earth moving activities in the sea, an estuary, or within the littoral active zone or a distance of 100 m inland of the high-water mark of the sea or an estuary, whichever is the greater, in respect of:* *(vi) infrastructure covering 50 m^2 or more...*	The proposed offshore production facility would be located in offshore Licence Block 2A. In addition, the proposed production pipeline (both offshore and onshore) would be located in the sea, within the littoral active zone and a distance of 100 m inland of the high-water mark of the sea. This infrastructure would cover an area of 50 m^2 or more. Refer to Section 3.3.1 and 3.3.2 for a description of the proposed offshore and onshore infrastructure, respectively.
18	*The infilling or depositing of any material of more than 5 m^3 into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock or more than 5 m^3 from:* *(i) a watercourse;* *(ii) the sea;* *(iii) the seashore;* *(iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater…*	The installation of the onshore production pipeline would require the excavation and infilling / depositing of more than 5 m^3 of soil and sand from the sea, the seashore, the littoral active zone and a watercourse. In addition, access roads may be needed for construction vehicles depending on which pipeline route alternative is selected. Refer to Section 3.3.2.1 for a description of proposed shore-crossings and Section 3.3.3.2 for the possible installation methods.
22	*The construction of a road, outside urban area: (ii) where no road reserve exists the road is wider than 8 m, …*	Access along the pipeline would be required for construction vehicles. Where the pipeline is not located adjacent to existing roads, a temporary access road may need to be constructed within the pipeline servitude. After construction the pipeline servitude would be rehabilitated, except for an access track (one vehicle width). Refer to Section 3.3.2.1 for a description of the proposed construction activities.
23	*The transformation of undeveloped, vacant or derelict land to: (ii) …industrial … use outside an urban area and where the total area to be transformed is bigger than 1 ha but less than 20 ha, except where such transformation takes place (i) for linear activities…*	The applicability of this activity depends on which site alternative is selected for the proposed onshore gas facility. An onshore gas facility, which would be approximately 1 ha in extent, adjacent to the existing Silwerstroom Strand Water Treatment Plant

Activity No.	Activity Description	Description of activity in relation to the proposed project
24	*The transformation of land bigger than 1 000 m^2 in size, to … industrial … use, where, at the time of the coming into effect of this Schedule or thereafter such land was zoned open space, conservation or had an equivalent zoning.*	would trigger this activity as these sites are located outside an urban area. Refer to Section 3.3.2.2 for a description of the proposed onshore facility alternatives.
47	*The widening of a road by more than 6 m, or the lengthening of a road by more than 1 km:* *(i) where the existing reserve is wider than 13.5 m; or* *(ii) where no reserve exists, where the existing road is wider than 8 m…*	Existing access roads may need to be widened or lengthened for construction purposes depending on which pipeline route alternative is selected. Refer to Section 3.3.2.1 for a description of the onshore pipeline route alternatives and Section 3.3.2.1 for a description of the proposed construction activities.
GN No. R545		
3	*The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 m^3.*	The production facility and pipeline would handle and store more than 500 m^3 of condensate and gas, respectively. Refer to Section 3.3.1 and 3.3.2 for a description of the proposed offshore and onshore infrastructure, respectively.
4	*The construction of facilities or infrastructure for the refining, extraction or processing of gas, oil or petroleum products with an installed capacity of 50 m^3 or more per day, …*	The production facility, production pipeline and onshore gas receiving facility would have an installed capacity of more than 50 m^3 or more per day. Refer to Section 3.3.1 and 3.3.2 for a description of the proposed offshore and onshore infrastructure, respectively.
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.*	An Air Emissions Licence is required for the offshore production facility and onshore gas receiving facility. Refer to Section 3.3.1.2 for a description of the offshore production facility and Section 3.3.2.2 for a description of the onshore gas receiving facility.
6	*The construction of facilities or infrastructure for the bulk transportation of dangerous goods:* *(i) in gas form, outside an industrial complex, using pipelines, exceeding 1 000 m in length, with a throughput capacity more than 700 tons per day;* *(ii) in liquid form, outside an industrial complex, using pipelines, exceeding 1 000 m in length, with a throughput capacity more than 50 m^3 per day; …*	The production pipeline from the proposed production facility to the proposed onshore gas receiving facility would be longer than 1 000 m. Refer to Section 3.3.1 and 3.3.2 for a description of the proposed offshore and onshore infrastructure, respectively.
14	*The construction of … or any other permanent structure on or along the seabed ...*	The offshore production pipeline would be left in place on the seafloor during decommissioning. In addition, concrete mattresses and concrete blocks (less than 0.5 m high) used to stabilise the pipelines would be left on the seafloor. Refer to Section 3.3.1 for a description of the proposed offshore infrastructure.

Activity No.	Activity Description	Description of activity in relation to the proposed project
15	*Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 ha or more, …*	The proposed project footprint (including offshore and onshore production pipeline and onshore gas receiving facility) would be greater than 20 ha. Refer to Section 3.3.1 and 3.3.2 for a description of the proposed offshore and onshore infrastructure, respectively.
26	*Commencing of an activity, which requires an atmospheric emission license in terms of Section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), except where such commencement requires basic assessment in terms of Notice of No. R544 of 2010.*	An Air Emissions Licence is required for the offshore production facility and onshore gas receiving facility. Refer to Section 3.3.1.2 for a description of the offshore production facility and Section 3.3.2.2 for a description of the onshore gas receiving facility.
GN No. R546		
4	*The construction of a road wider than 4 m with a reserve less than 13.5 m.* *(d) In Western Cape:* *(ii) All areas outside urban areas;* *(iii) In urban areas:* *(aa) Areas zoned for use as public open space within urban areas; and* *(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority, or zoned for a conservation purpose…*	Access roads may be needed for construction vehicles depending on which pipeline route alternative is selected. These may be located outside urban areas or in urban area zoned as open space or for conservation purposes. An access track would also be required adjacent to the pipeline for maintenance, testing and inspection purposes. However, this is likely to be only one vehicle width. Refer to Section 3.3.2.1 for a description of the proposed construction activities and Section 3.3.4.2 for a description of the proposed access track required during operation.
12	*The clearance of an area of 300 m^2 or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation.* *(a) Within any critically endangered or endangered ecosystems listed in terms of Section 52 of the NEMBA…;* *(b) Within Critical Biodiversity Areas(CBAs) identified in bioregional plans;* *(c) Within the littoral active zone or 100 m inland from high water mark of the sea or an estuary, whichever distance is the greater, ...*	Clearing for the proposed onshore production pipelines and access roads would be greater than 300 m^2 within the littoral active zone or 100 m of the high water mark. In addition, the onshore pipeline and gas receiving facility would also result in the clearing of critically endangered vegetation, endangered vegetation and CBAs. Refer to Section 3.3.2 for a description of the proposed onshore infrastructure.
13	*The clearance of an area of 1 ha or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, …* *(a) CBAs and ESAs as identified in systematic biodiversity plans adopted by the competent authority.* *(c) In … Western Cape …:* *(ii) Outside urban areas, the following:* *(gg) Areas within 1 km from the high-water mark of the sea if no such development setback line is determined.*	Clearing for the proposed onshore production pipelines and access roads would be greater than 1 ha within 1 km of the high water mark. In addition, the onshore pipeline and gas receiving facility would also result in the clearing of critically endangered, endangered vegetation and CBAs. Refer to Section 3.3.2 for a description of the proposed onshore infrastructure.
14	*The clearance of an area of 5 ha or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, …* *(a) In …Western Cape …:* *(i) All areas outside urban areas.*	The proposed project is located outside an urban area and clearing would be greater than 5 ha. Refer to Section 3.3.2 for a description of the proposed onshore infrastructure.

Activity No.	Activity Description	Description of activity in relation to the proposed project
16	*The construction of:* *(iii) buildings with a footprint exceeding 10 m² in size; or* *(iv) infrastructure covering 10 m² or more,* *where such construction occurs within a watercourse or within 32 m of a watercourse, measured from the edge of a watercourse, ...* *(a) In … Western Cape:* *(ii) Outside urban areas, in:* *(ff) CBAs or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* *(ii) Areas within 1 km from the high-water mark of the sea if no such development setback line is determined.*	Depending on which alternatives is considered, the onshore production pipeline or onshore gas receiving facility may be located within 32 m of a watercourse within a CBA or 1 km from the high water mark. Refer to Section 3.3.2 for a description of the proposed onshore infrastructure.
19	*The widening of a road by more than 4 m, or the lengthening of a road by more than 1 km.* *(a) In … Western Cape …:* *(ii) All areas outside urban areas:…*	Existing access roads, outside an urban area, may need to be widened or lengthened for construction purposes depending on which pipeline route alternative is selected. Refer to Section 3.3.2.1 for a description of the onshore pipeline route alternatives and Section 3.3.2.1 for a description of the proposed construction activities.

Table 2.2: List of applicable activities in terms of the EIA Regulations 2014.

Activity No.	Activity Description	Description of activity in relation to the proposed project
Listing Notice 1 (GN No. R983)		
12	*The development of: (x) buildings exceeding 100 m² in size; and (xii) infrastructure or structures with a physical footprint of 100 m² or more, where such development occurs (a) within a watercourse or (c) if no development setback exists, within 32 m of a watercourse, measured from the edge of a watercourse…*	This activity is similar to Activity 11 in GN No. R544 (see Table 2.1).
15	*The development of structures in the coastal public property where the development footprint is bigger than 50 m²…*	This activity is similar to Activity 14 in GN No. R544 (see Table 2.1).
17	*Development-* *(i) in the sea;* *(iii) within the littoral active zone;* *(v) if no development setback exists, within a distance of 100 m inland of the high- water mark of the sea or an estuary, whichever is the greater;* *in respect of-* *(d) rock revetments or stabilising structures including stabilising walls;* *(f) infrastructure with a development footprint of 50 m² or more -…*	This activity is similar to Activity 16 in GN No. R544 (see Table 2.1).

Activity No.	Activity Description	Description of activity in relation to the proposed project
19	*The infilling or depositing of any material of more than 5 m^3 into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 m^3 from:* *(i) a watercourse;* *(ii) the seashore; or* *(iii) the littoral active zone, an estuary or a distance of 100 m inland of the high-water mark of the sea or an estuary, whichever distance is the greater…*	This activity is similar to Activity 18 in GN No. R544 (see Table 2.1).
22	*The decommissioning of any activity requiring -* *(i) a closure certificate in terms of section 43 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002); or* *(ii) a prospecting right, mining right, mining permit, production right or exploration right, where the throughput of the activity has reduced by 90% or more over a period of 5 years excluding where the competent authority has in writing agreed that such reduction in throughput does not constitute closure.*	In terms of Section 43(3) of the MPRDA, a closure certificate must be applied for upon, *inter alia*: • The lapsing, abandonment or cancellation of the right; • Cessation of the operation; • The relinquishment of any portion of the licence area; or • Completion of the prescribed closing plan to which a right relates. Sunbird would be required to apply for a closure certificate after decommissioning. Refer to Section 3.3.6 decommissioning and abandonment.
27	*The clearance of an area of 1 ha or more, but less than 20 ha of indigenous vegetation, except where such clearance of indigenous vegetation is required for (i) the undertaking of a linear activity;*	This activity is similar to Activity 23 in GN No. R544 (see Table 2.1).
28	*Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 1 April 1998 and where such development:* *(i) will occur inside an urban area, where the total land to be developed is bigger than 5 ha; or* *(ii) will occur outside an urban area, where the total land to be developed is bigger than 1 ha; …*	The northern pipeline routes cross mainly farmland. Portions of the southern pipeline route also cross farmland. Farming would, however, be able to recommence once the pipeline has been laid. The construction footprint would be larger than 5 ha. Refer to Section 3.3.2.1 for a description of the onshore pipeline route alternatives and Section 3.3.2.1 for a description of the proposed construction activities.
Listing Notice 2 (GN No. R984)		
4	*The development of facilities or infrastructure, for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 m^3.*	This activity is similar to Activity 3 in GN No. R545 (see Table 2.1).
5	*The development and related operation of facilities or infrastructure for the refining, extraction or processing of gas, oil or petroleum products with an installed capacity of 50 m^3 or more per day, ….*	This activity is similar to Activity 4 in GN No. R545 (see Table 2.1).
6	*The development of facilities or infrastructure for any process or activity which requires a permit or licence in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent, …*	This activity is similar to Activity 5 in GN No. R545 (see Table 2.1).

Activity No.	Activity Description	Description of activity in relation to the proposed project
7	*The development and related operation of facilities or infrastructure for the bulk transportation of dangerous goods:* *(i) in gas form, outside an industrial complex, using pipelines, exceeding 1 000 m in length, with a throughput capacity of more than 700 tons per day;* *(ii) in liquid form, outside an industrial complex, using pipelines, exceeding 1 000 m in length, with a throughput capacity of more than 50* m^3 *per day; …*	This activity is similar to Activity 6 in GN No. R545 (see Table 2.1).
14	*The development and related operation of:* *(i) an island;* *(ii) anchored platform; or* *(iii) any other structure or infrastructure on, below or along the sea bed; …*	This activity is similar to Activity 14 in GN No. R545 (see Table 2.1).
20	*Any activity including the operation of that activity which requires a Production Right as contemplated in Section 83 of the MPRDA, 2002, including associated infrastructure, structures and earthworks, directly related to the primary processing of a petroleum resource.*	As noted in Section 2.1.3, although Sunbird has an existing Production Right, the approved EMPr must be amended to take account of the changes in the project scope on which the current Production Right is based. Refer to Section 3.3 for a detailed description of the proposed project.
22	*Any activity including the operation of that activity associated with the primary processing of a petroleum resource including winning, extraction, classifying, concentrating, water removal, …*	Primary processing of natural gas would occur on the production facility. Refer to Section 3.3.4.2 for a description of offshore operation activities.
28	*Commencing of an activity, which requires an atmospheric emission license in terms of section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), …*	This activity is similar to Activity 26 in GN No. R545 (see Table 2.1).
Listing Notice 3 (GN No. R985)		
4	*The development of a road wider than 4 m with a reserve less than 13.5 m.* (f) In Western Cape: i. Areas outside urban areas; (aa) Areas containing indigenous vegetation; (bb) Areas on the estuary side of the development setback line or in an estuarine functional zone where no such setback line has been determined; or ii. In urban areas: (cc) Areas zoned for conservation use; or (dd) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority.	This activity is similar to Activity 4 in GN No. R546 (see Table 2.1).

Activity No.	Activity Description	Description of activity in relation to the proposed project
12	*The clearance of an area of 300 m^2 or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.* *(a) In Western Cape provinces:* *i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA…;* *ii. Within critical biodiversity areas identified in bioregional plans;* *iii. Within the littoral active zone or 100 m inland from high water mark of the sea or …; or* *iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning.*	This activity is similar to Activity 12 in GN No. R546 (see Table 2.1).
14	*The development of:* *(x) buildings exceeding 10 square metres in size;* *(xii) infrastructure or structures with a physical footprint of 10 square metres or more; where such development occurs:* *(a) within a watercourse;* *(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse; …* *(f) In Western Cape:* *i. Outside urban areas, in:* *(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* *(gg) Core areas in biosphere reserves;…*	This activity is similar to Activity 16 in GN No. R546 (see Table 2.1).
15	*The transformation of land bigger than 1 000 m^2 in size, to residential, retail, commercial, industrial or institutional use, where, such land was zoned open space, conservation or had an equivalent zoning, on or after 2 August 2010.* *(c) In Western Cape:* *i. Outside urban areas, …*	The applicability of this activity depends on which pipeline alternative is selected. The Duynefontein alternative would pass through the Koeberg Nature Reserve. Refer to Section 3.3.2.1 for a description of the onshore pipeline route alternatives.
18	*The widening of a road by more than 4 m, or the lengthening of a road by more than 1 km.* *(f) In Western Cape:* *i. All areas outside urban areas:* *(aa) Areas containing indigenous vegetation;* *ii. In urban areas:* *(aa) Areas zoned for conservation use; or*	This activity is similar to Activity 19 in GN No. R546 (see Table 2.1).

2.1.2.2 REGULATIONS FOR THE CONTROL OF USE OF VEHICLES IN THE COASTAL ZONE

These regulations promulgated in terms of Section 44 of NEMA, and published in GN 1399 (21 December 2001), provide for the control of vehicle use in the coastal zone. In terms of Regulation 6, any person intending to drive in the coastal zone should lodge an application for a vehicle access permit with the DEA (Branch Oceans and Coast) before driving in this area.

Construction activities associated with the proposed production pipeline in the coastal zone would require a permit for the use of vehicles in this zone or, alternatively, an exemption from the requirements of these regulations.

2.1.3 MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002

In terms of the MPRDA, a Production Right must be granted prior to the commencement of development activities. A requirement for obtaining a Production Right is that an EMPr for the operation must be compiled and submitted to PASA for consideration and approval by the Minister of Mineral Resources (or the delegated authority).

As noted earlier, Sunbird holds an existing Production Right and has an approved EMPr for the development of the Ibhubesi Gas Field. The approved EMPr on which the current approved Production Right is based must, however, be amended to take account of the changes in the project scope on which the current Production Right is based. In terms of Section 102 of the MPRDA, an EMPr may be amended with the written consent of the Minister (or the delegated authority). Thus an EMPr Addendum is required for the proposed additional project components related to the Ibhubesi Gas Project in terms of Section 102 of the MPRDA in order to meet the requirements of Section 39 and Regulation 51 (GN No. R527) of the said Act.

In terms of Section 39[5] of the MPRDA an EMPr must:

3(a) Establish baseline information concerning the affected environment to determine protection, remedial measures and environmental management objectives;

(b) Investigate, assess and evaluate the impact of the proposed project on:
- (i) The environment;
- (ii) The socio-economic conditions of any person who might be directly affected by the production operation; and
- (iii) Any national estate referred to in Section 3(2) of the National Heritage Resources Act, 1999 (No. 25 of 1999), with the exception of the national estate contemplated in Section 3(2)(i)(vi) and (vii) of that Act.

(c) Develop an Environmental Awareness Plan;

(d) Describe the manner in which the Applicant intends to:
- (i) Modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;
- (ii) Contain or remedy the cause of pollution or degradation and migration of pollutants; and
- (iii) Comply with any prescribed waste standard or management or practices.

In terms of Regulation 51 of the MPRDA an EMPr must include the following:

(a) A description of the environmental objectives and specific goals for:
- (i) Closure;
- (ii) Management of identified impacts;
- (iii) The socio-economic conditions as identified in the Social and Labour Plan; and
- (iv) Historical and cultural aspects, if applicable.

[5] In terms of Section 69(2)(b)(iv) “Mining Rights” must be construed as reference to “Production Rights”.

(b) An outline of the implementation programme which must include:
  (i) A description of the appropriate technical and management options chosen for each environmental impact, socio-economic condition and historical and cultural aspects for each phase of production;
  (ii) Action plans to achieve the objectives and specific goals contemplated in paragraph (a);
  (iii) Procedures for environmental related emergencies and remediation;
  (iv) Planned monitoring and EMPr performance assessment;
  (v) Financial provision in relation to the execution of the EMPr which must include:
    (aa) The determination of the quantum of the financial provision; and
    (bb) Details of the method providing for financial provision;
  (vi) An Environmental Awareness Plan;
  (vii) All supporting information and specialist reports; and
  (viii) An undertaking by the applicant to comply with the provisions of the Act and regulations thereto.

In terms of Section 84(1)(g) of the MPRDA an applicant for a Production Right must, *inter alia*, prepare and provide financially for a Social and Labour Plan. The objectives of the Social and Labour Plan are to:
(a) Promote employment and advance the social and economic welfare of all South Africans;
(b) Contribute to transformation; and
(c) Ensure that holders of a Production Right contribute towards the socio-economic development of the areas in which they are operating.

Sunbirds' existing Social and Labour Plan would also be amended (as a separate process to the S&EIA) to take cognisance of the proposed Ibhubesi Gas Project.

2.1.4 NATIONAL HERITAGE RESOURCES ACT, 1999

Section 38(1) of the National Heritage Resources Act, 1999 (No. 25 of 1999) (NHRA) lists development activities that would require authorisation by the responsible heritage resources authority. Activities considered applicable to the proposed project are presented in Table 2.3.

Table 2.3: List of applicable activities in terms of Section 38(1) of the NHRA.

Activity No.	Activity Description	Description of activity in relation to the proposed project
38(1)(a)	*The construction of a road, …, pipeline, … exceeding 300 m in length…*	The proposed production pipeline and access road / track would exceed 300 m in length.
38(1)(c)	*Any development or other activity which will change the character of a site: (i) exceeding 5 000 m^2 in extent; …*	The proposed onshore production pipeline and gas receiving facility would change the character the site in excess of 5 000 m^2.
38(1)(d)	*The rezoning of a site exceeding 10 000 m^2 in extent…*	The site selected for the onshore gas receiving facility, which would be in the order of 1 ha, may need to be rezoned.

The NHRA requires that a person who intends to undertake a listed activity notify the relevant provincial heritage authority at the very earliest stages of initiating such as development. The relevant provincial heritage authority would then in turn, notify the person whether a Heritage Impact Assessment (HIA) should be submitted. However, according to Section 38(8) of the NHRA, a separate report would not be necessary if an evaluation of the impact of such development on heritage resources is required in terms of the Environment Conservation Act (now replaced by NEMA) or any other applicable legislation. The decision-making authority should, however, ensure that the heritage evaluation fulfils the requirements of the NHRA and take into account in its decision-making any comments and recommendations made by the relevant heritage resources authority.

It should be noted that both the South African Heritage Resources Agency (SAHRA) and Heritage Western Cape (HWC) were notified of the proposed project during the Scoping Study Phase. SAHRA recommended that a HIA be undertaken as part of the S&EIA process.

In terms of Section 34(1) of the Act, no person may, without a permit issued by the responsible heritage resources authority, alter or demolish any structure or part of a structure which is older than 60 years. In terms of Section 35(4) of the Act, no person may, without a permit issued by the responsible heritage resources authority, destroy, damage, excavate, alter or remove from its original position, or collect, any archaeological material or object. In terms of Section 36(3) of the Act, no person may, without a permit issued by the responsible heritage resources authority, destroy, damage, alter, exhume or remove from its original position or otherwise disturb any grave or burial ground older than 60 years, which is situated outside a formal cemetery administered by a local authority.

2.1.5 NATIONAL WATER ACT, 1989

The National Water Act, 1989 (No. 36 of 1998) (NWA) provides a legal framework for the effective and sustainable management of water resources[6] in South Africa. It serves to protect, use, develop, conserve, manage and control water resources as a whole, promoting the integrated management of water resources with the participation of all stakeholders. In terms of this Act, all water resources are the property of the State and the S&EIA process is used as a fundamental management tool.

A Water Use Licence is required for any new water use that is not listed in Schedule 1 or that is not covered by a General Authorisation. Water uses that may require Water Use Licence or General Authorisation are listed in Table 2.4. A Water Use Licence authorisation application would need to be submitted to the Department of Water and Sanitation (DWS) Western Cape Regional Office for approval, if these activities are not considered to be Generally Authorised.

Table 2.4: List of possible water use activities in terms of the NWA.

<table>
<tr><th>Water Use No.</th><th>Water Use Description</th><th>Description of the water use in relation to the proposed project</th></tr>
<tr><td>21(c)</td><td>Impeding and diverting the flow of water in a watercourse</td><td rowspan="2">The proposed onshore pipeline, depending on which alternative is selected, may pass through a watercourse. In addition, access roads may be needed for construction vehicles depending on which pipeline route alternative is selected. An access track would also be required adjacent to the pipeline for maintenance, testing and inspection purposes.

These project components may require the temporary diversion of water and / or alter of the bed and banks of the watercourse.</td></tr>
<tr><td>21(i)</td><td>Altering the bed, banks, course or characteristics of a watercourse</td></tr>
</table>

2.1.6 NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT, 2004

On 1 April 2010, the National Environmental Management: Air Quality Act, 2004 (No. 39 of 2004) (NEM:AQA) came into force and repealed the Atmospheric Pollution Prevention Act, 1965. NEM:AQA regulates all aspects of air quality, including prevention of pollution, providing for national norms and standards and including a requirement for an Atmospheric Emissions Licence for listed activities, which result in atmospheric emissions and have or may have a significant detrimental effect on the environment

[6] A water resource includes a watercourse, surface water, estuary or aquifer, and, where relevant, its bed and banks. A watercourse means a river or spring; a natural channel in which water flows regularly or intermittently; a wetland, lake or dam, into which or from which water flows; and any collection of water that the Minister may declare to be a watercourse.

(including health and social conditions, economic conditions, ecological conditions or cultural heritage). In terms of Section 22 of NEM:AQA no person may conduct a listed activity without an Atmospheric Emission Licence.

GN No. 893 (22 November 2013), published in terms of Section 21(1)(b) of NEM:AQA, lists the activities that would require an Atmospheric Emission Licence. Since the proposed project triggers activities in GN No. 893, an application for an Atmospheric Emission Licence must be submitted to the relevant authority (e.g. City of Cape Town for onshore applications and DEA for offshore applications). The proposed project would also need to comply with the Minimum Emission Standards (MES) as set out in the list of activities. Activities applicable to the proposed project are presented in Table 2.5.

Since an Atmospheric Emissions Licence is required for the proposed project, the Air Quality Assessment (see Appendix 13) has been compiled in the format as prescribed by the regulations (General Notice 945 in Government Gazette 35883 of 23 November 2012) and includes sections required for the S&EIA. An application for an Atmospheric Emission Licence, together with the Air Quality Assessment, will be submitted to the relevant authorities during the S&EIA process.

Table 2.5: List of applicable activities in terms of the NEM:AQA.

Sub-category No.	Activity Description	Description of activity in relation to the proposed project
Category 2: Petroleum Industry, the production of gaseous and liquid fuels as well as petrochemicals from crude oil, gas or biomass		
2.1	*Combustion installations:* *Combustion installations not used primarily for steam raising or electricity generation (furnaces and heaters)*	The southern onshore gas receiving facility would include onshore heating to ensure the gas is delivered with sufficient heat to the Ankerlig Power Plant (water bath heathers). There may be other processes (e.g. compressors, gas fired turbines and boilers) that fall under this activity.
2.4	*Storage and handling of petroleum products:* *All permanent immobile liquid storage facilities at a single site with a combined storage capacity > 1 000 m³.*	The storage in excess of 1 000 m^3 of petroleum products (including natural gas and condensate) at the offshore production platform, in the production pipeline and at gas receiving facility trigger this activity.
Category 8: Thermal treatment of General and Hazardous Waste		
8.1	*Thermal treatment of General and Hazardous Waste:* *Facilities where general and hazardous waste are treated by the application of heat*	The offshore production platform (and possibly support / supply vessels) would have an onboard incinerator to treat non-toxic combustible wastes (e.g. galley waste). The incinerators would be able to treat more than 10 kg of waste per day.

2.1.7 NATIONAL ENVIRONMENTAL MANAGEMENT: WASTE ACT, 2008

The National Environmental Management: Waste Act, 2008 (No. 59 of 2008) (NEM:WA) regulates all aspects of waste management and has an emphasis on waste avoidance and minimisation. NEM:WA creates a system for listing and licensing waste management activities. Listed waste management activities above certain thresholds are subject to a process of impact assessment and licensing. Activities listed in Category A require a Basic Assessment process, while activities listed in Category B require a S&EIA process.

As there has been uncertainty as to the applicability of NEM:WA with regards to operations offshore this issue was raised with DEA. They subsequently responded that NEM:WA is not applicable to offshore oil and gas operations. The proposed onshore activities would not trigger the need for a Waste Management Licence.

2.1.8 NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004

National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEM:BA) provides for the management and conservation of South Africa's biodiversity and the protection of species and ecosystems that warrant national protection.

NEMBA regulates the carrying out of restricted activities that may harm listed threatened or protected species or activities that encourage the spread of alien or invasive species subject to a permit. The list of restricted activities does not directly apply to offshore production activities directly as they relate to the keeping, moving, having in possession, importing, exporting and selling of species.

NEM:BA also 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.

Within the published bioregional (spatial) plan, terrestrial and aquatic features that are critical for conserving biodiversity and maintaining ecosystem functioning are indicated as Critical Biodiversity Areas (CBAs). Bioregional plans provide the guidelines for avoiding the loss or degradation of natural habitat in CBAs with the aim of informing S&EIAs and land-use planning (including Environmental Management Frameworks (EMFs), Spatial Development Frameworks (SDFs), and Integrated Development Plans (IDPs)).

A number of marine biodiversity protection focus areas overlap with the proposed project area (see Section 4.4.6.7), and these have been taken into consideration in the assessment of potential impacts.

2.1.9 NATIONAL ENVIRONMENTAL MANAGEMENT: INTEGRATED COASTAL MANAGEMENT ACT, 2008

The National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008) (NEM:ICMA) establishes a system of integrated coastal and estuarine management in South Africa, including norms, standards and policies, in order to promote the conservation of the coastal zone, and to maintain the natural attributes of coastal landscapes and seascapes, and to ensure the development and the use of natural resources within the coastal region is socially and economically justifiable, as well as ecologically sustainable.

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 Environmental Authorisation for any development within the coastal zone, and the consideration of impacts on coastal public property, the coastal protection zone (defined as being within 1 km of the shoreline in rural areas) and coastal access land.

Chapter 8 and Schedule 2 provide integrated procedures for regulating the disposal of effluent and waste into the sea. NEM:ICMA intends to regulate the discharge of effluent into coastal waters from vessels (Sections 70 and 71) by requiring permits to authorise such discharges. Section 70 prohibits incineration at sea (note; this does not include the combustion of operational waste from a vessel, aircraft, platform or other man-made structure at sea) and restricts dumping at sea (note: this does not include operational waste from a vessel, aircraft, platform or other man-made structure at sea) in accordance with South Africa's obligations under international law. Section 71 provides requirements applicable to dumping permits.

The proposed project includes the development of infrastructure in the coastal zone and coastal protection zone, as well as the discharge of chemically treated seawater following the System Leak Test or hydrotest of the production pipeline (see Section 3.3.3.1). A Coastal Water Discharge Permit (CWDP) or a General Discharge Authorisation (GDA) must be obtained from DEA (Coastal Pollution Management) prior to discharging the hydrotest water. The need for a CWDP or GDA would depend on exactly where the discharge takes place (nearshore, surf zone or beach), volumes and constituents.

2.1.10 MARINE LIVING RESOURCES ACT, 1998

The Marine Living Resources Act, 1998 (No. 18 of 1998) 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; and carry on any activity which may adversely impact on the ecosystems of that area.

There are a number of MPAs declared off the West Coast. However, the pipeline route alternatives do not cross any of these areas (see Section 4.4.6.7). The proposed project area, however, does coincide with a number of marine biodiversity protection focus areas (see Section 4.4.6.7), which have been identified for possible future MPAs. These areas have been taken into consideration in the assessment of potential impacts.

2.1.11 NATURE CONSERVATION ORDINANCE, 1974

In terms of the Nature Conservation Ordinance, 1974 (No. 19 of 1974), no person may, without a permit, damage or destroy any endangered or protected flora.

Since the proposed onshore infrastructure (production pipeline and gas receiving facility) would result in the clearing of endangered and critically endangered vegetation (see Sections 5.2.3 and 5.3.3), a permit application would need to be submitted to CapeNature prior to construction.

2.1.12 OTHER RELEVANT LEGISLATION

In addition to the foregoing, Sunbird would need to ensure compliance with the provisions of other relevant international and national legislation and conventions, which includes, amongst other, the following:

NO.	TITLE	DESCRIPTION
International Marine Pollution Conventions		
1	International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL)	MARPOL is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes
2	Amendment of the International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL) (Bulletin 567 – 2/08)	
3	International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC Convention)	OPRC is an international maritime convention establishing measures for dealing with marine oil pollution incidents nationally and in co-operation with other countries.
4	United Nations Convention on Law of the Sea, 1982 (UNCLOS)	UNCLOS defines the rights and responsibilities of nations with respect to their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources.

NO.	TITLE	DESCRIPTION
4	Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (the London Convention) and the 1996 Protocol (the Protocol)	The London Convention is an agreement to control pollution of the sea from dumping and to encourage regional agreements supplementary to the Convention. It covers the deliberate disposal at sea of wastes or other matter from vessels, aircraft and platforms. It does not cover discharges from land-based sources, such as pipes and outfalls, wastes generated incidental to normal operation of vessels, or placement of materials for purposes other than mere disposal, providing such disposal is not contrary to aims of the Convention.
5	International Convention relating to Intervention on the High Seas in case of Oil Pollution Casualties (1969) and Protocol on the Intervention on the High Seas in Cases of Marine Pollution by substances other than oil (1973)	This Convention is an international maritime convention affirming the right of a coastal State to "take such measures on the high seas as may be necessary to prevent, mitigate or eliminate grave and imminent danger to their coastline or related interests from pollution or threat of pollution of the sea by oil, following upon a maritime casualty or acts related to such a casualty".
6	Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal (1989)	This Convention is an international treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries. It does not, however, address the movement of radioactive waste.
7	Convention on Biological Diversity (1992)	This Convention has three main goals: (1) conservation of biological diversity (or biodiversity); (2) sustainable use of its components; and (3) fair and equitable sharing of benefits arising from genetic resources. Its objective is to develop national strategies for the conservation and sustainable use of biological diversity.
Other International Legislation		
8	International Commission on Radiological Protection (ICRP)	ICRP is an independent, international non-governmental organisation providing recommendations and guidance on radiation protection.
9	International Atomic Energy Agency (IAEA) Regulations for the Safe Transport of Radioactive Material, 1984	IAEA is an international organisation that seeks to promote the peaceful use of nuclear energy, and to inhibit its use for any military purpose, including nuclear weapons. These regulations provide international standards and approaches to safety promote consistency, help to provide assurance that nuclear and radiation related technologies are used safely, and facilitate international technical cooperation and trade.
Other South African Legislation		
10	Carriage of Goods by Sea Act, 1986 (No. 1 of 1986) (COGSA)	This Act provides for the carriage of goods by sea and applies where: (a) the port of shipment is a port in South Africa; (2) the bill of lading is issued in a state which applies the Hague-Visby Rules; (3) the carriage is from a port in a contracting state; and (4) the contract contained in or evidenced by the bill of lading provides that the South African COGSA applies.
11	Dumping at Sea Control Act, 1980 (No. 73 of 1980)	This Act controls the dumping of substances at sea. The Act lists substances that are prohibited to be dumped at sea (Schedule 1) and substances that are restricted when dumping at sea (Schedule 2). The Director-General may on application grant a special permit authorising the dumping of substances listed in Schedule 1 or 2.
12	Gas Act, 2001 (No. 48 of 2001)	This Act promotes the efficient, effective, sustainable and orderly development and operation of gas transmission, storage, distribution, liquefaction and regasification facilities and services. No person may without a licence issued by the Gas Regulator: (1) construct gas transmission, storage, distribution, liquefaction and regasification facilities; (2) operate gas transmission, storage, distribution, liquefaction and regasification facilities; or (3) trade in gas.

NO.	TITLE	DESCRIPTION
13	Hazardous Substances Act, 1983 and Regulations (No. 85 of 1983)	This Act provides for the control of substances which may cause injury or ill-health to or death of human. No person may, without a licence: (1) sell any Group I Hazardous Substance; (2) use, operate or apply any Group III Hazardous Substance (listed electronic products); and (3) install or keep any Group Ill Hazardous Substance. Authorisation is required to be in procession of, use or dispose of any Group IV Hazardous Substance (which include includes radioactive material).
14	Land Use Planning Act, 2014 (No. 3 of 2014) (LUPA)	LUPA consolidates legislation in the Province pertaining to, *inter alia*, provincial planning, regional planning and development, and urban and rural development. This Act provides minimum norms and standards for effective municipal development management. This Act also regulates provincial development management and the effect of land development on agriculture.
15	Marine Traffic Act, 1981 (No. 2 of 1981)	This Act regulates marine traffic in South Africa's territorial waters. It regulates the entry and dropping of anchor within 500 m safety zone of installations.
16	Marine Pollution (Control and Civil Liability) Act, 1981 (No. 6 of 1981)	The purpose of this Act is to provide protection of the marine environment from pollution by oil and other harmful substances, by giving power to the South African Maritime Safety Association (SAMSA) to take steps to prevent harmful substances being discharged from vessels. It is the responsibility of Sunbird to disclose to SAMSA before the commencement of proposed activities the amounts and types of chemicals that would be used and disposed of during operations.
17	Marine Pollution (Prevention of Pollution from Ships) Act, 1986 (No. 2 of 1986)	This Act regulates pollution from ships, tankers and offshore installations, and for that purpose gives effect to MARPOL 73/78. In terms of the Act, it is an offence to discharge any oil from a ship, tanker or offshore installation within 12 miles (19 km) off the South African coast. The discharge of oily water or oil and any other substance which contains more than a hundred parts per million of oil is prohibited between 19 – 80 km offshore.
18	Marine Pollution (Intervention) Act, 1987 (No. 65 of 1987)	This Act implements to the international convention relating to the Intervention of the High Seas in cases of oil pollution casualties, and to the Protocol relating to Intervention of the High Seas in cases of Marine Pollution by substances other than Oil in South African Waters.
19	Maritime Safety Authority Act, 1998 (No. 5 of 1998)	This Act provides for the establishment and functions of SAMSA. The objectives of the Act are to, *inter alia*: (1) ensure safety of life and property at sea; (2) prevent and combat pollution of the marine environment by ship; and (3) promote South Africa's maritime interests.
20	Maritime Safety Authority Levies Act, 1998 (No. 6 of 1998)	This Act provides for the imposition of levies by SAMSA. SAMSA is permitted to raise and collect a levy on all vessels calling at South African ports and operating in South African waters.
21	Maritime Zones Act 1994 (No. 15 of 1994)	The Act defines the maritime zones, including territorial waters, contiguous zone, exclusive economic zone and continental shelf. Section 9(1) states that any law in force in South Africa shall also apply on and in respect of an installation.
22	Merchant Shipping Act, 1951 (No. 57 of 1951)	This Act provides for the control of merchant shipping and matters incidental thereto.
23	Mine Health and Safety Act, 1996 (No. 29 of 1996)	This Act provides for health and safety requirements for mining operations and includes hazard and risk assessments, monitoring and awareness training.

NO.	TITLE	DESCRIPTION
24	National Nuclear Energy Regulator Act, 1999 (No. 47 of 1999)	This Act provides for, *inter alia*, for safety standards and regulatory practices for the protection of persons, property and the environment against nuclear damage. A licence is required for a vessel which has on board any radioactive material capable of causing nuclear damage (including any injury to or the death or any sickness or disease of a person). A certificate of registration is required for any action which is capable of causing nuclear damage.
25	National Ports Act, 2005 (No. 12 of 2005)	This Act regulates and controls navigation within port limits and the approaches to ports, cargo handling, and the pollution and the protection of the environment within the port limits. The Act specifies a requirement for an agreement with or a license from the National Ports Authority to operate a port facility or service.
26	Nuclear Energy Act, 1999 (No. 46 of 1999)	This Act provides for, *inter alia*, the regulation of the acquisition, possession and use of nuclear fuel, certain nuclear and related material and certain related equipment and prescribes measures regarding the discarding of radioactive waste and the storage of irradiated nuclear fuel. Authorisation is required for the acquisition, possession and use of nuclear material (i.e. source material and special nuclear material), restricted material and nuclear-related equipment and material.
27	Occupational Health and Safety Act, 1993 (No. 85 of 1993) and Major Hazard Installation Regulations	This Act provides for the health and safety of persons at work and the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work. Every employer shall provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of his employees.
28	Petroleum Pipelines Act, 2003 (No. 60 of 2003)	This Act provides for the establishment of a national regulatory framework for petroleum pipelines and a Petroleum Pipelines Regulatory Authority as the custodian and enforcer of the national regulatory framework.
29	Sea-Shore Act, 1935 (No. 21 of 1935)	This Act declares the State President the owner of the seashore and the sea within the territorial waters of South Africa and provides for the grant of rights in respect of the seashore and the sea and for the alienation of portions of the seashore and the sea.
30	Sea Birds and Seals Protection Act, 1973 (No. 46 of 1973)	This Act provides for the control over certain islands and the protection of seabirds and seals. It is an offence to wilfully disturb seabirds and seals on the coast or on offshore islands, unless in possession of a permit.
31	Ship Registration Act, 1998 (No. 58 of 1998)	This Act provides for the registration of ships in South Africa.
32	Wreck and Salvage Act, 1995 (No. 94 of 1995)	This Act regulates the law of salvage in South Africa and provides for the application in South Africa of the International Convention of Salvage, 1989.

2.1.13 GUIDELINES

The guidelines listed below have been taken into account during the S&EIA process.

Guideline	Governing body	Applicability
IEM Guideline Series (Guideline 5): Companion to the EIA Regulations 2010 (October 2012)	DEA	This guideline was consulted to inform the applicability listed activities to the propose project.
Scoping, Integrated Environmental Management, Information Series 2 (2002)	DEA	This guideline was consulted to obtain guidance on how to implement scoping.

Guideline	Governing body	Applicability
IEM Guideline Series (Guideline 9): Draft guideline on need and desirability in terms of the EIA Regulations 2010 (October 2012)	DEA	This guideline was consulted to inform the need and desirability of the proposed project.
Stakeholder Engagement, Integrated Environmental Management, Information Series 3 (2002)	DEA	These public participation guidelines were consulted to ensure that an adequate public participation process is undertaken.
IEM Guideline Series (Guideline 7): Public participation in the EIA process (October 2012)		
Specialist Studies, Integrated Environmental Management, Information Series 4 (2002)	DEA	This guideline was consulted to ensure adequate development of terms of reference for specialist studies.
Impact significance, Integrated Environmental Management, Information Series 5 (2002)	DEA	This guideline was consulted to inform the assessment of significance of impacts of the proposed project.
Cumulative Effects Assessment, Integrated Environmental Management, Information Series 7 (2004)	DEA	This guideline was consulted to inform the consideration of potential cumulative effects of the proposed project.
Criteria for determining Alternatives in EIA, Integrated Environmental Management, Information Series 11 (2004)	DEA	This guideline was consulted to inform the consideration of alternatives.
Environmental Management Plans, Integrated Environmental Management, Information Series 12 (2004)	DEA	This guideline was consulted to ensure that the Environmental Management Programme (EMP) has been adequately compiled.
Draft guideline on need and desirability (October 2012)	DEA	This guideline was consulted to inform the need and desirability of the proposed project.
Environmental Impact Reporting, Integrated Environmental Management, Information Series 15 (2004)	DEA	This guideline was consulted to inform the approach to impact reporting.

2.2 S&EIA PROCESS

2.2.1 STUDY OBJECTIVES

The S&EIA process has the following important objectives:

- To dovetail the processes required in terms of the NEMA and the MPRDA;
- To provide a reasonable opportunity for I&APs to be involved in the study;
- To ensure that all potential key environmental issues and impacts that would result from the proposed project are identified;
- To identify feasible alternatives related to the project proposal;
- To assess potential impacts of the proposed project alternatives during the different phases of project development;
- To present appropriate mitigation or optimisation measures to minimise potential impacts or enhance potential benefits, respectively; and
- Through the above, to ensure informed, transparent and accountable decision-making by the relevant authorities.

The S&EIA process consists of a series of steps to ensure compliance with these objectives and the EIA Regulations 2010 as set out in GN No. R543. The process involves an open, participatory approach to ensure that all impacts are identified and that decision-making takes place in an informed, transparent and accountable manner.

2.2.2 ASSUMPTIONS AND LIMITATIONS

The S&EIA assumptions and limitations are listed below:

- The S&EIA assumes that CCA has been provided with all relevant project information and that it was correct, technically feasible and valid at the time it was provided;
- Specialists have been provided with all the relevant project information in order to produce accurate and unbiased assessments;
- There will be no significant changes to the project description or surrounding environment between the completion of the Final EIR and implementation of the proposed project that could substantially influence findings, recommendations with respect to mitigation and management, etc.;
- Approval of all project components as part of the initial Environmental Authorisation and Production Right (e.g. well drilling, subsea infrastructure, initial well fluid processing, etc.) remain in place and thus do not form part of this S&EIA process;
- This assessment is based on preliminary pipeline route alignments. These alignments may be adjusted slightly when the final routing is determined based on a detailed route and site survey. The specialist studies have, however, taken this limitation into consideration in their assessment of potential impacts; and
- The locality of the northern onshore gas receiving facility is currently not known, as no specific customer exists at this stage. The assessment for an onshore facility and link to a customer would be undertaken as a separate S&EIA.

2.2.3 S&EIA PROCESS

A flowchart indicating the entire S&EIA process is presented in Figure 2.1.

2.2.3.1 Scoping Phase

The Scoping Phase undertaken complied with the requirements of NEMA and the EIA Regulations 2010, as set out in GN No. R543. This involved a process of notifying I&APs of the proposed project and S&EIA / EMPr Addendum process in order to ensure that all potential key environmental impacts, including those requiring further investigation, were identified. Steps undertaken during this phase are summarised in Box 2.1.

The key issues and concerns identified by the project team, with I&AP input, during the Scoping Phase are summarised in Box 2.2. This information provided the basis on which the specialist studies and associated terms of references were determined.

The Final Scoping Report (FSR), which was prepared in compliance with Section 28(1) of the EIA Regulations 2010, was accepted by DEA on 27 November 2014 (see Appendix 1). The DEA acceptance stated that the next phase of the S&EIA may proceed in accordance with the tasks outlined in the Plan of Study for EIA, which was included in the FSR.

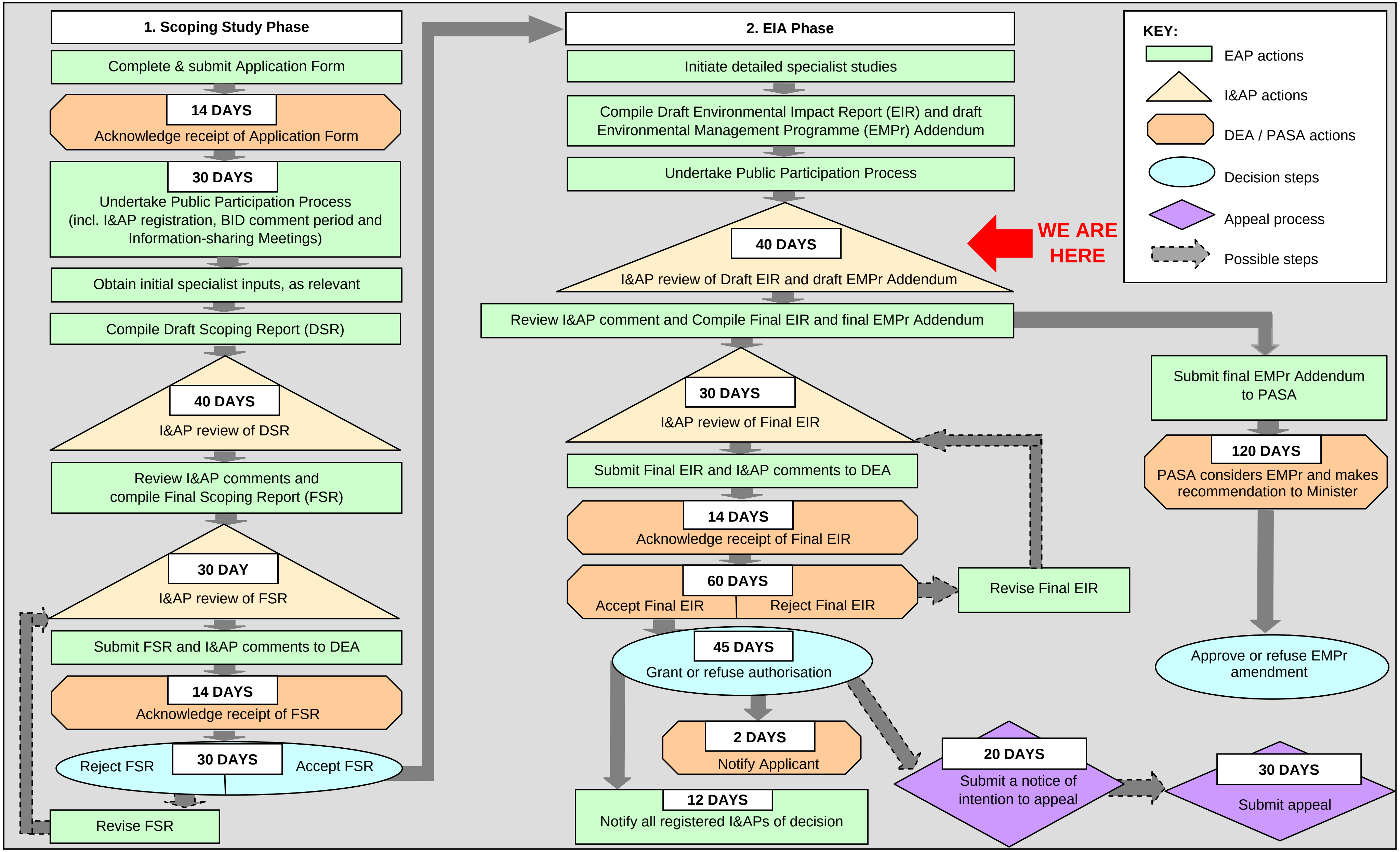


Figure 2.1: Flow diagram showing the S&EIA process (including EMPr addendum process).

Box: 2.1: Tasks undertaken during the Scoping Study.

1. Project registration

An Application for Environmental Authorisation was submitted to DEA on 5 September 2013. The submitted application was accepted on 17 October 2013 (DEA reference number: 14/12/16/3/3/2/587).

2. Initial public participation process

The initial public participation process involved the following:

- Identification of I&APs: A preliminary I&AP database of authorities, Non-Governmental Organisations, Community-based Organisations and other key stakeholders was compiled using the existing database for the Ibhubesi Gas Field, as well as other databases of previous studies undertaken in the Atlantis and Saldanha Bay areas. Additional I&APs were added to the database based on all the tasks listed below. To date a total of 416 I&APs have been registered on the project database (see Appendix 2.1).
- <u>Distribution of Background Information Document (BID):</u> A notification letter and BID were distributed for a 30-day registration and comment period from 22 November 2013 to 10 January 2014. The purpose of the letter and BID was to convey information on the proposed project and to invite I&APs to register on the project database and provide initial comment.
- <u>Advertisements:</u> Advertisements announcing the proposed project, the availability of the BID, I&AP registration / comment period and Information-sharing Meetings were placed in regional newspapers (Cape Times and Die Burger) and a local newspaper (Weslander).
- <u>Notices:</u> Notices (in English and Afrikaans) announcing the proposed project, the availability of the BID, I&AP registration / comment period and Information-sharing Meetings were erected in the following locations: Vredenburg Public Library; Saldanha Bay Municipality offices; Langebaan Library; Cape West Coast Biosphere Reserve office (Yzerfontein); Silwerstroom Strand Resort (reception); Wesfleur Library (Atlantis); Labour office in Wesfleur (Atlantis); Avondale Library (Atlantis); Koeberg Library (Melkbosstrand); Koeberg Club (Duynefontein); and Post Net (Melkbosstrand).
- <u>Authority and key stakeholder meetings:</u> Authority meetings were held with the City of Cape Town (Environmental Resource Management Department, City of Cape Town (Property Management), Eskom (Koeberg), National Nuclear Regulator, Cape West Coast Biosphere Reserve, CapeNature and PASA.
- <u>Public information-sharing meetings:</u> Three Information-sharing Meetings were held during the BID comment period in Cape Town, Melkbosstrand and Saldanha.

3. Compilation and review of Draft Scoping Report (DSR)

The preparation of the DSR was informed by comments received during the initial public participation process. A total of 48 written submissions were received. All comments received were collated, and responded to, into an initial Comments and Responses Report, which was appended to the DSR.

The DSR was distributed for a 40-day review and comment period from 2 May 2014 to 11 June 2014. Tasks undertaken included:

- <u>DSR availability:</u> Copies of the DSR were made available on the CCA website and at various venues in Cape Town, Melkbosstrand, Atlantis, Yzerfontein, Langebaan, Saldanha and Vredenburg. Copies of the DSR were also sent directly to key authorities and key stakeholders.
- <u>I&AP notification:</u> A notification letter was sent to all I&APs registered on the project database.

4. Compilation and review of FSR

The preparation of the FSR was informed by comments received during the DSR comment period. A total of 31 written submissions were received during this period, all of which were collated and responded to into an updated Comments and Responses Report, which was appended to the FSR.

The FSR was distributed for a 30-day review and comment period from 29 September to 29 October 2014. Notification and distribution of the FSR was as per that undertaken for the DSR.

5. Submission of FSR and associated comments to DEA

A total of 22 written submissions were received during the FSR review and comment period (see Appendix 2.2). The FSR, together with all comments received on the FSR, was submitted to DEA on 18 September 2014 for consideration and acceptance.

All comments received on the FSR have been collated, and responded to, in a Comments and Responses Report (see Appendix 2.3).

Box 2.2: Key issues identified by the project team, with I&APs input, during the Scoping Phase.

- Effect on vegetation:
  - > Loss of vegetation associated with vegetation clearing and trenching.
- Effect on freshwater resources:
  - > Loss of freshwater habitat.
  - > Impedance of water flow.
  - > Pollution of freshwater resources.
- Effect on terrestrial fauna:
  - > Loss of faunal habitat associated with vegetation clearing and trenching.
- Effect on marine fauna:
  - > Physical damage to the seabed and sediment disturbance due to pipeline installation.
  - > Localised disturbance of fauna due to noise from the pipe-laying vessel and production facility.
  - > Faunal attraction due to lighting from the pipe-laying vessel and production facility.
  - > Increased biodiversity and biomass in the vicinity of the pipeline.
  - > Restriction or alteration of migration routes of benthic species.
  - > Accidental release of oil.
- Effect on heritage
  - > Loss or disturbance to heritage resources (including archaeological sites, palaeontology and cultural heritage).
- Effect on air quality
  - > Impact on human health of due to emissions from production platform and onshore facility.
- Risks from gas pipeline
  - > Risks to surrounding communities due to pipeline failure and loss of containment.
- Effect on sense of place and aesthetics
  - > Alteration of the visual landscape / rural character of the site.
- Effect on fisheries
  - > Loss of access to fishing grounds due to production facility and pipeline.
  - > Disruption of fishing activities due to presence of pipe-lay vessel.
  - > Accidental release of oil.
- Effect on social environment
  - > Employment and business opportunities.
  - > Skills development.
  - > Influx of external job seekers.
  - > Sense of health and well-being of affected communities and surrounding landowners.
  - > Impact on existing land uses and infrastructure.
  - > Impact on sense of place and rural character of the landscape.
  - > Decreased large vehicle traffic to Ankerlig.
  - > Local economic development through social investment.
- Effect on economic environment
  - > Generation of cheaper and a more secure energy supply.
  - > Creation of employment and local expenditure.
  - > Impact on existing land uses and economic activities.

2.2.3.2 EIA Phase

Specialist studies

During this phase 12 specialist studies were undertaken to address the key issues that required investigation and detailed assessment. A list of the specialist studies undertaken and associated specialists is provided in Table 2.6.

The terms of reference of these studies were included in the FSR, which was accepted by DEA. Specialist studies involved the gathering of data relevant to identifying and assessing environmental impacts that may occur as a result of the proposed project. These impacts were then assessed according to pre-defined rating scales (see Appendix 3). Specialists also recommended appropriate mitigation or optimisation measures to minimise potential impacts or enhance potential benefits, respectively.

Table 2.6: List of specialist studies and specialists.

No.	Specialist study	Author / Review	Company	Appendix
1	Marine Ecology Assessment	Dr A. Pulfrich	Pisces Environmental Services	6
2	Fisheries Assessment	D. Japp	Capricorn Marine Environmental	7
		S. Wilkinson		
3	Oil Spill Assessment	J. Blood	CCA Environmental	8
		J. Crowther		
4	Vegetation Assessment	Dr D. McDonald	Bergwind Botanical Surveys & Tours	9
5	Freshwater Assessment	T. Belcher	BlueScience	10
		D. Grobler		
6	Terrestrial Fauna Assessment	E. Costandius	CCA Environmental	11
		Prof L. Mouton	Stellenbosch University	
7	Heritage Assessment	T. Hart	ACO Associates	12
		N. Kendrick		
		Dr G. Avery	Iziko Museums of South Africa	
8	Air Quality Assessment	Dr L. Burger	Airshed Planning Professionals	13
		G. Petzer		
		N. Shackleton		
9	Risk Assessment	Dr L. Burger	RisCom	14
		M. Oberholzer		
10	Visual Assessment	Q. Lawson	Meirelles Lawson Burger Architects	15
		B. Oberholzer	BOLA	
11	Social Assessment	B. Petrie	One World Group	16
		C. Pengelly		
		D. Petrik		
12	Economic Assessment	T. Leiman	University of Cape Town	17
		R. Hasson		

Compilation of Draft EIR

This Draft EIR has been prepared in compliance with Section 31(2) of the EIA Regulations 2010 (see Table 2.7). The specialist studies and other relevant information / assessments have been integrated into this report. This report has also been informed by DEA's acceptance of the FSR (see Appendix 1) and I&AP comments received during the FSR comment period (see Appendix 2.2 and 2.3).

This report aims to present all information in a clear and understandable format, suitable for easy interpretation by I&APs and authorities, and to provide an opportunity for them to comment on the proposed project and findings of the S&EIA process (see Section 1.6 for details of the comment period).

Completion of the EIA Phase

The following steps are envisaged for the remainder of the S&EIA process (see Figure 2.1):

- After closure of the Draft EIR comment period, all comments received on the draft report will be incorporated and responded to in an updated Comments and Responses Report. The draft report will then be updated into a Final EIR, to which the Comments and Responses Report will be appended;
- The Final EIR will be released for a further 30-day comment period. All I&APs on the project database will be notified when the Final EIR is available for comment;
- The Final EIR, including any comments received from I&APs on the Final EIR, will be submitted to DEA for consideration and decision-making;
- After DEA has reached a decision, all I&APs on the project database will be notified of the outcome of the application and the reasons for the decision; and
- A statutory appeal period in terms of the National Appeal Regulations (GN No. R993) will follow the issuing of the decision.

Table 2.7: Requirements of an Environmental Impact Report in terms of the EIA Regulations 2010.

Section 31(2)	Content of Environmental Impact Report	Completed (Y/N or N/A)	Location in Draft EIR
(a)	(i & ii) Details and expertise of EAP who prepared the report.	Y	Page ii
(b)	Detailed description of the proposed activity.	Y	Chapter 3
(c)	A description of the property on which the activity is to be undertaken and the location of the activity on the property, or if it is:	Y	Section 3.3
	(i) a linear activity, a description of the route of the activity; or	Y	
	(ii) An ocean-based activity, the co-ordinates where the activity is to be undertaken.	Y	
(d)	A description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity.	Y	Chapters 4 & 5
(e)	Details of the public participation process conducted in terms of sub-Regulation 1, including:		
	(i) Steps undertaken in accordance with the plan of study;	Y	Sections 1.6 & 2.2.3.2
	(ii) A list of all persons or organisations and organs of state that were registered as interested and affected parties;	Y	Appendix 2.1
	(iii) A summary of comments received from and a summary of issues raised by registered I&APs, the date of receipt of these comments and the response of the EAP to those comments; and	Y	Appendix 2.2
	(iv) Copies of any representations and comments received from registered I&APs.	Y	Appendix 2.3
(f)	A description of the need and desirability of the proposed activity.	Y	Section 3.1

Section 31(2)	Content of Environmental Impact Report	Completed (Y/N or N/A)	Location in Draft EIR
(g)	A description of identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity.	Y	Section 3.3 & 3.3.7, 3.4
(h)	An indication of the methodology used in determining the significance of potential environmental impacts.	Y	Appendix 3
(i)	A description and comparative assessment of all alternatives identified during the EIA process.	Y	Chapters 6 to 8 & Section 9.1.3
(j)	A summary of the findings and recommendations of any specialist report or report on a specialised process.	Y	Chapters 6 to 9
(k)	A description of all environmental issues that were identified during the EIA process, an assessment of the significance of each issue and an indication of the extent to which the issues could be addressed by the adoption of mitigation measures.	Y	Box 2.2 & Chapters 6 to 8
(l)	An assessment of each identified potentially significant impact, including: (i) Cumulative impacts; (ii) The nature of the impact; (iii) The extent and duration of the impact; (iv) The probability of the impact occurring; (v) The degree to which the impact can be reversed; (vi) The degree to which the impact may cause irreplaceable loss of resources; and (vii) The degree to which the impact can be mitigated.	Y	Chapters 6 to 8
(m)	A description of any assumptions, uncertainties and gaps in knowledge.	Y	Section 2.2.2
(n)	A reasoned opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation.	Y	Sections 9.1.4 & 9.2
(o)	An environmental impact statement which contains: (i) A summary of the key findings of the EIA; and (ii) A comparative assessment of the positive and negative implications of the proposed activity and identified alternatives.	Y	Section 9.1
(p)	A draft environmental management programme containing the aspects contemplated in Regulation 33.	Y	Chapter 10
(q)	Copies of specialist reports and reports on specialised processes complying with Regulation 32.	Y	Appendices 6 to 17
(r)	Any specific information that may be required by the competent authority. DEA's acceptance of the FSR requested the following. • Please ensure comments are received from all relevant stakeholders, including City of Cape Town, DEA (Branch Oceans and Coast); CapeNature, SAHRA, Swartland Local Municipality, Western cape Human Settlements Department, DEA&DP, DEA&DP (Coastal Management Unit); Department of Water & Sanitation, west Coast District Municipality, Eskom, DENC (Northern Cape), Saldanha Bay Municipality, West Coast National Park, DAFF, Western Cape Government: Department of Agriculture. • Provide proof of correspondence in the Final EIR; • Ensure compliance with Regulations 56, 57 and 67 relating to public participation; • Include an A3 regional map in the Final EIR; • A letter is required from HWC should Section 38 of the NHRA be applicable; and • Provide two hardcopies and one electronic copy of the Final EIR to DEA.	Y	Figure 1.1 Appendix 1 (note: proof of compliance with the public participation requirements will be provided in the Final EIR)

Section 31(2)	Content of Environmental Impact Report	Completed (Y/N or N/A)	Location in Draft EIR
(s)	Any other matters required in terms of Sections 24(4)(a) and (b) of the Act. (This refers to Environmental Authorisations and procedures for the investigation, assessment and communication of the potential consequences or impacts of activities on the environment that the authority needs to consider when reviewing an Application).	Y	-

3. PROJECT DESCRIPTION

This chapter provides a description of the proposed project including the need, desirability and project history. An outline of the development infrastructure both offshore and onshore is provided and is followed by a short description of the proposed activities from construction through to the decommission phase of the project.

3.1 NEED AND DESIRABILITY

3.1.1 DRAFT INFRASTRUCTURE DEVELOPMENT BILL (2013) AND STRATEGIC INTEGRATED PROJECTS

The South African Government adopted a National Infrastructure Plan in 2012 that intends to transform the economic landscape while simultaneously creating significant numbers of new jobs, strengthening the delivery of basic services, and supporting the integration of African economies. A commission, the Presidential Infrastructure Co-ordinating Commission (PICC), was established to integrate and co-ordinate the long-term infrastructure build. PICC has identified infrastructure gaps, population movement and economic performance within a special framework and has developed eighteen Strategic Integrated Projects (SIPs) to address the country's needs, as well as a more comprehensive 'Infrastructure Book' of 645 projects.

The draft Infrastructure Development Bill, 2013 (Government Gazette No. 36143) provides for, *inter alia*, the identification and implementation of SIPs which are of significant economic or social importance. A project qualifies as a SIP if:

(a) It comprises of one or more installation, structure, facility, system, service or process relating to any matter specified in Schedule 1;

(b) It complies with any of the following criteria:

  (i) It would be of significant economic or social importance to South Africa;

  (ii) It would contribute substantially to any national strategy or policy relating to infrastructure development; or

  (iii) It is above a certain monetary value determined by the PICC.

(c) The PICC has included the project in the National Infrastructure Plan and has designated the project as a SIP.

The proposed project would fall under Schedule 1 of the Bill as it relates to the installation of a gas pipeline and installation of a facility to supply gas to a power station. In addition, the proposed project falls under the following SIPs:

- SIP 5 (Saldanha-Northern Cape development corridor): SIP 5 includes the strengthening of maritime support capacity for oil and gas along the African West Coast.
- SIP 8 (Green energy in support of the South African economy): SIP 8 supports sustainable green energy initiatives on a national scale through a diverse range of clean energy options as envisaged in the Integrated Resource Plan (IRP2010). The IRP2010 acknowledges that it is feasible for OCGT peaking capacity to operate on gas rather than the current practice of utilising diesel. The IRP2010 recommends that, *inter alia*, regional and domestic gas options are pursued.
- SIP 9 (Electricity generation to support socio- economic development): Acceleration of the construction of new electricity generation capacity in accordance with the IRP2010 to meet the needs of the economy and address historical imbalances.

3.1.2 NATIONAL DEVELOPMENT PLAN (2030)

The National Development Plan (2030) prioritises certain infrastructure investments, including the construction of infrastructure to import liquefied natural gas and increasing exploration to find domestic gas feedstock in order to diversify the energy mix, reduce greenhouse gas emissions and improve energy efficiency.

The plan also proposes to incorporate a greater share of gas in the energy mix and the development of infrastructure for the import of liquefied natural gas, mainly for power production, over the short- to medium-term. The plan also notes that if gas reserves are proven and environmental concerns alleviated, then development of these resources and gas-to-power projects should be fast-tracked.

The development of the Ibhubesi Gas Field and the proposed Ibhubesi Gas Project would meet a number of the objectives in the National Development Plan (2030).

3.1.3 OPERATION PHAKISA

In July 2014 the South African Government launched Operation Phakisa[1], which is an innovative, pioneering and inspiring approach that will enable South Africa to implement its policies and programmes better, faster and more effectively. Operation Phakisa aims to, *inter alia*, unlock the economic potential of South Africa's oceans. In this regard four priority sectors have been selected as new growth areas in the ocean economy, including:

(a) Marine transport and manufacturing activities, such as coastal shipping, trans-shipment, boat building, repair and refurbishment;
(b) Offshore oil and gas exploration;
(c) Aquaculture; and
(d) Marine protection services and ocean governance.

In terms of offshore oil and gas exploration the goal is to further enhance the enabling environment for exploration of oil and gas, resulting in an increased number of exploration wells drilled, while simultaneously maximising the value captured for South Africa.

The proposal by Sunbird, although a production project, includes the drilling of a number of wells and thus provides an opportunity to further establish the extent of the indigenous gas reserves in Block 2A.

3.1.4 MEMORANDUM OF UNDERSTANDING BETWEEN ESKOM AND SUNBIRD

South Africa's power utility Eskom has issued a RFI for the supply and delivery of gas to Ankerlig in order to replace the current diesel fuel source. The proposed Ibhubesi Gas Project provides an opportunity to supply gas to Ankerlig while at the same time develop South African indigenous gas reserves off the West Coast.

Ankerlig currently operates by heating diesel to gas, which passes through turbines to generate electricity. This is widely acknowledged as being both an expensive and inefficient use of fuel. Based on finding a solution to reduce these costs, Eskom is seeking to convert Ankerlig to gas. Sunbird has signed a memorandum of understanding and term sheet with Eskom to investigate the feasibility of supplying gas from the Ibhubesi Gas Field to Ankerlig. The use of gas from the Ibhubesi Gas Field is supported on a national level by a number of policies and plans as indicated in the sections above.

[1] Address by President Jacob Zuma at the launch of Operation Phakisa, 19 July 2014; http://www.thepresidency.gov.za/pebble.asp?relid=17739)

3.1.5 CONCLUSION

The proposed project would help diversify the country's energy mix, improve improving energy security and reduce carbon emissions. It also fits in with the development of a gas industry in the Western Cape.

Thus the project demonstrates that it would be largely aligned with the policies of government at a national, provincial and municipal level, as it meets a number of the objectives in the National Development Plan 2030 and Operation Phakisa, as well as meeting several SIP criteria.

3.2 HISTORY OF THE IBHUBESI GAS FIELD (THE APPROVED PROJECT)

Forest Exploration International (South Africa) (Pty) Ltd (Forest) and its partners (PetroSA and Anschutz Overseas Corporation Limited) commenced with exploration activities off the West Coast of South Africa in 1998. Gas reserves were confirmed by undertaking seismic surveys and drilling eight exploration wells between 2001 and 2003 in what is referred to as the Ibhubesi Gas Field (Block 2A). Based on the 2P (P50) proven reserves of 540 billion cubic feet (Bcf), Forest then applied for Environmental Authorisation in terms of NEMA and for a Production Right in term of the MPRDA. Environmental Authorisation and the Production Right for the proposed development of the Ibhubesi Gas Field Development Project were obtained in 2008 and 2009, respectively. A brief description of the approved Ibhubesi Gas Field is provided in Box 3.1.

In 2013 Sunbird took over as the operator of the Ibhubesi Gas Field with a 76% interest in the Production Right, with PetroSA holding a 24% interest. As indicated earlier, Sunbird has re-evaluated the original development proposal and is considering various additional and alternative project components from that originally approved / authorised, as described in Section 3.3. The original approvals will remain in place.

Box 3.1: Brief description of the approved Ibhubesi Gas Field.

1. Gas reserves

The expected gas would consist largely of methane (CH_4) with a number of minor constituents including ethane, carbon dioxide, propane, and long chained hydrocarbons. In the process of extracting gas, condensate (a liquid hydrocarbon) would be formed and captured. A breakdown of the key components of the gas is presented in the Figure 3.1 below. The Ibhubesi Gas Field has a 2P (P50) reserve of 540 Bcf gas. The flow rate of gas from Ibhubesi Gas Field to shore is expected to be around 100 million standard cubic feet per day (MMscf/d).

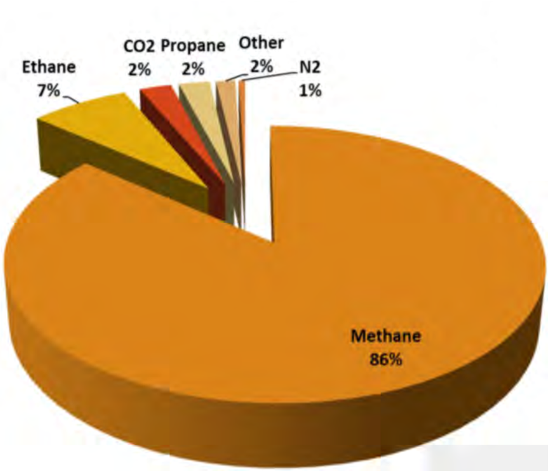


Figure 3.1: Breakdown of the key gas components

2. Resource development

The approval of the Ibhubesi Gas Field included the undertaking of 3D seismic surveys in Block 2A in order to further investigate subsea geological formations within the Production Right area. Between May and July 2011 Forest undertook a 3D seismic survey covering an area of approximately 710 km^2 in the south-western portion of Block 2A.

The approved development plan includes the drilling of 99 development wells over four development phases totalling 20 years (see Figure 3.2).

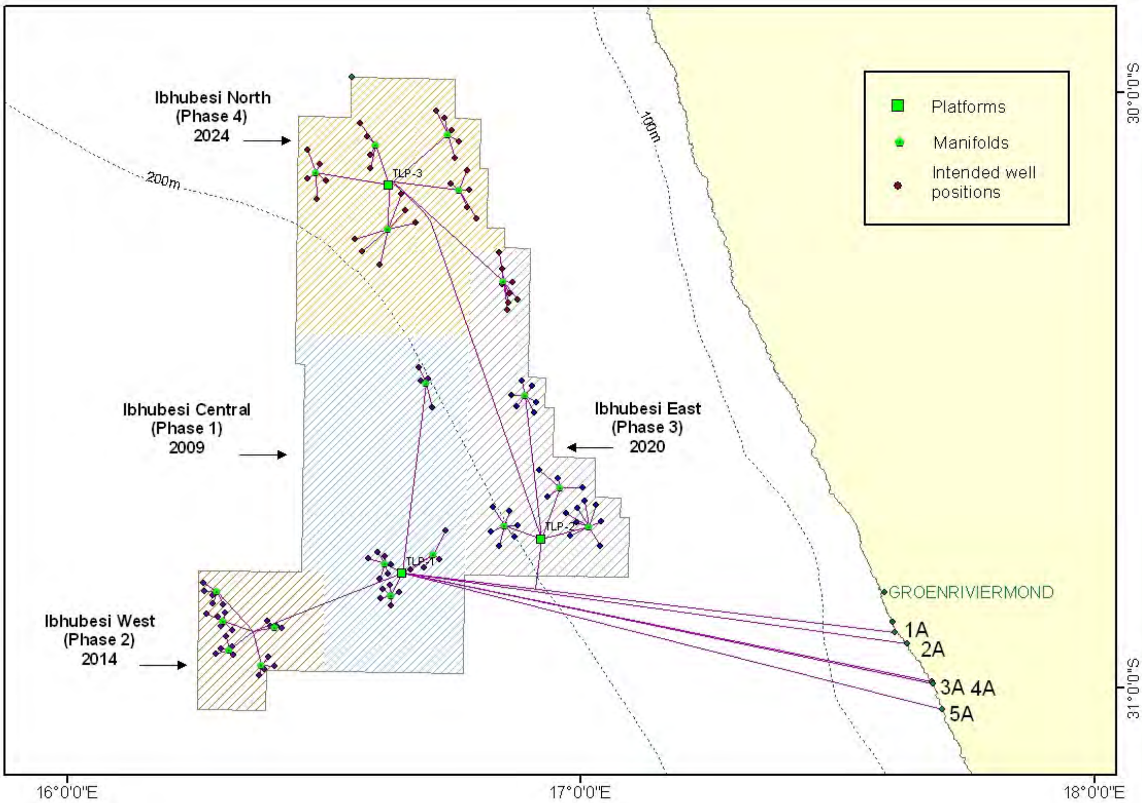


Figure 3.2: Ibhubesi Gas Field Development Plan

3. Offshore component

The main offshore infrastructure components of the approved Ibhubesi Gas Field includes:

- A subsea production system, including subsea wellhead structures (including production trees) grouped in "four to six well cluster" configurations, manifolds and subsea pipelines (flow lines, umbilicals, Mono-Ethylene Glycol (MEG) lines and risers that connect the wellhead structures to the manifolds and production platforms). Subsea pipelines would be restrained and stabilised by clump weights and concrete mattresses;
- Three offshore production platforms or Tension Leg Platforms (TLPs), which are floating structures held in place by vertical, tensioned tendons secured to the seafloor by anchor (foundation) piles. The production platforms contain equipment for controlling the subsea infrastructure, fluid processing and compression; and
- Two 12-inch production pipelines approximately 110 km long, which will convey produced gas and condensate from the southern TLP to a landing point approximately 20 km south of the Groen River mouth, and onto the onshore gas processing facility.

Well fluids extracted from the wells would pass through flow lines to a production platform. The flow rate would be controlled by production trees, which are hydraulically controlled from the production platform via umbilicals. Initial processing on the production platforms would consist mainly of the separation of gas and condensate from the produced water. Produced water would be treated to acceptable standards before discharge overboard. The approved project allows for the discharge of approximately 200 barrels per day (bpd) of produced water during the initial stages, increasing to 1 600 bpd as the field matures. Based on a 30 mg/l dispersed oil concentration in produced water (OSPAR standard), approximately 2.8 tonnes of oil could be discharged per year at the maximum produced water production of 1 600 bpd. After this initial processing, the gas and condensate streams would be recombined and the product compressed to facilitate transport via the production pipelines to the onshore gas processing facility.

4. Onshore component

The main onshore infrastructure components include:

- An onshore gas processing facility, covering a floor area of about 4 ha, for the removal and stabilisation of the condensate liquids and to provide for compression of the dry gas. Facilities at the onshore facility would include separation equipment (which separates the pipeline liquids from the gas stream for further processing), condensate stabilisers, compressors, dehydration equipment and storage tanks. The processing facility would also include a number of other buildings (e.g. administration), a fuel truck terminal and a desalination plant;
- Access route to the onshore facility; and
- Services (e.g. water supply, sewage disposal and electricity).

The condensate and gas from the offshore platforms would enter the gas processing plant where the condensate and any remaining produced water would be separated out from the natural gas. The gas would flow directly to a compressor in order to compress for distribution into an onshore export pipeline, which would take the gas to market most probably in or near Cape Town and possibly mining operations in the Northern Cape. The onshore export pipeline did not form part of the original project description project, as this was considered to be a South African government initiative. The condensate would be temporarily stored at the onshore facility before being sold and trucked off-site.

3.3 PROPOSED IBHUBESI GAS PROJECT (THE CURRENT PROJECT)

Sunbird has reassessed the approved development concept previously developed for the Ibhubesi Gas Field. Rather than supplying the gas from Block 2A to an onshore processing facility in the Northern Cape, the project concept has been altered to consider supplying gas to end users in the Atlantis and / or Saldanha industrial areas of the Western Cape. The key components of the revised project proposal for the Ibhubesi Gas Project are described below. Sunbird estimates that the proposed Ibhubesi Gas project could supply Eskom's Ankerlig power station with 30 Bcf of gas a year for up to 15 years.

Table 3.1 provides a summary of those aspects which are covered by the existing Production Right and Environmental Authorisation and those aspects covered by this S&EIA.

3.3.1 OFFSHORE INFRASTRUCTURE

3.3.1.1 Production wells and subsea production system

The production wells for this project would be part of the 99 approved wells. Thus no additional wells are proposed. It is anticipated that the first phase of the Ibhubesi Gas Project would include the drilling of up to 10 of these production wells with a further 10 wells drilled as part of a second development phase. New wells would be drilled as and when required, based on market demand.

The subsea production system would be similar to that of the approved Ibhubesi Project (see Box 3.1), except that the actual layout would differ depending on final well locations. Figure 3.3 presents an updated well field development plan for the first phase of production. Each “well cluster” configuration would be connected to a subsea gathering manifold (see Figure 3.4).

Table 3.1: Summary of project components and the status regarding approval / authorisation.

No.	Project activity/infrastructure/component	Status and comment
1.	Exploration phase	
1.1	3D seismic surveys.	Approved / authorised - not included in the current S&EIA process.
1.2	Development well drilling (99 wells).	Approved / authorised - not included in current S&EIA process. Actual well locations may differ from that shown in the indicative gas field development plan presented in the original S&EIA. An updated well location diagram for the first phase of production is provided in Figure 3.3.
2.	Infrastructure	
2.1	Subsea in-field infrastructure, including wellheads, production trees, flow lines, risers, umbilicals, MEG lines, manifolds and supporting infrastructure (e.g. clump weights and concrete mattresses).	Approved / authorised - not included in current S&EIA process. Layout may differ depending on actual well locations. An updated well location diagram for the first phase is provided in Figure 3.3.
2.2	Offshore production facility: floating production, storage and offloading unit (FPSO) or semi-submersible platform.	Included in current S&EIA process.
2.3	Production pipeline (400 km) to a southern and northern shore-crossing in the Western Cape.	Included in current S&EIA process.
2.4	Onshore gas receiving facility located near Ankerlig.	Included in current S&EIA process.
2.5	Onshore pipeline from shore-crossing to onshore gas receiving facility.	Included in current S&EIA process.
3.	Operation	
3.1	Extraction and separation of well fluids, including treatment and discharge of produced water.	Approved / authorised - not included in current S&EIA process. Produced water volumes would be as per existing approval. Discharge would comply with the approved produced water standards.
3.2	Offshore treatment and disposal of waste from production facility (including sewage, galley waste and deck drainage).	Included in current S&EIA process. Waste discharge volumes from FPSO or semi-submersible platform at a single location may be higher than originally approved for TLPs at separate locations.
3.3	Offshore flaring.	Approved / authorised - not included in current S&EIA process.
3.4	Offshore storage and offloading of condensate.	Included in current S&EIA process.
3.5	Onshore processing activities at Ankerlig gas receiving facility.	Included in current S&EIA process.
3.6	Offshore support – vessels from Cape Town or Saldanha and helicopters from Kleinzee.	Approved / authorised - not included in current S&EIA process.
4.	Decommissioning phase	
4.1	Subsea in-field infrastructure.	Approved / authorised - not included in current S&EIA process. Decommissioning would not change from existing approval.
4.2	Offshore production facility.	Included in current S&EIA process.
4.3	Production pipeline.	Included in current S&EIA process.
4.4	Onshore gas receiving facility:	Included in current S&EIA process.

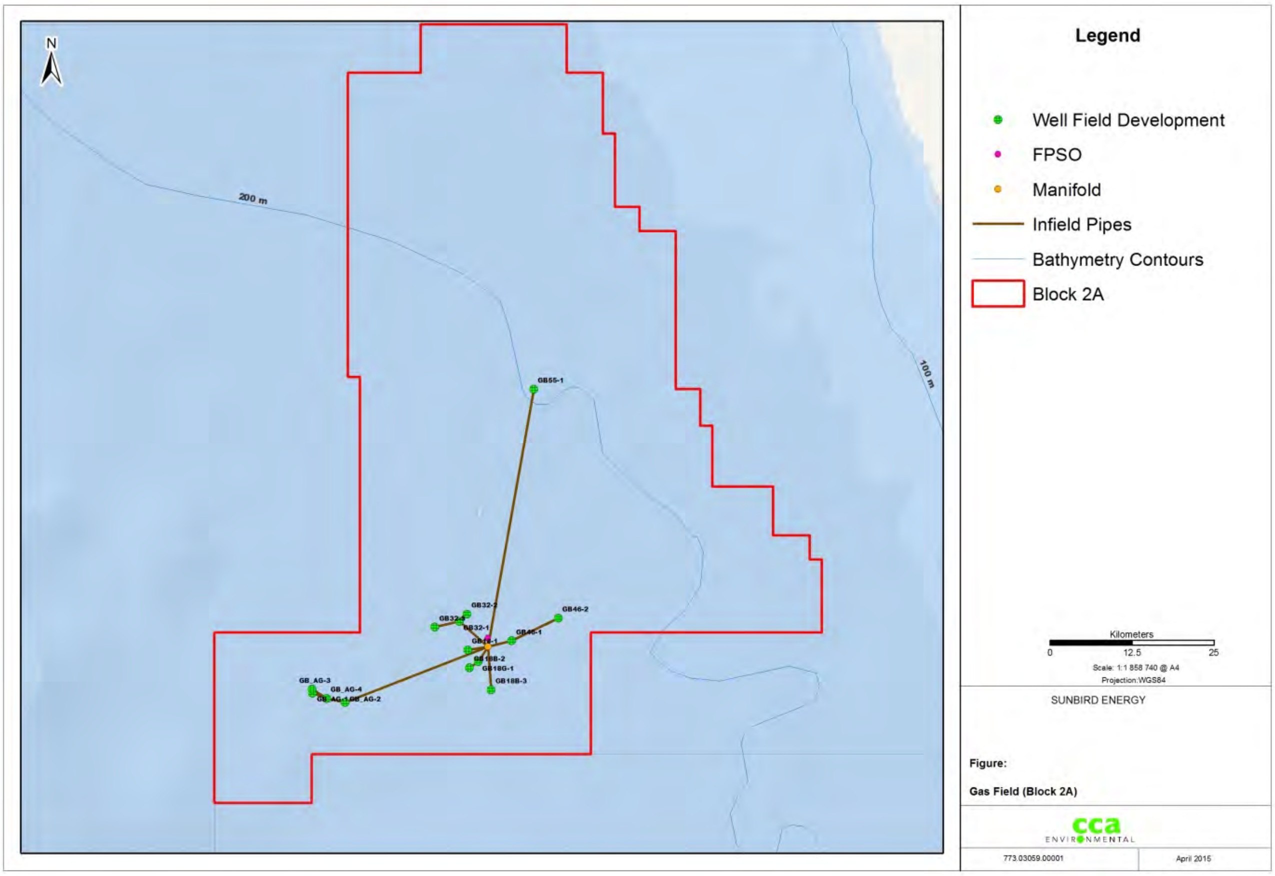


Figure 3.3: **Updated well field development plan for the first phase of production (after Sunbird).**

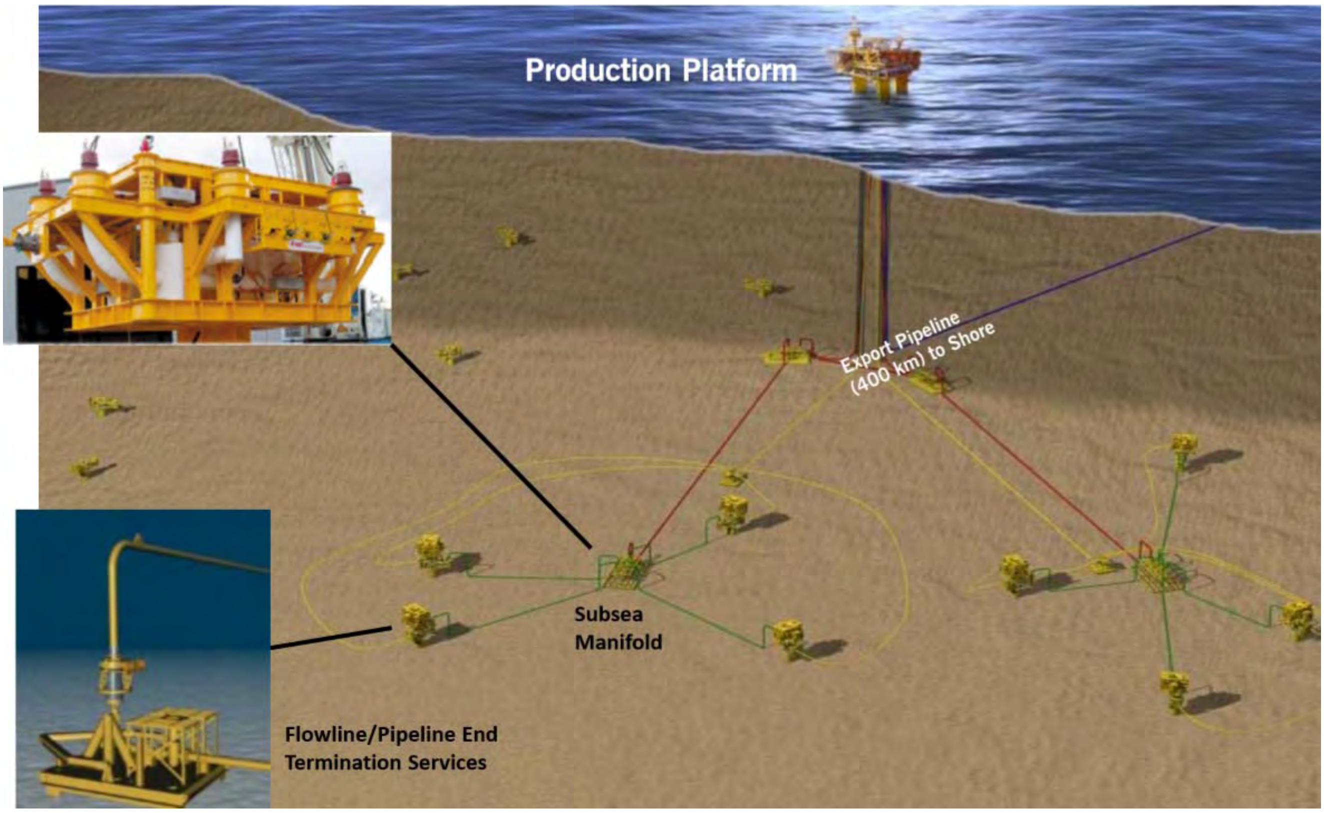


Figure 3.4: **Subsea production system schematic of the Ibhubesi Gas Project.**

3.3.1.2 Offshore production facility

Two production facility alternatives are being considered (see Plate 3.1), namely:

- <u>A floating production, storage and offloading unit (FPSO)</u>
  A FPSO is a floating vessel used for the processing and storage of hydrocarbons. Generally it would be a converted oil tanker or purpose-built vessel designed specifically for the project. The proposed mooring system is based upon a weather-vanning, non disconnectable system with chains and cables and standard suction anchors. A FPSO typically includes a bow cantilevered mooring system including a production swivel and in the order of nine mooring lines.
- <u>A semi-submersible platform</u>
  A semi-submersible platform is a floating structure comprised of three to six (or more) hollow steel legs that are typically connected by horizontal pontoons. A platform typically, but not necessarily, requires a tow vessel or transport barge to transport the unit to its location. Once on location, the hollow legs and pontoons would be flooded (or ballasted) to submerge the pontoons to a pre-determined depth below the sea level where wave motion is minimised in order to provide stability. The platform would be held in position by at least three vertical, tensioned tendons (usually six or eight, depending on the number of pontoons) secured to the seafloor by anchor (foundation) piles. The tendons allow for the use of this platform type in a broad range of water depths and allow for significant side-to-side movement with little vertical movement. The vertical tendons also allow for the smallest possible mooring footprint and minimise pitch and roll in rough seas.

The production facility would contain the equipment for controlling the production trees, the initial processing of well fluids, handling waste streams, compression facilities required to enable transport of the produced gas via the production pipeline, storage of condensate in on-board tanks (FPSO) or pontoons (semi-submersible platform) and an accommodation area with living quarters and associated utilities.

Under the Marine Traffic Act, 1981 (No. 2 of 1981), a "production platform" falls under the definition of an "offshore installation", and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone. Thus all vessels would be required to avoid the 500 m safety zone around the production platform. It should, however, be noted that this restrictions is no different to the safety zone associated with the Tension Leg Platforms for which Sunbird already has approval.

Approximately 48 - 72 people would be employed to operate the production facility, with roughly half this number being on the unit at any one time. Transport of personnel to and from the production facility would be via both helicopter and support vessel.

Plate 3.1: Examples of (i) a typical FPSO (www.modec.com) and (ii) a semi-submersible production platform (www.kepcorp.com).

3.3.1.3 Offshore production pipeline

Produced gas would be transferred from the production facility via a rigid subsea production pipeline laid on the seafloor (14- to 18-inch in diameter) to the shore-crossing locations (see Section 3.3.2.1). The pipeline would be approximately 400 km in length (depending on the selected shore-crossing location) and would run roughly parallel to the coast between the 100 m and 250 m contour line (see Figure 3.5). Since the final routing of the pipeline would ultimately be determined by a subsea route and site survey, this study assesses the potential impacts related to a pipeline located anywhere between these water depths.

Figure 3.5: Proposed production pipeline route alternatives in relation to the bathymetry.

In order to provide some protection and help to reduce buoyancy and improve stability of the pipeline (or sections thereof) it may be concrete coated or be provided with concrete mattress protection. The pipeline wall thickness would be influenced by the expected high pressure / high temperature gas in the Ibhubesi Gas Field.

Although a pipeline, which is used for the transfer of any substance to or from the coast, also falls under the definition of an "offshore installation", it is not protected by a 500 m safety zone. The production pipeline is, however, afforded some protection in terms of Section 8B of the Marine Traffic Act, 1981.

The master or any person in charge of navigation of a ship shall be guilty of an offence if:

a) through his act or omission in connection with the navigation of the ship in question <u>an offshore installation or any part thereof is damaged</u>;
b) the ship, except while rendering an emergency service or previously agreed service to the offshore installation in question, enters a safety zone, <u>or drops or drags anchor nearer than 500 metres to a pipeline</u> or a telecommunications line; or
c) while engaged in fishing, <u>the ship bottom trawls nearer than 500 metres to such a pipeline</u> or telecommunications line.

3.3.2 ONSHORE INFRASTRUCTURE

3.3.2.1 Onshore production pipelines

Two potential shore-crossing locations are being considered; a southern location between Grotto Bay and Duynefontein and a northern location on the Saldanha Peninsula.

Southern shore-crossings between Grotto Bay and Duynefontein

The specific destination for the southern shore-crossing and associated onshore pipeline is the Ankerlig power station near Atlantis. Thirteen potential shore-crossing alternatives were originally identified between Yzerfontein and Duynefontein. These alternatives were screened via a detailed multi-criteria analysis that considered (PRDW 2013):

- Technical engineering aspects (e.g. physical characteristics and length of shore-crossing, complexity of installation, relative angle of wave attack, rate of sediment transport and available services);
- Environmental sensitivity (e.g. topography, vegetation and freshwater); and
- Social considerations (e.g. proximity to residential areas, existing services and visibility).

The screening of alternatives identified three shore-crossings as the preferred alternatives for assessment in the S&EIA. The preferred alternatives are described below and shown graphically in Figure 3.6:

- <u>Grotto Bay (see Figure 3.7, Plate 3.2 and 3.3):</u> The Grotto Bay shore-crossing location is situated immediately south of the Grotto Bay Private Nature Reserve and residential area. To minimise the environmental impact, the onshore route is proposed to follow the Grotto Drive road reserve fence line and associated fire break to the south of the existing road until just east of the R27 and then southwards to Ankerlig. The Grotto Bay shore-crossing would allow for easy site access with an existing parking area available for site setup and a lay-down area. Directional drilling would be required to install the pipeline at this location (shore-crossing techniques are described in Section 3.3.3.2).

- <u>Silwerstroom Strand (see Figure 3.8, Plate 3.4 and 3.5):</u> The Silwerstroom Strand shore-crossing location is situated on the northern boundary of the Silwerstroom Strand resort. This shore-crossing was selected as a preferred alternative due to the flat beach, which is favourable for a traditional bottom-tow shore-crossing installation (see Section 3.3.3.2), existing services and access roads.

A portion of the existing municipal campsite could be used as lay-down area and construction yard. Depending on the exact routing of the pipeline, a number of campsites and ablution blocks may need to be demolished and re-constructed to allow the installation of the pipeline. The onshore routing between the shore-crossing and the R27 could follow one of three alternatives, namely:

> Alternative 1 (Northern Route): Via the existing Silwerstroom Water Treatment Plant to the existing Silwerstroom Road.

> Alternative 2 (Central Route): The alignment of the existing Silwerstroom Strand Road; and

> Alternative 3 (Southern Route): Via a private farm road and fence line on Farm Groote Springfontein to the south of the resort.

- <u>Duynefontein (see Figure 3.9, Plate 3.6 and 3.7):</u> The Duynefontein shore-crossing location is situated within the Koeberg nuclear power station property of Eskom, approximately 200 m north of the Duynefontein residential area. This shore-crossing was selected as an alternative due to its proximity to Ankerlig (shortest pipeline route) and its favourable beach conditions (flat beach and lack of rock outcrops), which would be ideal for a bottom-tow installation. There would be sufficient space for a construction site setup and lay-down area. The onshore route would follow an existing track through the Koeberg Power Station property to the R27.

The following options are being considered for the north-south corridor:

- A new pipeline servitude parallel and adjacent to the existing Chevron pipeline servitude; and
- A new pipeline servitude to the east of R27 road reserve. This option was identified following input from the City of Cape Town: Environmental Resource Department. As the area through which the pipeline would pass is expected to form part of a new conservation area (the Dassenberg Coastal Catchment Partnership (DCCP), which will extend from Koeberg to Grotto Bay), it was suggested that the alignment should follow the edge of a future management block and associated fire break, which would run adjacent to and east of the R27.

The east link to Ankerlig would follow the southern side of Dassenberg Road reserve. It should be noted that another alternative was considered for the Duynefontein shore-crossing, which followed the existing power transmission line servitude directly from the Koeberg Power Station to Ankerlig. However, this alternative was dropped during the Scoping Phase due to concerns raised by Eskom that the proposed pipeline could result in electromagnetic coupling and the corrosion of the power line infrastructure.

The approximate total pipeline lengths from the shore-crossing locations to Ankerlig are presented below.

Alternative		Estimated total pipeline length
Grotto Bay to Ankerlig		26.0 km
Silwerstroom Stand to Ankerlig	Alt 1	18.6 km
	Alt 2	19.4 km
	Alt 3	17.3 km
Duynefontein to Ankerlig		13.9 km

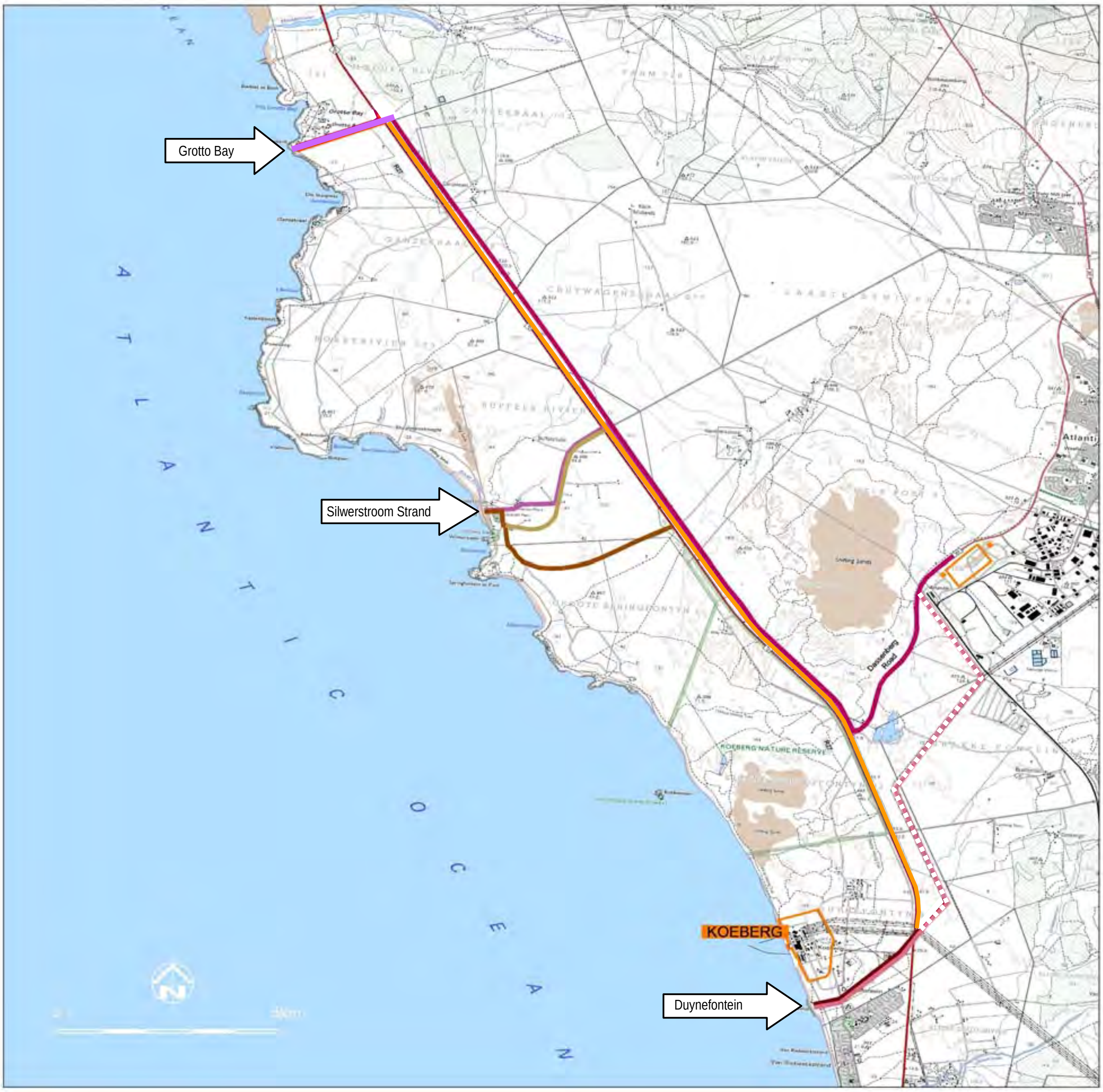


Figure 3.6: **Location of southern shore-crossings and onshore pipeline route alternatives between Grotto Bay and Duynefontein. Note: the alternative shown as a stippled line was dropped during the Scoping Phase and is no longer being considered.**

Figure 3.7: Grotto Bay shore-crossing and onshore pipeline (after GoogleEarth 2015).

Plate 3.2: Grotto Bay – Location of pipeline in firebreak looking east towards the R27.

Plate 3.3: Grotto Bay – rocky coastline (looking due west).

Figure 3.8: Silwerstroom Strand shore-crossing and onshore pipeline (after GoogleEarth 2015).

Plate 3.4: Silwerstroom Strand shore-crossing location.

Plate 3.5: Silwerstroom Strand - flat beach (looking north)

Figure 3.9: Duynefontein shore-crossing and onshore pipeline (after GoogleEarth 2015).

Plate 3.6: Duynefontein shore-crossing location.

Plate 3.7: Duynefontein - dunes behind the flat, wide beach (looking south-west).

Northern shore-crossings on the Saldanha Peninsula

The specific target for the pipeline end point has not yet been established, as no specific customer has been confirmed at this stage. Thus end points have been selected adjacent to major roads, from which an extended future pipeline could easily link into a future customer. Six potential shore-crossing alternatives were considered on the Saldanha Peninsula. Screening of these alternatives, via a detailed multi-criteria analysis that considered technical engineering aspects, potential environmental impacts and potential social implications (PRDW 2013), identified three shore-crossings for assessment in the S&EIA. These are described below and shown graphically in Figure 3.10:

- St Helena West (see Figure 3.11, Plate 3.8 and 3.9): The St Helena West shore-crossing location is positioned on the southern side of St Helena Bay, west-southwest of the mouth of the Berg River. This shore-crossing site was selected as a preferred alternative due to: the easy access to this location; the natural vegetation has largely been disturbed by agriculture; and, that St Helena Bay is a protected low energy marine environment. The rocky shallow offshore environment and shoreline would add some technical difficulty to a pipeline installation at this location. A conventional bottom-tow subsea pipeline installation methodology is considered the most likely methodology, as directional drilling may not be feasible due to the fractured rock and length of the shore-crossing. This alternative could require some blasting to excavate a trench in which to lay the pipeline after which it would be covered in rock fill to conceal and protect it through the wave zone. Based on the bathymetry near St Helena, which is flat and shallow (20 m water depth located approximately 8 km offshore), a relatively long shore-crossing may be required.
- St Helena East (see Figure 3.11, Plate 3.8 and 3.10): The St Helena East shore-crossing is located approximately 2.5 km east of the St. Helena West shore-crossing location. During the Scoping Phase this shore-crossing alternative and pipeline were repositioned approximately 1.2 km to the west in order to avoid the Berg River Ecosystem Priority Area. The site conditions for the St Helena East shore-crossing are very similar to those for the St Helena West crossing.
- Noordwesbaai (see Figure 3.12, Plate 3.11 and 3.12): Noordwesbaai is located approximately 20 km south of Shelley Point and 10 km west of the town of Vredenburg. Noordwesbaai is a small beach with rocky headlands at both the southern and northern ends (commonly termed a "pocket beach"). The shore-crossing location is characterised by steep dunes. A bottom-tow installation method could be applied due to the deep sandy beach. The regional bathymetry is fairly steep and deep (20 m water depth located approximately 1.5 km offshore). Therefore, this shore-crossing would be shorter when compared to the two St Helena alternatives but would require the construction of a trench and access road through the dune field. During the Scoping Phase a portion of this pipeline alternative was repositioned to the west in order to avoid the Bok River Ecosystem Priority Area and a proposed residential development (Solar City).

All routes cross mainly farmland, as well as a number of roads, the crossing of which could be implemented by either directional drilling underneath the road or closing the road and excavating a temporary trench. The St Helena East and West alternatives largely share the same onshore routing, apart from a short section, between the coast and the R45 main road. The Noordwesbaai shore-crossing route follows a south-easterly direction to the R399 between Saldanha and Vredenburg. Initially the route follows an existing dirt track through a CBA. In order to minimise the length within the CBA two alternatives are proposed, namely Noordwesbaai West and Noordwesbaai East. After exiting the CBA, the Noordwesbaai East route would largely follow existing fence lines in a south-easterly direction, avoiding other CBAs, and intersect the Jacobsbaai Road, after which it continues in a south-easterly before turning east towards the R399.

The approximate total pipeline lengths are presented below.

Alternative		Estimated total pipeline length
St Helena West		17.5 km
St Helena East		17.8 km
Noordwesbaai	West	15.3 km
	East	15.1 km

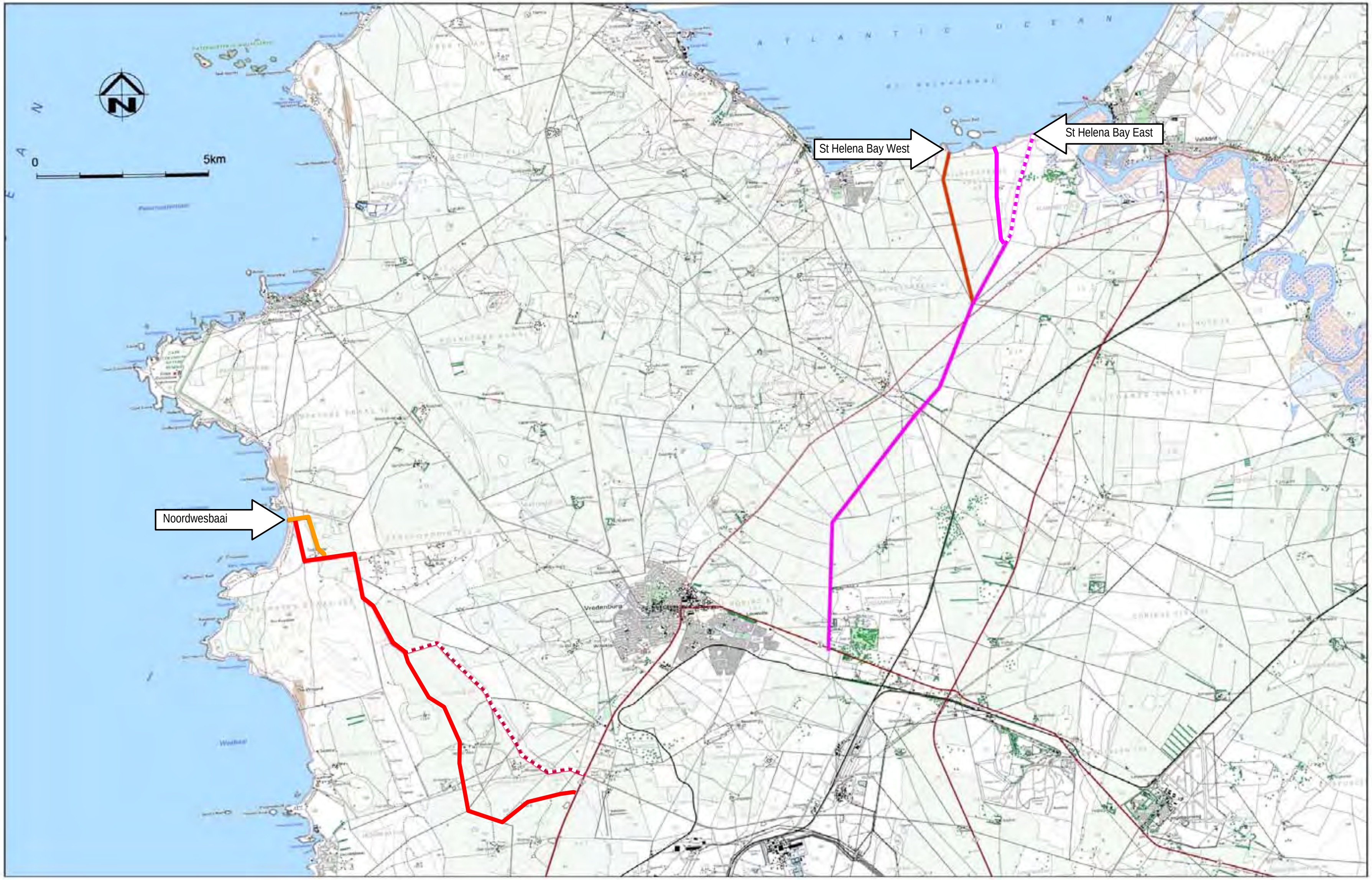


Figure 3.10: Location of northern shore-crossings and pipeline route alternatives on the Saldanha Peninsula. Note: the alternatives shown as stippled lines were dropped during the Scoping Phase and are no longer being considered.

Figure 3.11: St Helena East and West shore-crossings and onshore pipelines (after GoogleEarth 2015).

Plate 3.8: St Helena East and West shore-crossing locations

Plate 3.9: St Helena West– rocky coastline (looking west).

Plate 3.10: St Helena East – rocky coastline (looking north-east).

Figure 3.12: Duynefontein shore-crossing and onshore pipeline (after GoogleEarth 2015).

Plate 3.11: Noordwesbaai shore-crossing location.

Plate 3.12: Noordwesbaai - Sandy coastline, with rock outcrops visible in the background (looking north).

3.3.2.2 Onshore gas receiving facility

An onshore gas receiving facility would be required to reduce gas pressure in the production pipeline and measure the gas flow rate before it is fed through to the end user. The facility would require an area of approximately 1.85 ha and would be located at one of two sites adjacent to the Ankerlig power station (see Figure 3.13) or at one of two sites adjacent to the Silwerstroom Strand Water Treatment Plant (see Figure 3.14). For the northern pipeline alternatives, no onshore facility is being considered, as no specific customer exists at this stage.

The onshore gas receiving facility would include onshore heating to ensure the gas is delivered at the correct temperature to Ankerlig. Heating would be provided through indirect gas heated water baths with fuel gas sourced from the gas exported from the production facility. An electric super heater would heat the arriving gas to 50°C for use in the fire tube water bath heaters. In addition, provision would be made for an onshore filter coalescer, onshore gas metering and a pressure reduction station such that gas is supplied to the power plant at correct pressure.

The onshore facility would essentially consist of a process area (including water bath heathers, flues and vent stacks), a utilities area (including an electrical substation, emergency power generators, workshop, warehouse, control room, ablutions, etc.) and parking (see Figures 3.15 and 3.16; Plate 3.13). The tallest part of the gas processing facility would be the flues and cold vent stacks, which would be 10 m high, and the water bath heaters, which would be 5 m high. All other buildings would be single storey in height.

Power and potable water would be obtained from the local municipal grid / supply.

Figure 3.13: Location alternatives (Alternative 1a and 1b) for the proposed onshore gas receiving facility near the Ankerlig Peaking Power Plant (after GoogleEarth 2015).

Figure 3.14: Location alternatives (Alternative 2a and 2b) for the proposed onshore gas receiving facility near the existing Silwerstroom Strand Water Treatment Plant (after GoogleEarth 2015). The proposed onshore pipeline alternatives associated with the Silwerstroom Strand shore-crossing are also shown.

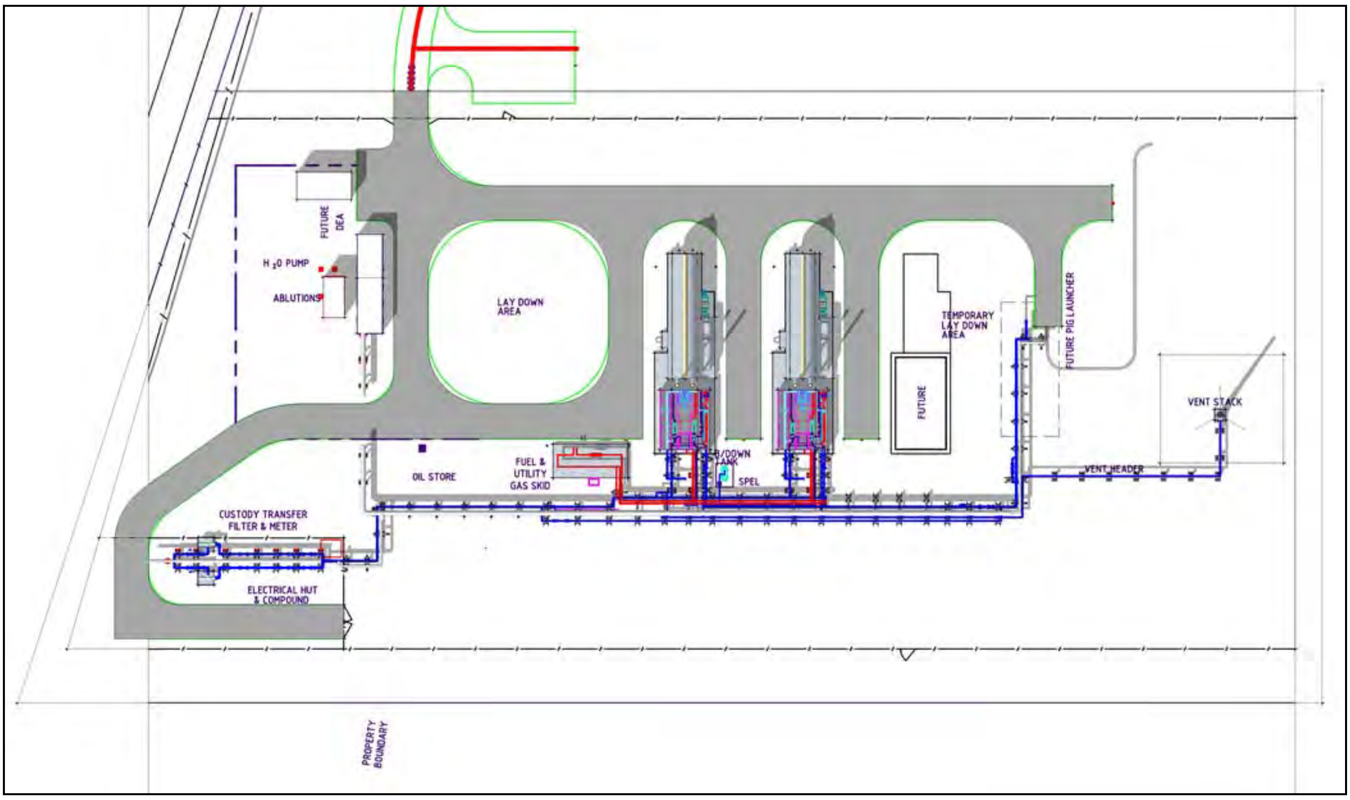


Figure 3.15: Indicative layout of the proposed onshore gas receiving facility.

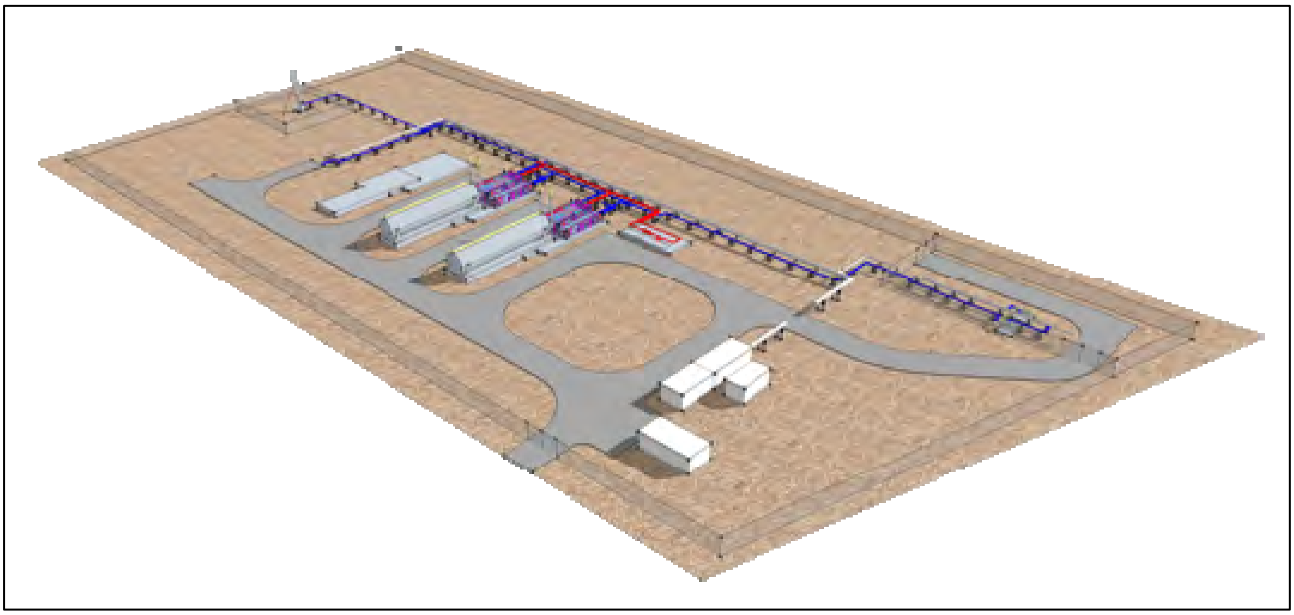


Figure 3.16: Indicative 3D model of the proposed onshore gas receiving facility.

Plate 3.13: An example of a typical gas processing facility (Photo: Richard Montjoie).

3.3.3 ESTABLISHMENT

3.3.3.1 Offshore

Pipeline installation
The offshore production facility would be constructed at a shipyard and barged to location. The necessary activities would then be undertaken to fix the facility on site. Various vessels (including pipe lay, maintenance and support vessels) and Remotely Operated Vehicles (ROVs) would be used to install the subsea infrastructure. The installation of all offshore infrastructure is expected to take in the order of 30 to 36 months.

Installation of the production pipeline would most likely be undertaken using a pipe-lay vessel. Pipe sections would be supplied from an onshore logistics base at the Cape Town and / or Saldanha Bay harbours. The traditional method for installing offshore pipelines in relatively shallow water, and most likely to be used, is commonly referred to as the S-Lay method (see Figure 3.17) due to the profile of the pipe as it moves in a horizontal plane from the welding and inspection stations on the vessel across the stern of the vessel and onto the ocean floor forms an elongated "S." Twelve metre lengths of pipeline would be welded together and then subjected to non-destructive testing (NDT) and joint coating.

In extremely deep water the angle of the pipe becomes so steep that the required stinger length may not be feasible. A comparatively new method for installing offshore pipelines in deeper water is the J-lay method. The method is so-named because the configuration of the pipe as it is being assembled resembles a "J." Lengths of pipe are joined to each other by welding or other means while supported in a vertical or near vertical position by a tower and, as more pipe lengths are added to the string, the string is lowered to the ocean floor. The J-lay method is inherently slower than the S-lay method and is therefore more costly. Installation of the production pipeline is expected to take in the order of three to four months to complete. It is unlikely that the J-lay method would be used for the current project.

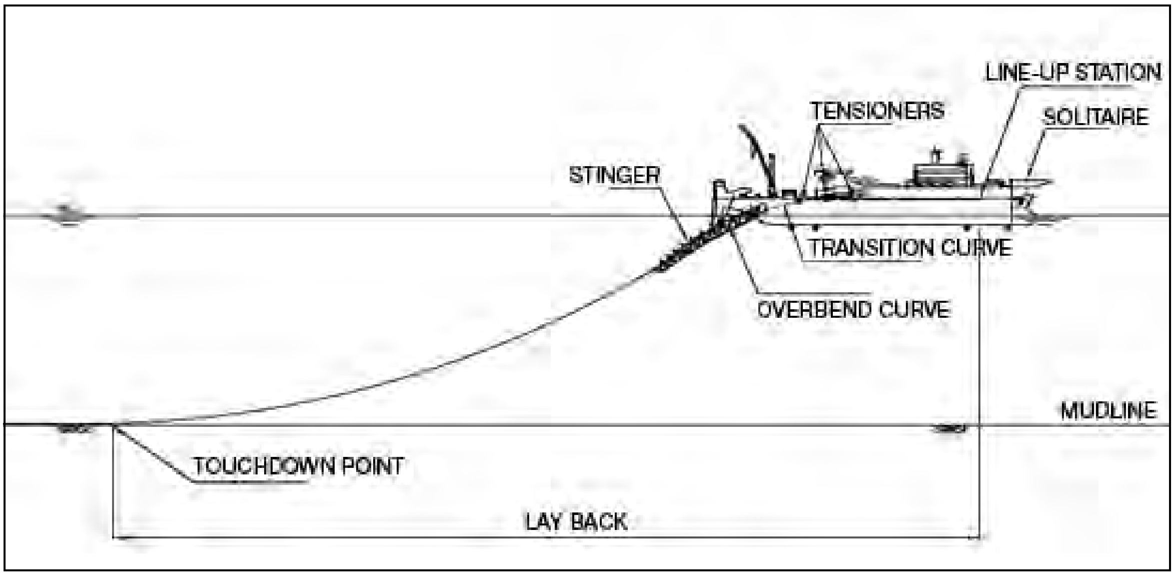


Figure 3.17: Diagrammatic illustration of the S-lay pipe-laying method.

System Leak Test or Hydrotest

In order to check for leaks along the production pipeline a System Leak Test or hydrotest would be undertaken using chemically treated seawater to prevent pipeline corrosion. Prior to tie-in the pipeline would be flooded with inhibited seawater. Typically seawater is treated with the following chemicals:

- Biocide (e.g. HYCOR SB - 420 ppm);
- Oxygen scavenger (e.g. HYCOR OX 67 - 89 ppm);
- Corrosion inhibitor (note: this may not be required if a biocide and oxygen scavenger are used); and
- Fluorescein dye for leak detection (e.g. HYCOR FLS - 40 ppm).

During pipeline flooding various pigs[2] (a pig train) would be inserted in the pipeline to clean and detect any dents or other anomalies in the pipeline (see Plate 3.14).

It is envisaged that the pig train would be launched from a vessel at the lay down head in the Ibhubesi Gas Field. The pig train would be pre-installed by the pipe-lay contractor and would be run pumping water from the vessel towards the beach. The pig train would be pumped to an overflow pond on the beach where the pigs would be retrieved. The volume of treated seawater that would be discharged during the hydrotesting phase would be small relative to the total volume in the pipeline (in the order of 50 m^3). Once the pigs have been received and successfully inspected, the contractor would then commence pressure testing operations.

Plate 3.14: An example of a cleaning pig for a 28-inch oil pipeline (https://en.wikipedia.org/wiki/Pigging).

[2] A "pig" in the pipeline industry is a tool that is sent down a pipeline and propelled by the pressure of the product flow in the pipeline itself.

Dewatering, drying and inerting

Pipeline dewatering operations would be performed after successful leak testing of the pipeline. Dewatering would likely be performed from onshore to offshore to simplify the discharge of the hydrotest water.

The entire pig train would be driven by dry air which would help to reduce the water content in the pipeline. The volume of treated seawater that would be discharged in the gas field during the dewatering phase would be in the order of 34 000 m^3 depending upon the final pipeline diameter and wall thickness. When all pigs are received at the offshore end, the pipeline would be dried. Drying could be achieved by the following methods:

- Air drying;
- Vacuum drying; and
- Chemical conditioning.

The most likely base case is air drying. Nitrogen would be introduced into the line until the oxygen level in the pipeline is lowered to a safe level at which gas can be introduced to the pipeline.

Pipeline start up may be achieved by pushing a bi-directional pig to the proposed onshore receiving facility with production gas.

3.3.3.2 Onshore

The pipeline would be buried through the surf zone and along its full onshore length to a depth of approximately 1 m to 1.5 m below ground until it reaches the proposed onshore gas receiving facility.

Two primary installation methods would be used for shore-crossing, namely:

- Trenching and bottom tow: The preferred option would be to assemble the pipeline onshore and then pull it out to sea from an anchored barge (see Plate 3.15). An alternative is for the pipe to be assembled and launched from a pipe-laying vessel and then to be pulled onshore using a winch mounted on the beach. Through the beach and surf zone the pipeline would need to be burial to protect it from waves and to ensure that during the seasonal variation of the beach levels, the pipeline is not exposed or undermined. To enable a trench to be excavated through the surf zone, a temporary sheet piled cofferdam may need to be constructed. To facilitate the construction of the cofferdam, a temporary jetty (or alternatively a temporary groin) would be constructed to provide a working platform from which the work through the beach zone can be carried out; and
- Horizontal directional drilling (HDD): Directional drilling would entail drilling a hole under the shoreline and then pulling a pipeline through the hole using an anchored barge (see Figure 3.18). Drilling can either be performed from an offshore jack-up barge towards the shore or from the shore towards the target exit point. A drilling fluid would be used to cool and lubricate the drill bit, stabilise the bore hole during drilling, seal fractures in the formation and carry cuttings out of the bore hole. It is common practice on long bores to recycle the returned drilling muds. This would be achieved by pumping the returned muds into a lined sump or containment dam and then to the recycling unit where the drill cuttings are removed from the re-circulating mud stream. The cuttings would then be taken offsite to a suitable disposal site.

Plate 3.15: Examples of a trenching and bottom tow installation method (Source: Murray & Roberts Marine – Mossel Bay).

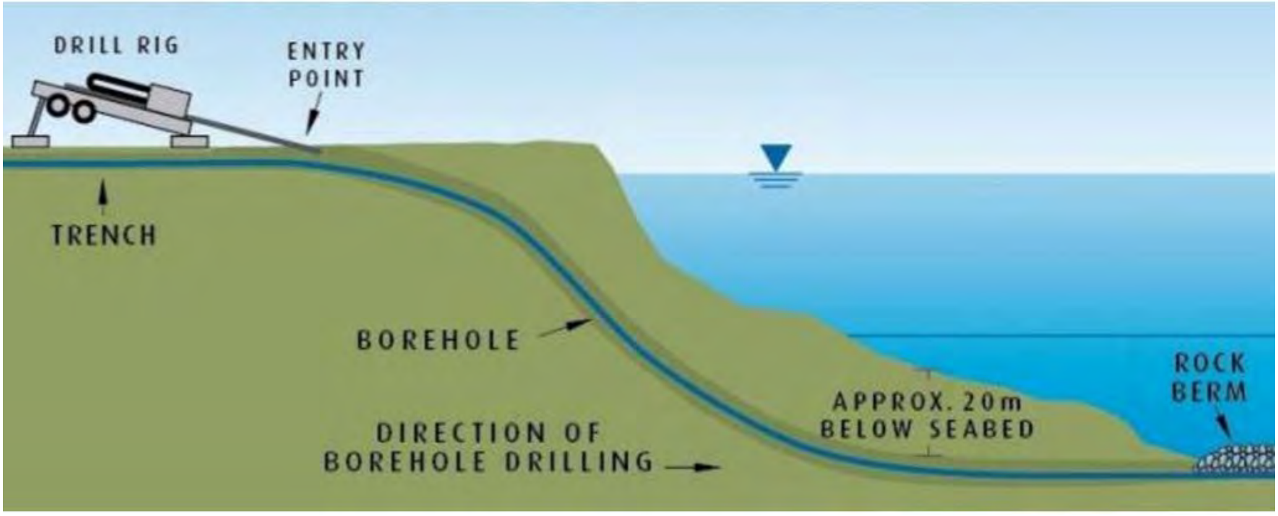


Figure 3.18: Schematic presentation of horizontal directional drilling method.

The selection and feasibility of each method would be dependent on a number of factors, including geotechnical, metocean conditions (wind, waves and currents), beach characteristics and overall length of the shore-crossing. A summary of the most likely installation methods for each shore-crossing alternative (based on the preliminary engineering report, PRDW 2013) is provided in Table 3.2.

Table 3.2: Summary of likely pipeline installation methods for the shore-crossing alternatives.

Alternative	Trenching and bottom-tow	Horizontal directional drilling (HDD)	Blasting in coastal zone	Cofferdam and jetty / groin
Southern shore-crossings				
Grotto Bay	X	✓	Possible blasting on landward side of HDD operation - depends on depth of bedrock	X
Silwerstroom Strand	✓	Unlikely	Unlikely - depends on the presence of offshore reefs and if these cannot be avoided	✓
Duynefontein	✓	X	X	✓

Alternative	Trenching and bottom-tow	Horizontal directional drilling (HDD)	Blasting in coastal zone	Cofferdam and jetty / groin
Northern shore-crossings				
St Helena West	✓	Unlikely due to fractured nature of the rock	✓	✓
St Helena East	✓		✓	✓
Noordwesbaai	✓	X	Unlikely - depends on depth of bedrock	✓

The trenching and bottom tow method would require a lay-down area for the construction operation of approximately 2 ha in close proximity to the shore-crossing site, whereas directional drilling is less extensive requiring a smaller construction area of approximately 0.3 ha. Construction areas would be cleared of vegetation and topsoil would be removed and stockpiled for use during rehabilitation. The area may need to be graded and compacted to support heavy equipment.

The onshore portion of the pipeline would be laid by normal pipe-laying methods after the route is cleared of vegetation and any other obstacles. The area of disturbance along the onshore pipeline route would ultimately be determined by the geotechnical characteristics of the proposed route, e.g. sandy soils would require a wider trench and would thus have a greater area of disturbance. It is estimated that the width of the construction servitude (including access road) would be approximately 15 to 20 m along the entire length of the pipeline route. Depending on the underlying geotechnical conditions some blasting may also be required. Disturbed areas along the pipeline route would be rehabilitated after construction with the aim of restoring the area back to near its original state.

The onshore portion of the production pipeline would also be hydrotested in order to check for leaks as described in Section 3.3.3.1.

It is envisaged that the construction duration for the shore-crossing and onshore pipeline would be between approximately 8 to 10 months.

3.3.3.3 Employment

A summary of the estimated number of direct employment opportunities during the design / construction phase is presented in Table 3.3.

During the design phase, a project management team and Front End Engineering and Design (FEED) contractor would be appointed. It is not envisaged that the project management team would be entirely South African based, as the location of the personnel would be largely driven by the location of the FEED contractor. It is estimated that the FEED contractor would expend around 25 000 man-hours with 20 – 30% of this work being conducted in South Africa. The services performed would largely be engineering with drafting, procurement and project support services. In addition to the engineering workload, a number of site data acquisition activities would be necessary. These activities would involve specialised survey, metocean and geotechnical personnel capable of undertaking the data gathering.

The construction phase includes a number of different workloads, including:

- Engineering detailed design: The detailed design phase builds upon the work undertaken by the FEED contractor and would most likely be conducted in the region of supply (likely Singapore/Malaysia or Indonesia);

- Manufacturing and fabrication: The manufacturing and fabrication of the various elements would typically take place in the centres from which material is procured. As this is a new industry to South Africa, many of the components required would be sourced from outside South Africa, although opportunities to utilise South African capability would be explored;
- Offshore installation: Many of the specialised services would come with the contracted vessels (e.g. pipe-lay) from overseas. Local employment opportunities would exist in the form of maintenance and support vessels;
- Onshore construction: Onshore construction would include the site clearing, civil works and facilities preparation and site erection, and hook-up of the onshore gas receiving facility, as well as the trenching, laying and backfilling of the onshore pipeline. This would require a crew of skilled and non-skilled workers including pipeline welders, trades assistants, testing personnel, quality control personnel, surveyors, fitters, mechanics, electricians, instrument technicians, heavy machinery operators, site safety and engineering oversight. This would also be undertaken by a local contractor and most employment would be local.

Table 3.3: Summary of direct employment opportunities during the design / construction phase.

Phase	Number of Personnel
Design (13 to 15 months)	
FEED and project management team	10 - 12
Site data acquisition services	65 - 85
Construction (30 to 36 months)	
Well construction	80 - 100
Onshore construction	50 - 60
Offshore installation: pipe-lay	280 - 300
Offshore installation: mooring system installation	60 - 80
Onshore support and supply staff	50
Hook-up	60 - 70
Pre-commissioning	60 - 75
Commissioning	60 - 70
Total	**775 - 907**

3.3.4 OPERATION

3.3.4.1 General

All operations of the proposed Ibhubesi Gas Project, both offshore and onshore, would be managed in accordance with the operators' integrated management system for Safety, Health, Environmental management and Quality control (SHEQ). The integrated SHEQ system would include certification to ISO9001 and 14000.

All identified aspects and impacts would be managed and monitored according to the following categories of environmental related activities:

- Air emissions control;
- Waste management and control;
- Noise pollution;
- Management of ecological systems;
- Offshore and onshore installations operation; and
- Additional aspects of environmental management.

The relevant emergency/contingency plans, which identify corrective and emergency actions, would be compiled and implemented where required. Attention would be given to communicative, administrative and technological aspects of environmental management.

3.3.4.2 Financial provision

Although the Financial Provision requirements under the MPRDA have been repealed and included under NEMA, the financial provision for the current project would still be provided in terms of the MPRDA based on the transitional arrangements provided under NEMLA 3 (see Section 2.1.1).

In terms of Section 41(1) of the MPRDA, Sunbird is required to make financial provision to meet its obligations and for the rehabilitation or management of environmental impacts. In addition, in terms of Section 89 of the MPRDA no production operation may commence unless the rights holder has provided for a financial provision acceptable to PASA guaranteeing the availability of sufficient funds to fulfil its obligations in terms of the production work programme.

It is Sunbird's policy to ensure appropriate financial provision is in place prior to any work being undertaken. Sunbird’s existing Financial Provision will thus be updated in light of the proposed project. Sunbird will discuss and conclude the nature and quantum of the financial provision required for the management of and remediation of environmental damage with PASA prior to any production activities being undertaken.

3.3.4.3 Offshore operations

Natural gas is lighter than air and in most gas wells, after the well is completed and the wellhead and production tree installed, hydrocarbons would naturally rise to the surface. Gas and well fluids extracted from the wells would pass through the flow lines to the production facility. The flow rate would be controlled by the production trees, which in turn would be hydraulically controlled from the production platform via umbilicals.

Initial processing on the production facility would consist mainly of the separation of liquids, in the form of condensate and any produced water, from the gas. The initial gas/condensate/water separation would be achieved in the upstream separators (i.e. inlet separator and water condensate separator) with gas routed to a glycol contactor for dehydration. The condensate, which can be utilised as a fuel source, would be stored on-board for later offloading to a shuttle tanker for export to market. The produced water would be treated to acceptable standards before being discharged overboard (as per the existing Environmental Authorisation and Production Right). Spillage of liquid hydrocarbons could occur during normal operations, specifically during the transfer of condensate from the production facility to the tanker and during fuel bunkering. An oil spill contingency plan would be prepared and be in place at all times during operation.

The gas would then be further processed by means of a dewpointing system incorporating a gas exchanger and low temperature separator, to ensure the gas meets specifications and that there is no liquid drop out in the production pipeline. The separated gas would be compressed to an export pressure of approximately 26 MPa(g) and transferred via the offshore production pipeline to shore.

Fuel gas for the production facility topsides would be sourced downstream of the hydrocarbon dewpointing unit and superheated to 50°C for supply to the power generation units.

Hydrocarbon liquids removed from the production separators would be heated (via the stabiliser pre-heater) and routed to the condensate stabilisation column where the condensate is conditioned to 70 kPa(a) before being cooled to 45°C by the rundown cooler. Flash gas from the stabilisation column would be pressurised up to 3.2 MPa(g) via one stage of flash gas compression and further compressed to 8 MPa(g) via booster compression prior to being fed to the glycol contactor. Liquids removed within the flash gas compression train would be routed to the inlet separator or stabiliser feed drum subject to the pressure profile requirements.

Aqueous fluids separated in the upstream separators would be processed in the produced water flash drum and MEG regeneration package, where water is removed from the rich MEG to generate 85 wt% lean MEG. The MEG system would be sized to accommodate 250 barrels per day (bpd) of formation water in addition to condensed water from the reservoir. This dual strategy requires two risers, two Inlet Separators and two Water Condensate Separators to prevent mixing of the inhibited and non-inhibited water streams. The lean MEG would then be routed to storage prior to being pumped to the subsea wells by means of booster and injection pumps.

Heating for the topsides equipment would be supplied via a hot oil system with heat provided by waste heat recovery units attached to the power generation turbines. Cooling would be provided through indirect cooling via cooling water/seawater exchangers.

Supply vessels and helicopters would be used to transport personnel and supplies between the offshore production facility and an onshore logistics support base, which would be based in either Cape Town or Saldanha (approved as part of the original project). Transportation of personnel to and from the production facility would be provided by helicopter operations from an existing airport on the West Coast, e.g. Kleinzee. During the operational phase of the Ibhubesi Gas Field development, divers and ROVs would be used to do routine checks and maintenance on the subsea equipment.

3.3.4.4 Onshore operations

The onshore gas receiving facility would reduce gas pressure in the production pipeline from 26 MPa(g) to 3.45 MPa(g) and measure the gas flow rate before it is fed through to the end user at Ankerlig. Thus the onshore facility would include gas metering and a pressure reduction station. In addition, the operation at the gas receiving facility would include heating to ensure the gas is delivered to Ankerlig with sufficient heat. Heating would be provided through indirect gas heated water baths with fuel gas sourced from the gas exported from the production facility. An electric super heater would heat the arriving gas to 50°C for use in the fire tube water bath heaters.

Maintenance, regular testing and frequent inspection of the proposed onshore pipeline would be undertaken to minimise the potential for leaks in the pipeline. An access track (one vehicle width) within the pipeline servitude would be provided where the pipeline route does not follow existing road servitudes.

3.3.4.5 Employment

A summary of the estimated direct employment opportunities during the operations phase is presented in Table 3.4. An estimated 100 to 140 people would be employed fulltime on this project.

Table 3.4: Summary of direct employment opportunities during the operation phase.

Phase	Number of Personnel
Offshore operational staff	48 - 72
Production support vessel staff	12 - 14
Onshore plant operations staff	10 - 14
Support and logistics staff	30 - 40
Total	**100 - 140**

3.3.5 EMISSIONS AND DISCHARGES

3.3.5.1 Offshore

Offshore emissions and discharges are similar to those associated with the existing Environmental Authorisation and Production Right. These would include:

- Air emissions from exhausts, fugitive emissions, flaring, venting, incineration, etc.;
- Noise emissions generated mainly during construction and drilling operations. Increased marine and air traffic would also generate noise;
- Discharge of drill cuttings and galley waste to sea;
- Effluent discharges such as deck drainage and machinery space wastewater, sewage, produced water, etc.; and
- Onshore disposal of general waste such as packaging material, medical, etc.

3.3.5.2 Onshore

Activities during the construction of the onshore portion of the offshore production pipeline and gas receiving facility would generate the usual types of emissions and discharges that can be expected from construction operations. The onshore pipelines, once constructed, would not result in any emissions during normal operations.

Activities during operation of the onshore gas receiving facility would result in the following emissions and discharges:

- Air emissions from exhausts, fugitive emissions, venting, etc.;
- Sewage and waste water generated from administrative buildings would be discharged into the existing municipal sewerage system; and
- Disposal of solid waste (domestic and general industrial waste) and hazardous waste. The disposal of solid waste would be conducted in co-operation with local authorities and a local waste contractor to ensure that disposal is carried out in an environmentally acceptable manner in accordance with the appropriate laws and ordinances.

3.3.6 DECOMMISSIONING AND ABANDONMENT

The ultimate objectives for decommissioning and closure are to:

- Minimise environmental, social and economic impacts of decommissioning;
- Minimise possible health and safety threats to humans and animals;
- Provide for future land-uses.

Proposed decommissioning is described below.

At the end of the economic life of the Ibhubesi Gas Field, the production facility would be decommissioned and removed from location. The offshore production pipeline would be thoroughly flushed, plugged off, and left on the seabed.

The remaining subsea infrastructure (including the wellheads, production trees, umbilicals, flow lines, etc.) would be decommissioned as per the existing Environmental Authorisation and Production Right. Wellheads would be cut-off below the seafloor, plugged with cement and tested for integrity. All remaining offshore facilities (production trees, manifolds, flow lines and umbilicals) would be removed from the seafloor. Concrete mattresses and concrete blocks (less than 0.5 m high) used to stabilise the pipelines would be left on the seafloor.

The onshore gas receiving facility would be decommissioned and removed from site and the area rehabilitated. The onshore pipeline would be thoroughly flushed, plugged off, and left underground. Decommissioned equipment would either be sold for reuse or scrap.

It is estimated that 60 to 80 direct employment opportunities would be created during the decommissioning phase.

3.3.7 SUMMARY OF PROJECT ALTERNATIVES

Table 3.5 provides a summary of the project alternatives that have been considered during the S&EIA.

Table 3.5: Summary of project alternatives.

No.	Alternatives	Description
1. Site / location alternatives		
1.1	Production facility location	Sunbird is the operator and holder of an existing Production Right for Block 2A. Thus the proposed production facility would be located within this licence area. Sunbird is, however, proposing to locate the production facility to the southern portion of the licence area (refer to Figure 3.3). Although the final production facility location would be based on a number of factors, including further analysis of the seismic data, the geological target and seafloor obstacles, this study Addendum assumes that the production facility could be located anywhere within the licence area.
1.2	Onshore study area / end users	The proposal is to supply natural gas to both Ankerlig (southern study area) and end users on the Saldanha Peninsula (northern study area) (refer to Section 3.3.2). This S&EIA assesses the potential impacts related to both study areas.
1.3	Offshore pipeline alignment	The pipeline would be approximately 400 km in length and would run roughly parallel to the coast between the 100 m and 250 m contour line. Although the final routing of the pipeline would ultimately be determined by a subsea route and site survey, the S&EIA considers the location of the pipe anywhere between these water depths, excluding where it comes to shore.

<table>
<tr><th>No.</th><th>Alternatives</th><th>Description</th></tr>
<tr><td>1.4</td><td>Southern shore-crossing locations and alignments</td><td>The southern shore-crossing would be located at one of three locations (refer to Section 3.3.2.1), including:
• Grotto Bay: One alignment is being considered;
• Silwerstroom Strand: Three alignments are being considered:
> Alternative 1 (Northern Route): Via the existing Silwerstroom Water Treatment Plant to the existing Silwerstroom Road.
> Alternative 2 (Central Route): The alignment of the existing Silwerstroom Strand Road; and
> Alternative 3 (Southern Route): A private fence line and fire break to the south of the resort.
• Duynefontein: One alignment is being considered (note: another alignment was dropped during the Scoping Phase).

Two alignments are being considered for the north-south corridor:
• A new pipeline servitude parallel and adjacent to the existing Chevron pipeline servitude; and
• A new pipeline servitude parallel and adjacent to the R27 road servitude.

This S&EIA assesses the potential impacts related all shore-crossing locations and associated onshore pipeline alignments.</td></tr>
<tr><td>1.5</td><td>Northern shore-crossing locations and alignments</td><td>The northern shore-crossing would be located at one of three locations (refer to Section 3.3.2.1), including:
• St Helena West: One is being considered;
• St Helena East: One is being considered; and
• Noordwesbaai: Two alignments are being considered (note: another alignment was dropped during the Scoping Phase):
> Noordwesbaai West; and
> Noordwesbaai East.

This S&EIA assesses the potential impacts related all shore-crossing locations and associated onshore pipeline alignments.</td></tr>
<tr><td>1.6</td><td>Onshore gas receiving facility location</td><td>The onshore gas receiving facility would be located at one of four locations (refer to Section 3.3.2.2), including:
• Ankerlig (Alternative 1a): South-west of Ankerlig;
• Ankerlig (Alternative 1b): North-east of Ankerlig;
• Silwerstroom Stand (Alternative 2a): South of the Water Treatment Works; and
• Silwerstroom Stand (Alternative 2b): North-eat of the Water Treatment Works.

This S&EIA assesses the potential impacts related all four facility locations.</td></tr>
<tr><td colspan="3">2. Activity alternatives</td></tr>
<tr><td>2.1</td><td>Production activities</td><td>Sunbird has an existing Production Right and Environmental Authorisation to develop the Ibhubesi Gas Field. Since production is the next logical step after exploration, this S&EIA is only considering the potential impacts related to the additional and alternative project components that were not approved as part of the original project.</td></tr>
<tr><td colspan="3">3. Design alternatives</td></tr>
<tr><td>3.1</td><td>Production facility alternatives</td><td>Sunbird is considering two production facility alternatives, namely: (1) a floating production, storage and offloading unit (FPSO); and (2) a semi-submersible platform (refer to Section 3.3.1.2).

This S&EIA assesses the potential impacts related to both alternatives.</td></tr>
</table>

No.	Alternatives	Description
3.2	Production pipeline diameter	The production pipeline would be 14- to 18-inches in diameter (refer to Section 3.3.1.3). This S&EIA assesses the potential impacts related to the larger diameter.
4. Technology / process alternatives		
4.1	Offshore pipe-laying method	The offshore pipeline would be installed using one of two methods (refer to Section 3.3.3.1), namely: • S-Lay method: The traditional method for installing offshore pipelines in relatively shallow water; and • J-lay method: A comparatively new method for installing offshore pipelines in deeper water This S&EIA assesses the potential impacts related to both installation methods.
4.2	Shore-crossing pipe-laying method	Two primary installation methods would be used for the shore-crossing, namely (refer to Section 3.3.3.2), namely: • Trenching and bottom tow; and • Horizontal directional drilling. This S&EIA assesses the potential impacts related to both installation methods.

3.4 NO-GO ALTERNATIVE

As indicated in Sections 1.2 and 3.2, Sunbird currently has in place an Environmental Authorisation and holds a Production Right to develop the Ibhubesi Gas Field. Sunbird has, however, re-evaluated the original development proposal and is considering various additional and alternative project components from that originally approved / authorised. Since the original NEMA and MPRDA approvals are still in place, the no-go alternative could on one hand relate to the implementation of the original project proposal, i.e. two subsea production pipelines to an onshore gas processing facility on the Northern Cape coast. The impacts associated with this alternative were assessed as part of the original S&EIA.

Alternatively, the no-go alternative could be the option of not proceeding with the proposed gas field development project in any form. In this case, the residual impacts (i.e. impacts after implementation of mitigation measures) of the proposed activities would not occur. The implications of not going ahead with the proposed project are as follows:

- South Africa would lose the opportunity to establish the extent of indigenous oil / gas reserves on the West Coast;
- South Africa would lose the opportunity to maximise the use of its own indigenous oil and gas reserves, and create an oil and gas industry on the West Coast;
- There would be lost economic opportunities related to sunken costs (i.e. costs already incurred by Sunbird) of exploration in the licence area;
- Ankerlig would continue to operate using diesel, which is an expensive and inefficient operation. Thus there would be a lost opportunity to lower energy costs;
- There would also be a lost opportunity to improve energy security and diversify the country’s energy mix; and
- South Africa would continue to rely on coal to meet almost 90% of its energy needs. Thus there would be a lost opportunity to generate a ”cleaner” energy, which could have significance benefits for the regional and South Africa as a whole.

4. DESCRIPTION OF THE OFFSHORE MARINE ENVIRONMENT

This chapter provides a general overview of the physical and biological oceanography and human utilisation off the West Coast of South Africa and, where applicable, detailed descriptions of the marine environment that may be directly affected by the proposed project.

4.1 METEOROLOGY

Winds are one of the main physical drivers of the nearshore Benguela region, both on an oceanic scale, generating the heavy and consistent south-westerly swells that impact this coast, and locally, contributing to the northward-flowing longshore currents, and being the prime mover of sediments in the terrestrial environment. Consequently, physical processes are characterised by the average seasonal wind patterns, and substantial episodic changes in these wind patterns have strong effects on the entire Benguela region.

The prevailing winds in the Benguela region are controlled by the South Atlantic subtropical anticyclone, the eastward moving mid-latitude cyclones south of southern Africa and the seasonal atmospheric pressure field over the subcontinent.

The strongest winds occur during the summer (October to March) (CSIR 2006). Virtually all winds in summer come from the south to south-southeast (see Figure 4.1), strongly dominated by southerlies which occur over 40% of the time, averaging 20 - 30 knots (kts) and reaching speeds in excess of 60 kts (100 km/h). South-easterlies are almost as common, blowing about one-third of the time and also averaging 20 - 30 kts. The combination of these southerly and south-easterly winds drive the massive offshore movement of surface water, resulting in strong upwelling of nutrient-rich bottom waters, which characterise this region in summer.

Winter remains dominated by southerly to south-easterly winds, but the closer proximity of the winter cold-front systems results in a significant south-westerly to north-westerly component (see Figure 4.1). This ‘reversal’ from the summer condition results in cessation of upwelling, movement of warmer mid-Atlantic water shorewards and breakdown of the strong thermoclines which typically develop in summer. There are also more calms in winter, occurring about 3% of the time, and wind speeds generally do not reach the maximum speeds of summer. However, the westerly winds blow in synchrony with the prevailing south-westerly swell direction, resulting in heavier swell conditions in winter.

Another important wind type that occurs along the West Coast are katabatic ‘berg’ winds during the formation of a high-pressure system (lasting a few days) over, or just south of, the south-eastern part of the subcontinent. This results in the movement of dry adiabatically heated air offshore (typically at 29 knots). At times, such winds may blow along a large proportion of the West Coast north of Cape Point and can be intensified by local topography. Aeolian transport of fine sand and dust may occur up to 150 km offshore.

4.2 PHYSICAL OCEANOGRAPHY

4.2.1 BATHYMETRY AND TOPOGRAPHY

The continental shelf along the West Coast is generally wide and deep, although large variations in both depth and width occur. The shelf maintains a general north-northwest trend, widening north of Cape Columbine and reaching its widest (180 km) off the Orange River. The nature of the shelf break varies off the West Coast of South Africa. Between Cape Columbine and the Orange River, there is usually a double shelf break, with the distinct inner and outer slopes, separated by a gently sloping ledge. The immediate nearshore area consists mainly of a narrow (about 8 km wide) rugged rocky zone and slopes steeply seawards to a depth of around 80 m. The middle and outer shelf normally lacks relief and slopes gently seawards reaching the shelf break at a depth of approximately 300 m.

Banks on the continental shelf include the Orange Bank (Shelf or Cone), a shallow (160 - 190 m) zone that reaches maximal widths (180 km) offshore of the Orange River, and Child's Bank, situated approximately 150 km offshore at about 31°S, and approximately 75 km due west of the Ibhubesi Gas Field (see Figure 4.2). Child's Bank is the only known submarine bank within South Africa's Exclusive Economic Zone (EEZ), rising from a depth of 350 - 400 m water to less than 200 m at its shallowest point. The bank area has been estimated to cover some 1 450 km^2 (Sink *et al*. 2012).

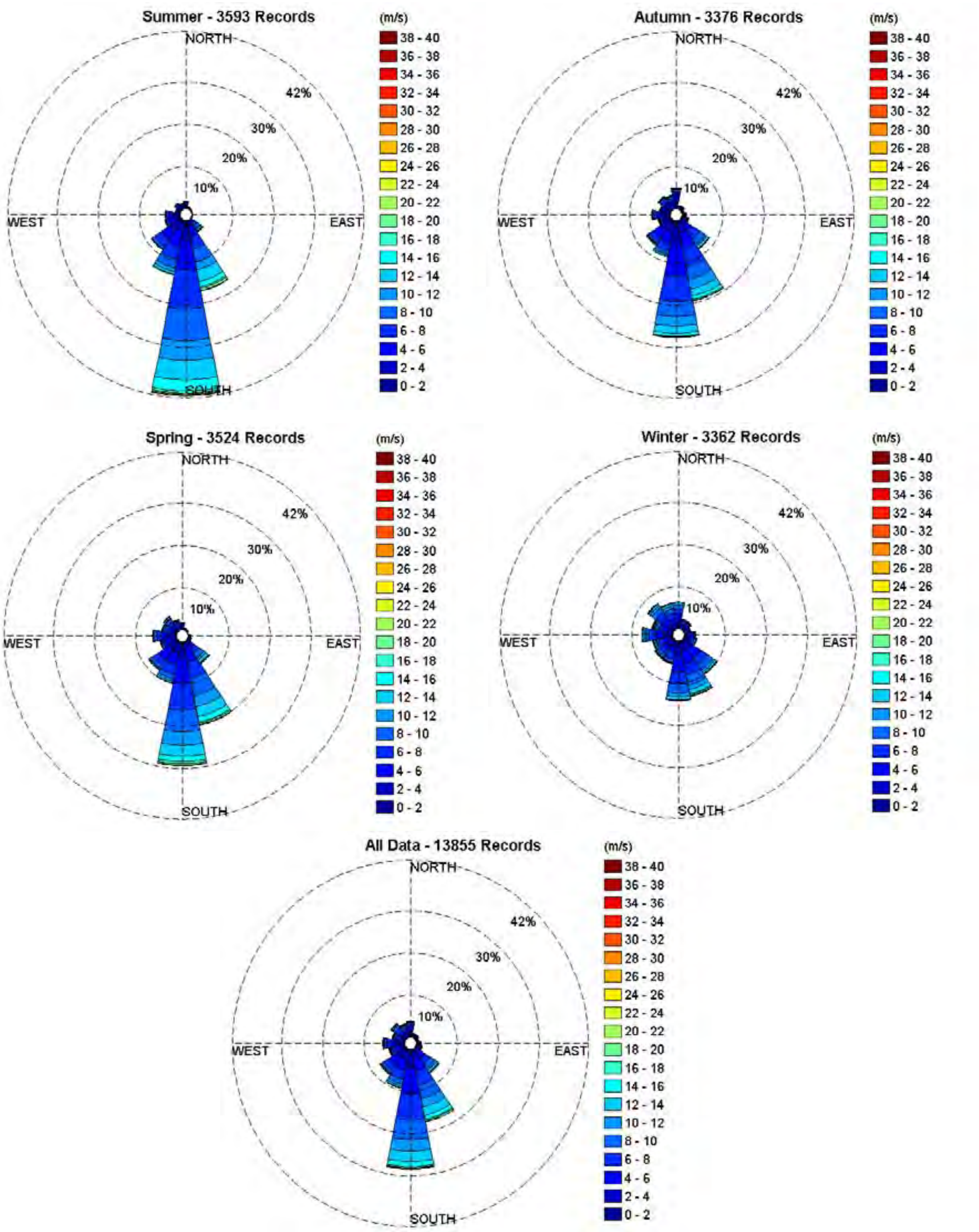


Figure 4.1: VOS Wind Speed vs Wind Direction data for the Cape Columbine area 32.0 to 32.9 S and 17.0 to 17.9 E (1903-11-01 to 2011-05-24; 13 855 records) (from CSIR).

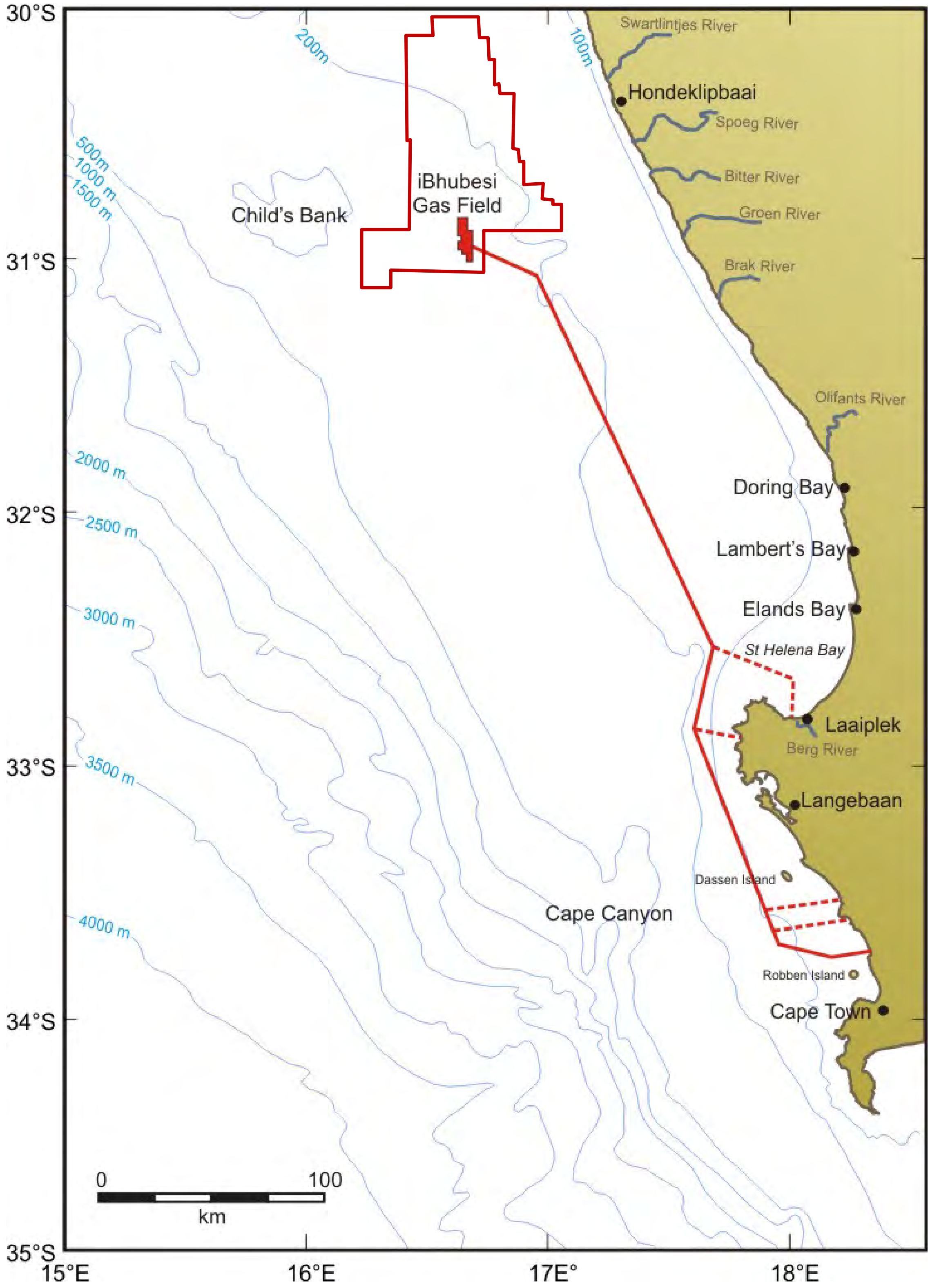


Figure 4.2: Ibhubesi Gas Field and proposed production pipeline route alternatives in relation to bathymetry and seabed features off the West Coast.

4.2.2 WAVES AND TIDES

Most of the West Coast of southern Africa is exposed and experiences strong wave action, rated 13 to 17 on the 20 point exposure scale (McLachlan 1980). It is impacted by heavy south-westerly swells generated in the roaring forties, as well as significant sea waves generated locally by the prevailing moderate to strong southerly winds. The peak wave energy periods fall in the range 9.7 – 15.5 seconds.

The wave regime along the southern African West Coast shows only moderate seasonal variation in direction, with virtually all swells throughout the year coming from the south and south-southwest direction. Winter swells are strongly dominated by those from south and south-southwest, which occur almost 80% of the time, and typically exceed 2 m in height, averaging about 3 m, and often attaining over 5 m. With wind speeds capable of reaching 100 km/h during heavy winter south-westerly storms, winter swell heights can exceed 10 m.

In comparison, summer swells tend to be smaller on average, typically around 2 m, not reaching the maximum swell heights of winter. There is also a slightly more pronounced southerly swell component in summer. These southerly swells tend to be wind-induced, with shorter wave periods (approximately 8 seconds), and are generally steeper than swell waves (CSIR 1996). These wind-induced southerly waves are relatively local and, although less powerful, tend to work together with the strong southerly winds of summer to cause the northward-flowing.

In common with the rest of the southern African coast, tides are semi-diurnal, with a total range of some 1.5 m at spring tide, but only 0.6 m during neap tide periods.

4.2.3 WATER CIRCULATION AND COASTAL CURRENTS

Water circulation off the West Coast is dominated by upwelling (see Section 4.2.4).

The ocean currents occurring off the West Coast are complex and are summarised in Figure 4.3. Data suggests that currents north of Cape Columbine are weaker and more variable than the currents to the south (Boyd *et al*. 1992). The most important is the Benguela current, which constitutes a broad, shallow and slow NW flow along the West Coast between the cool coastal upwelled waters and warmer Central Atlantic surface waters further offshore. The current is driven by the moderate to strong south to south-east winds which are characteristic of the region and is most prevalent at the surface, although it does follow the major seafloor topographic features (Nelson and Hutchings 1983). Current velocities in continental shelf areas generally range between 10–30 cm/s (Boyd & Oberholster 1994). Shelf edge jet currents exist off both Cape Columbine (Nelson and Hutchings 1983) and the Cape Peninsula (Bang 1970; Shillington 1998), where flow is locally more intense (up to 50 cm/s off Cape Columbine and 70 cm/s off the Cape Peninsula). In the south the Benguela current has a width of 200 km, widening rapidly northwards to 750 km.

The flows are predominantly wind-forced, barotropic and fluctuate between poleward and equatorward flow (Shillington *et al.* 1990; Nelson & Hutchings 1983). Near bottom shelf flow is mainly poleward with low velocities of typically 5 cm/s. The poleward flow becomes more consistent in the southern Benguela (Pulfrich, 2011). A southward flow of surface water occurs close inshore during periods of barotropic reversals and during winter when upwelling is not taking place.

Agulhas Current water does occasionally enter the south-east Atlantic in summer as warm water filaments (<50 m deep) or eddies (several 100 m wide and deep). These warm water tongues are usually at least 180 km offshore and seldom move further north than 33°S and do not appear to impact the Benguela shelf region.

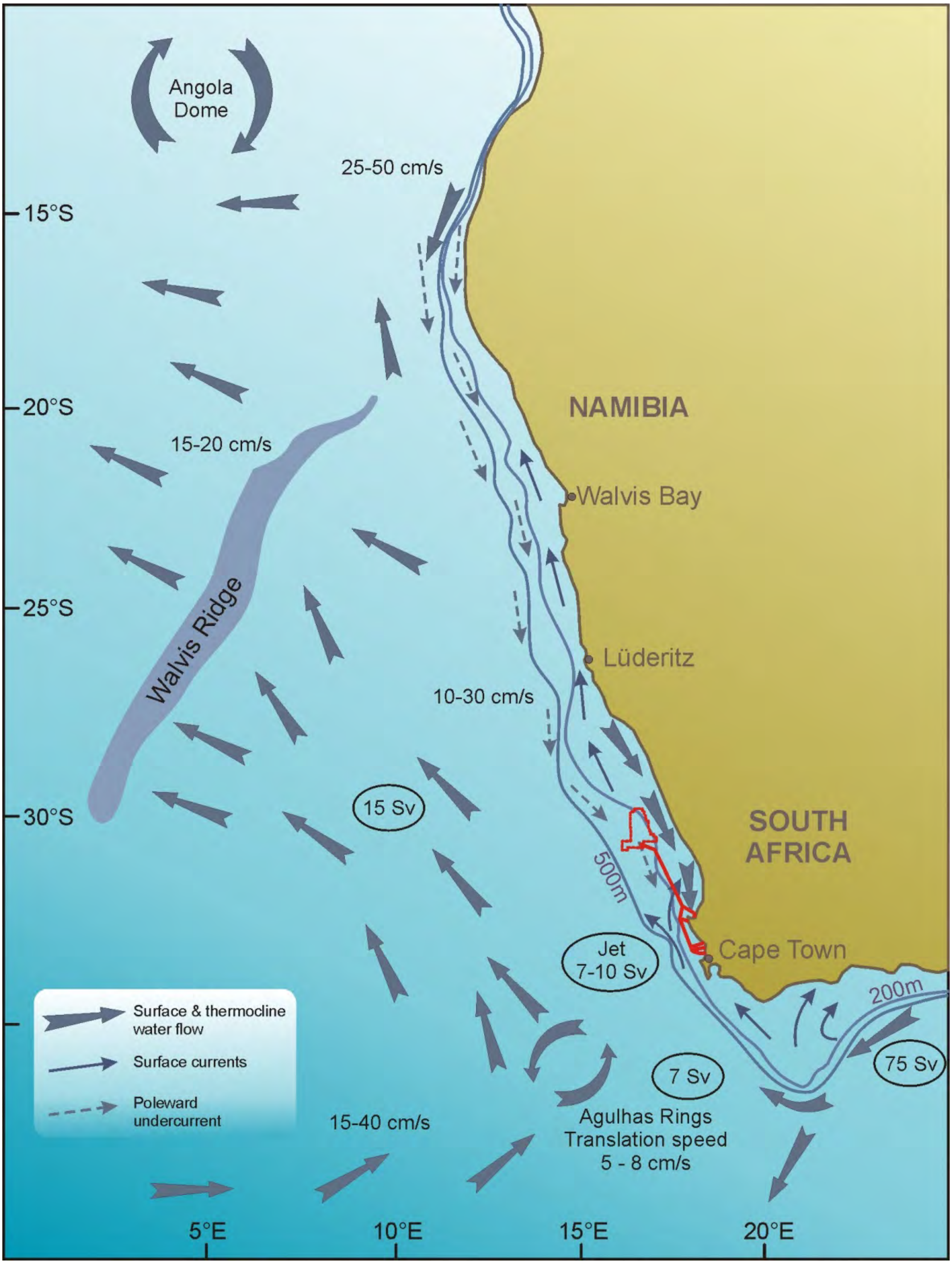


Figure 4.3: **Major features of the predominant circulation patterns and volume flows in the Benguela System, along the southern Namibian and South African west coasts (re-drawn from Shannon & Nelson 1996). The licence area and the proposed pipeline route alternatives are also shown.**

4.2.4 UPWELLING

Upwelling occurs along the West Coast from Cape Agulhas to northern Namibia. During upwelling the comparatively nutrient-poor surface waters are displaced by enriched deep water, supporting substantial seasonal primary phytoplankton production. The cold, upwelled water is rich in inorganic nutrients, the major contributors being various forms of nitrates, phosphates and silicates (Chapman & Shannon 1985). This is mediated by nutrient regeneration from biogenic material in the sediments (Bailey *et al*. 1985). The range of nutrient concentrations can thus be large but, in general, concentrations are high

There are three upwelling centres in the southern Benguela, namely the Cape Point (34°S), Cape Columbine (33°S) and Namaqua (30°S) upwelling cells (Taunton-Clark 1985) (Figure 4.4). Upwelling in these cells is seasonal, with maximum upwelling occurring between September and March.

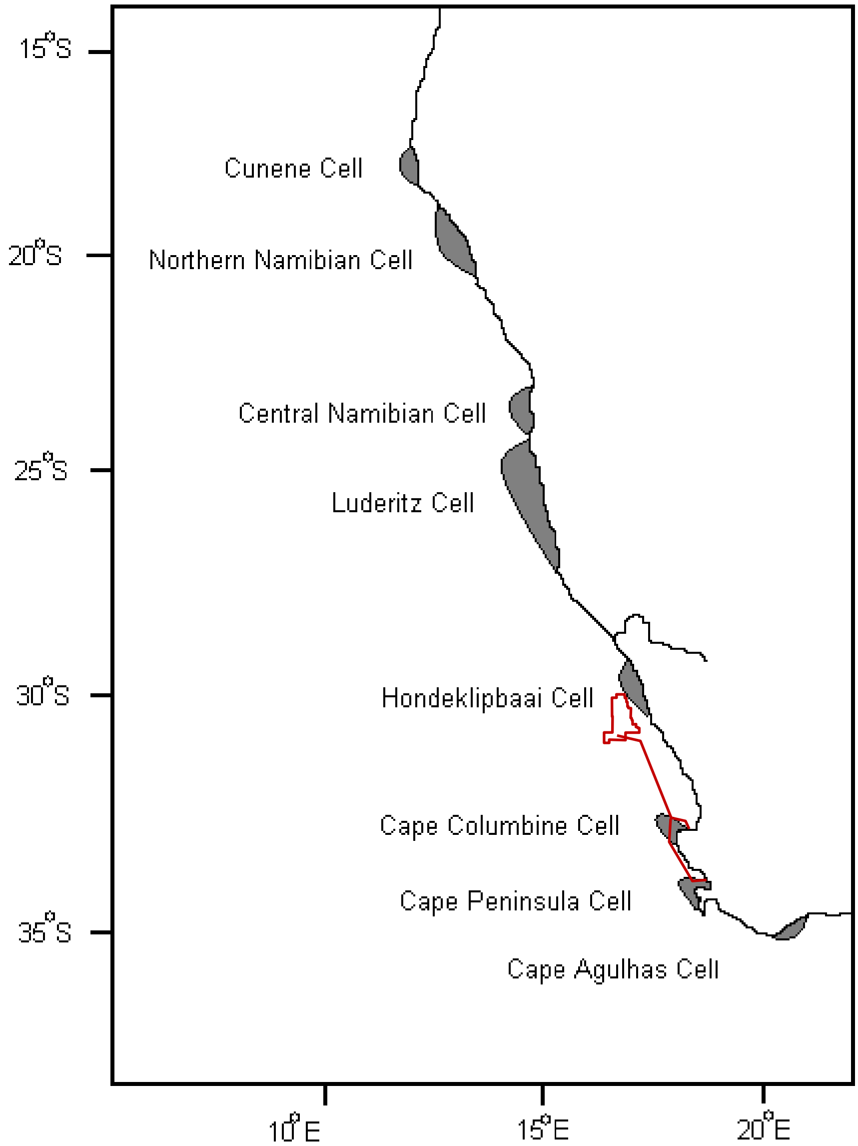


Figure 4.4: The location of three major upwelling cells along the West Coast (Shannon and Nelson, 1996). Approximate location of Block 2A and the proposed production pipeline area also indicated.

Once upwelled, the water warms and stabilises, and moves offshore where a thermocline usually develops. Nutrient-rich upwelled water enhances primary production, and the West Coast region consequently supports substantial pelagic fisheries (Heydorn and Tinley 1980; Shillington 1998). Although the rate and intensity of upwelling fluctuates with seasonal variations in wind patterns, the most intense upwelling tends to occur where the shelf is narrowest and the wind strongest.

High phytoplankton productivity in the upper layers again depletes the nutrients in these surface waters. This results in a wind-related cycle of plankton production, mortality, sinking of plankton detritus and eventual nutrient re-enrichment occurring below the thermocline as the phytoplankton decays. Biological decay of plankton blooms can in turn lead to “black tide” events, as the available dissolved oxygen is stripped from the water during the decomposition process. Subsequent anoxic decomposition by sulphur reducing bacteria can result in the formation and release of hydrogen sulphide (Pitcher & Calder 2000).

4.2.5 NUTRIENT DISTRIBUTION

Above thermoclines (that develop as water movement stabilises) phytoplankton production consumes nutrients, thus depleting the nutrients in the surface layer. Below the thermocline, nutrient re-enrichment occurs as biological decay occurs. As upwelled water is nutrient enriched compared to surface water, nutrient distribution on the West Coast is closely linked to upwelling (Chapman and Shannon 1985). Highest nutrient concentrations are thus located at the upwelling sites (Andrews and Hutchings 1980), offshore of which it decreases (Chapman and Shannon 1985).

Phosphate levels are low at the surface and offshore, but high (up to 3.0 μM) in bottom waters of the shelf and in newly upwelled waters. Upwelled waters can at times be enriched in phosphate as they pass over phosphorus rich shelf sediments. Phosphate is unlikely to ever become a limiting nutrient in the Benguela region.

Nitrate normally occurs in greater concentrations at the bottom than in upwelling source water, and decreases in availability at the surface (to less than 1 μM). Nitrate appears to be the limiting nutrient in the Benguela region.

Silicate levels range between 5-15 μM within the Benguela system, although these may at times be enhanced considerably over the shelf. It is not likely to be limiting in the southern Benguela.

4.2.6 OXYGEN CONCENTRATION

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations with <40% saturation occurring frequently (e.g. Visser 1969; Bailey *et al*. 1985). The low oxygen concentrations are attributed to nutrient remineralisation in the bottom waters of the system (Chapman & Shannon 1985). This rate is dependent upon the net organic material build-up in the sediments, with the carbon rich mud deposits playing an important role. As the mud on the shelf is distributed in discrete patches, there are corresponding preferential areas for the formation of oxygen-poor water.

The two main areas of low-oxygen water formation in the southern Benguela region are in the Orange River Bight and St Helena Bay (Chapman & Shannon 1985; Bailey 1991; Shannon & O’Toole 1998; Bailey 1999; Fossing *et al*. 2000). The spatial distribution of oxygen-poor water in each of the areas is subject to short- and medium-term variability in the volume of hypoxic water that develops.

De Decker (1970) showed that the occurrence of low oxygen water off Lambert’s Bay is seasonal, with highest development in summer/autumn. Bailey & Chapman (1991), on the other hand, demonstrated that in the St Helena Bay area daily variability exists as a result of downward flux of oxygen through thermoclines and short-term variations in upwelling intensity. Subsequent upwelling processes can move this low-oxygen water up onto the inner shelf, and into nearshore waters, often with devastating effects on marine communities.

Periodic low oxygen events in the nearshore region can have catastrophic effects on the marine communities leading to large-scale stranding of rock lobsters and mass mortalities of marine biota and fish (Newman & Pollock 1974; Matthews & Pitcher 1996; Pitcher 1998; Cockcroft *et al*. 2000). The development of anoxic conditions as a result of the decomposition of huge amounts of organic matter generated by phytoplankton blooms is the main cause for these mortalities and walkouts. The blooms develop over a period of unusually calm wind conditions when sea surface temperatures where high. Algal blooms usually occur during summer-autumn (February to April) but can also develop in winter during the 'berg' wind periods, when similar warm windless conditions occur for extended periods.

4.2.7 SEDIMENTS

Figure 4.5 illustrates the distribution of seabed surface sediment types off the West Coast of South Africa. The inner shelf is underlain by Precambrian bedrock (Pre-Mesozoic basement), whilst the middle and outer shelf areas are composed of Cretaceous and Tertiary sediments (Dingle 1973; Dingle *et al*. 1987; Birch *et al*. 1976; Rogers 1977; Rogers & Bremner 1991).

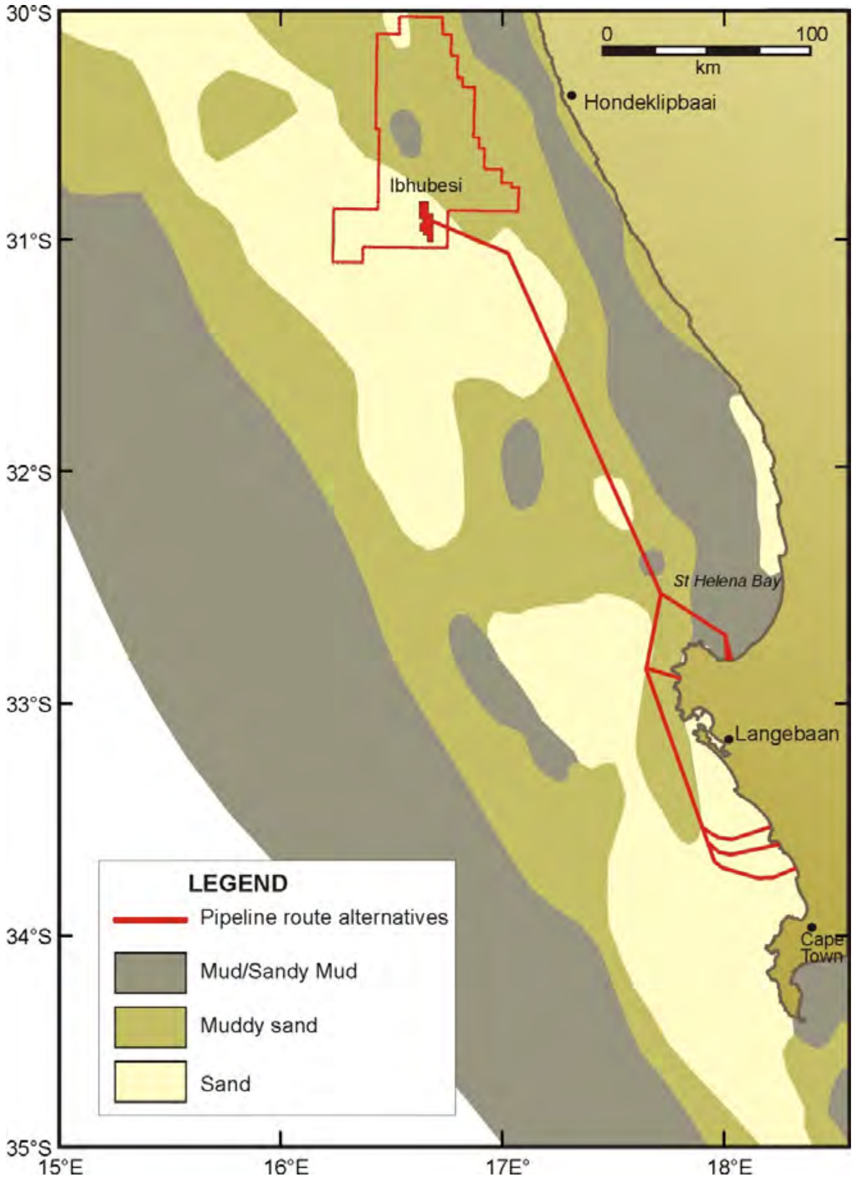


Figure 4.5: Ibhubesi Gas Field and proposed production pipeline route alternatives in relation to sediment distribution on the continental shelf of the West Coast (adapted from Rogers 1977).

As a result of erosion on the continental shelf, the unconsolidated sediment cover is generally thin, often less than 1 m. Sediments are finer seawards, changing from sand on the inner and outer shelves to muddy sand and sandy mud in deeper water. However, this general pattern has been modified considerably by biological deposition (large areas of shelf sediments contain high levels of calcium carbonate) and localised river input.

An approximately 500 km long mud belt (up to 40 km wide and of 15 m average thickness) is situated over the innershelf between the Orange River and St Helena Bay (Birch *et al*. 1976). Further offshore, sediment is dominated by muds and sandy muds. The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze.

Present day sedimentation is limited to input from the Orange River. This sediment is generally transported northward. The Orange River, when in flood, still contributes largely to the mud belt as suspended sediment is carried southward by poleward flow. In this context, the absence of large sediment bodies on the inner shelf reflects on the paucity of terrigenous sediment being introduced by the few rivers that presently drain the West Coast coastal plain.

4.2.8 TURBIDITY

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulate matter. Total Suspended Particulate Matter (TSPM) can be divided into Particulate Organic Matter (POM) and Particulate Inorganic Matter (PIM), the ratios between them varying considerably.

The POM usually consists of detritus, bacteria, phytoplankton and zooplankton, and serves as a source of food for filter-feeders. Seasonal microphyte production associated with upwelling events plays an important role in determining the concentrations of POM in coastal waters. PIM, on the other hand, is primarily of geological origin consisting of fine sands, silts and clays. Off Namaqualand, the PIM loading in nearshore waters is strongly related to natural inputs from the Orange River or from ‘berg’ wind events. Although highly variable, annual discharge rates of sediments by the Orange River is estimated to vary from 8 - 26 million tons/yr (Rogers 1979). ‘Berg’ wind events can potentially contribute the same order of magnitude of sediment input as the annual estimated input of sediment by the Orange River (Shannon and Anderson 1982; Zoutendyk 1992, 1995; Shannon and O’Toole 1998; Lane and Carter 1999).

Concentrations of suspended particulate matter in shallow coastal waters can vary both spatially and temporally, typically ranging from a few mg/l to several tens of mg/l (Bricelj and Malouf 1984; Berg and Newell 1986; Fegley et al. 1992). Field measurements of TSPM and PIM concentrations in the Benguela current system have indicated that outside of major flood events, background concentrations of coastal and continental shelf suspended sediments are generally <12 mg/l, showing significant long-shore variation (Zoutendyk 1995). Considerably higher concentrations of PIM have, however, been reported from southern African West Coast waters under stronger wave conditions associated with high tides and storms, or under flood conditions. During storm events, concentrations near the seabed may even reach up to 10 000 mg/l (Miller and Sternberg 1988). In the vicinity of the Orange River mouth, where river outflow strongly influences the turbidity of coastal waters, measured concentrations ranged from 14.3 mg/L at Alexander Bay just south of the mouth (Zoutendyk 1995) to peak values of 7 400 mg/l immediately upstream of the river mouth during the 1988 Orange River flood (Bremner et al. 1990).

The major source of turbidity in the swell-influenced nearshore areas off the West Coast is the redistribution of fine inner shelf sediments by long-period Southern Ocean swells. The current velocities typical of the Benguela (10-30 cm/s) are capable of resuspending and transporting considerable quantities of sediment equatorwards. Under relatively calm wind conditions, however, much of the suspended fraction (silt and clay) that remains in suspension for longer periods becomes entrained in the slow poleward undercurrent (Shillington *et al*. 1990; Rogers & Bremner 1991).

Superimposed on the suspended fine fraction, is the northward littoral drift of coarser bedload sediments, parallel to the coastline. This northward, nearshore transport is generated by the predominantly south-westerly swell and wind-induced waves. Longshore sediment transport varies considerably in the shore-perpendicular dimension, being substantially higher in the surf-zone than at depth, due to high turbulence and convective flows associated with breaking waves, which suspend and mobilise sediment (Smith and Mocke 2002).

On the inner and middle continental shelf, the ambient currents are insufficient to transport coarse sediments typical of those depths, and re-suspension and shoreward movement of these by wave-induced currents occur primarily under storm conditions (see also Drake *et al*. 1985; Ward 1985). Most of the sediment shallower than 90 m can therefore be subject to re-suspension and transport by heavy swells (Lane & Carter 1999).

Mean sediment deposition is naturally higher near the seafloor due to constant re-suspension of coarse and fine PIM by tides and wind-induced waves. The combination of re-suspension of seabed sediments by heavy swells, and the faster settling rates of larger inorganic particles, typically causes higher sediment concentrations near the seabed. Significant re-suspension of sediments can also occur up into the water column under stronger wave conditions associated with high tides and storms. Re-suspension can result in dramatic increases in PIM concentrations within a few hours (Sheng et al. 1994). Wind speed and direction have also been found to influence the amount of material re-suspended (Ward 1985).

4.3 BIOLOGICAL OCEANOGRAPHY

South Africa is divided into nine bioregions (see Figure 4.6). The proposed pipeline falls within the cold temperate Namaqua and the South-western Cape Bioregions (Emanuel *et al*. 1992; Lombard *et al.* 2004). The coastal, wind-induced upwelling characterising the Western Cape coastline, is the principle physical process which shapes the marine ecology of the southern Benguela region. The Benguela system is characterised by the presence of cold surface water, high biological productivity, and highly variable physical, chemical and biological conditions. The West Coast is, however, characterised by low marine species richness and low endemicity (Awad *et al.* 2002).

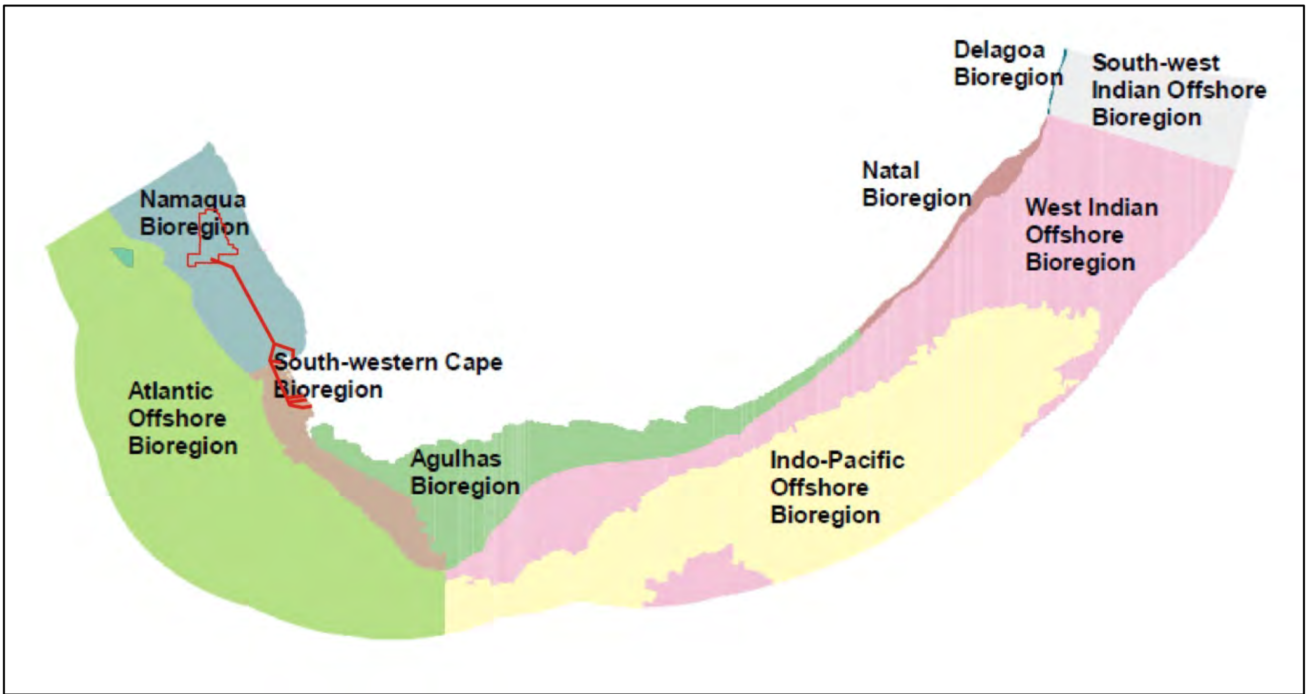


Figure 4.6: Proposed production pipeline route alternatives in relation to the South African inshore and offshore bioregions (red line) (adapted from Lombard *et al*. 2004).

The biotas of the nearshore marine habitats off the West Coast are relatively robust, being naturally adapted to an extremely dynamic environment where biophysical disturbances are commonplace. Communities within this region are largely ubiquitous, particular to substrate type (i.e. hard vs. soft bottom), exposure to wave action, or water depth. Habitats specific to the study area include:

- Sandy intertidal and subtidal substrates;
- Intertidal rocky shores and subtidal reefs; and
- The water column / body.

The biological communities consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales). No rare or endangered species have been recorded (Awad *et al.* 2002). The biological communities 'typical' of these habitats are described briefly below, focussing both on dominant, commercially important and conspicuous species, as well as potentially threatened or sensitive species, which may be affected by the proposed pipeline routing.

4.3.1 THREAT STATUS

Sink et. al. (2012) mapped the ecosystem threat status of offshore benthic and pelagic habitats. The proposed offshore production pipeline route coincides with benthic habitats mapped largely as 'least threatened' (see Figure 4.7). The proposed pipeline would traverse an area of 'vulnerable' habitat to the south-east of Child's Bank and 'endangered' habitat in the nearshore areas on the innershelf south of Cape Columbine. The majority of the offshore pelagic habitat types is rated as 'least threatened' with only a narrow band along the shelf break of the West Coast being rated as 'vulnerable' (see Figure 4.7), primarily due to its importance as a migration pathway for various resource species (e.g. whales, tuna, billfish, turtles).

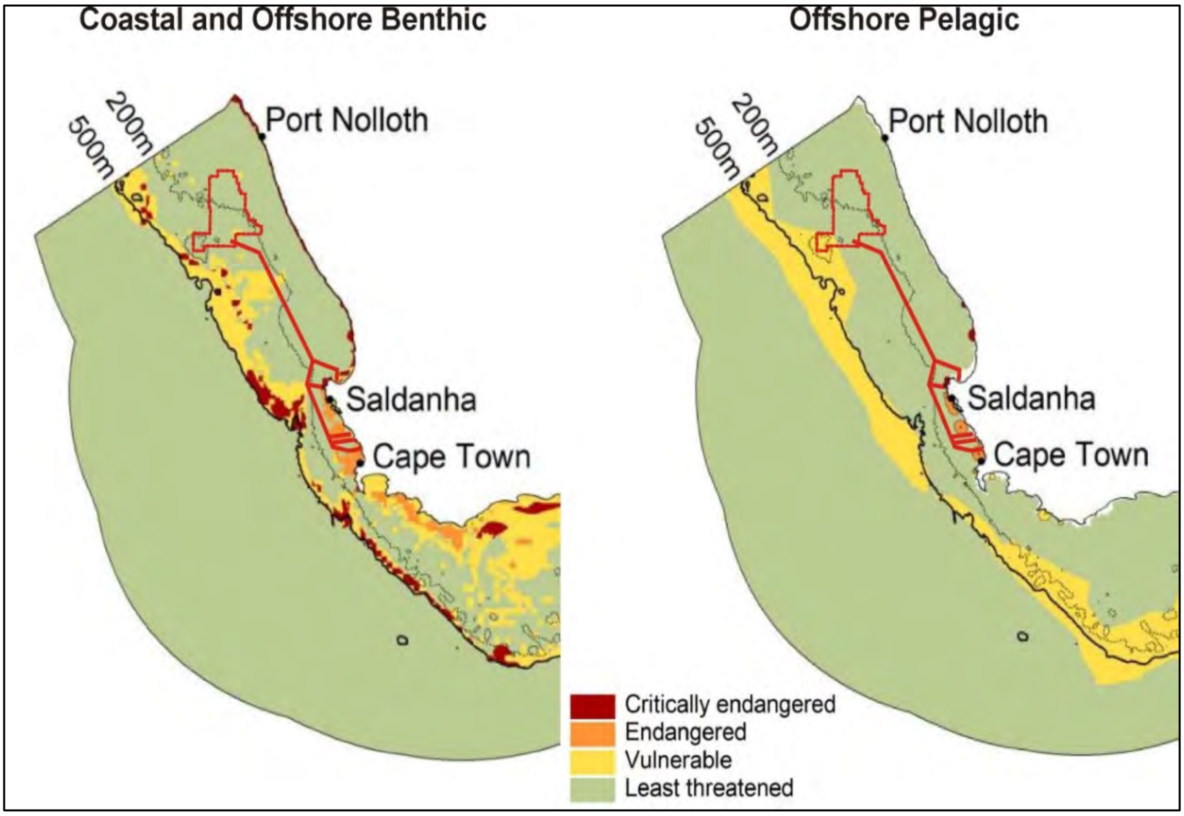


Figure 4.7: Proposed production pipeline route alternatives in relation to the ecosystem threat status for coastal and offshore benthic habitat types (left), and offshore pelagic habitat types on the South African West Coast (adapted from Sink *et al*. 2012).

Majiedt *et al*. 2013 also mapped benthic and coastal habitat types and their associated threat status. The benthic habitats potentially affected by the proposed production pipeline are shown in Figure 4.8 and Table 4.1. Of the southern shore-crossing alternatives, the Duynefontein and Silwerstroom Strand alternatives pass through areas considered to be “critically endangered” marine habitats, whereas the Grotto Bay alternative passes through “vulnerable” and “endangered” marine habitats (see Figure 4.9). The northern shore-crossing alternatives at Noordwesbaai and St Helena (West and East) all pass through areas considered to be “critically endangered” marine habitats near the coast (see Figure 4.10).

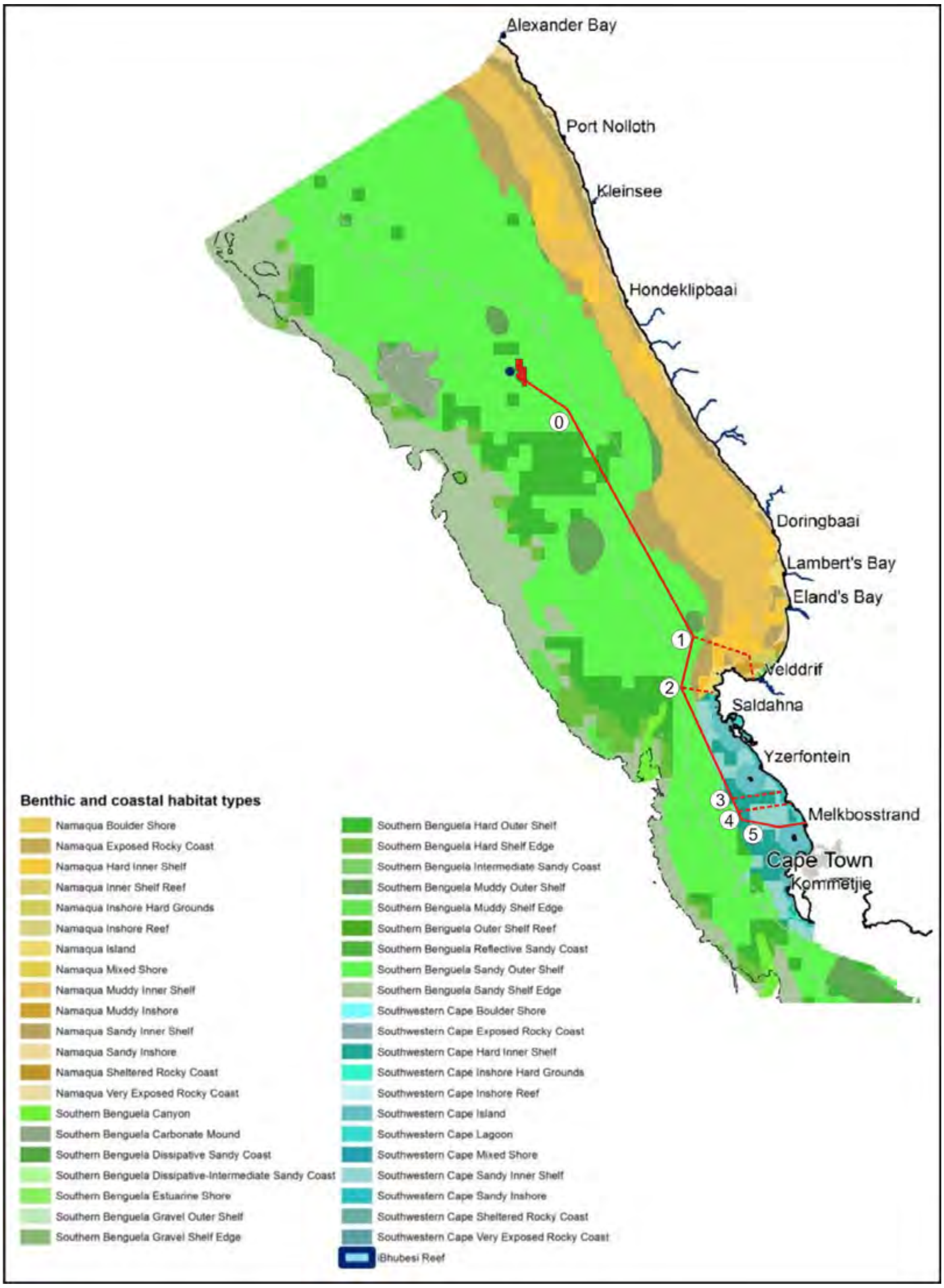


Figure 4.8: Ibhubesi Gas Field and proposed production pipeline route alternatives in relation to benthic and coastal habitat types on the West Coast (adapted from Majiedt *et al*. 2013).

Table 4.1: Ecosystem threat status for marine and coastal habitat types on the West Coast (adapted from Sink *et al*. 2011). Only those habitats affected by the proposed gas pipeline routes are shown.

Habitat Type (numbers relate to route alternative in Figure 4.8)	Threat Status
Namaqua Inshore Hard Grounds (1)	Critically Endangered
Namaqua Mixed Shore (1)	Endangered
Namaqua Muddy Inshore (1)	Vulnerable
Namaqua Sandy Inshore (1)	Critically Endangered
Namaqua Hard Inner Shelf (1, 2)	Least Threatened
Namaqua Muddy Inner Shelf (1)	Least Threatened
Namaqua Sandy Inner Shelf (0, 1, 2)	Least Threatened
Southern Benguela Dissipative sandy coast (4, 5)	Least Threatened
Southern Benguela Hard Outer Shelf (0)	Vulnerable
Southern Benguela Intermediate Sandy Coast (1, 2)	Least Threatened
Southern Benguela Muddy Outer Shelf (0)	Least Threatened
Southern Benguela Sandy Outer Shelf (0, 1, 2)	Least Threatened
Southwestern Cape Hard Inner Shelf (2, 3, 4, 5)	Endangered
Southwestern Cape Inshore Hard Grounds (4, 5)	Critically Endangered
Southwestern Cape Mixed Shore (2)	Vulnerable
Southwestern Cape Sandy Inner Shelf (2, 3, 4, 5)	Least Threatened
Southwestern Cape Sandy Inshore (2, 3, 4, 5)	Vulnerable

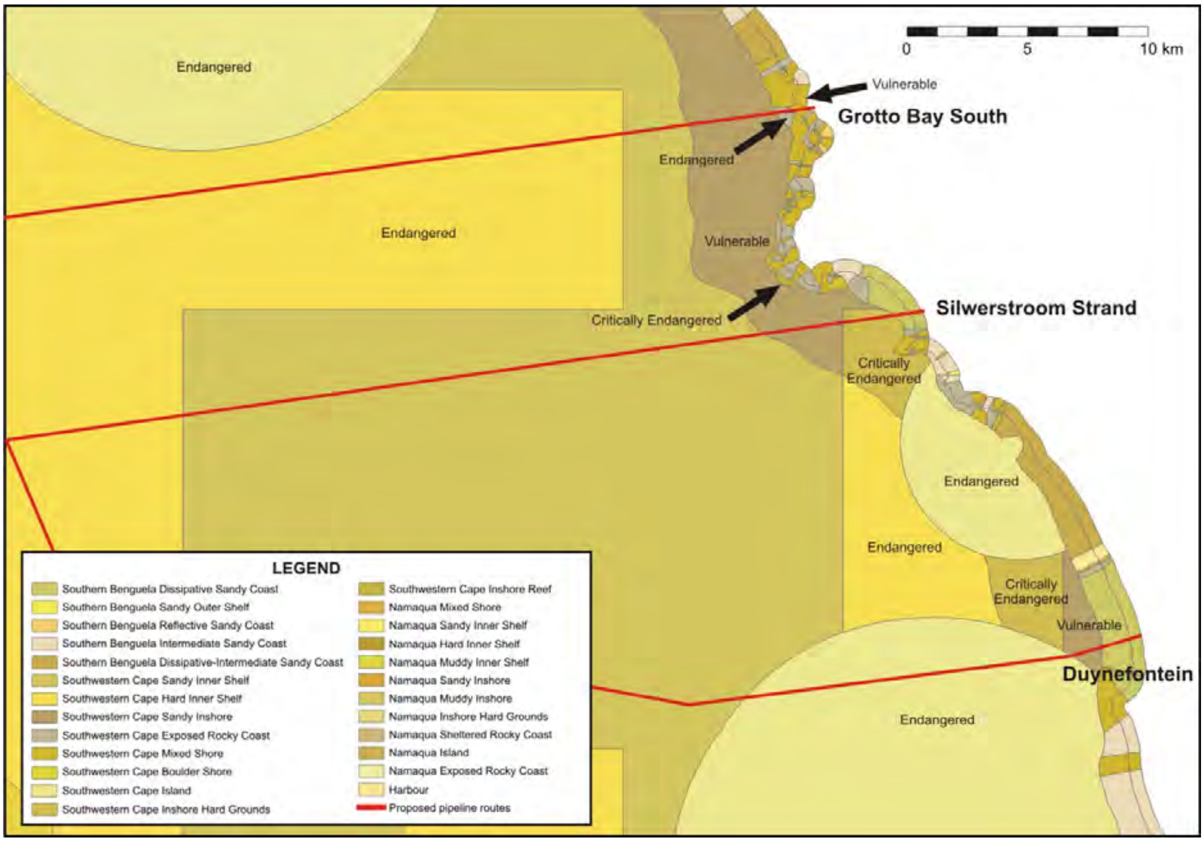


Figure 4.9: Offshore benthic and coastal habitat types affected by the southern shore-crossing alternatives between Grotto Bay and Duynefontein.

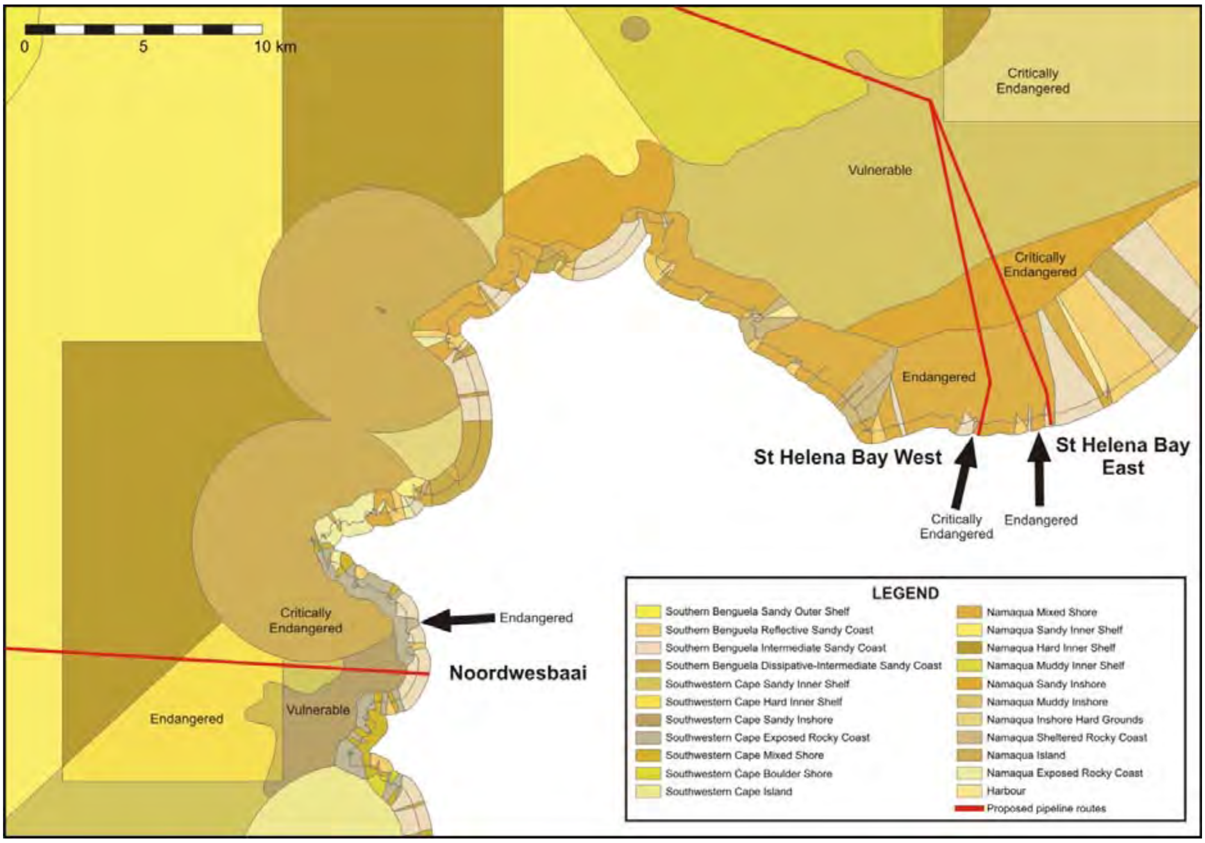


Figure 4.10: Offshore benthic and coastal habitat types affected by the northern shore-crossing alternatives on the Saldanha Peninsula.

4.3.2 SANDY SUBSTRATE HABITATS AND BIOTA

The 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).

4.3.2.1 Intertidal sandy beaches

The coastlines from Hondeklipbaai to the Olifants River mouth is dominated by rocky shores, but south of the river mouth to Table Bay, sandy shores are found to dominate.

Sandy beaches are one of the most dynamic coastal environments. With the exception of a few beaches in large bay systems (such as St Helena Bay, Saldanha Bay, Table Bay), the beaches along the West Coast of South Africa are typically highly exposed. Exposed sandy shores consist of coupled surf-zone, beach and dune systems, which together form the active littoral sand transport zone (Short & Hesp 1985).

The composition of their faunal communities is largely dependent on the interaction of wave energy, beach slope and sand particle size, which is termed beach morphodynamics. Three morphodynamic beach types are described: dissipative, reflective and intermediate beaches (McLachlan *et al.* 1993):

- *Dissipative beaches* are relatively wide and flat with fine sands and low wave energy. Waves start to break far from the shore in a series of spilling breakers that 'dissipate' their energy along a broad surf zone. This generates slow swashes with long periods, resulting in less turbulent conditions on the gently sloping beach face. These beaches usually harbour the richest intertidal faunal communities.

- *Reflective beaches* in contrast, have high wave energy, and are coarse grained (>500 µm sand) with narrow and steep intertidal beach faces. The relative absence of a surf-zone causes the waves to break directly on the shore causing a high turnover of sand. The result is depauperate faunal communities.
- *Intermediate beaches* exist between these extremes and have a very variable species composition (McLachlan *et al.* 1993; Jaramillo *et al.* 1995, Soares 2003). This variability is mainly attributable to the amount and quality of food available. Beaches with a high input of e.g. kelp wrack have a rich and diverse drift-line fauna, which is sparse or absent on beaches lacking a drift-line (Branch & Griffiths 1988). As a result of the combination of typical beach characteristics, and the special adaptations of beach fauna to these, beaches act as filters and energy recyclers in the nearshore environment (Brown & McLachlan 1990).

Numerous methods of classifying beach zonation have been proposed, based either on physical or biological criteria. The general scheme proposed by Branch & Griffiths (1988) is used below (Figure 4.11), supplemented by data from various publications on West Coast sandy beach biota (e.g. Bally 1987; Brown *et al.* 1989; Soares *et al.* 1996, 1997; Nel 2001; Nel *et al*. 2003; Soares 2003; Branch *et al.* 2010; Harris 2012).

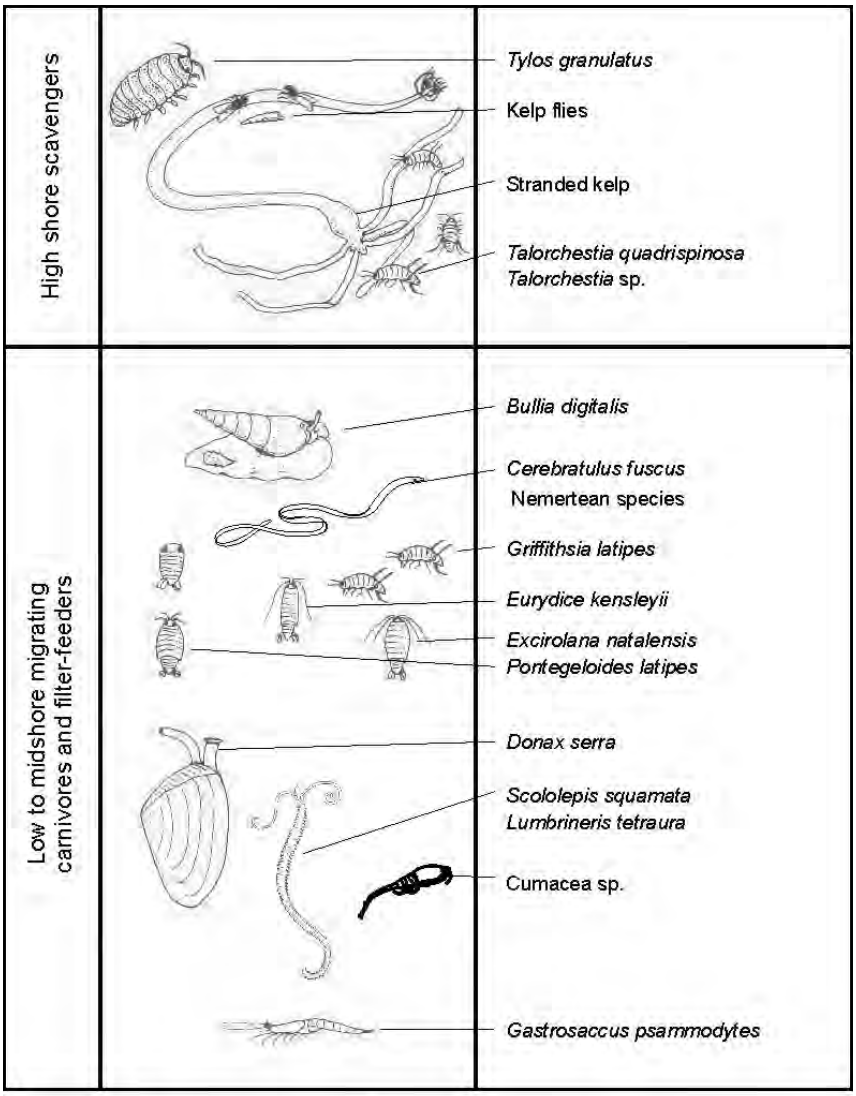


Figure 4.11: Schematic representation of the West Coast intertidal beach zonation (adapted from Branch & Branch 1981). Species commonly occurring on the beaches are listed.

The macrofaunal communities of sandy beaches are generally ubiquitous throughout the southern African West Coast region, being particular only to substratum type, wave exposure and/or depth zone. Due to the exposed nature of the coastline in the study area, most beaches are of the intermediate to reflective type.

The macrofauna occurring in the different zones off the beach (Figure 4.12) consist of:

- The *supralittoral zone* is situated above the high water spring (HWS) tide level, and receives water input only from large waves at spring high tides or through sea spray. This zone is characterised by a mixture of air breathing terrestrial and semi-terrestrial fauna, often associated with and feeding on kelp deposited near or on the driftline. Terrestrial species include a diverse array of beetles and arachnids and some oligochaetes, while semi-terrestrial fauna include the oniscid isopod *Tylos granulatus*, and amphipods of the genus *Talorchestia*.
- The *intertidal zone or mid-littoral zone* has a vertical range of about 2 m. This mid-shore region is characterised by the cirolanid isopods *Pontogeloides latipes*, *Eurydice* (*longicornis*=) *kensleyi* and *Excirolana natalensis*, the polychaetes *Scolelepis squamata*, *Orbinia angrapequensis*, *Nepthys hombergii* and *Lumbrineris tetraura*, and amphipods of the families Haustoridae and Phoxocephalidae. In some areas, juvenile and adult sand mussels *Donax serra* may also be present in considerable numbers.
- The *inner turbulent zone* extends from the Low Water Spring mark to about approximately 2 m depth. The mysid *Gastrosaccus psammodytes* (Mysidacea, Crustacea), the ribbon worm *Cerebratulus fuscus* (Nemertea), the cumacean *Cumopsis robusta* (Cumacea) and a variety of polychaetes including *Scolelepis squamata* and *Lumbrineris tetraura*, are typical of this zone, although they generally extend partially into the midlittoral above. In areas where a suitable swash climate exists, the gastropod *Bullia digitalis* (Gastropoda, Mollusca) may also be present in considerable numbers, surfing up and down the beach in search of carrion.
- The *transition zone* spans approximately 2 - 5 m depth beyond the inner turbulent zone. Extreme turbulence is experienced in this zone, and as a consequence this zone typically harbours the lowest diversity on sandy beaches. Typical fauna include amphipods such as *Cunicus profundus* and burrowing polychaetes such as *Cirriformia tentaculata* and *Lumbrineris tetraura.*
- The *zone below 5 m depth* shows increase in species diversity due to reduced turbulence. In addition to the polychaetes found in the transition zone, other polychaetes in this zone include *Pectinaria capensis*, and *Sabellides ludertizii*. The sea pen V*irgularia schultzi* (Pennatulacea, Cnidaria) is also common as is a host of amphipod species and the three spot swimming crab *Ovalipes punctatus* (Brachyura, Crustacea).

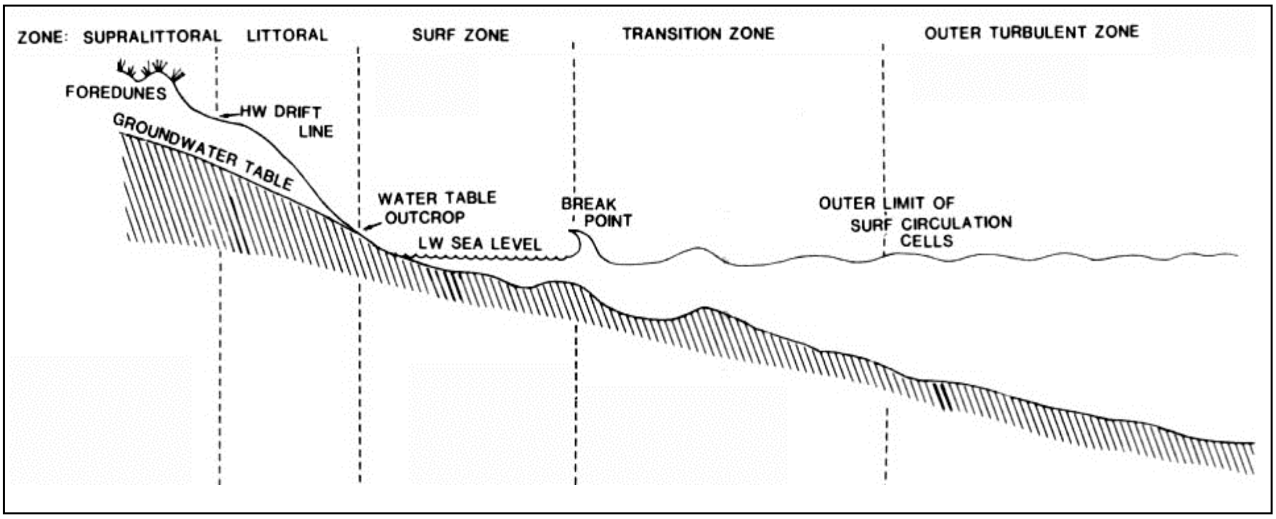


Figure 4.12: Generalised scheme of zonation on sandy shores (Modified from Brown & MacLachlan 1990).

4.3.2.2 Nearshore and offshore unconsolidated habitats

Three macro-infauna communities have been identified on the inner- (0-30 m depth) and mid-shelf (30-150 m depth) off the West Coast (Karenyi unpublished data). These are described below.

- The *inner-shelf community*, which is affected by wave action, is characterised by various mobile predators (e.g. the gastropod *Bullia laevissima* and polychaete *Nereis* sp.), sedentary polychaetes and isopods.
- The *mid-shelf community* inhabits the mudbelt and is characterised by the mud prawns *Callianassa* sp. and *Calocaris barnardi*. A second mid-shelf sandy community occurring in sandy sediments is characterised by various polychaetes including deposit-feeding *Spiophanes soederstromi* and *Paraprionospio pinnata*. Polychaetes, crustaceans and molluscs make up the largest proportion of individuals, biomass and species on the West Coast.

The distribution of species within these communities is inherently patchy reflecting the high natural spatial and temporal variability associated with macro-infauna of unconsolidated sediments. Generally species richness increases from the inner-shelf across the mid-shelf and is influenced by sediment type (Karenyi unpublished data). The highest total abundance and species diversity was measured in sandy sediments of the mid-shelf. Biomass is highest in the inshore (± 50 g/m^2 wet weight) and decreases across the mid-shelf averaging around 30 g/m^2 wet weight. This is contrary to Christie (1974) who found that biomass was greatest in the mudbelt at 80 m depth off Lamberts Bay, where the sediment characteristics and the impact of environmental stressors (such as low oxygen events) are likely to differ from those further offshore.

Benthic communities are known to be structured by the complex interplay of a large array of environmental factors, including water depth, sediment grain size, shear bed stress (a measure of the impact of current velocity on sediment), oxygen concentration, productivity, organic carbon and seafloor temperature.

Other natural processes operating in the deep water shelf areas of the West Coast can over-ride the suitability of sediments in determining benthic community structure, and it is likely that periodic intrusion of low oxygen water masses is a major cause of this variability (Monteiro & van der Plas 2006; Pulfrich *et al*. 2006). In areas of frequent oxygen deficiency, benthic communities will be characterised either by species able to survive chronic low oxygen conditions or colonising and fast-growing species able to rapidly recruit into areas that have suffered oxygen depletion.

The invertebrate macrofauna are important in the marine benthic environment as they influence major ecological processes (e.g. remineralisation and flux of organic matter deposited on the sea floor, pollutant metabolism and sediment stability) and serve as important food source for commercially valuable fish species and other higher order consumers.

Also associated with soft-bottom substrates are demersal communities that comprise epifauna and bottom-dwelling vertebrate species, many of which are dependent on the invertebrate benthic macrofauna as a food source. According to Lange (2012) the continental shelf on the West Coast between depths of 100 m and 250 m, contained a single epifaunal community characterised by the hermit crabs *Sympagurus dimorphus* and *Parapaguris pilosimanus*, the prawn *Funchalia woodwardi* and the sea urchin *Brisaster capensis*. Atkinson (2009) also reported numerous species of urchins and burrowing anemones beyond 300 m depth off the West Coast.

A review of video footage from previous drilling operations in Block 2A has confirmed that the seabed at 200-250 m water depth is comprised of unconsolidated sediments, with some evidence of patches of shelly grit. Epifauna comprised primarily sea pens, brittle stars, burrowing anemones and hermit crabs, with gorgonians and sponges being observed in isolated areas only.

4.3.3 ROCKY SUBSTRATE HABITATS AND BIOTA

The biological communities of rocky intertidal and subtidal reefs are generally ubiquitous throughout the southern African West Coast region, being particular only to wave exposure, turbulence and/or depth zone.

4.3.3.1 Intertidal rocky shores

West Coast rocky intertidal shores can be divided into five zones on the basis of their characteristic biological communities: The Littorina, Upper Balanoid, Lower Balanoid, Cochlear/Argenvillei and the Infratidal Zones (see Figure 4.13 and Plate 4.1). These biological zones correspond roughly to zones based on tidal heights.

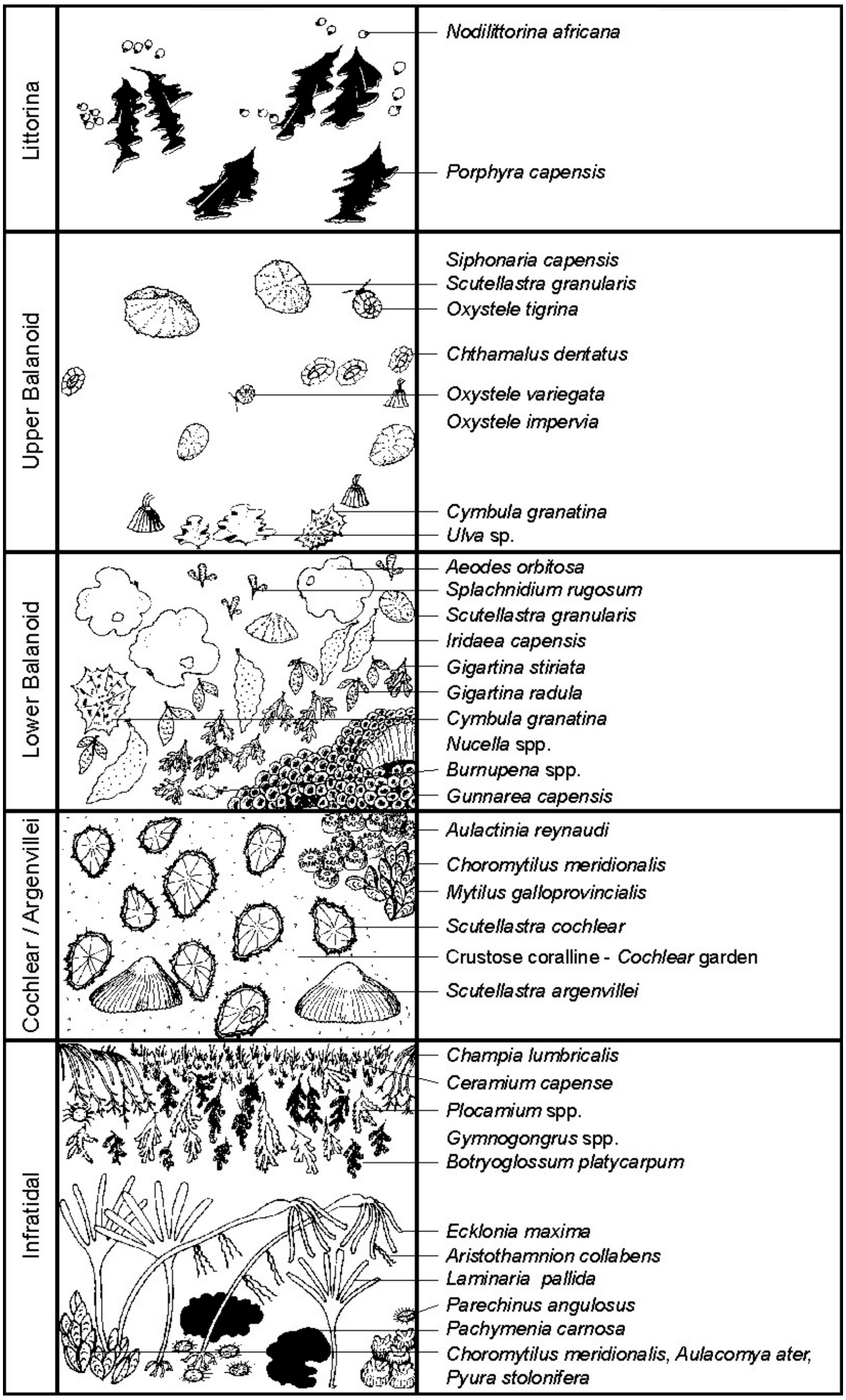


Figure 4.13: Schematic representation of the West Coast intertidal zonation (adapted from Branch & Branch 1981).

Plate 4.1: Typical rocky intertidal zonation on the southern African West Coast.

Several studies on the West Coast of southern Africa have documented the important effects of wave action on the intertidal rocky-shore community. Wave action enhances filter-feeders by increasing the concentration and turnover of particulate food, leading to an elevation of overall biomass despite a low species diversity (McQuaid & Branch 1985, Bustamante & Branch 1995a, 1996a, henninnte *et al.* 1997). Conversely, sheltered shores are diverse with a relatively low biomass, and only in relatively sheltered embayments does drift kelp accumulate and provide a vital support for kelp trapping limpets. In the subtidal, these differences diminish as wave exposure is moderated with depth.

Biota found in these different habitats is described below.

- The uppermost part of the shore is the *supralittoral fringe*, which is the part of the shore that is most exposed to air, perhaps having more in common with the terrestrial environment. The supralittoral is characterised by low species diversity, with the tiny periwinkle *Afrolittorina knysnaensis*, and the red alga *Porphyra capensis* constituting the most common macroscopic life.
- The *upper mid-littoral or upper balanoid zone* is characterised by the limpet *Scutellastra granularis*, which is present on all shores. The gastropods *Oxystele variegata*, *Nucella dubia*, and *Helcion pectunculus* are variably present, as are low densities of the barnacles *Tetraclita serrata*, *Octomeris angulosa* and *Chthalamus dentatus*. Flora is best represented by the green algae *Ulva* spp.
- Toward the *lower mid-littoral or lower balanoid zone*, biological communities are determined by exposure to wave action. On sheltered and moderately exposed shores, a diversity of algae abounds, namely green algae; brown algae – *Splachnidium rugosum*; and red algae – *Aeodes orbitosa*, *Mazzaella (=Iridaea) capensis*, *Gigartina polycarpa* (=*radula*), *Sarcothalia* (=*Gigartina*) *stiriata*, and with increasing wave exposure *Plocamium rigidum* and *P. cornutum*, and *Champia lumbricalis*. 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, the alien mussel *Mytilus galloprovinciali* is found. It is now the most abundant and widespread invasive marine species along the entire West Coast and parts of the South Coast (Robinson *et al.* 2005). Recently, another alien invasive has been recorded, the acorn barnacle *Balanus glandul.*
- Along the *sublittoral fringe or cochlear zone*, the large kelp-trapping limpet *Scutellastra argenvillei* dominates forming dense, almost monospecific stands. Similarly, *C. granatina* is the dominant grazer on more sheltered shores. On more exposed shores *M. galloprovincialis* dominates and as the cover

of *M. galloprovincialis* increases, the abundance and size of *S. argenvillei* declines. Semi-exposed shores do, however, offer a refuge preventing global extinction of the limpet. The anemone *Aulactinia reynaudi*, numerous whelk species and the sea urchin *Parechinus angulosus* are also found. Very recently, the invasion of west coast rocky shores by another mytilid, the small *Semimytilus algosus*, was noted (de Greef *et al.* 2013).

4.3.3.2 Rocky habitats and kelp beds

Biological communities of the rocky sublittoral can be broadly grouped into an inshore zone from the sublittoral fringe to a depth of about 10 m dominated by flora and an offshore zone below 10 m depth dominated by fauna.

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, namely the canopy forming kelp *Ecklonia maxima* (see Plate 4.2) and the smaller *Laminaria pallida*, which forms a sub-canopy to a height of about 2 m. *Ecklonia maxima* is the dominant species from west of Cape Agulhas to north of Cape Columbine, whereas *Laminaria pallida* becomes the dominant kelp north of Cape Columbine and thus in the project area, extending from Danger Point east of Cape Agulhas to Rocky Point in northern Namibia (Stegenga *et al.* 1997; Rand 2006).

Plate 4.2: The canopy-forming kelp *Ecklonia maxima* provides an important habitat for a diversity of marine biota (Photo: Geoff Spiby).

Kelp beds absorb and dissipate much of the typically high wave energy reaching the shore, thereby providing important partially-sheltered habitats for a high diversity of marine flora and fauna, resulting in diverse and typical kelp-forest communities being established. There is substantial spatial and temporal variability in the density and biomass of kelp beds, depending on the action of storms, seabed topography, and the presence or absence of sand and grazers.

Growing beneath the kelp canopy, and epiphytically on the kelps themselves, are a diversity of understorey algae. Representative algae include *Botryocarpa prolifera*, *Neuroglossum binderianum*, *Botryoglossum platycarpum*, *Hymenena venosa* and *Rhodymenia* (=*Epymenia*) *obtusa*, various coralline algae, as well as subtidal extensions of some algae occurring primarily in the intertidal zones (Bolton 1986). Epiphytic species include *Polysiphonia virgata*, *Gelidium vittatum (=Suhria vittata)* and *Carpoblepharis flaccida*. In particular, the presence of coralline crusts is thought to be a key factor in supporting a rich shallow-water community by providing substrate, refuge and food to a wide variety of infaunal and epifaunal invertebrates (Chenelot *et al.* 2008).

The sublittoral invertebrate fauna is dominated by suspension and filter-feeders, such as the mussels *Aulacomya ater* and *Choromytilus meriodonalis*, and the Cape reef worm *Gunnarea capensis*, and a variety of sponges and sea cucumbers. Grazers are less common, with most herbivors being restricted to grazing of juvenile algae or debris-feeding on detached macrophytes. The dominant herbivore is the sea urchin *Parechinus angulosus*, with lesser grazing pressure from limpets, the isopod *Paridotea reticulata* and the amphipod *Ampithoe humeralis*. The abalone *Haliotis midae*, an important commercial species present in kelp beds south of Cape Columbine, but is naturally absent north thereof.

Key predators in the sub-littoral include the commercially important West Coast rock lobster *Jasus lalandii* and the octopus *Octopus vulgaris*. The rock lobster acts as a keystone species as it influences community structure *via* predation on a wide range of benthic organisms (Mayfield *et al.* 2000) including the reduction in density, or even elimination, of black mussel *Choromytilus meriodonalis*, and ribbed mussels *Aulacomya ater*.

Of lesser importance as predators, although numerically significant, are various starfish, feather and brittle stars, and gastropods, including the whelks *Nucella* spp. and *Burnupena* spp. Fish species commonly found in kelp beds off the West Coast include hottentot *Pachymetopon blochii*, two tone finger fin *Chirodactylus brachydactylus*, red fingers *Cheilodactylus fasciatus*, galjoen *Dichistius capensis*, rock suckers *Chorisochismus dentex* and the catshark *Haploblepharus pictus* (Branch *et al.* 2010).

4.3.3.3 Deep water coral and seamount communities

Deep water corals are benthic filter-feeders and generally occur at depths below 150 m with some species being recorded from as deep as 3 000 m. Some species form reefs while others are smaller and remain solitary. Corals add structural complexity to otherwise uniform seabed habitats thereby creating areas of high biological diversity (Breeze *et al*. 1997; MacIssac *et al*. 2001). Deep water corals establish themselves below the thermocline where there is a continuous and regular supply of concentrated particulate organic matter, caused by the flow of a relatively strong current over special topographical formations which cause eddies to form.

The effects of such seabed features on the surrounding water masses can include the upwelling of relatively cool, nutrient-rich water into nutrient-poor surface water thereby resulting in higher productivity (Clark *et al.* 1999), which can in turn strongly influences the distribution of organisms on and around seamounts.

Evidence of enrichment of bottom-associated communities and high abundances of demersal fishes has been regularly reported over such seabed features. It provides an important habitat for commercial deepwater fish stocks such as orange roughy, oreos, alfonsino and Patagonian toothfish, which aggregate around these features for either spawning or feeding (Koslow 1996).

Such complex benthic ecosystems in turn enhance foraging opportunities for many other predators, serving as mid-ocean focal points for a variety of pelagic species with large ranges (turtles, tunas and billfish, pelagic sharks, cetaceans and pelagic seabirds). Seamounts thus serve as feeding grounds, spawning and nursery grounds and possibly navigational markers for a large number of species (SPRFMA 2007).

Enhanced currents, steep slopes and volcanic rocky substrata, in combination with locally generated detritus, favour the development of suspension feeders in the benthic communities characterising seamounts (Rogers 1994). Deep- and cold-water corals (including stony corals, black corals and soft corals) (see Plate 4.3) are a prominent component of many seamounts, accompanied by barnacles, bryozoans, polychaetes, molluscs, sponges, sea squirts, basket stars, brittle stars and crinoids (reviewed in Rogers 2004). There is also associated mobile benthic fauna that includes echinoderms (sea urchins and sea cucumbers) and crustaceans (crabs and lobsters) (reviewed by Rogers 1994; Kenyon *et al.* 2003).


Plate 4.3: Gorgonians and bryozoans communities recorded on deep-water reefs (100-120 m) off the southern African West Coast (Photos: De Beers Marine).

A geological feature of note in the vicinity of Block 2A is the carbonate mound (bioherm), Child's Bank (Dingle *et al.* 1987). It is composed of sediments and the calcareous deposits from an accumulation of carbonate skeletons of sessile organisms (e.g. cold-water coral, foraminifera or marl). Deep water corals are known from the Ibhubesi Reef to the east of the Ibhubesi Gas Field. Furthermore, evidence from video footage taken on hard-substrate habitats in 100 - 120 m depth off southern Namibia and to the south-east of Child's Bank (De Beers Marine, unpublished data) suggest that vulnerable communities including gorgonians, octocorals and reef-building sponges do occur on the continental shelf.

Levels of endemism on seamounts are relatively high and have been identified as Vulnerable Marine Ecosystems (VMEs). They are known to being particularly sensitive to anthropogenic disturbance (primarily deep-water trawl fisheries and mining), and once damaged are very slow to recover, or may never recover (FAO 2008). It is not always the case that seamount habitats are VMEs, as some seamounts may not host communities of fragile animals or be associated with high levels of endemism. South Africa's seamounts and their associated benthic communities have not been extensively sampled by either geologists or biologists (Sink & Samaai 2009).

In the productive Benguela region, substantial areas on and off the edge of the shelf should potentially be capable of supporting rich, cold water, benthic, filter-feeding communities. Potential VMEs, including the shelf break, seamounts, submarine canyons, hard grounds, submarine banks, deep reefs and cold water coral reefs, within the general study area are illustrated in Figure 4.14. Deep water corals are known to occur on the Ibhubesi Reef, which occurs in Block 2A (see Figures 4.14 and 4.18). Furthermore, evidence from video footage taken on hard-substrate habitats in 100 - 120 m depth off southern Namibia and to the south-east of Child's Bank (De Beers Marine, unpublished data) suggest that vulnerable communities including gorgonians, octocorals and reef-building sponges do occur on the continental shelf.

Sediment samples collected at the base of Norwegian cold-water coral reefs revealed high interstitial concentrations of light hydrocarbons (e.g. methane, propane, ethane). Some scientists believe there is a strong correlation between the occurrence of deep-water coral reefs and the relatively high values of light hydrocarbons (methane, ethane, propane and n-butane) in near-surface sediments (Hovland *et al*. 1998, Duncan & Roberts 2001, Hall-Spencer *et al*. 2002, Roberts & Gage 2003).

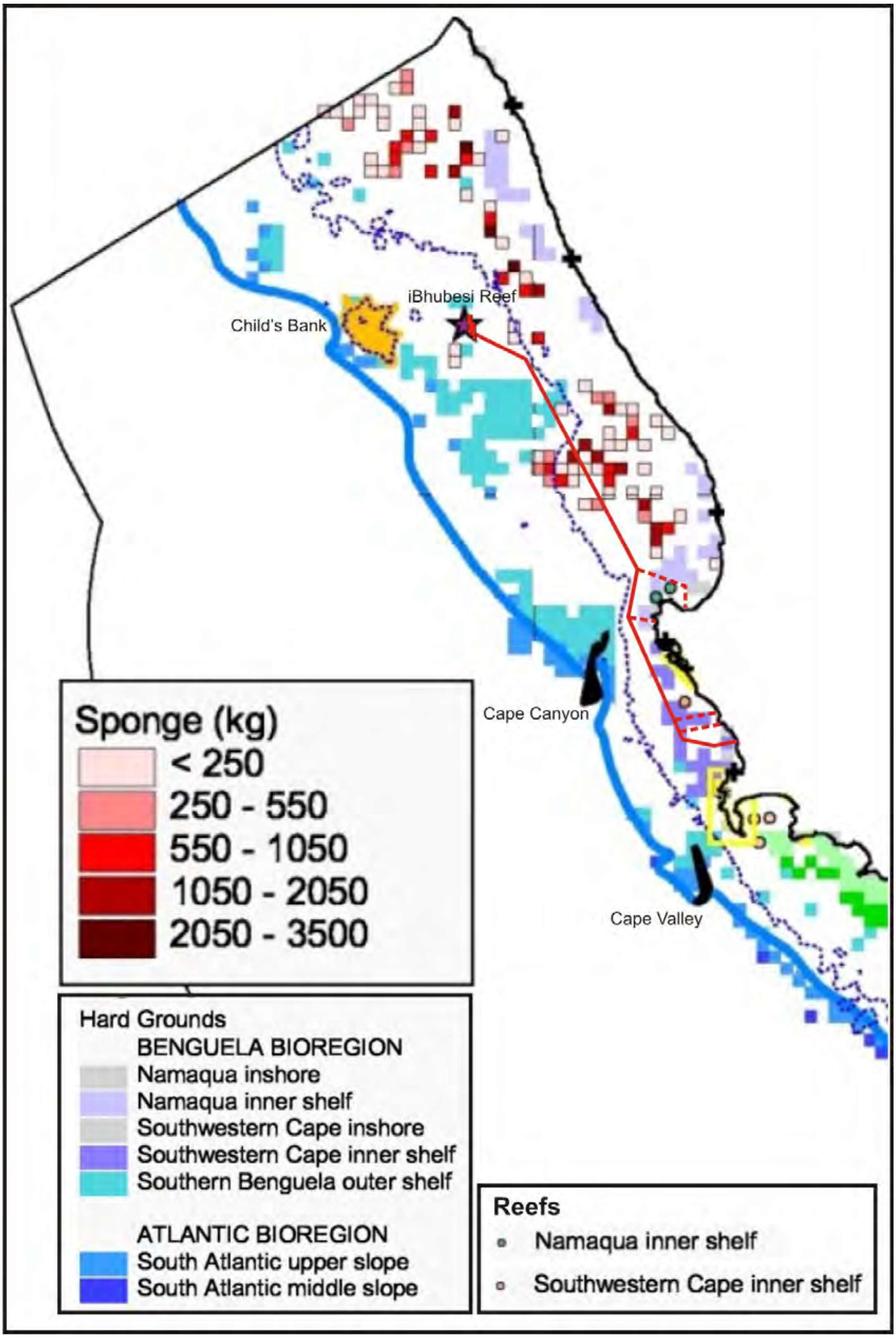


Figure 4.14: Proposed production pipeline route alternatives in relation to potential Vulnerable Marine Ecosystems on the West Coast (adapted from Sink *et al*. 2011).

4.3.4 THE WATER COLUMN / BODY

4.3.4.1 Plankton

Plankton is particularly abundant in the shelf waters off the West Coast, being associated with the upwelling characteristic of the area. Plankton range from single-celled bacteria to jellyfish of 2-m diameter, and include bacterio-plankton, phytoplankton, zooplankton, and ichthyoplankton:

- *Phytoplankton* are the principle primary producers with mean productivity ranging from 2.5 - 3.5 g C/m^2/day for the midshelf region and decreasing to 1 g C/m^2/day inshore of 130 m (Shannon & Field 1985; Mitchell-Innes & Walker 1991; Walker & Peterson 1991). The phytoplankton is dominated by large-celled organisms, which are adapted to the turbulent sea conditions. The most common diatom genera are *Chaetoceros*, *Nitschia*, *Thalassiosira*, *Skeletonema*, *Rhizosolenia*, *Coscinodiscus* and *Asterionella* (Shannon & Pillar 1985). Diatom blooms occur after upwelling events, whereas dinoflagellates (e.g. *Prorocentrum*, *Ceratium* and *Peridinium*) are more common in blooms that occur during quiescent periods, since they can grow rapidly at low nutrient concentrations. In the surf zone, diatoms and dinoflagellates are nearly equally important members of the phytoplankton, and some silicoflagellates are also present. Red-tides are ubiquitous features of the Benguela system (see Shannon & Pillar, 1986).
- The *mesozooplankton* (≥200 µm) is dominated by copepods, which are overall the most dominant and diverse group in southern African zooplankton. Important species are *Centropages brachiatus*, *Calanoides carinatus*, *Metridia lucens*, *Nannocalanus minor*, *Clausocalanus arcuicornis*, *Paracalanus parvus*, *P. crassirostris* and *Ctenocalanus vanus*. All of the above species typically occur in the phytoplankton rich upper mixed layer of the water column, with the exception of *M. lucens* which undertakes considerable vertical migration.
- The *macrozooplankton* (≥1 600 µm) are dominated by euphausiids of which 18 species occur in the area. The dominant species occurring in the nearshore are *Euphausia lucens* and *Nyctiphanes capensis*. Standing stock estimates of mesozooplankton for the southern Benguela area range from 0.2 - 2.0 g C/m^2, with maximum values recorded during upwelling periods, with production increasing north of Cape Columbine (Pillar 1986). Beyond the continental slope biomass decreases markedly. Localised peaks in biomass may, however, occur in the vicinity of Child's Bank in response to topographically steered upwelling around such seabed features.
- Although *ichthyoplankton* (fish eggs and larvae) comprise a minor component of the overall plankton, it remains significant due to the commercial importance of the overall fishery in the region. Various pelagic and demersal fish species are known to spawn in the inshore regions of the southern Benguela, (including pilchard, round herring, chub mackerel lanternfish and hakes (Crawford *et al.* 1987) and their eggs and larvae form an important contribution to the ichthyoplankton in the region (see Figure 4.15). Ichthyoplankton abundance along the proposed pipeline route is thus expected to be high.

4.3.4.2 Cephalopods

On the basis of abundance and trophic links with other species, eight species of cephalopod are important and a further five species have potential importance within the Benguela system (Table 4.2). The major cephalopod resource in the southern Benguela are sepiods/cuttlefish (Lipinski 1992; Augustyn *et al.* 1995). Most of the cephalopod resource is distributed on the mid-shelf with *Sepia australis* being most abundant at depths between 60-190 m, whereas *S. hieronis* densities were higher at depths between 110-250 m. *Rossia enigmatica* occurs more commonly on the edge of the shelf to depths of 500 m. Biomass of these species is generally higher in the summer than in winter.

Cuttlefish are largely epi-benthic and occur on mud and fine sediments in association with their major prey item; mantis shrimps (Augustyn *et al.* 1995). They form an important food item for demersal fish.

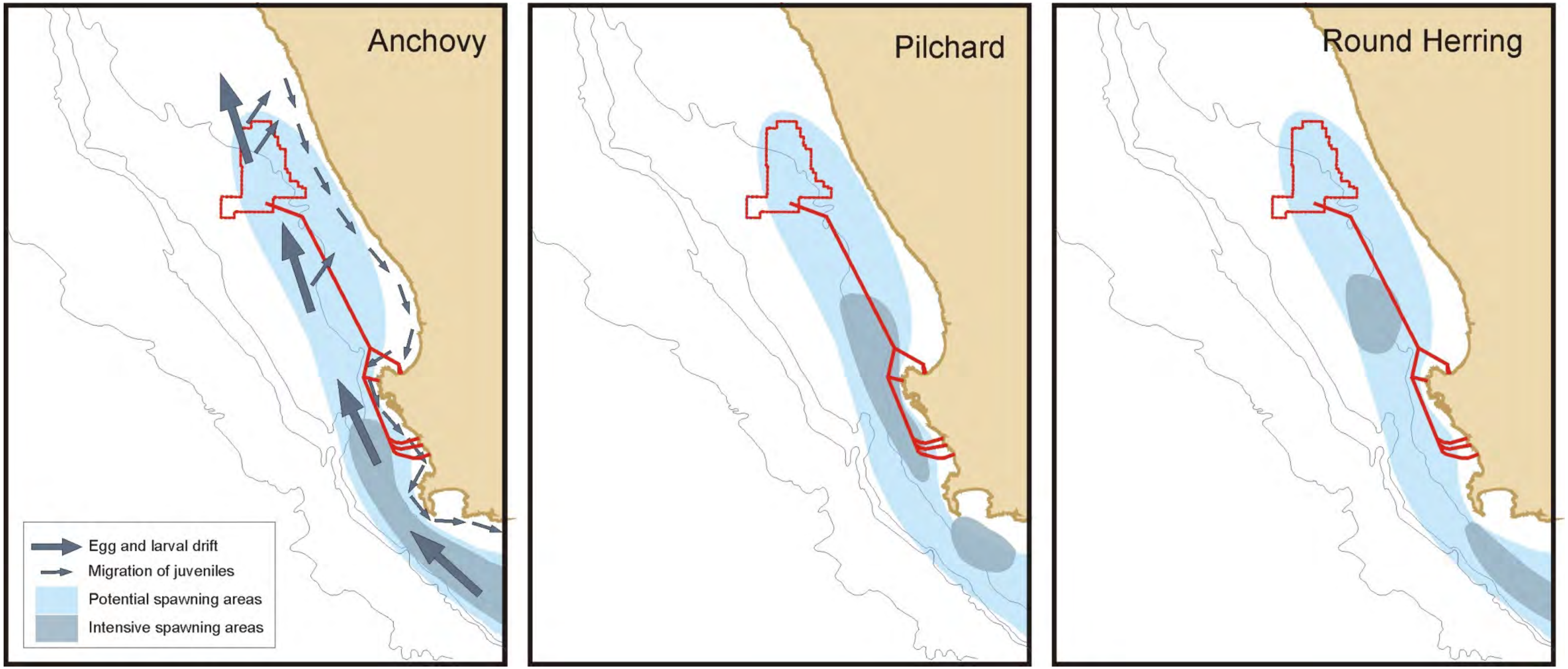


Figure 4.15: Proposed production pipeline route alternatives in relation to major spawning areas in the southern Benguela region (adapted from Cruikshank 1990).

Table 4.2: Cephalopod species of importance or potential importance within the Benguela System (after Lipinski 1992).

Scientific Name	Importance
Important species:	
Sepia australis	Very abundant in survey catches, prey of many fish species. Potential for fishery.
Sepia hieronis	Densities higher at depths between 110-250 m
Loligo vulgaris reynaudii	Fisheries exist, predator of anchovy and hake, prey of seals and fish.
Todarodes angolensis	Fisheries exist (mainly by-catch), predator of lightfish, lanternfish and hake, prey of seals.
Todaropsis eblanae	Some by-catch fishery, predator of lightfish and lanternfish, prey of seals and fish. Potential for fishery.
Lycoteuthis lorigera	Unconfirmed by-catch, prey of many fish species. Potential for fishery.
Octopus spp.	Bait and artinisal fishery, prey of seals and sharks.
Argonauta spp.	No fisheries, prey of seals.
Rossia enigmata	No fisheries, common in survey catches.
Potentially important species:	
Ommastrephes bartramii	No fisheries.
Abraliopsis gilchristi	No fisheries.
Todarodes filippovae	No fisheries.
Lolliguncula mercatoris	No fisheries.
Histioteuthis miranda	No fisheries.

4.3.4.3 Fishes

Marine fish can generally be divided in three different groups, namely demersal (those associated with the substratum), pelagic (those species associated with water column) or meso-pelagic (fish found generally in deeper water and may be associated with both the seafloor and the pelagic environment). Demersal fish can be grouped according to the substratum with which they are associated, for example rocky reef or soft substrata. Pelagic species include two major groups, the planktivorous clupeid-like fishes such as anchovy or pilchard and piscivorous predatory fish. It must be noted that such divisions are generally simplistic, as certain species associate with more than one community.

(a) Demersal fish species

As many as 110 species of bony and cartilaginous fish have been identified in the demersal communities on the continental shelf of the West Coast (Roel 1987). Changes in fish communities occur with increasing depth (Roel 1987; Smale et al. 1993; Macpherson & Gordoa 1992; Bianchi et al. 2001; Atkinson 2009), with the most substantial change in species composition occurring in the shelf break region between 300 m and 400 m depth (Roel 1987; Atkinson 2009). The shelf community (<380 m) is dominated by the Cape hake *Merluccius capensis*, and includes jacopever *Helicolenus dactylopterus*, Izak catshark *Holohalaelurus regain*, soupfin shark *Galeorhinus galeus* and whitespotted houndshark *Mustelus palumbes*. The more diverse deeper water community is dominated by the deepwater *hake M. paradoxus*, monkfish *Lophius vomerinus*, kingklip *Genypterus capensis*, bronze whiptail *Lucigadus ori* and hairy conger *Bassanago albescens* and various squalid shark species. There is some degree of species overlap between the depth zones.

Roel (1987) showed seasonal variations in the distribution ranges shelf communities, with species such as the pelagic goby *Sufflogobius bibarbatus*, and West Coast sole *Austroglossus microlepis* only occurring in shallow water north of Cape Point during summer. The deep-sea community was found to be homogenous both spatially and temporally. However, two long-term community shifts in demersal fish communities have been noted; the first (early to mid-1990s) being associated with an overall increase in density of many species, whilst many species decreased in density during the second shift (mid-2000s). These community shifts correspond temporally with regime shifts detected in environmental forcing variables.

The diversity and distribution of demersal cartilagenous fishes on the West Coast is discussed by Compagno *et al*. (1991). The species that may occur on the continental shelf in the general project area, and their approximate depth range, are listed in Table 4.3.

Table 4.3: Demersal cartilaginous species found on the continental shelf along the West Coast, with approximate depth range at which the species occurs (Compagno *et al*. 1991).

Common Name	Scientific name	Depth Range (m)
Frilled shark	*Chlamydoselachus anguineus*	200-1 000
Six gill cowshark	*Hexanchus griseus*	150-600
Bramble shark	*Echinorhinus brucus*	55-285
Arrowhead dogfish	*Deania profundorum*	200-500
Longsnout dogfish	*Deania quadrispinosum*	200-650
Spotted spiny dogfish	*Squalus acanthias*	100-400
Shortnose spiny dogfish	*Squalus megalops*	75-460
Shortspine spiny dogfish	*Squalus mitsukurii*	150-600
Sixgill sawshark	*Pliotrema warreni*	60-500
Tigar catshark	*Halaelurus natalensis*	50-100
Izak catshark	*Holohalaelurus regani*	100-500
Yellowspotted catshark	*Scyliorhinus capensis*	150-500
Soupfin shark/Vaalhaai	*Galeorhinus galeus*	<10-300
Houndshark	*Mustelus mustelus*	<100
Whitespotted houndshark	*Mustelus palumbes*	>350
Little guitarfish	*Rhinobatos annulatus*	>100
Atlantic electric ray	*Torpedo nobiliana*	120-450
Roughnose legskate	*Crurirajaparcomaculata*	150-620
Thorny skate	*Raja radiata*	50-600
Slime skate	*Raja pullopunctatus*	15-460
Rough-belly skate	*Raja springeri*	85-500
Yellowspot skate	*Raja wallacei*	70-500
Biscuit skate	*Raja clavata*	25-500
Bigthorn skate	*Raja confundens*	100-800
Spearnose skate	*Raja alba*	75-260
St Joseph	*Callorhinchus capensis*	30-380

(b) Pelagic fish species

The structure of the nearshore and surf zone fish community varies greatly with the degree of wave exposure. Species richness and abundance is generally high in sheltered and semi-exposed areas but typically very low off the more exposed beaches (Clark 1997a, 1997b).

The surf-zone and outer turbulent zone habitats of sandy beaches are considered to be important nursery habitats for marine fishes (Modde 1980; Lasiak 1981; Kinoshita & Fujita 1988; Clark *et al.* 1994). Surf-zone fish communities off the South African West Coast have relatively high biomass, but low species diversity. Typical surf-zone fish include harders (*Liza richardsonii*), white stumpnose (*Rhabdosargus globiceps*), Cape sole (*Heteromycteris capensis*), Cape gurnard (*Chelidonichthys capensis*), False Bay klipfish (*Clinus latipennis*), sandsharks (*Rhinobatos annulatus*), eagle ray (*Myliobatis aquila*), and smooth-hound (*Mustelus mustelus*) (Clark 1997b).

Fish species commonly found in kelp beds off the West Coast include hottentot *Pachymetopon blochii*, twotone fingerfin *Chirodactylus brachydactylus*, red fingers *Cheilodactylus fasciatus*, galjoen *Dichistius capensis*, rock suckers *Chorisochismus dentex,* maned blennies *Scartella emarginata* and the catshark *Haploblepharus pictus* (Sauer *et al.* 1997; Brouwer *et al*. 1997; Branch *et al*. 2010).

Small pelagic species occurring beyond the surfzone and generally within the 200 m contour include the sardine/pilchard (*Sadinops ocellatus*), anchovy (*Engraulis capensis*), chub mackerel (*Scomber japonicus*), horse mackerel (*Trachurus capensis*) and round herring (*Etrumeus whiteheadi*). These species typically occur in mixed shoals of various sizes (Crawford *et al*. 1987), and exhibit similar life history patterns involving seasonal migrations between the west and south coasts.

The spawning areas of the major pelagic fish species (see Figure 4.15) are distributed on the continental shelf and along the shelf edge extending from south of St Helena Bay to Mossel Bay on the South Coast (Shannon & Pillar 1986). They spawn downstream of major upwelling centres in spring and summer, and their eggs and larvae are subsequently carried around Cape Point and up the coast in northward flowing surface waters.

At the start of winter every year, juveniles of most small pelagic shoaling species recruit into coastal waters in large numbers between the Orange River and Cape Columbine. They gradually move southwards in the inshore flowing surface current, towards the major spawning grounds east of Cape Point.

Two species that migrate along the West Coast following the shoals of anchovy and pilchards are snoek *Thyrsites atun* and chub mackerel *Scomber japonicas*. Their appearance along the West and South-West coasts are highly seasonal. Snoek migrating along the southern African West Coast reach the area between St Helena Bay and the Cape Peninsula between May and August. They spawn in these waters between July and October before moving offshore and commencing their return northward migration (Payne & Crawford 1989). They are voracious predators occurring throughout the water column, feeding on both demersal and pelagic invertebrates and fish. Chub mackerel similarly migrate along the southern African West Coast reaching South-Western Cape waters between April and August. They move inshore in June and July to spawn before starting the return northwards offshore migration later in the year (Payne & Crawford 1989).

Large pelagic species include tunas, billfish and pelagic sharks, which migrate throughout the southern oceans, between surface and deep waters (>300 m) and have a highly seasonal abundance in the Benguela. Many of the large migratory pelagic species are considered threatened by the IUCN, primarily due to overfishing (see Table 4.4).

Tuna and swordfish are targeted by high seas fishing fleets and illegal overfishing has severely damaged the stocks of many of these species. Similarly, pelagic sharks are either caught as bycatch by the pelagic long-line fishery or are specifically targeted for their fins.

Table 4.4: Some of the more important large migratory pelagic fish likely to occur in the offshore regions of the South Coast.

Common Name	Species	IUCN Conservation Status
Tunas		
Southern Bluefin Tuna	*Thunnus maccoyii*	Critically Endangered
Bigeye Tuna	*Thunnus obesus*	Vulnerable
Longfin Tuna/Albacore	*Thunnus alalunga*	Near Threatened
Yellowfin Tuna	*Thunnus albacares*	Near Threatened
Frigate Tuna	*Auxis thazard*	Least concern
Skipjack Tuna	*Katsuwonus pelamis*	Least concern
Billfish		
Blue Marlin	*Makaira nigricans*	Vulnerable
Sailfish	*Istiophorus platypterus*	Least concern
Swordfish	*Xiphias gladius*	Least concern
Black Marlin	*Istiompax indica*	Data deficient
Pelagic Sharks		
Pelagic Thresher Shark	*Alopias pelagicus*	Vulnerable
Common Thresher Shark	*Alopias vulpinus*	Vulnerable
Great White Shark	*Carcharodon carcharias*	Vulnerable
Shortfin Mako	*Isurus oxyrinchus*	Vulnerable
Longfin Mako	*Isurus paucus*	Vulnerable
Blue Shark	*Prionace glauca*	Near Threatened
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Vulnerable

4.3.4.4 Turtles

Three species of turtle occur along the West Coast, namely the leatherback (*Dermochelys coriacea*), and occasionally the loggerhead (*Caretta caretta*) and the green (*Chelonia mydas*) turtle. The Leatherback is the only turtle likely to be encountered in the offshore waters of west South Africa. Loggerhead and green turtles are expected to occur only as occasional visitors along the West Coast.

Leatherback turtles inhabit deeper waters and are considered a pelagic species. The Benguela ecosystem, especially the northern Benguela where jelly fish numbers are high, is increasingly being recognised as a potentially important feeding area for leatherback turtles. Leatherback turtles are listed as “Critically Endangered” worldwide by the IUCN and are in the highest categories in terms of need for conservation in CITES and CMS (Convention on Migratory Species). Leatherback turtles from the east South Africa population have been satellite tracked swimming around the West Coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem (Lambardi *et al.* 2008) (Figure 4.16). Leatherback turtles inhabit deeper waters and are considered a pelagic species, travelling the ocean currents in search of their prey (primarily jellyfish). While hunting they may dive to over 600 m and remain submerged for up to 54 minutes (Hays et al. 2004). Their abundance in the study area is unknown but expected to be low.

Loggerhead and green turtles are listed as “Endangered”. As a signatory of CMS, South Africa has endorsed and signed a CMS International Memorandum of Understanding specific to the conservation of marine turtles. South Africa is thus committed to conserve these species at an international level.

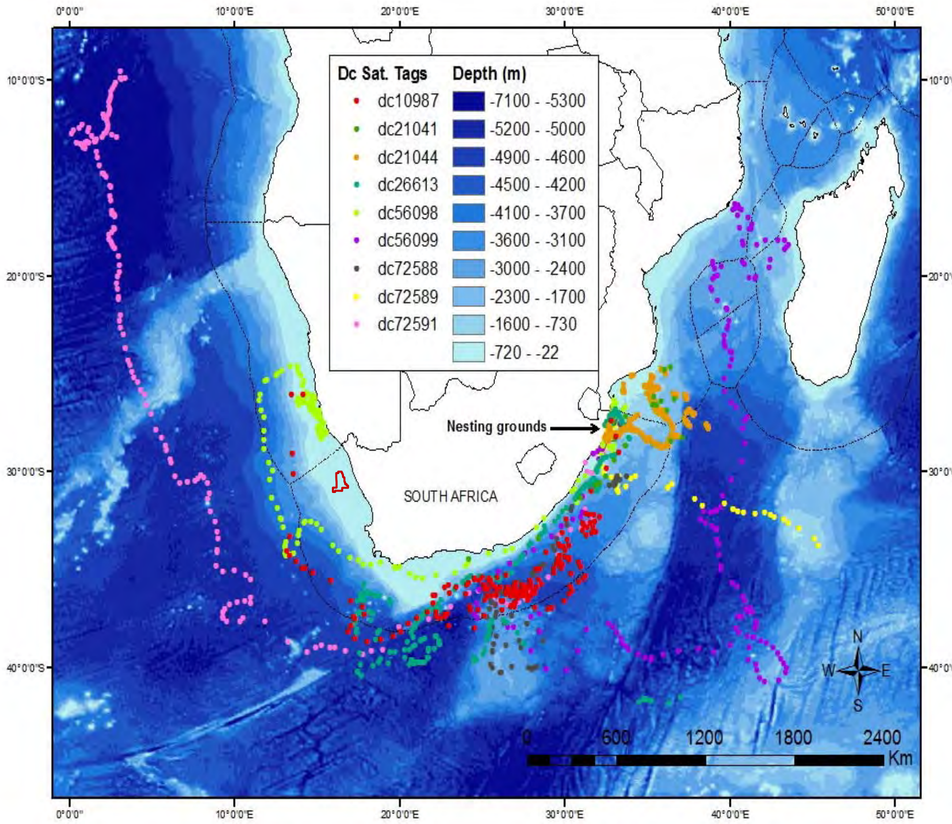


Figure 4.16: The post-nesting distribution of nine satellite tagged leatherback females (1996 – 2006; Oceans and Coast, unpublished data). The approximate location of Block 2A is also shown.

4.3.4.5 Seabirds

There are a total of 49 species of seabirds occurring within the southern Benguela area, of which 14 are resident species, 25 are migrants from the southern ocean and 10 are visitors from the northern hemisphere. Table 4.5 provides a list of the common species occurring within the study area.

The area between Cape Point and the Orange River supports 38% and 33% of the overall population of pelagic seabirds in winter and summer, respectively. Most of the species in the region reach highest densities offshore of the shelf break (200 to 500 m depth), well inshore of the proposed area of interest, with highest population levels during their non-breeding season (winter).

The availability of breeding sites is an extremely important determinant in the distribution of resident seabirds. Although breeding areas are distributed along the whole coast, islands are especially important, particularly those between Dyer Island and Lamberts Bay. Fourteen resident species breed along the West Coast, including Cape gannet, African penguin, four species of cormorant, white pelican, three gull and four tern species (Table 4.6).

Cape Gannets breed only on islands and Lamberts Bay and Malgas Island are important colonies. Cape cormorants breed mainly on offshore islands (Dyer, Jutten, Seal, Dassen, Bird (Lamberts Bay), Malgas and Vondeling Islands), although the large colonies may associate with estuaries, lagoons or sewerage works. The bank and crowned cormorants are endemic to the Benguela system and both breed between Namibia and just to the west of Cape Agulhas. Although white-breasted cormorants occur between northern Namibia and the Eastern Cape in southern Africa, the majority of the population is concentrated between Swakopmund and Cape Agulhas.

Most of these resident species feed on fish (with the exception of the gulls, which scavenge, and feed on molluscs and crustaceans). Feeding strategies can be grouped into surface plunging (gannets and terns), pursuit diving (cormorants and penguins) and scavenging and surface seizing (gulls and pelicans). Most of the breeding seabird species forage at sea with most birds being found relatively close inshore (10-30 km). Cape Gannets, however, are known to forage up to 140 km offshore (Dundee 2006; Ludynia 2007), and African Penguins have also been recorded as far as 60 km offshore.

African penguin colonies (*Spheniscus demersus*) occur at 27 localities around the coast of South Africa and Namibia (see Figure 4.17). The species forages at sea with most birds being found within 20 km of their colonies. African penguin distribution at sea is consistent with that of the pelagic shoaling fish, which generally occur within the 200 m isobath. The decline in the African penguin population is ascribed primarily to the removal of the accumulated guano from the islands during the nineteenth century. Penguins used to breed in burrows in the guano and are now forced to nest in the open, thereby being exposed to much greater predation and thermal stress.

The Cape gannet, a plunge diver feeding on epipelagic fish, is thought to have declined as a result of the collapse of the pilchard, whereas the Cape cormorant was able to shift its diet to pelagic goby. Furthermore, the recent increase in the seal population has resulted in seals competing for island space to the detriment of the breeding success of both gannets and penguins.

Shore birds likely to be encountered in the area of the proposed pipeline shore crossings include the African black oystercatcher *Haematopus moquini* (Listed as “Near-threatened” on the IUCN red data list).

Table 4.5: Pelagic seabirds common in the southern Benguela region (Crawford *et al*. 1991).

Common Name	Species name	Global IUCN
Shy albatross	*Thalassarche cauta*	Near Threatened
Black browed albatross	*Thalassarche melanophrys*	Endangered
Yellow nosed albatross	*Thalassarche chlororhynchos*	Endangered
Giant petrel sp.	*Macronectes halli/giganteus*	Near Threatened
Pintado petrel	*Daption capense*	Least concern
Greatwinged petrel	*Pterodroma macroptera*	Least concern
Soft plumaged petrel	*Pterodroma mollis*	Least concern
Prion spp	*Pachyptila* spp.	Least concern
White chinned petrel	*Procellaria aequinoctialis*	Vulnerable
Cory’s shearwater	*Calonectris diomedea*	Least concern
Great shearwater	*Puffinus gravis*	Least concern
Sooty shearwater	*Puffinus griseus*	Near Threatened
European Storm petrel	*Hydrobates pelagicus*	Least concern
Leach’s storm petrel	*Oceanodroma leucorhoa*	Least concern
Wilson’s storm petrel	*Oceanites oceanicus*	Least concern
Blackbellied storm petrel	*Fregetta tropica*	Least concern
Skua spp.	*Catharacta/Stercorarius* spp.	Least concern
Sabine’s gull	*Larus sabini*	Least concern

Table 4.6: Breeding resident seabirds present along the West Coast (CCA & CMS 2001).

Common name	Species name	Global IUCN Status
African Penguin	*Spheniscus demersus*	Endangered
Great Cormorant	*Phalacrocorax carbo*	Least Concern
Cape Cormorant	*Phalacrocorax capensis*	Near Threatened
Bank Cormorant	*Phalacrocorax neglectus*	Endangered
Crowned Cormorant	*Phalacrocorax coronatus*	Least Concern
White Pelican	*Pelecanus onocrotalus*	Least Concern
Cape Gannet	*Morus capensis*	Vulnerable
Kelp Gull	*Larus dominicanus*	Least Concern
Greyheaded Gull	*Larus cirrocephalus*	Least Concern
Hartlaub's Gull	*Larus hartlaubii*	Least Concern
Caspian Tern	*Hydroprogne caspia*	Vulnerable
Swift Tern	*Sterna bergii*	Least Concern
Roseate Tern	*Sterna dougallii*	Least Concern
Damara Tern	*Sterna balaenarum*	Near Threatened

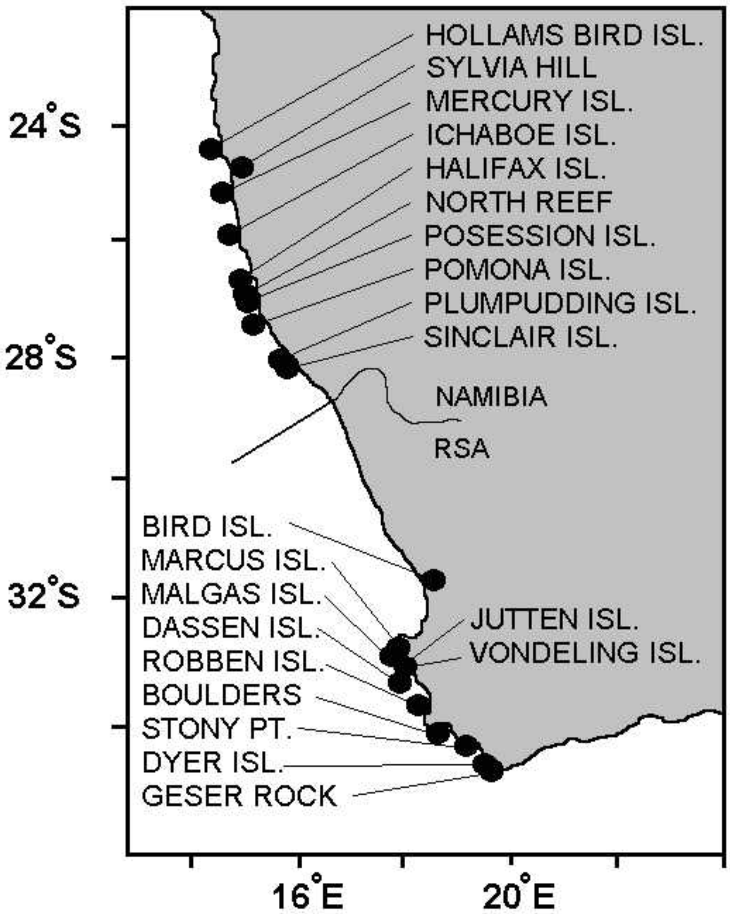


Figure 4.17: The distribution of breeding colonies of African penguins on the South African West Coast.

4.3.4.6 Cetaceans

The cetacean fauna of the West Coast comprises 33 species of whales and dolphins known or to occur here (see Table 4.7). The offshore areas have been particularly poorly studied with almost all available information from deeper waters (>200 m) arising from historic whaling records. Information on smaller cetaceans in deeper waters is particularly poor. The distribution of whales and dolphins on the West Coast can largely be split into those associated with the continental shelf and those that occur in deep, oceanic waters. Species from both environments may, however, be found associated with the shelf (200 - 1 000 m), making this the most species-rich area for cetaceans.

Cetaceans comprised two basic taxonomic groups: the mysticetes (filter-feeding baleen whales) and the odontocetes (toothed predatory whales and dolphins).

(a) Mysticetes (baleen) whales

Most of mysticetes whales occur in pelagic waters, with only occasional visits into shelf waters. All of these species show some degree of migration either to, or through, the latitudes encompassed by the broader study area when *en route* between higher-latitude feeding grounds (Antarctic or Subantarctic) and lower-latitude breeding grounds. Depending on the ultimate location of these feeding and breeding grounds, seasonality off South Africa can be either unimodal (usually in June-August, e.g. minke and blue whales) or bimodal (usually May-July and October-November, e.g. fin whales), reflecting a northward and southward migration through the area. As whales follow geographic or oceanographic features, the northward and southward migrations may take place at difference distances from the coast, thereby influencing the seasonality of occurrence at different locations. Due to the complexities of the migration patterns, each species is discussed in further detail below.

- Southern right and humpback whales: The most abundant baleen whales off the coast of South Africa are southern right (listed as Least Concern) and humpback whales (listed as Least Concern). Southern right whales migrate to the southern Africa subcontinent to breed and calve, where they tend to have an extremely coastal distribution mainly in sheltered bays (90% <2 km from shore; Best 1990, Elwen & Best 2004). They typically arrive in coastal waters off the West Coast in June, increasing to a maximum number in September/October, with most departing in December (although animals may be sighted as early as April and as late as February). On the West Coast they are most common south of Lambert’s Bay (CCA & CMS 2001), although a number of the bays between Chameis Bay (27°56’S) and Conception Bay (23°55’S) in Namibia have in recent years become popular calving sites (Currie *et al*. 2009), with sightings reported as far north as the Kunene and Möwe Bay (Roux *et al*. 2001). The Southern Right calving season extends from late June to late October, peaking in August (Best 1994; Roux *et al*. 2001), with cow-calf pairs remaining in sheltered bays for up to two months before starting their southern migration.

  The majority of humpback whales on the West Coast are migrating past the southern African continent to breeding grounds off Angola, Republic of Congo and Gabon (Rosenbaum *et al.* 2009, Barendse *et al*. 2010). On the West Coast it is thought that only a small proportion of the main migration comes close inshore, the majority choosing the shortest route to the central West African breeding grounds by following the edge of the continental shelf (Best 2007; Best & Allison 2010). Humpback whales migrate at various distances from the coast including pelagic waters (Barendse et al. 2002), and as they are likely to regularly cross the study area, will probably be the most abundant large whale encountered. Most humpbacks reach southern African waters around April, continuing through to September/October when the southern migration begins and continues through to December. The calving season for humpbacks extends from July to October, peaking in early August (Best 2007). Cow-calf pairs are typically the last to leave southern African waters on the return southward migration, although considerable variation in the departure time from breeding areas has been recorded (Barendse *et al*. 2010).

Table 4.7: Cetaceans occurrence off the West Coast of South Africa, their seasonality, likely encounter frequency with proposed pipeline construction and IUCN conservation status.

Common Name	Species	Shelf	Offshore	Seasonality	Likely encounter frequency	IUCN Conservation Status
Delphinids						
Dusky dolphin	*Lagenorhynchus obscurus*	Yes (0- 800 m)	No	Year round	Daily	Data Deficient
Heaviside's dolphin	*Cephalorhynchus heavisidii*	Yes (0-200 m)	No	Year round	Daily	Data Deficient
Common bottlenose dolphin	*Tursiops truncatus*	Yes	Yes	Year round	Monthly	Least Concern
Common (short beaked) dolphin	*Delphinus delphis*	Yes	Yes	Year round	Monthly	Least Concern
Southern right whale dolphin	*Lissodelphis peronii*	Yes	Yes	Year round	Occasional	Data Deficient
Striped dolphin	*Stenella coeruleoalba*	No	?	?	Very rare	Least Concern
Pantropical spotted dolphin	*Stenella attenuata*	Edge	Yes	Year round	Very rare	Least Concern
Long-finned pilot whale	*Globicephala melas*	Edge	Yes	Year round	<Weekly	Data Deficient
Short-finned pilot whale	*Globicephala macrorhynchus*	?	?	?	Very rare	Data Deficient
Rough-toothed dolphin	*Steno bredanensis*	?	?	?	Very rare	Least Concern
Killer whale	*Orcinus orca*	Occasional	Yes	Year round	Occasional	Data Deficient
False killer whale	*Pseudorca crassidens*	Occasional	Yes	Year round	Monthly	Data Deficient
Pygmy killer whale	*Feresa attenuata*	?	Yes	?	Occasional	Least Concern
Risso's dolphin	*Grampus griseus*	Yes (edge)	Yes	?	Occasional	Data Deficient
Sperm whales						
Pygmy sperm whale	*Kogia breviceps*	Edge	Yes	Year round	Occasional	Data Deficient
Dwarf sperm whale	*Kogia sima*	Edge	?	?	Very rare	Data Deficient
Sperm whale	*Physeter macrocephalus*	Edge	Yes	Year round	Occasional	Vulnerable

Common Name	Species	Shelf	Offshore	Seasonality	Likely encounter frequency	IUCN Conservation Status
Beaked whales						
Cuvier's	*Ziphius cavirostris*	No	Yes	Year round	Occasional	Least Concern
Arnoux's	*Beradius arnouxii*	No	Yes	Year round	Occasional	Data Deficient
Southern bottlenose	*Hyperoodon planifrons*	No	Yes	Year round	Occasional	Not assessed
Layard's	*Mesoplodon layardii*	No	Yes	Year round	Occasional	Data Deficient
True's	*M. mirus*	No	Yes	Year round		Data Deficient
Gray's	*M. grayi*	No	Yes	Year round	Occasional	Data Deficient
Blainville's	*M. densirostris*	No	Yes	Year round		Data Deficient
Baleen whales						
Antarctic Minke	*Balaenoptera bonaerensis*	Yes	Yes	>Winter	Monthly	Data Deficient
Dwarf minke	*B. acutorostrata*	Yes	Yes	Year round	Occasional	Least Concern
Fin whale	*B. physalus*	Yes	Yes	MJJ & ON, rarely in summer	Occasional	Endangered
Blue whale	*B. musculus*	No	Yes	?	Occasional	Endangered
Sei whale	*B. borealis*	Yes	Yes	MJ & ASO	Occasional	Endangered
Bryde's (offshore)	*B. brydei*	Yes	Yes	Summer (JF)	Occasional	Not assessed
Bryde's (inshore)	*B brydei (subspp)*	Yes	Yes	Year round	Occasional	Data Deficient
Pygmy right	*Caperea marginata*	Yes	?	Year round	Occasional	Least Concern
Humpback	*Megaptera novaeangliae*	Yes	Yes	Year round, higher in SONDJF	Daily*	Least Concern
Southern right	*Eubalaena australis*	Yes	No	Year round, higher in SONDJF	Daily*	Least Concern

In the last decade, deviations from the predictable and seasonal migration patterns of these two species have been reported from the Cape Columbine – Yzerfontein area (Best 2007; Barendse *et al*. 2010). High abundances of both Southern Right and Humpback whales in this area during spring and summer (September-February), indicates that the upwelling zones off Saldanha and St Helena Bay may serve as an important summer feeding area (Barendse *et al.* 2011, Mate *et al*. 2011). It was previously thought that whales feed only rarely while migrating (Best *et al.* 1995), but these localised summer concentrations suggest that these whales may in fact have more flexible foraging habits. The offshore location of the proposed area of interest makes encounters with whales undergoing summer migrations highly unlikely.

Since the southern right population is still continuing to grow at approximately 7% per year (Brandaõ *et al.* 2011), the population size in 2013 would number more than 6 000 individuals. Recent abundance estimates put the number of humpback whales in the west African breeding population to be in excess of 9 000 individuals in 2005 and it is likely to have increased since this time at about 5% per annum (IWC 2012).

- Bryde's whales: Two types of Bryde's whales are recorded from South African waters - a larger pelagic form described as *Balaenoptera brydei* and a smaller neritic form (of which the taxonomic status is uncertain) but included by Best (2007) with *B. brydei* for the subregion. The migration patterns of Bryde's whales differ from those of all other baleen whales in the region. The inshore population is unique in that it is resident year round on the Agulhas Bank ranging from Durban in the east to at least St Helena Bay off the West Coast, and does not migrate at all, although some movement up the West Coast in winter has been reported (Best 2007, 2001; Best *et al*. 1984). The offshore population of Bryde's whale lives off the continental shelf (>200 m depth) and migrates between wintering grounds off equatorial West Africa (Gabon) and summering grounds off the South African West Coast (Best 2001). Its seasonality within South African waters is thus opposite to the majority of the other migratory cetaceans, with abundance in the study area likely to be highest in January-February.

- Sei whales: Sei whales (listed as Endangered) spend time at high latitudes (40-50˚S) during summer months and migrate through South African waters to unknown breeding grounds further north. Their migration pattern shows a bimodal peak with numbers west of Cape Columbine highest in May and June, and again in August, September and October. Based on whaling records, all whales were caught in waters deeper than 200 m with most deeper than 1 000 m (Best & Lockyer 2002).

- Fin whales: Fin whales (listed as Vulnerable) have a bimodal peak in the catch data suggesting animals were migrating further north during May-June to breed, before returning during August-October *en route* to Antarctic feeding grounds. Some juvenile animals may feed year round in deeper waters off the shelf (Best 2007). There are no recent data on the abundance or distribution of fin whales off the west coast, although a sighting of a live animal in St Helena Bay in 2011 (MRI unpubl. data) confirm their contemporary occurrence in the region.

- Blue whales: Antarctic blue whales were historically caught in high numbers during commercial whaling activities, with a single peak in catch rates during July in Walvis Bay, Namibia and at Namibe, Angola suggesting that in the eastern South Atlantic these latitudes are close to the northern migration limit for the species (Best 2007). Only two confirmed sightings of blue whales have occurred off the entire West Coast of Africa since 1973 (Branch *et al.* 2007), although search effort (and thus information), especially in pelagic waters is very low. This suggests that the population using the area may have been extirpated by whaling and there is a low chance of encountering the species in the study area.

- Minke whales: Two forms of minke whale occur in the southern Hemisphere, the Antarctic minke whale and the dwarf minke whale, both of which occur in the Benguela region (Best 2007). Antarctic minke whales range from Antarctica to tropical waters and are usually seen more than approximately 50 km offshore. Although adults of the species do migrate from the Southern Ocean (summer) to tropical/temperate waters (winter) where they are thought to breed, some animals, especially juveniles, are known to stay in tropical/temperate waters year round. The dwarf minke whale has a more temperate distribution than the Antarctic minke and they do not range further south than 60-65°S. Dwarf minkes have a similar migration pattern to Antarctic minkes with at least some animals migrating to the Southern Ocean during summer. Dwarf minke whales occur closer to shore than Antarctic minkes. Both species are generally solitary and densities are likely to be low in the study area.

- Pygmy right whale: The smallest of the baleen whales, the pygmy right whale occurs in the Benguela region (Leeney *et al.* 2013). The species is more commonly associated with cool temperate waters between 30°S and 55°S. There are no data on the abundance or conservation status of this species. As it was not subjected to commercial whaling, the population is expected to be near to original numbers. Sightings of this species at sea are rare (Best 2007) due in part to their small size and inconspicuous blows. Density in the study area is likely to be low.

(b) Odontocetes (toothed) whales

The Odontoceti are a varied group of animals including the dolphins, porpoises, beaked whales and sperm whales. Species occurring within the broader study area display a diversity of features, for example their ranging patterns vary from extremely coastal and highly site specific to oceanic and wide ranging. There is almost no data available on the abundance, distribution or seasonality of the smaller odontocetes (including the beaked whales and dolphins) known to occur in oceanic waters off the shelf of the West Coast. Beaked whales are all considered to be true deep water species usually being seen in waters in excess of 1 000 – 2 000 m depth (Best 2007). Their presence in the area may fluctuate seasonally, but insufficient data exist to define this clearly.

- Sperm whales: Sperm whales are the largest of the toothed whales and have a complex, well-structured social system with adult males behaving differently from younger males and female groups. They live in deep ocean waters, usually greater than 1 000 m depth, occasionally coming into depths of 500-200 m on the shelf (Best 2007). Seasonality of catches off the West Coast suggest that medium- and large-sized males are more abundant during winter, while female groups are more abundant in autumn (March-April), although animals occur year round (Best 2007). Sperm whales feed at great depth, during dives in excess of 30 minutes, making them difficult to detect visually. Sperm whales in the project area are likely to be encountered in relatively high numbers in deeper waters (>500 m) beyond the proposed pipeline depth, predominantly in the winter months (April - October).

- Pygmy and dwarf sperm whales: Dwarf sperm whales are associated with the warmer waters south and east of St Helena Bay. Abundance in the study area is likely to be very low and only in the warmer waters west of the Benguela current. Pygmy sperm whales are recorded from both the Benguela and Agulhas ecosystem (Best 2007) and are likely to occur in the study area at low levels in waters deeper than 1 000 m.

- Killer whales: Killer whales have a circum-global distribution being found in all oceans from the equator to the ice edge (Best 2007). Killer whales occur year round in low densities off western South Africa (Best *et al.* 2010), Namibia (Elwen & Leeney 2011) and in the Eastern Tropical Atlantic (Weir *et al.* 2010). Killer whales are found in all depths from the coast to deep open ocean environments and may thus be encountered in the study area at low levels.

- False killer whales: The species has a tropical to temperate distribution and most sightings off southern Africa have occurred in water deeper than 1 000 m but with a few close to shore as well (Findlay *et al*. 1992). False killer whales usually occur in groups ranging in size from 1 - 100 animals (mean 20.2) (Best 2007), and are thus likely to be fairly easily seen in most weather conditions. There is no information on population numbers of conservation status and no evidence of seasonality in the region (Best 2007).

- Long-finned pilot whales: Long finned pilot whales display a preference for temperate waters and are usually associated with the continental shelf or deep water adjacent to it (Mate *et al.* 2005; Findlay *et al.* 1992; Weir 2011). They are regularly seen associated with the shelf edge by marine mammal observers and fisheries observers and researchers. The distinction between long-finned and short finned pilot whales is difficult to make at sea. As the latter are regarded as more tropical species (Best 2007), it is likely that the vast majority of pilot whales encountered in the study area will be long-finned.

- Common bottlenose dolphins: Two species of bottlenose dolphins occur around southern Africa, the smaller Indo-Pacific bottlenose dolphins, which occurs exclusively to the east of Cape Point in water usually less than 30 m deep, and the larger common bottlenose dolphin forms. The larger common bottlenose dolphin species occur in two forms. The inshore form occurs as a small and apparently isolated population that occupies the very coastal (usually <15 m deep) waters of the central Namibian coast as far south as Lüderitz and is unlikely to be encountered in the project area. Little is known about the offshore form in terms of their population size or conservation status. They sometimes occur in association with other species such as pilot whales (NDP unpublished data) or false killer whales (Best 2007) and are likely to be present year round in waters deeper than 200 m.

- Common dolphin: The common dolphin is known to occur offshore in West Coast waters (Findlay *et al.* 1992; Best 2007). The extent to which they occur in the study area is unknown, but likely to be low. Group sizes of common dolphins can be large, averaging 267 (± *SD* 287) for the South Africa region (Findlay *et al.* 1992) and 92 (± SD 115) for Angola (Weir 2011) and 37 (± *SD* 31) in Namibia (NDP unpubl. data). They are more frequently seen in the warmer waters offshore and to the north of the country, seasonality is not known.

- Southern right whale dolphins: The cold waters of the Benguela provide a northwards extension of the normally subantarctic habitat of this species (Best 2007). Most records in the region originate in a relatively restricted region between 26˚S and 28˚S off Lüderitz (Rose & Payne 1991) in water 100 – 2 000 m deep (Best, 2007), where they are seen several times per year (Findlay *et al*. 1992; JP Roux[1] pers comm.). It is possible that the Namibian sightings represent a resident population (Findlay *et al.* 1992). Encounters in the study area are unlikely.

- Dusky dolphins: In water <500 m deep, dusky dolphins are likely to be the most frequently encountered small cetacean as they are very “boat friendly” and often approach vessels to bowride. The species is resident year round throughout the Benguela ecosystem in waters from the coast to at least 500 m deep (Findlay *et al.* 1992). Although no information is available on the size of the population, they are regularly encountered in near shore waters between Cape Town and Lamberts Bay (Elwen *et al.* 2010a; NDP unpubl. data) with group sizes of up to 800 having been reported (Findlay *et al.* 1992). A hiatus in sightings (or low density area) is reported between ~27°S and 30°S, associated with the Lüderitz upwelling cell (Findlay *et al.* 1992). Dusky dolphins are resident year round in the Benguela.

[1] Ministry of Fisheries and Marine Resources (Namibia).

- Heaviside's dolphins: This species is relatively abundant in the Benguela ecosystem within the region of 10 000 animals estimated to live in the 400 km of coast between Cape Town and Lamberts Bay (Elwen *et al.* 2009). Individuals show high site fidelity to small home ranges, 50 - 80 km along shore (Elwen *et al*. 2006) and may thus be more vulnerable to threats within their home range. This species occupies waters from the coast to at least 200 m depth (Elwen *et al.* 2006; Best 2007), and may show a diurnal onshore-offshore movement pattern (Elwen *et al*. 2010b), but this varies throughout the species range. Heaviside's dolphins are resident year round.

- Beaked whales (various species): Beaked whales were never targeted commercially and their pelagic distribution makes them largely inaccessible to most researchers making them the most poorly studied group of cetaceans. All the beaked whales that may be encountered in the study area are pelagic species that tend to occur in small groups usually less than five, although larger aggregations of some species are known (MacLeod & D'Amico 2006; Best 2007). The long, deep dives of beaked whales make them both difficult to detect visually.

- Other delphinids: Several other species of dolphins that might occur in deeper waters at low levels include the pygmy killer whale, Risso's dolphin, rough toothed dolphin, pan tropical spotted dolphin and striped dolphin (Findlay *et al.* 1992; Best 2007). Nothing is known about the population size or density of these species in the project area but it is likely that encounters would be rare.

4.3.4.7 Seals

The Cape fur seal (*Arctocephalus pusillus pusillus*) is the only species of seal resident along the West Coast of Africa, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs. Vagrant records from four other species of seal more usually associated with the subantarctic environment have also been recorded: southern elephant seal (*Mirounga leoninas),* subantarctic fur seal (*Arctocephalus tropicalis),* crabeater *(Lobodon carcinophagus)* and leopard seals (*Hydrurga leptonyx)* (David 1989).

There are a number of Cape fur seal colonies within the broader study area: Elephant Rocks (north of the Olifants River mouth), Paternoster Rocks and Jacobs Reef at Cape Columbine, and Robbesteen near Koeberg. Non-breeding colonies occur at Strandfontein Point (south of Hondeklipbaai), on Bird Island at Lamberts Bay and at Paternoster Point at Cape Columbine and Duikerklip in Hout Bay (see Figure 4.18). All have important conservation value since they are largely undisturbed at present.

Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nm offshore (Shaughnessy 1979), with bulls ranging further out to sea than females. The timing of the annual breeding cycle is very regular, occurring between November and January. Breeding success is highly dependent on the local abundance of food, territorial bulls and lactating females being most vulnerable to local fluctuations as they feed in the vicinity of the colonies prior to and after the pupping season (Oosthuizen 1991).

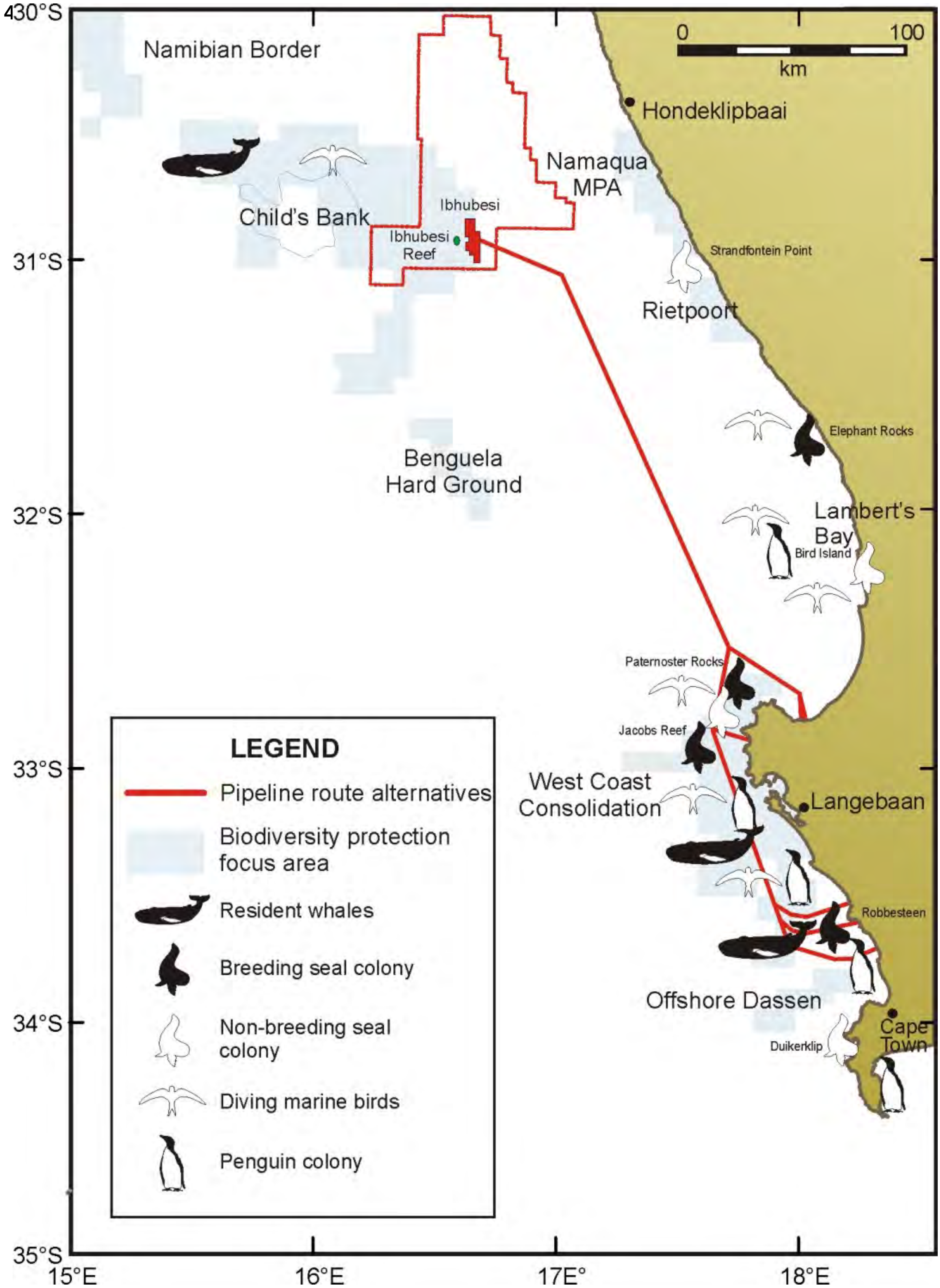


Figure 4.18: Ibhubesi Gas Field and proposed production pipeline route alternatives in relation to seabird and seal colonies and resident whale populations. Focus areas identified by Majiedt et al. (2013) as priority areas for the protection of benthic and pelagic habitats are also shown.

4.4 OTHER USES OF MARINE ENVIRONMENT

4.4.1 FISHERIES

The South African fishing industry consists of 14 commercial sectors operating within the country's 200 nm EEZ. The following fisheries are active off the West Coast:

- Demersal trawl;
- Small pelagic purse-seine;
- Demersal long-line (hake and shark);
- Large pelagic long-line;
- Tuna pole;
- Traditional line fish; and
- West Coast rock lobster.

4.4.1.1 *Demersal trawl*

Demersal trawl is South Africa's most valuable fishery accounting for approximately half of the income generated from commercial fisheries. Demersal trawlers operate extensively around the coast primarily targeting the bottom-dwelling (demersal) species of hake (*Merluccius paradoxus* and *M. capensis*). Main by-catch species include monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*). The hake-directed trawl fishery is split into two sub-sectors: a small inshore trawling sector active off the South Coast and a large deep-sea trawl sector operating on both the South and West coasts. There are currently 45 trawlers operating within the offshore sector. The current annual hake Total Allowable Catch (TAC) of hake across all sectors is 156 075 tons (2013), of which the majority is landed by the demersal trawl sector.

The towed gear typically consists of trawl warps, bridles and trawl doors, a footrope, headrope, net and codend (see Figure 4.19). The monk-directed trawlers use slightly heavier trawl gear, trawl at slower speeds and for longer periods (up to eight hours) compared to the hake-directed trawlers (60 minutes to four hours). Monk gear includes the use of "tickler" chains positioned ahead of the footrope to chase the monk off the substrate and into the net.

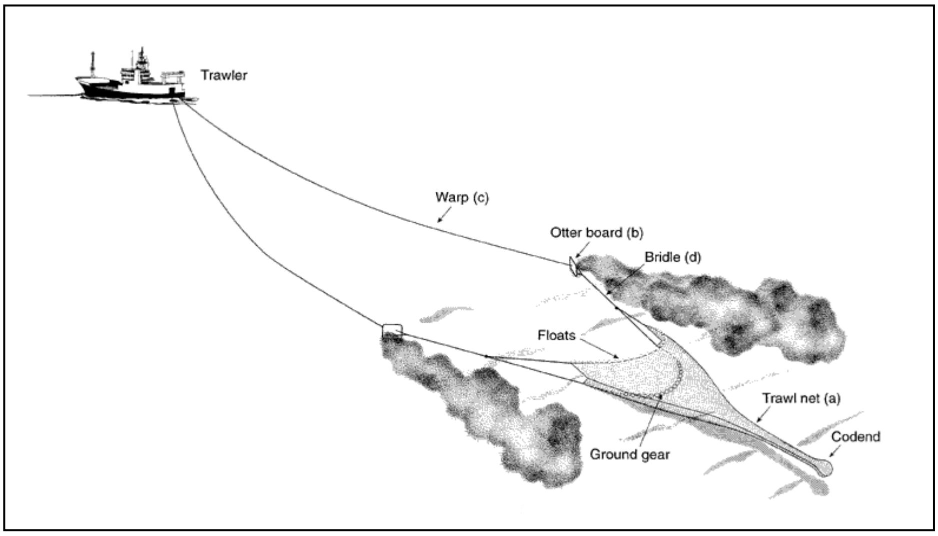


Figure 4.19: Typical gear configuration used by demersal trawlers (offshore) targeting hake.

The landings of hake by the demersal trawl sector (offshore and inshore) over the period 1990 to 2013 are presented in Figure 4.20. Over the period 2000 to 2012, the demersal trawl fishery reported an average of 57 920 trawls per year with an associated catch of 127 743 tons of hake and 166 902 tons of all species landed. Recent years (2008 to 2012) have seen a decline in catch and effort with a reported 44 092 trawls per year and an associated catch of 113 607 tons of hake and 125 599 tons of all species landed. The fishery is active year-round, with a relatively constant amount of effort expended each month.

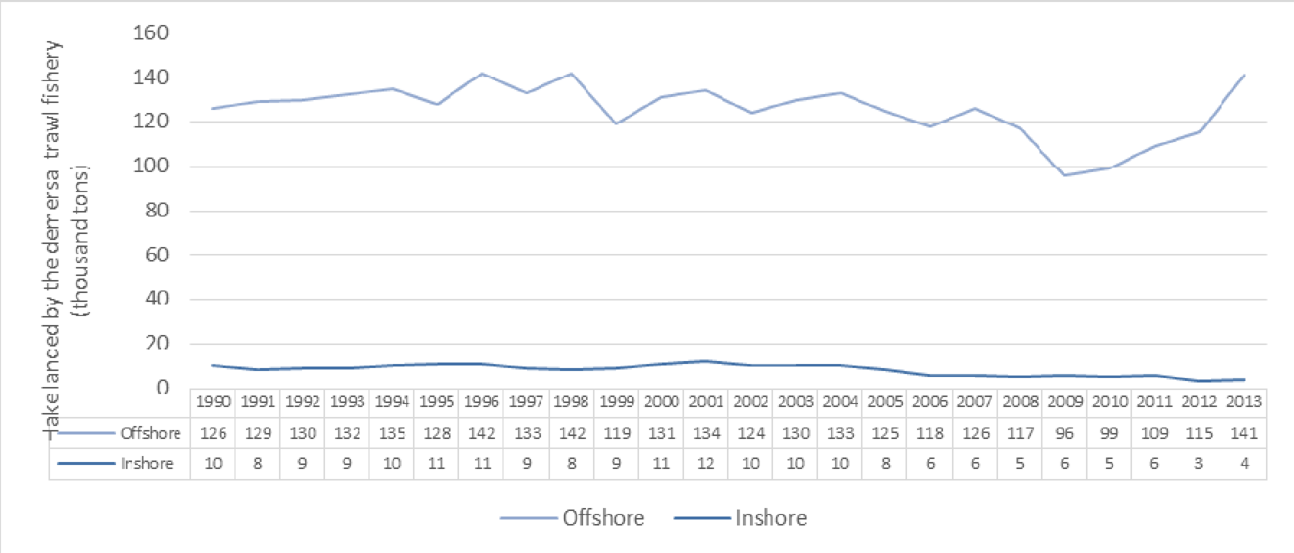


Figure 4.20: Landing of hake by the offshore and inshore demersal trawl fleets between 1990 and 2013.

The deep sea trawl sector on the West Coast operates mainly in a continuous band along the shelf edge between the 300 m and 1 000 m bathymetric contours. Monk-directed trawlers tend to fish in shallower waters compared to the hake-directed vessels on mostly muddy substrates. Trawl nets are generally towed along depth contours (thereby maintaining a relatively constant depth) running parallel to the depth contours in a north-westerly or south-easterly direction. Trawlers also target fish aggregations around bathymetric features, in particular seamounts and canyons (i.e. Child's Bank, Cape Columbine and Cape Canyon), where there is an increase in seafloor slope and in these cases the direction of trawls follow the depth contours. Trawlers are prohibited from operating within 5 nm of the coastline.

The spatial distribution of demersal trawl fishing effort (2000 to 2012) along the West Coast in relation to Block 2A and the proposed offshore pipeline route alternatives is shown in Figure 4.21. Fishing grounds do not coincide with Block 2A. The proposed offshore pipeline only passes through one commercial fisheries grid block along its length (i.e. Grid Block 441 offshore of Saldanha Bay). Records show that approximately 0.02% and 0.07% of the national catch and effort, respectively, has been recorded in Grid Block 441.

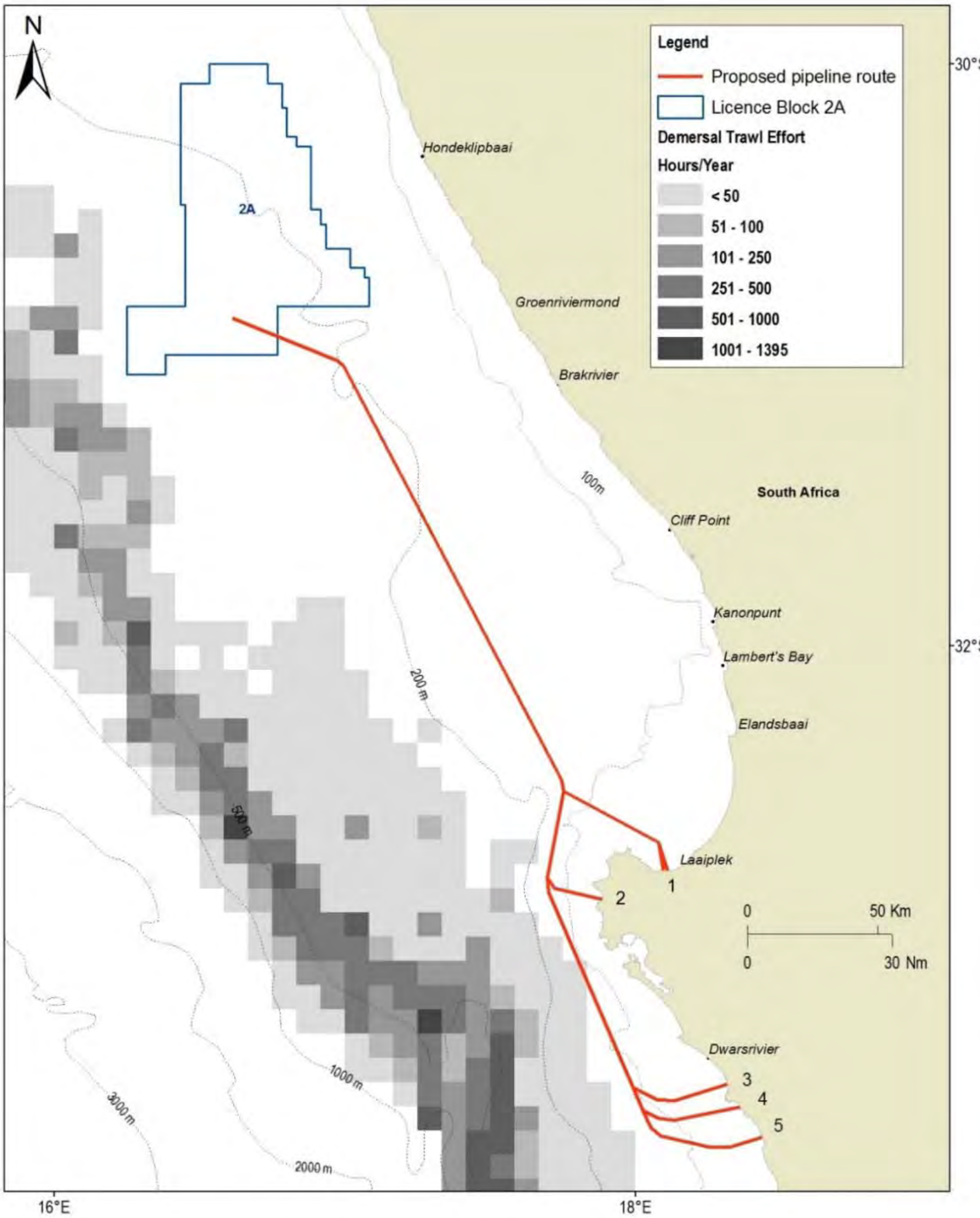


Figure 4.21: The location of Block 2A and proposed pipeline alternatives in relation to hake-directed demersal trawl effort along West Coast between 2000 and 2012.

4.4.1.2 Small pelagic purse-seine fishing

The South African small pelagic purse-seine fishery is the largest fishery by volume and the second most important in terms of value. The two main targeted species are sardine and anchovy, with associated by-catch of round herring (red-eye) and juvenile horse mackerel. Annual landings have fluctuated between 300 000 and 600 000 tons over the last decade, with landings of 468 000 tons recorded per annum between 2000 and 2012, compared to 391 000 tons per annum recorded between 2008 and 2012.

The South African fishery, consisting of approximately 101 vessels, is active all year round with a short break from mid-December to mid-January (to reduce impact on juvenile sardine), with seasonal trends in the specific species targeted. The geographical distribution and intensity of the fishery is largely dependent on the seasonal fluctuation and geographical distribution of the targeted species. Fishing grounds occur primarily along the Western Cape and Eastern Cape coast up to a distance of 100 km offshore, but usually closer inshore. The sardine-directed fishery tends to concentrate effort in a broad area extending from St Helena Bay, southwards past Cape Town towards Cape Point and then eastwards along the coast to Mossel Bay and Port Elizabeth. The anchovy-directed fishery takes place predominantly on the South-West Coast from Lamberts Bay to Kleinbaai (19.5°E) on the South Coast and is most active in the period from March to September. Round herring (non-quota species) is targeted when available and specifically in the early part of the year (January to March) and is distributed from Lambert's Bay to south of Cape Point.

Once a shoal has been located the vessel steams around it and encircle it with a large net. The depth of the net is usually between 60 m and 90 m. Netting walls surround aggregated fish both from the sides and from underneath, thus preventing them from escaping by diving downwards. These are surface nets framed by lines: a float line on top and lead line at the bottom (see Figure 4.22). Once the shoal has been encircled the net is pursed and hauled in and the fish are pumped onboard into the hold of the vessel. After the net is deployed the vessel has no ability to manoeuvre until the net has been fully recovered onboard, which may take up to 1.5 hours. Vessels usually operate overnight and return to offload their catch the following day.

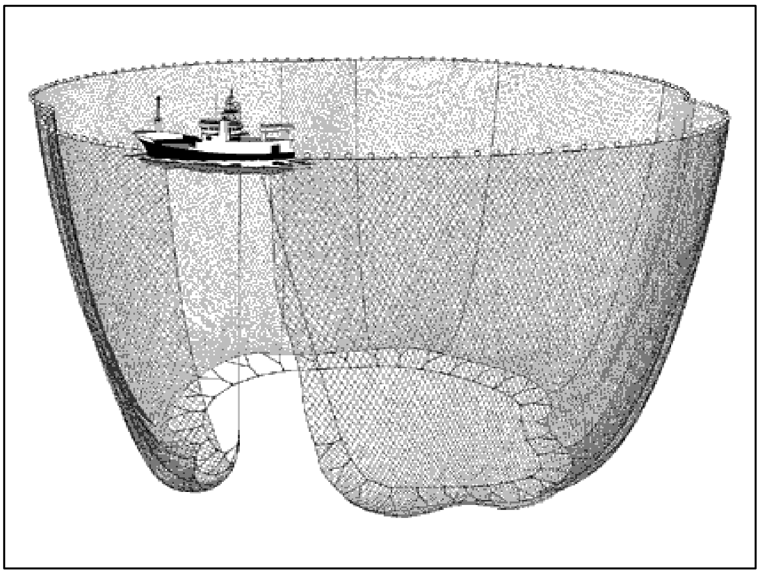


Figure 4.22: Pelagic purse-seine gear configuration.

The reported annual effort expended by the small pelagic purse-seine sector for the period 2000 to 2012 in relation to the proposed offshore pipeline alternatives are shown in Figures 4.23 and 4.24. Although there is no effort recorded in Block 2A, fishing activity is evident along the majority of the length of the proposed offshore pipeline. Since the fishery is pelagic in nature, fishing operations would not be affected by the presence of a pipeline on the seafloor. The fishery could, however, be affected during pipeline installation due to the 500 m safety zone around the pipe-laying vessel. Effort recorded by this fishery over the period 2000 to 2012 indicates that the safety zone would coincide with between 0.06% and 0.48% of the total number of fishing events recorded by the fishery, depending on the landing site selected (see Table 4.8).

Table 4.8: Percentage of total fishing events undertaken by the small pelagic purse-seine fishery from 2000 to 2012 within the 500 m safety zone around six alternative offshore pipeline alternatives.

Landing Points	Percentage of total throws
St Helena East	0.15
St Helena West	0.14
Noordwesbaai	0.06
Grotto Bay	0.44
Silwerstroom Strand	0.42
Duynefontein	0.48

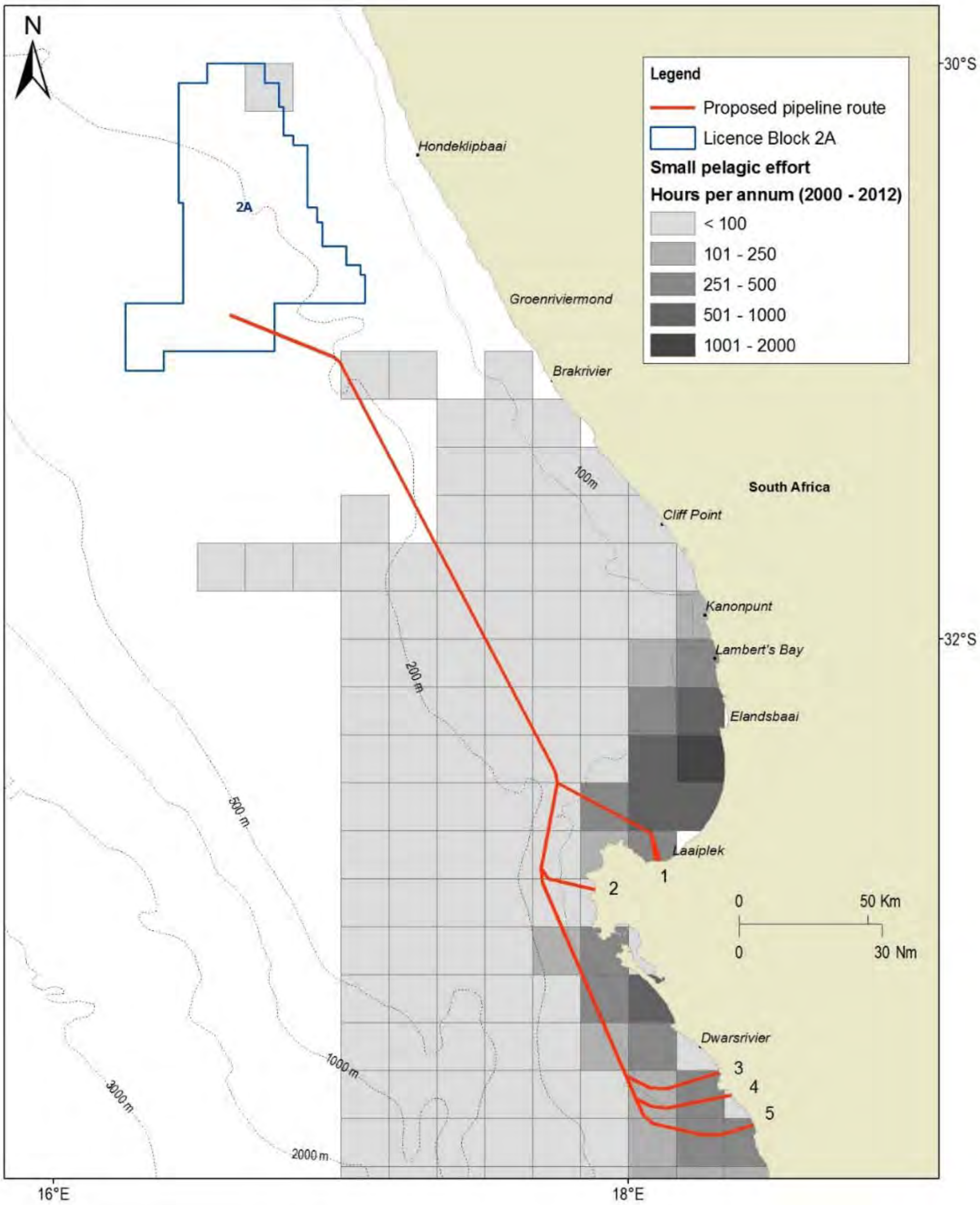


Figure 4.23: The location of Block 2A and the proposed pipeline alternatives in relation to pelagic purse-seine effort between 2000 and 2012.

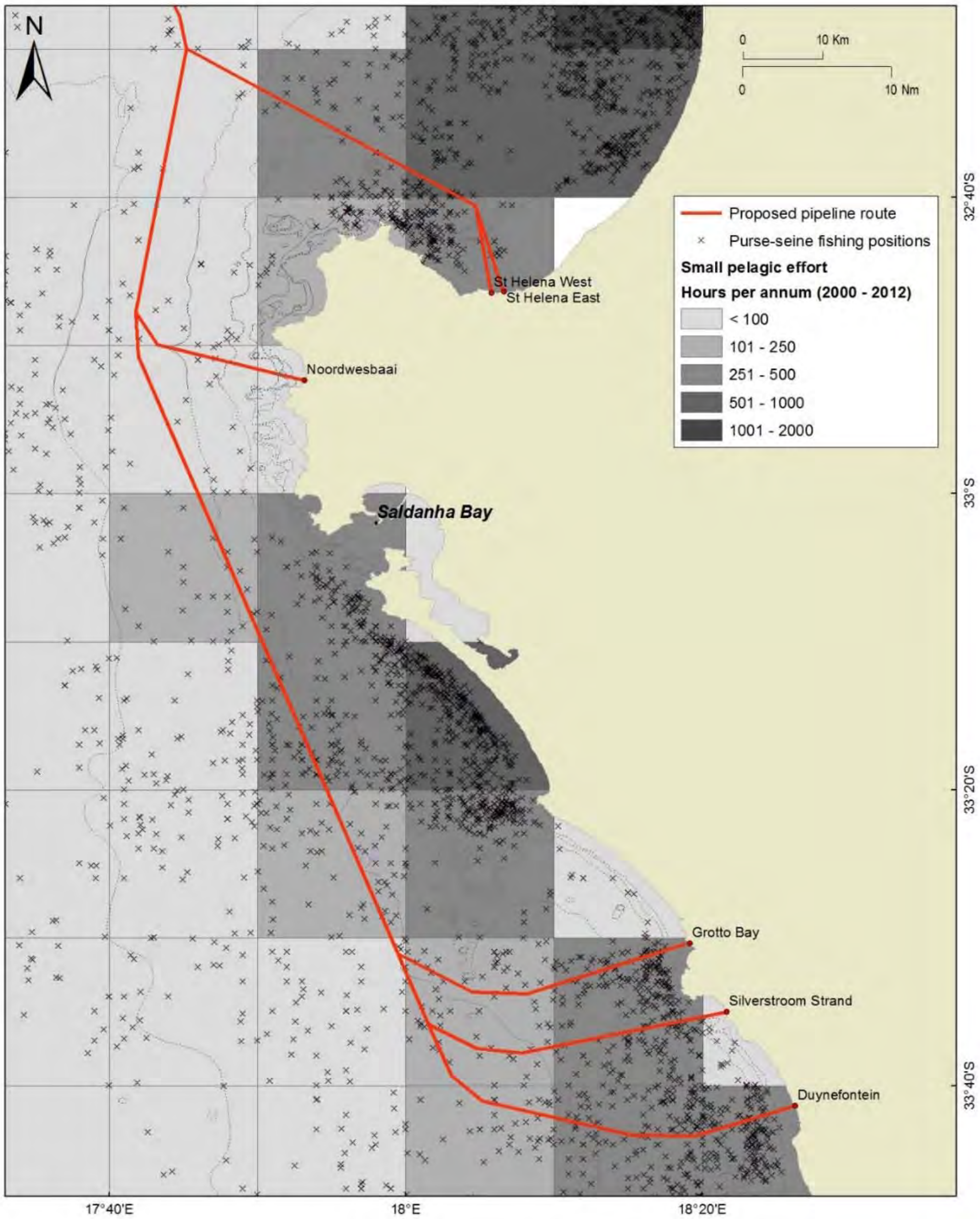


Figure 4.24: The location of the proposed pipeline shore-crossing alternatives in relation to pelagic purse-seine effort between 2000 and 2012.

4.4.1.3 Demersal long-line

In South Africa the demersal long-line fishery operates in well-defined areas extending along the shelf break from Port Nolloth to Cape Agulhas and is comprised of the hake-directed, with a small non-targeted commercial by-catch that includes kingklip, and shark-directed demersal long-line sectors.

Bottom-set long-line gear is robust and comprises two lines as well as dropper lines with subsurface floats attached (see Figure 4.25). Lines are typically between 10 km and 20 km in length, carrying between 6 900 and 15 600 hooks each. Baited hooks are attached to the bottom line at regular intervals (1 to 1.5 m) by means of a snood. Gear is usually set at night at a speed of between five and nine knots. Once deployed the line is left for up to eight hours before it is retrieved. A line hauler is used to retrieve gear (at a speed of approximately one knot) and can take six to ten hours to complete. During hauling operations a demersal long-line vessel would be severely restricted in manoeuvrability.

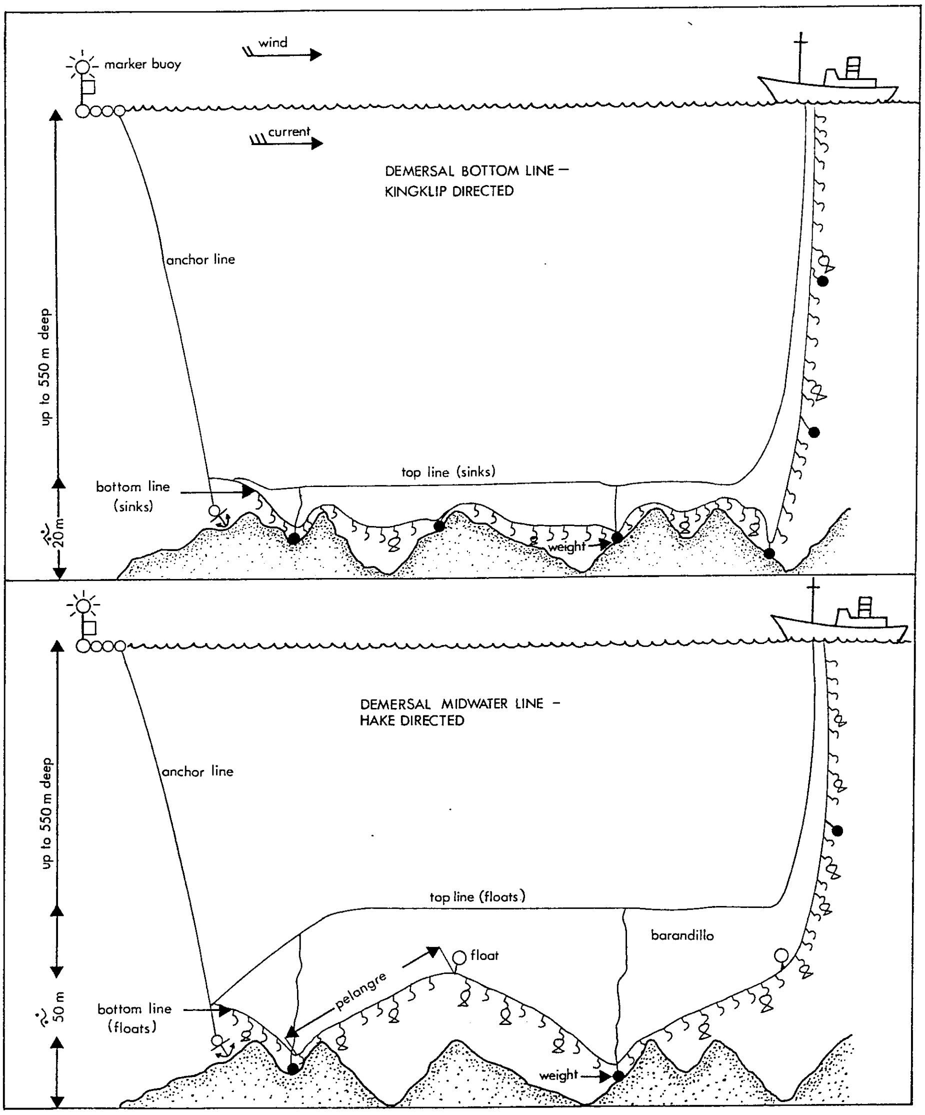


Figure 4.25: Typical configuration of Demersal (bottom-set) hake long-line gear used in South African waters.

(a) Hake-directed demersal long-line sector

Most of the 64 hake-directed vessels are based at the harbours of Cape Town and Hout Bay. Operations are *ad hoc* and intermittent, subject to market demand. The fishery operates year-round with a slight increase in activity between August and December.

Annual landings of hake by the demersal long-line fishery over the period 1990 to 2002 are shown in Figure 4.26. Over the period 2000 to 2012, the fishery set an average of 30.7 million hooks and landed 8 791 tons of hake per year. This is slightly higher than the reported catch and effort over the period between 2008 and 2012, during which time the fishery set an average of 28.9 million hooks and landed 8 368 tons of hake per year.

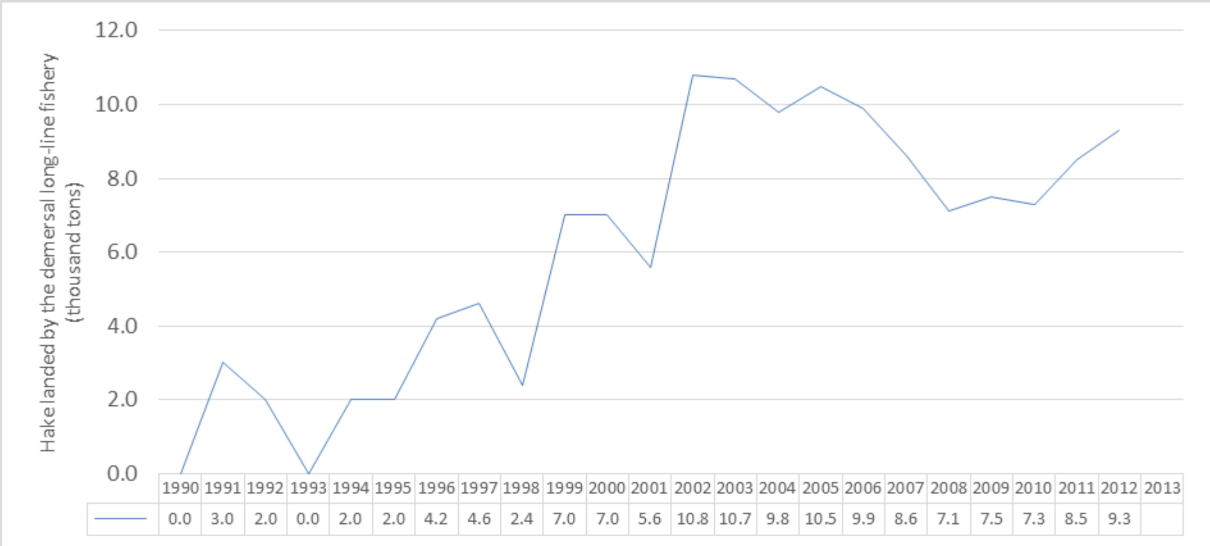


Figure 4.26: Hake landings recorded by the demersal long-line fishery over the period 1990 to 2012.

Figure 4.27 shows the spatial distribution of hake-directed long-line effort recorded off the West Coast between 2000 and 2012. Demersal long-line fishing grounds are similar to those targeted by the hake-directed trawl fleet. Lines are set parallel to bathymetric contours, predominantly along the shelf edge. On the West Coast (i.e. West of 20°E), effort is expended predominantly between the 250 m and 500 m isobaths in an almost continuous band extending from south of the Agulhas Bank to in line with St Helena Bay. Northwards of St Helena Bay, effort is more fragmented but runs predominantly between the 350 m and 450 m isobaths.

During the period 2000 to 2013, while some effort was recorded within grid blocks through which the pipeline passes, there is only one recorded fishing event that coincides with the proposed pipeline (see Grid Block 414 in Figure 4.28). Although fishing effort in the vicinity of the proposed pipeline is low, fishing is likely to occur. It is anticipated that, in terms of the Marine Traffic Act, 1981, demersal long-line vessels would not be permitted to set lines within 500 m of the proposed pipeline as the gear includes anchoring, which could damage to the pipeline.

(b) Shark-directed demersal long-line sector

The demersal shark fishery targets soupfin shark, smooth-hound shark, spiny dogfish, St Joseph shark, *Charcharhinus* spp., rays and skates. Other species which are not targeted but may be landed include Cape gurnards, jacopever and smooth hammerhead shark. Effort is continuous throughout the year with a relative increase between May and October. Catches are landed at the harbours of Cape Town, Hout Bay, Mossel Bay, Plettenberg Bay, Cape St Francis, Saldanha Bay, St Helena Bay, Gansbaai and Port Elizabeth and currently six permit holders have been issued with long-term rights to operate within the fishery. Over the period 2007 to 2012, the fishery reported an annual average of 430 500 hooks set and 175 tons landed annually.

The spatial distribution of effort expended by the shark-directed demersal long-line fishery in the vicinity of the proposed production pipeline is shown in Figure 4.29. On the West Coast (West of 20°E), fishing grounds are centred predominantly in coastal waters inshore of the 200 m isobaths around the South-Western Cape coastline and extending up to Saldanha Bay.

The fishing grounds do not coincide with Block 2A or the northern pipeline route alternatives. There have, however, been several fishing events in close proximity to the proposed pipeline route alternatives associated with the southern shore-crossing and the fishery could be expected to operate within these areas. The level of fishing effort in the vicinity of the southern shore-crossings is relatively low compared with that expended by the fishery on a national level.

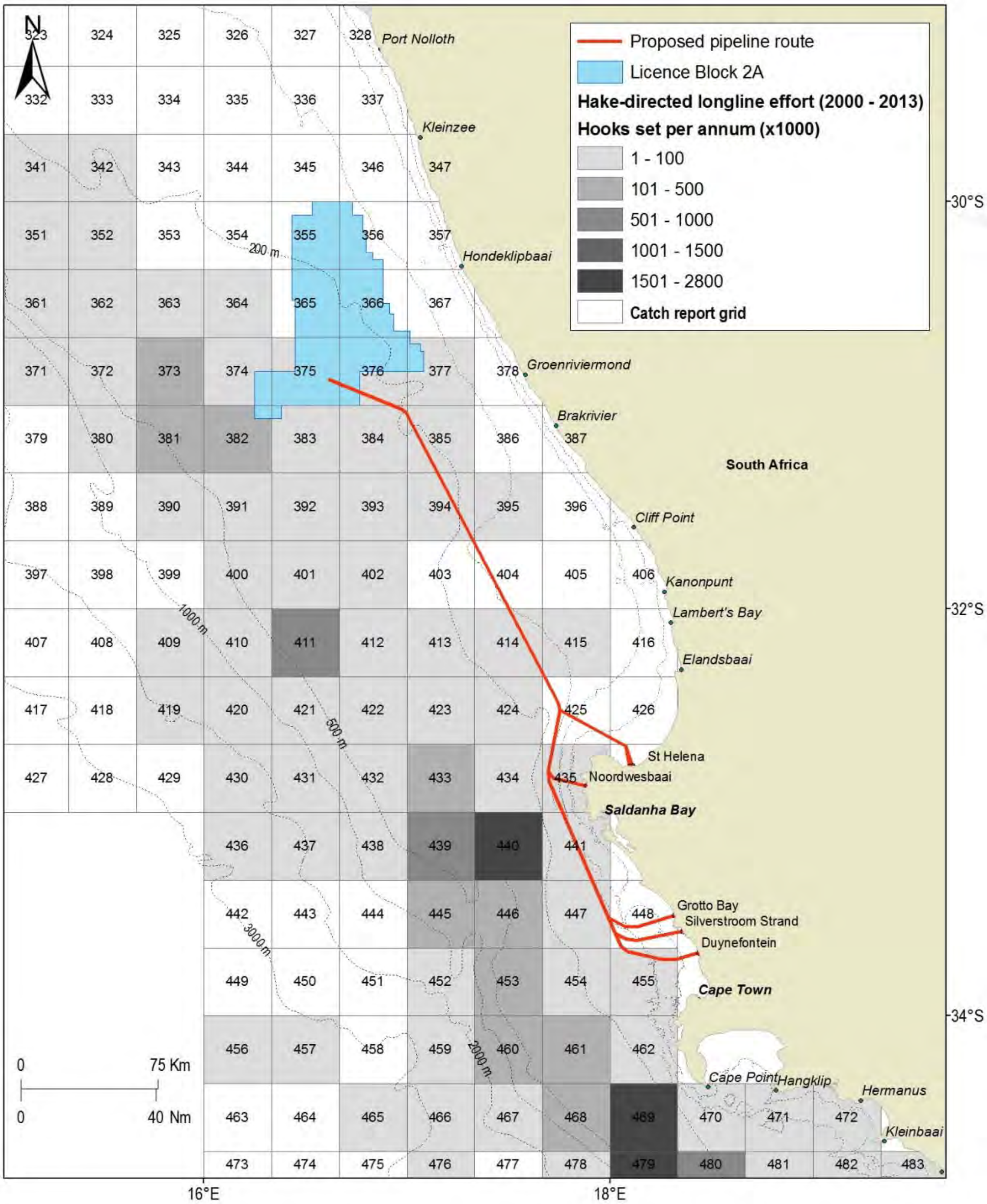


Figure 4.27: The location of Block 2A and the proposed production pipeline in relation to hake-directed demersal long-line effort along the West Coast between 2000 and 2013.

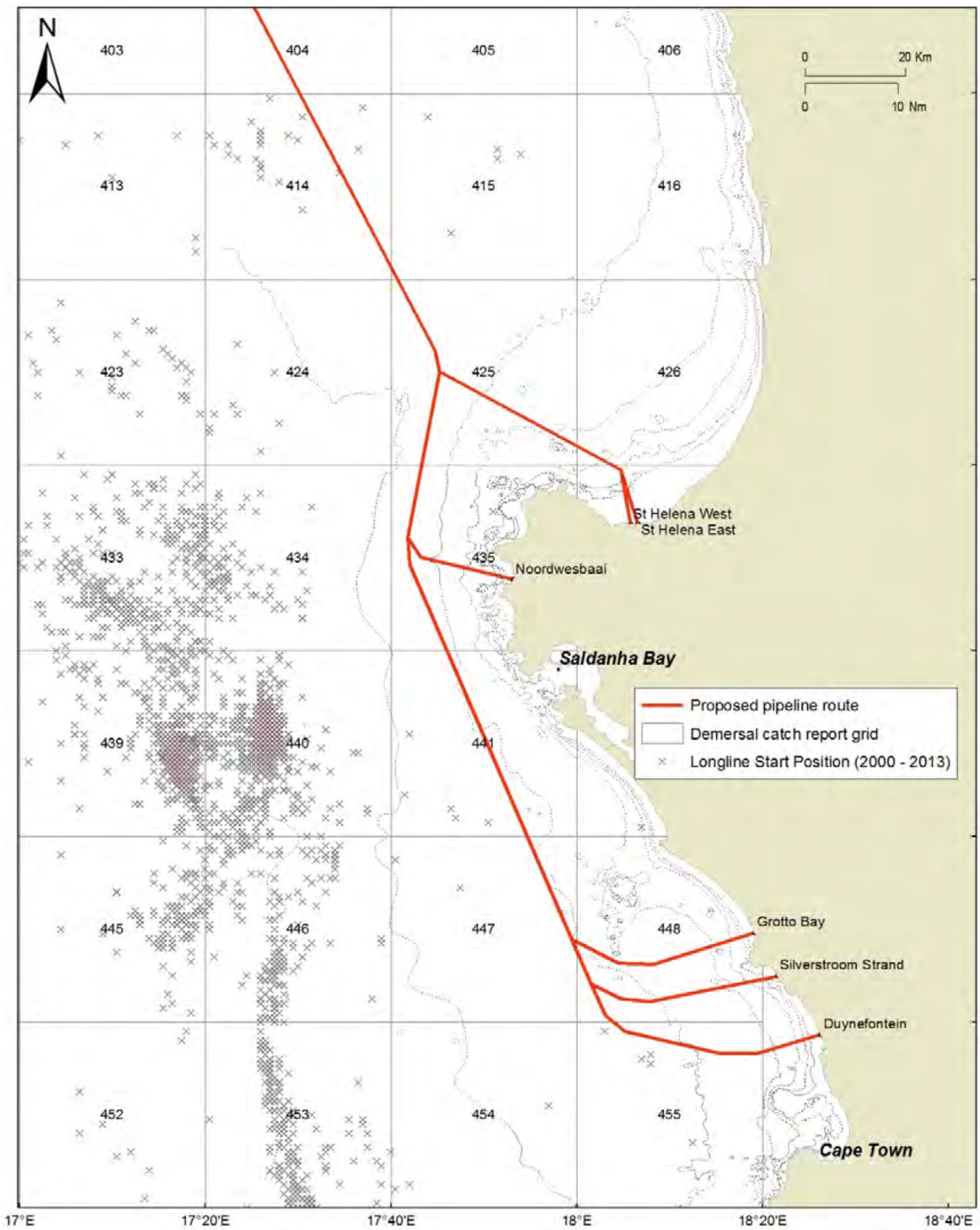


Figure 4.28: The location of the proposed pipeline shore-crossing alternatives in relation to hake-directed demersal long-line effort. Effort is indicated as the recorded position of the start of lines set between 2000 and 2013.

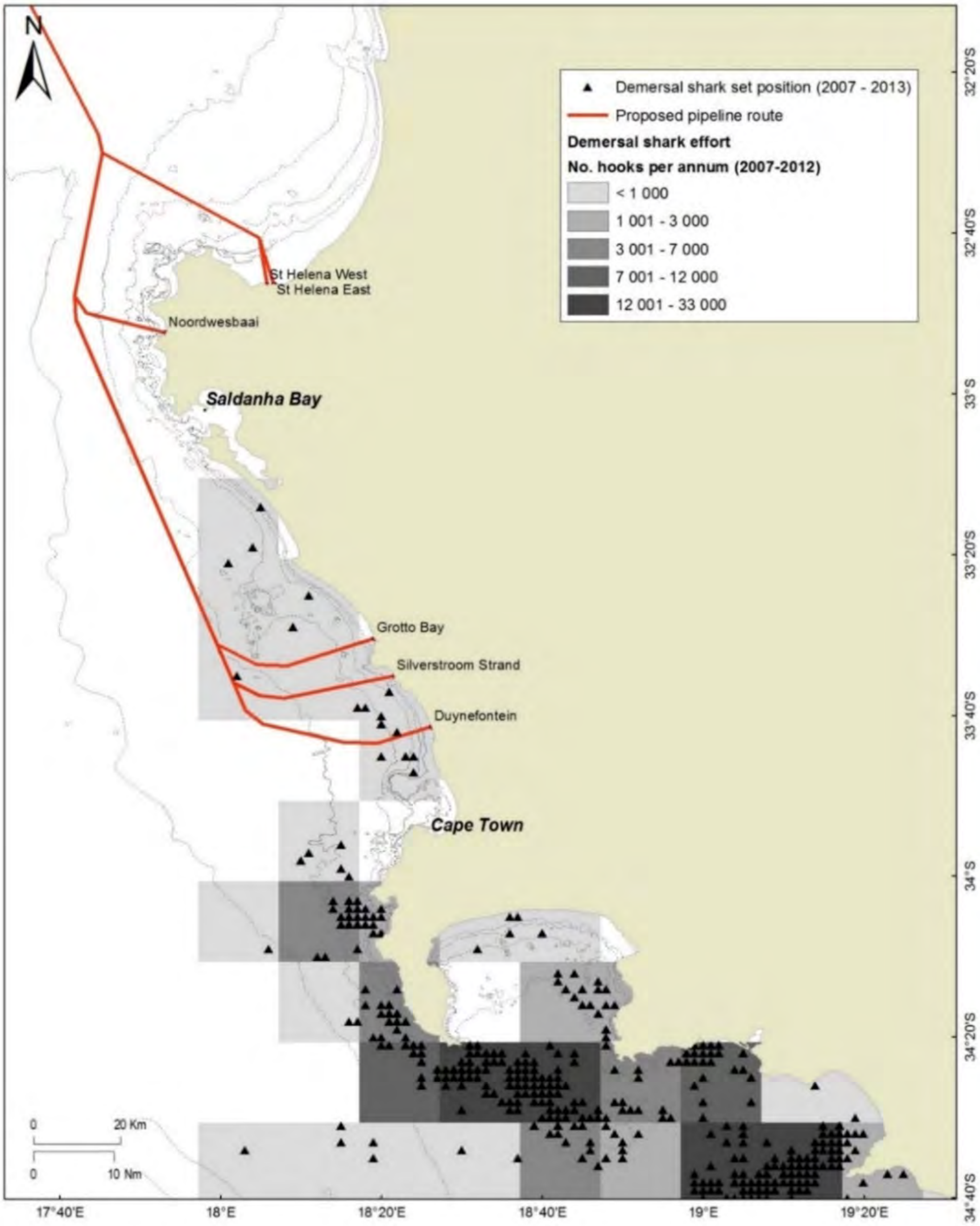


Figure 4.29: The location of the proposed pipeline shore-crossing alternatives in relation to shark-directed demersal long-line effort between 2007 and 2012.

4.4.1.4 Pelagic long-line

The large pelagic long-line fishery operates year-round with a relative increase in effort during winter and spring, extensively within the South African EEZ targeting primarily tuna and swordfish. Due to the highly migratory nature of these species, stocks straddle the EEZ of a number of countries and international waters. As such they are managed as a “shared resource” amongst various countries mainly through the International Convention for the Conservation of Atlantic Tunas (ICCAT). There are currently 30 commercial large pelagic fishing rights issued for South African waters and there are 31 vessels active in the fishery.

Pelagic long-line vessels set a drifting mainline, which can be up to 100 km in length. The mainline is kept near the surface or at a certain depth (20 m below) by means of buoys connected via “buoy-lines”, which are spaced approximately 500 m apart along the length of the mainline (see Figure 4.30). Hooks are attached to the mainline via 20 m long trace lines, which are clipped to the mainline at intervals of approximately 50 m. There can be up to 3 500 hooks per line. A single main line consists of twisted rope (6 to 8 mm diameter) or a thick nylon monofilament (5 to 7.5 mm diameter). Various types of buoys are used in combinations to keep the mainline near the surface and locate it should the line be cut or break for any reason. Each end of the line is marked by a Dahn Buoy and Radar reflector, which marks it’s position for later retrieval by the fishing vessel. A line may be left drifting for up to 18 hours before retrieval by means of a powered hauler at a speed of approximately 1 knot. During hauling a vessel’s manoeuvrability is severely restricted and, in the event of an emergency, the line may be dropped to be hauled in at a later stage.

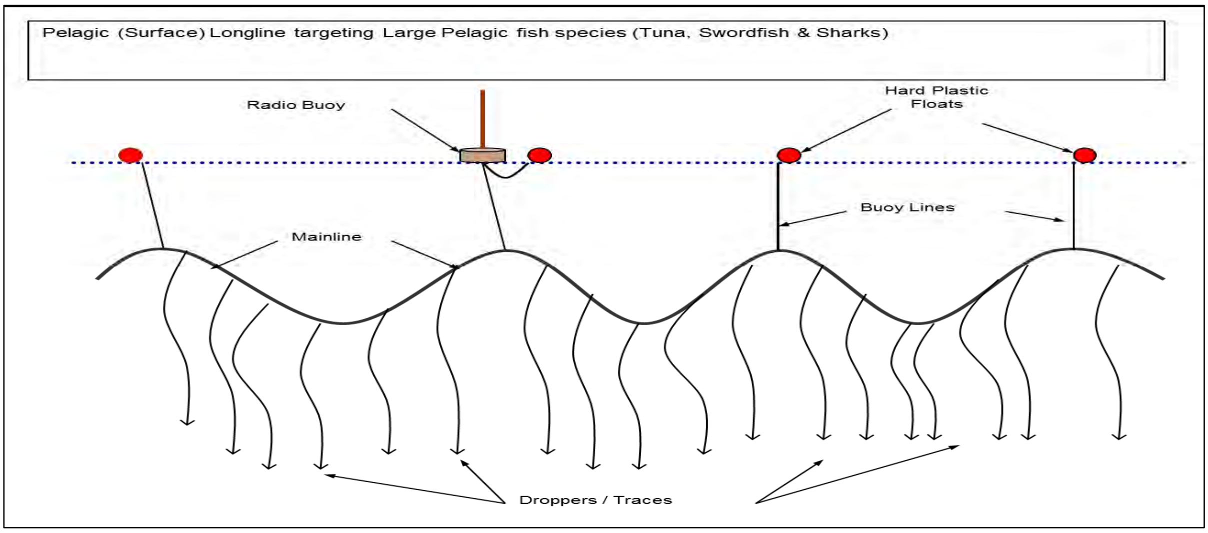


Figure 4.30: Typical Pelagic long-line configuration targeting tuna, swordfish and shark species.

The fishery operates extensively from the continental shelf break into deeper waters. During the period 2000 to 2012, the national catch and effort recorded within the large pelagic fishery amounted to an average of 3 018 tons and 3.49 million hooks set per year. However, during the period 2008 to 2012 there has been an increase in effort, whilst landings have remained relatively constant within the fishery (3 047 tons and 4.84 million hooks set per year).

Figure 4.31 shows the spatial distribution of catch reported by the large pelagic long-line sector in the vicinity of Block 2A and the proposed production pipeline. Fishing activity is concentrated at the shelf break, predominantly seawards of the 500 m isobath but with incidental records closer inshore. There is very limited catch record from Block 2A and it is unlikely that the 500 m safety zone around the proposed production facility would impact this sector. There is no evidence of fishing activity having taken place within 500 m of the proposed offshore pipeline route over the period 2000 to 2012 and it is, therefore, unlikely that the sector would be affected by the installation of the proposed pipeline.

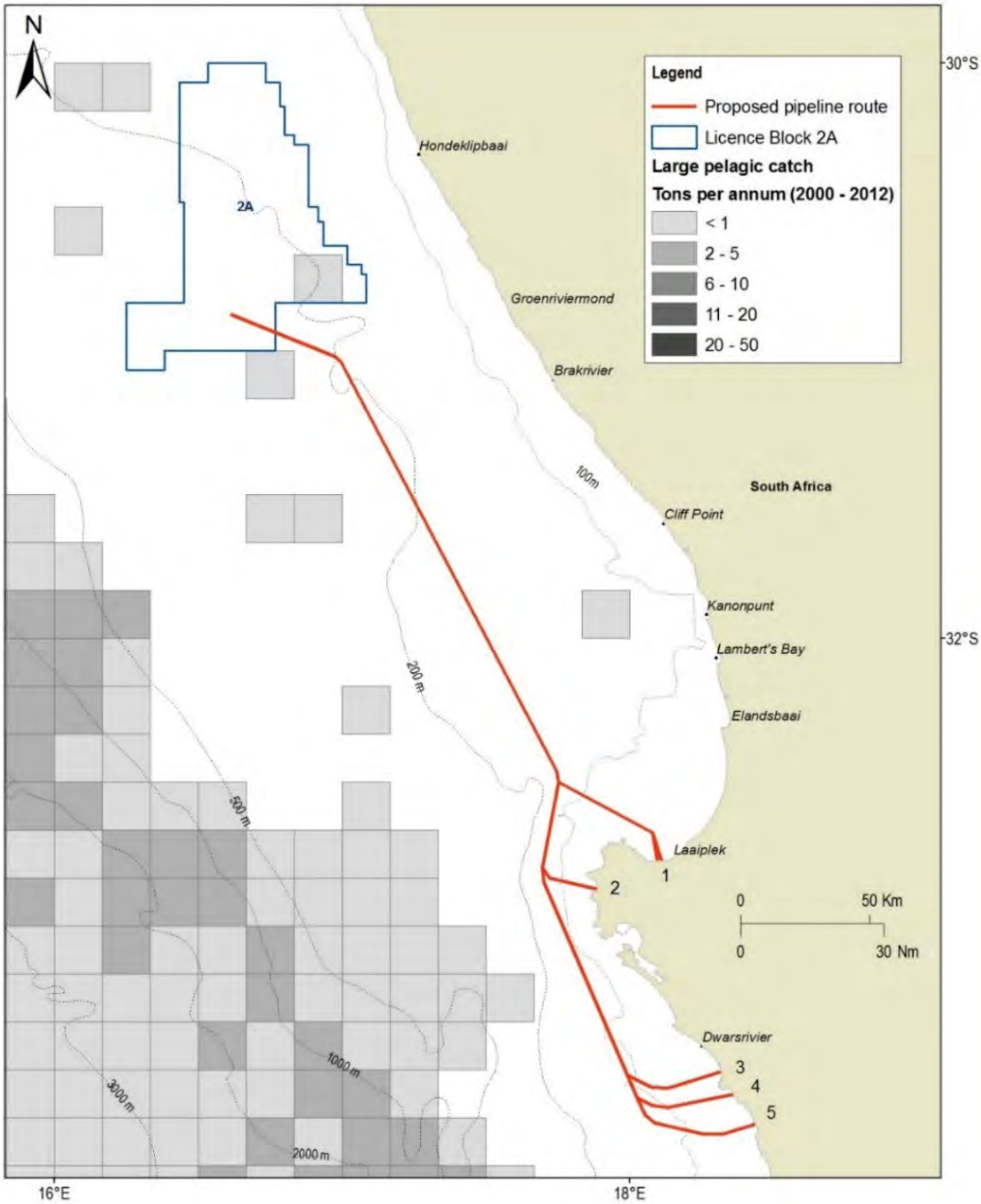


Figure 4.31: The location of Block 2A and the proposed production pipeline in relation to pelagic long-line catch along West Coast between 2000 and 2012.

4.4.1.5 Tuna pole

The tuna pole fishery is based on migratory species of tuna, predominantly Atlantic longfin tuna stock and a very small amount of skipjack tuna, yellowfin tuna and bigeye tuna. The South African fleet consists of approximately 128 pole-and-line vessels, which are based at the ports of Cape Town, Hout Bay and Saldanha Bay. The fishery is seasonal with vessel activity mostly between December and May and peak catches in February and March. The 2014 TAC for the South African tuna pole fishery (albacore) was set at 4 400 tons.

Vessels drift whilst attracting and catching shoals of pelagic tunas. Sonars and echo sounders are used to locate schools of tuna. Once a school is located, water is sprayed outwards from high-pressure nozzles to simulate small baitfish aggregating near the water surface. Live bait is then used to entice the tuna to the surface (chumming). Tuna swimming near the surface are caught with hand-held fishing poles. The ends of the 2 to 3 m poles are fitted with a short length of fishing line leading to a hook. In order to land heavier fish, lines may be strung from the ends of the poles to overhead blocks to increase lifting power (see Figure 4.32). Vessels are relatively small (less than 25 m in length) and store catch on ice, thus staying at sea for short periods (approximately five days). The nature of the fishery and communication between vessels often results in a large number of vessels operating in close proximity to each other at a time. The vessels fish predominantly during daylight hours and are highly manoeuvrable. However, at night in fair weather conditions the fleet of vessels may drift or deploy drogues to remain within an area and would be less responsive during these periods.

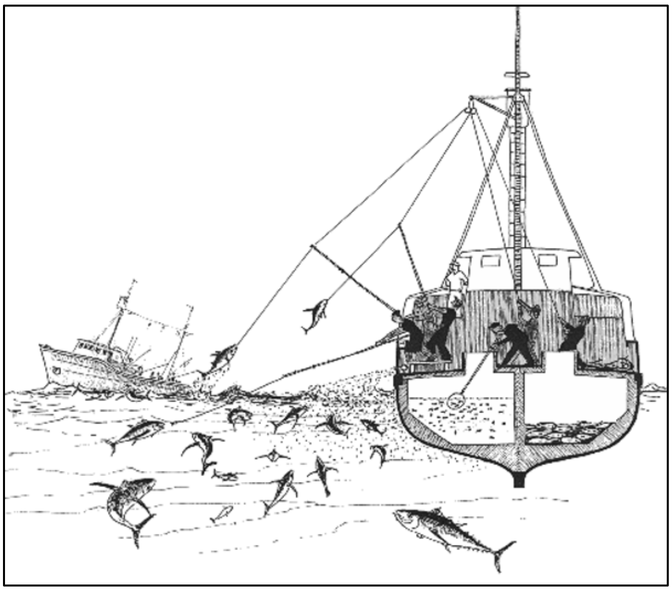


Figure 4.32: Schematic diagram of pole and line operation (www.fao.org/fishery).

Fishing activity occurs along the entire West Coast beyond the 200 m bathymetric contour. Activity would be expected to occur along the shelf break with favoured fishing grounds including areas north of Cape Columbine and between 60 km and 120 km offshore from Saldanha Bay.

Figure 4.33 shows the spatial distribution of catch in the vicinity of Block 2A and the proposed production pipeline. While some catches have been recorded within grids through which the proposed pipeline passes, over the period 2003 to 2012, there have been no recorded fishing events that have occurred within 500 m of the proposed pipeline and only a few fishing events have been in close proximity to the pipeline corridor (see Figure 4.34).

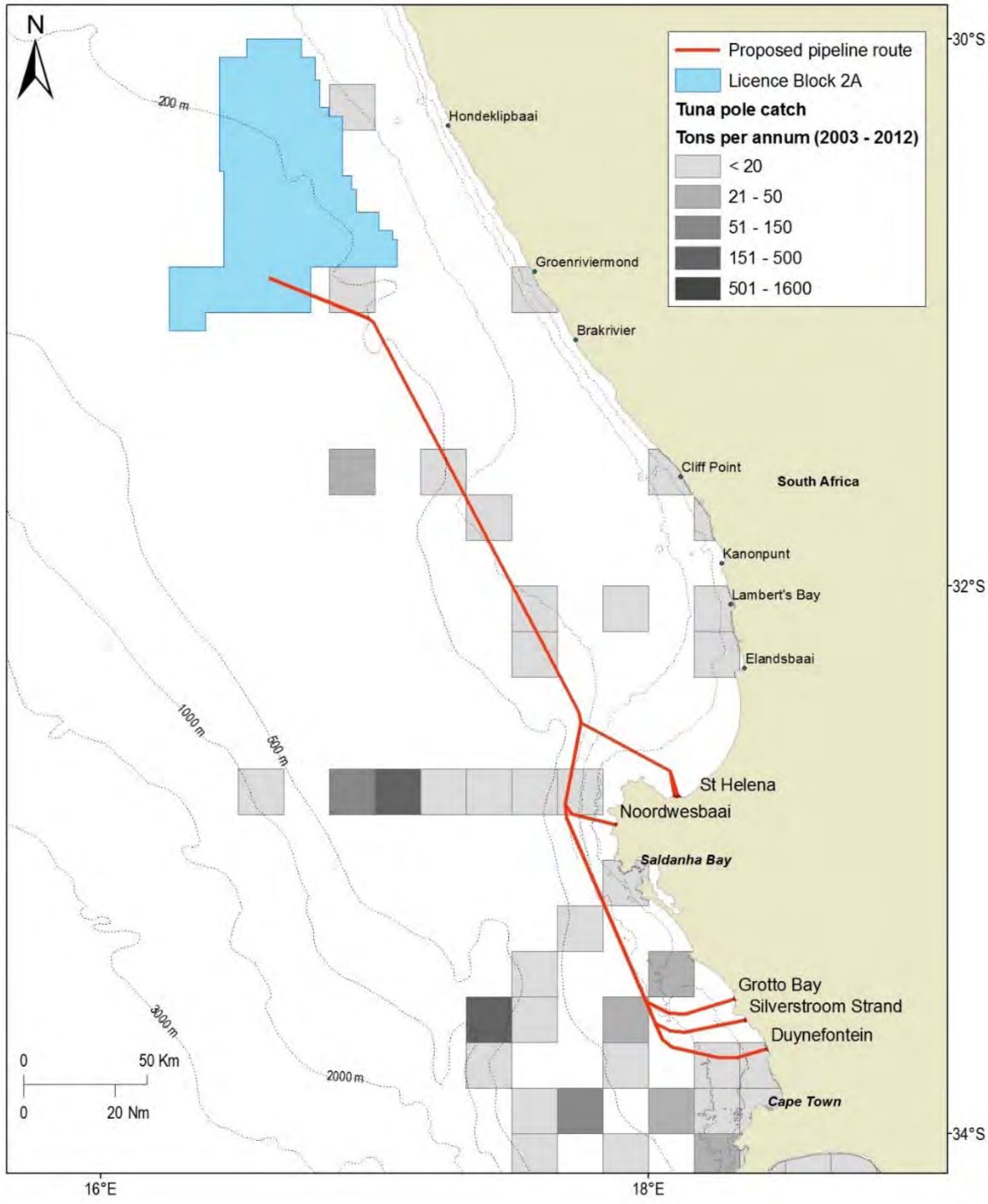


Figure 4.33: The location of Block 2A and the proposed production pipeline in relation to tuna pole catch along West Coast between 2003 and 2012.

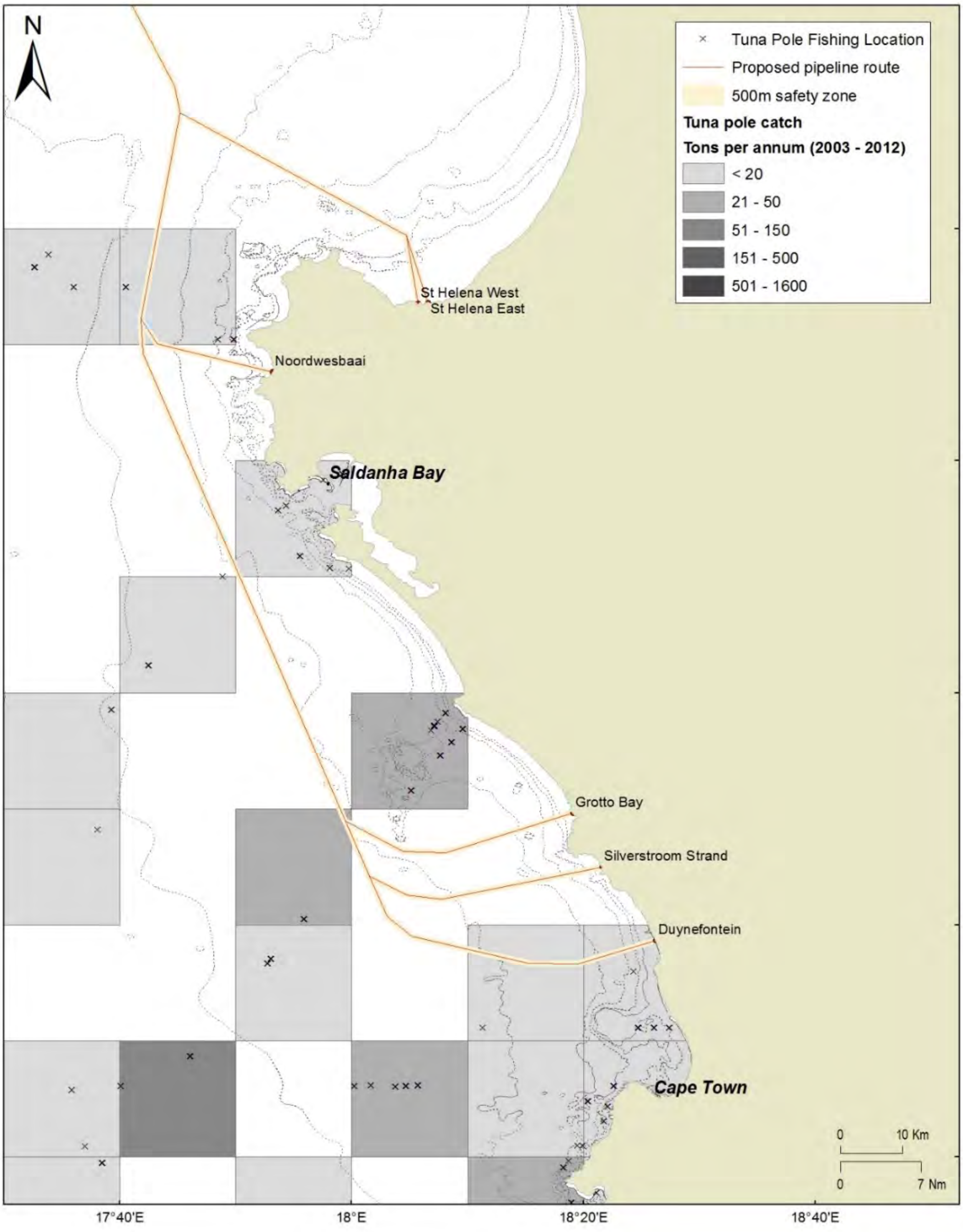


Figure 4.34: The location of the proposed pipeline shore-crossing alternatives in relation to tuna pole catch between 2003 and 2012.

4.4.1.6 Traditional line fish

This fishery includes commercial, subsistence and recreational sectors. The South African commercial line fishery is the country's third most important fishery in terms of total tons landed and economic value. The bulk of the fishery catch is made up of approximately 35 species of reef fish, as well as pelagic and demersal species. The fishery is widespread across the country's shoreline from Port Nolloth on the West Coast to Cape Vidal on the East Coast. Effort is managed geographically with the spatial effort of the fishery divided into three zones. The majority of the catch (up to 95%) is landed by the Cape commercial fishery, which operates on the continental shelf between from the Namibian border on the West Coast to the Kei River in the Eastern Cape. Fishing vessels generally range up to a maximum of 40 nm offshore, although fishing at the outer limit and beyond this range would be sporadic (C. Wilke, *pers. comm*.). Up to 3 000 boats are involved in the fishery on the national level, 450 of which are involved in the commercial fishery.

Line fishing techniques consist of hook and line deployments (up to 10 hooks per line) and differ from the pelagic long-line fishing technique in that the use of set long-lines is not permitted.

The fishery operates year-round and records of fishing activity off the West Coast of South Africa are predominantly coastal up to the 200 m isobath. During the period 2000 to 2012, while some effort is recorded within grid blocks through which the pipeline passes (Figure 4.35), there is only one recorded fishing event that coincides with the proposed pipeline at the Grotto Bay pipeline landing site (Figure 4.36). Although fishing effort in the vicinity of the proposed production platform and pipeline is low, it can be expected to occur. There are several small-scale fishing communities in the St Helena Bay area, at Saldanha Bay, Langebaan and Mamre/Atlantis, close to Silwerstroom Strand. Since the fishery is pelagic in nature, fishing operations would not be affected by the presence of a pipeline on the seafloor. The fishery could, however, be affected during pipeline installation due to the 500 m safety zone around the pipe-laying vessel.

4.4.1.7 West Coast rock lobster

The West Coast rock lobster occurs inside the 200 m depth contour along the West Coast from Namibia to East London on the East Coast of South Africa. In South Africa the fishery is divided into two sectors, namely the offshore sector which operates in a water depth range of 30 m to 100 m and the inshore fishery which is restricted by the type of gear used to waters shallower than 30 m in depth. Fishing grounds are divided for management purposes into zones (and further subdivided into areas) stretching from the Orange River mouth to east of Cape Hangklip in the South-Eastern Cape. The fishery operates seasonally operating from the shore and coastal harbours, with closed seasons applicable to different zones:

- Zone A (Management Area 1 and 2) operates from 1 October to 30 April; and
- Zone B – F (Management Area 3 to 14) operates between 15 November and 30 June. Management Area 8, located within the deep-water area off Cape Point, operates between 15 November and 30 September (D. van Zyl, *pers. comm*.).

The landing sites for this fishery are distributed along the West Coast and include Port Nolloth, St Helena Bay, Laaiplek, Doringbaai, Lambert Bay, Saldanha Bay and Yzerfontein. The offshore sector makes use of traps consisting of rectangular metal frames covered by netting, which are deployed from trap boats, whilst the inshore fishery makes use of hoop nets deployed from small dinghy's. Traps are set at dusk and retrieved during the early morning. Vessels using traps will leave up to 30 traps per vessel in the fishing grounds overnight during the week.

Catch is managed using a TAC, 80% and 20% of which is allocated to the offshore and inshore fisheries respectively. Catches of rock lobster have declined systematically due to heavy fishing pressure and are currently estimated to be at only 3% of their pristine state. A total national landing of approximately 1 879 tons (whole weight) was recorded for 2012 and a TAC of 2 167 tons has been set for the 2013/14 season.

Figure 4.37 shows the spatial distribution of catch taken by the inshore and offshore West Coast rock lobster fisheries over the period 1969 to 2012. Although there is no effort recorded in Block 2A and the majority of the proposed pipeline, fishing activity can be expected for all pipeline alternatives inshore of the 100 m isobath, in particular around shallow-water bathymetric features within Rock Lobster Management Areas 4, 5, 6 and 7 indicated in Figure 4.38 and Figure 4.39. It is anticipated that, in terms of the Marine Traffic Act, 1981, vessels could potentially set traps within 500 m of the pipeline. However, due to possible risk of pipeline damage traps may not be allowed to be set over or in very close proximity to the pipeline.

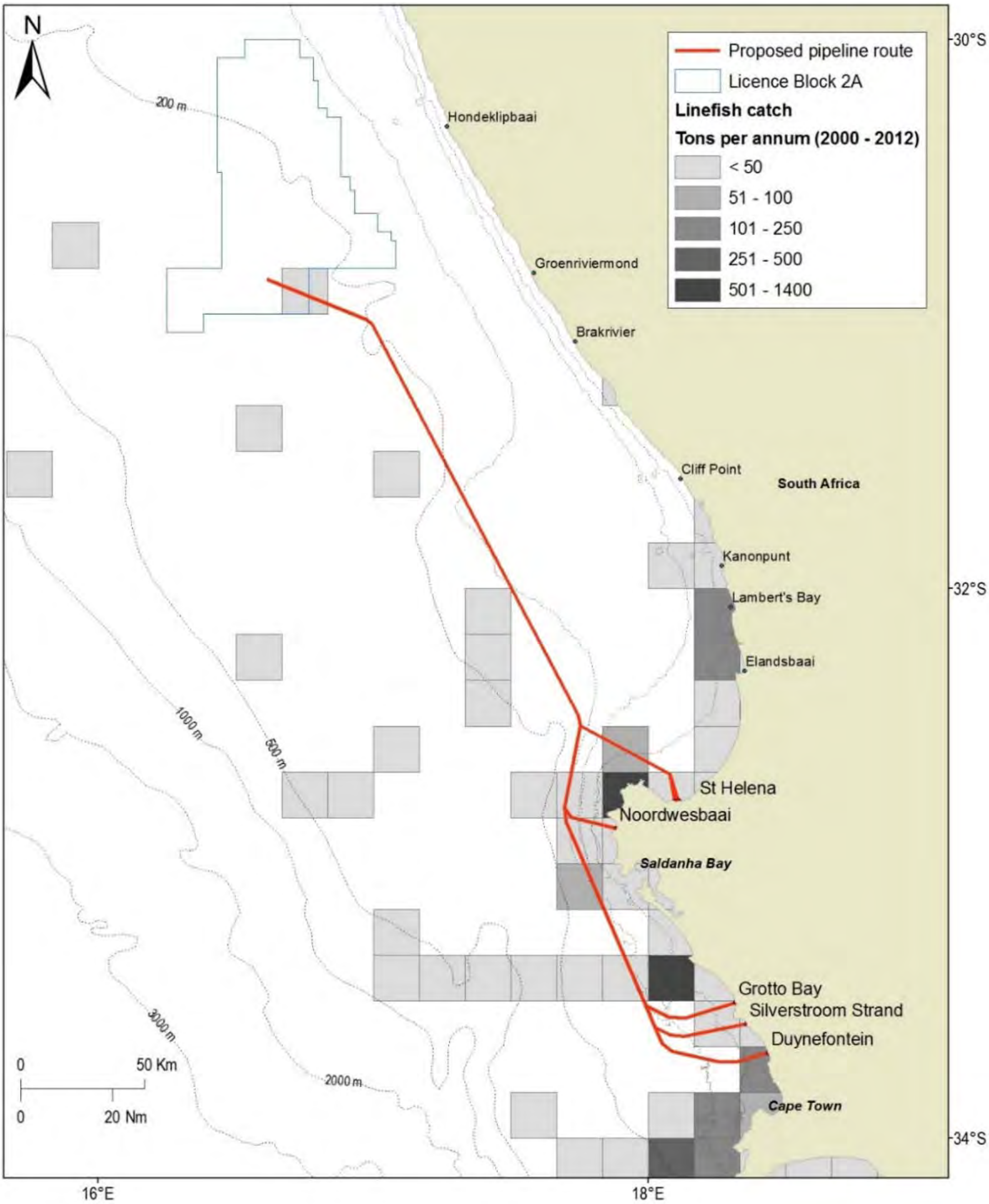


Figure 4.35: The location of Block 2A and the proposed production pipeline in relation to traditional line fishing catch along the West Coast between 2000 and 2102.

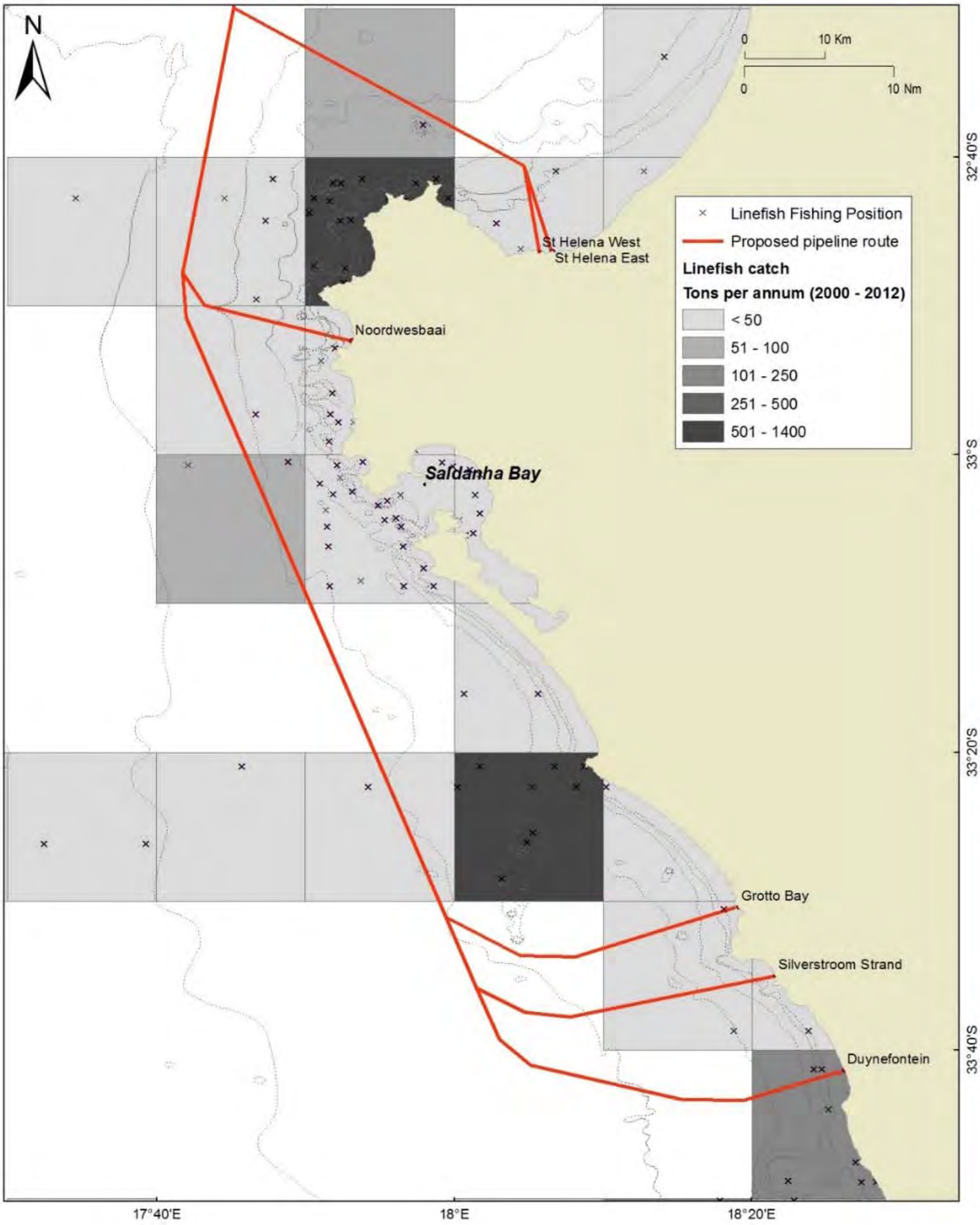


Figure 4.36: The location of the proposed pipeline shore-crossing alternatives in relation to traditional line fishing catch between 2000 and 2102.

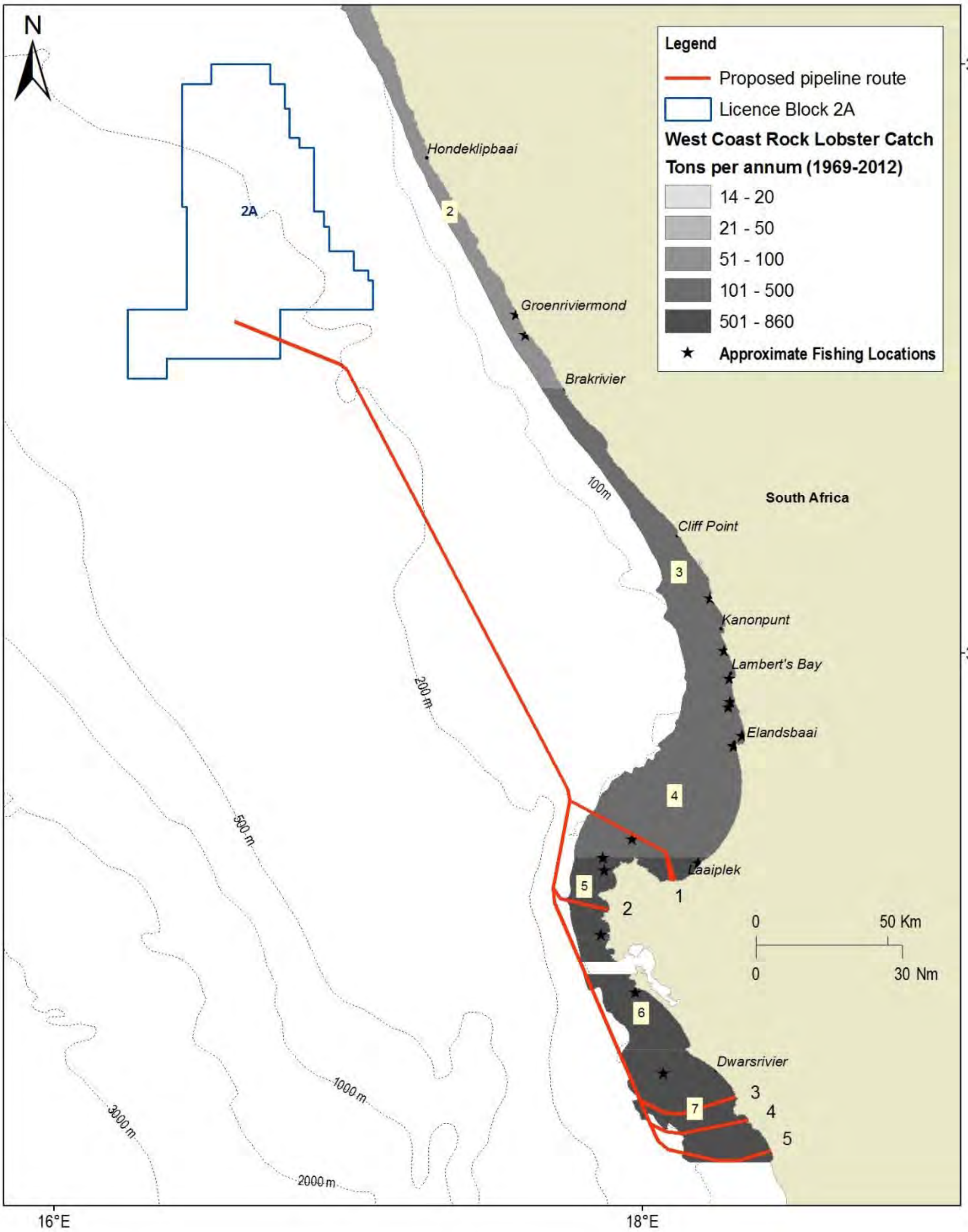


Figure 4.37: The location of Block 2A and the proposed production pipeline in relation to West Coast Rock Lobster Management Areas and catch along West Coast between 1969 and 2012.

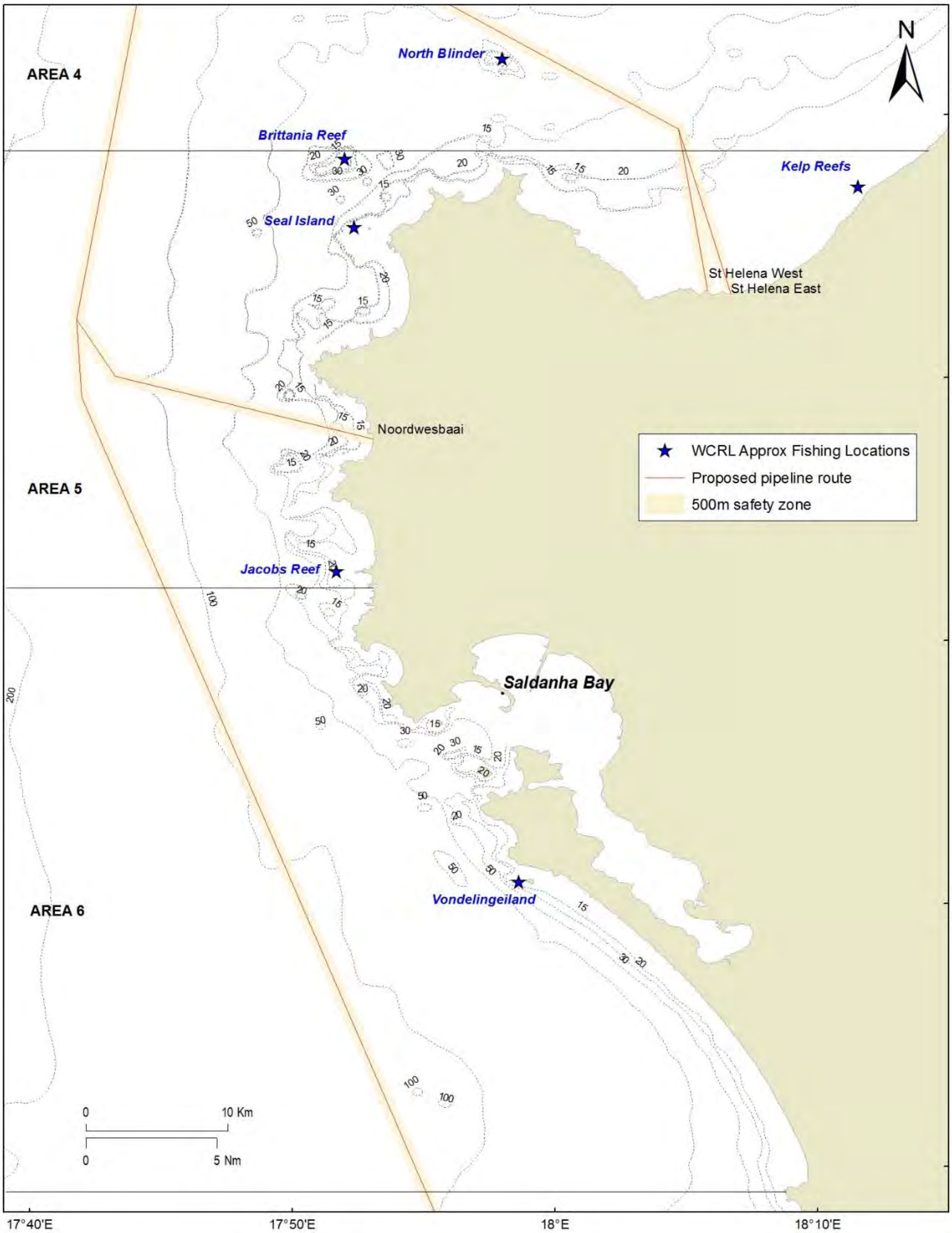


Figure 4.38: The location of the proposed northern shore-crossing alternatives in relation to the approximate location of fishing grounds utilised by the West Coast rock lobster fishery

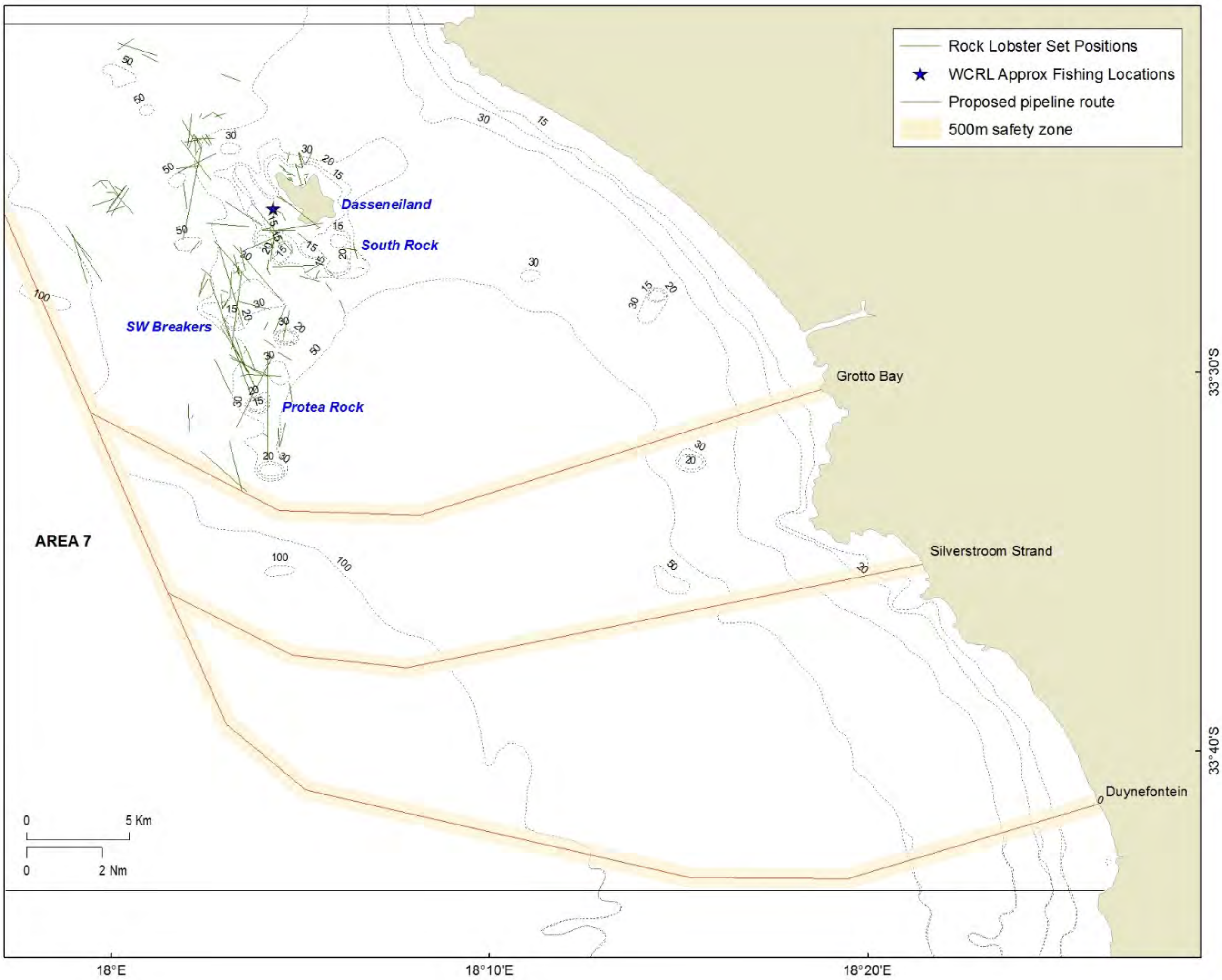


Figure 4.39: The location of the proposed southern shore-crossing alternatives in relation to the approximate location of fishing grounds utilised by the West Coast rock lobster fishery

4.4.1.8 Fisheries research

Surveys of demersal fish resources are carried out in January (West Coast survey) and May (South Coast survey) each year by the Department of Agriculture, Forestry and Fisheries (DAFF) in order to set the annual TACs for demersal fisheries. Stratified, bottom trawls are conducted to assess the biomass, abundance and distribution of hake, horse mackerel, squid and other demersal trawl species on the shelf and upper slope of the South African coast. The gear configuration is similar to that of commercial demersal trawlers, however, nets are towed for a shorter duration of generally 30 minutes per tow. Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1 000 m bathymetric contour. Approximately 120 trawls are conducted during each survey over a period of approximately one month. The spatial distribution of research trawls undertaken in relation to the proposed project development area is shown below in Figure 4.40.

The biomass of small pelagic species is also assessed bi-annually by an acoustic survey. The first of these surveys is timed to commence mid-May and runs until mid-June while the second starts in mid-October and runs until mid-December. During these surveys the survey vessel travels pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200 m bathymetric contour (see Figure 4.41). The survey is designed to cover an extensive area from the Orange River on the West Coast to Port Alfred on the East Coast.

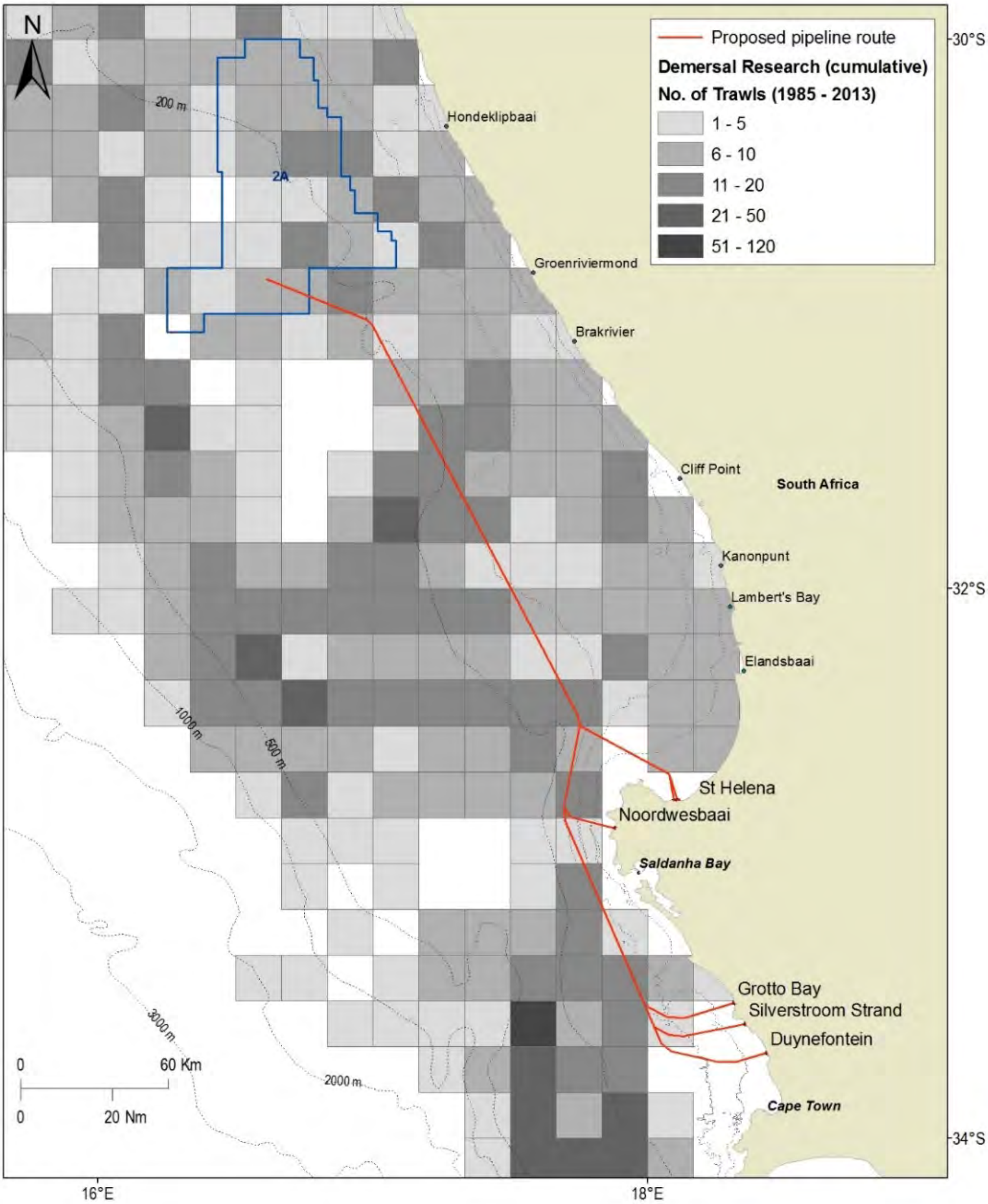


Figure 4.40: The location of Block 2A and the proposed production pipeline in relation to demersal research trawling effort along West Coast between 1985 and 2013.

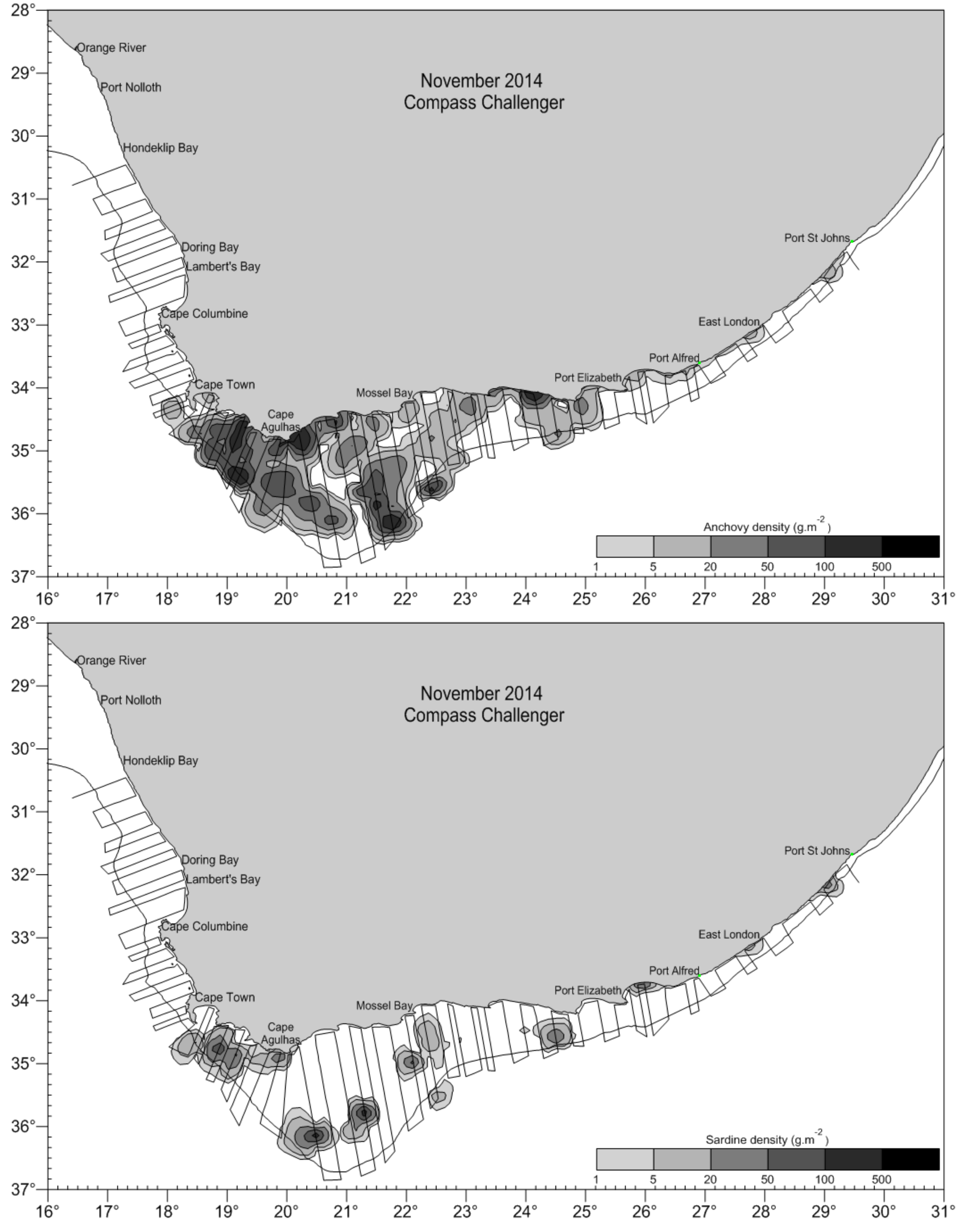


Figure 4.41: Spatial distribution of survey tracks undertaken during the acoustic biomass survey by DAFF during November 2014. Density of anchovy (above) and sardine (below) is also shown.

4.4.2 SHIPPING TRANSPORT

The majority of shipping traffic is located on the outer edge of the continental shelf with traffic inshore of the continental shelf along the West Coast largely comprising fishing and mining vessels, especially between Kleinsee and Oranjemund. Figure 4.42 shows that the majority of the shipping traffic *en route* to Cape Town would pass offshore of the proposed production pipeline route.

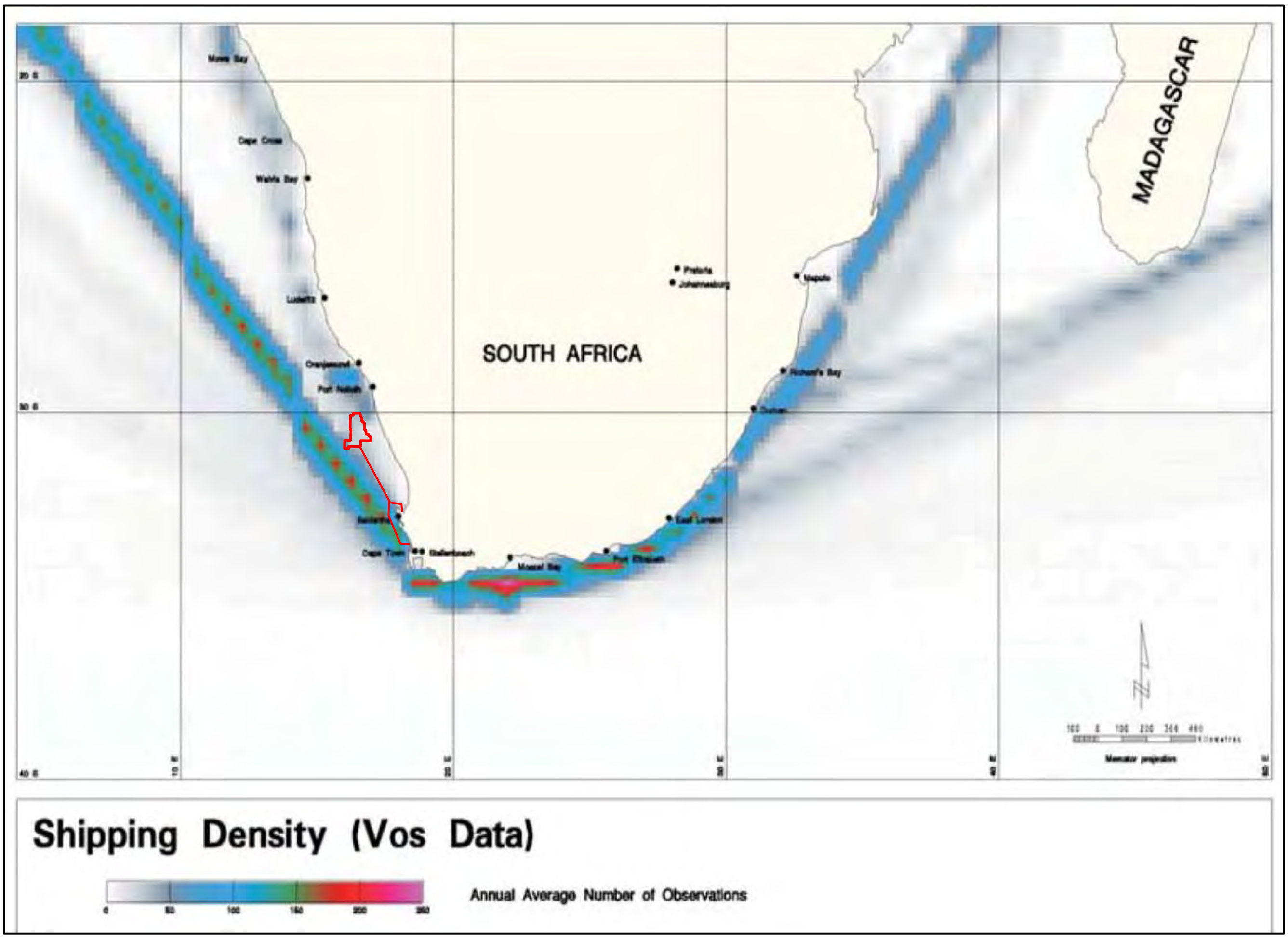


Figure 4.42: Major shipping routes around southern Africa. The approximate location of Licence Block 2A and proposed production pipeline are also shown. Data from the South African Data Centre for Oceanography (image source: CSIR).

4.4.3 OIL AND GAS EXPLORATION AND PRODUCTION

Exploration for oil and gas is currently undertaken in a number of licence blocks off the West, South and East coasts of South Africa (see Figure 4.43).

There is no current development or production from the South African West Coast offshore. The Ibhubesi Gas Field (Block 2A) and Kudu Gas Field (off the coast of southern Namibia) have been identified for development.

4.4.4 DIAMOND PROSPECTING AND MINING

Marine diamonds are mined along the West Coast of South Africa from just south of Lamberts Bay to the Orange River mouth. Twenty diamond mining concessions have been established along the West Coast with each concession divided into four zones from the coast seaward (a, b, c & d). Figure 4.43 shows Block 2A and proposed pipeline in relation to the diamond mining concessions. The majority of concessions worked at present are those closer inshore (water depths are mostly less than 150 m). No deep water diamond mining is currently being undertaken in the South African offshore concession areas, since mining activities ceased in Mining Licence 3 (ML3) (currently referred to as MPT25/2011) in 2010. De Beers Marine has applied to the Department of Mineral Resources for closure of this mining licence.

International Mining and Dredging SA (Pty) Ltd (as part of a mining agreement with Alexkor) is currently undertaking sampling activities in concessions 1B and 1C. Belton Park Trading 127 (Pty) Ltd, a company of the International Mining and Dredging Holding Limited group, has a prospecting right (diamonds) for concessions 2C, 3C, 4C and 5C, which overlap with ML3.

4.4.5 PROSPECTING AND MINING OF OTHER MINERALS

4.4.5.1 Heavy minerals

Heavy mineral sands containing, amongst other minerals, zircon, ilmenite, garnet and rutile may be found offshore of the West Coast. Tronox's Namakwa Sands is currently exploiting heavy minerals from onshore deposits near Brand-se-Baai (approximately 385 km north of Cape Town). In October 2009, De Beers Marine secured a Prospecting Right for platinum group metals, gold and sapphires in the DMBC licence area (see Figure 4.44).

In addition, De Beers Consolidated Mines secured a prospecting right (including heavy minerals, platinum group metals, gold and sapphire) for three areas inshore of the 200 m bathymetric contour (see Figure 4.45). De Beers Marine is the operator of this prospecting right.

4.4.5.2 Glauconite and phosphate

Glauconite pellets (an iron and magnesium rich clay mineral) and bedded and peletal phosphorite occur on the seafloor over large areas of the continental shelf on the West Coast. These represent potentially commercial resources that could be considered for mining as a source of agricultural phosphate and potassium (Birch 1979a & b; Dingle et al. 1987; Rogers and Bremner 1991).

A number of prospecting areas for glauconite and phosphorite / phosphate are located off the West Coast (see Figure 4.46), one of which is partially located within Licence Block 2A and the proposed production pipeline route (i.e. Prospecting area 251). Green Flash Trading received their prospecting rights for Areas 251 and 257 in 2012/2013. The prospecting rights for Agrimin1, Agrimin2 and SOM1 have expired (Jan Briers, *pers. comm* - previously at DMR).

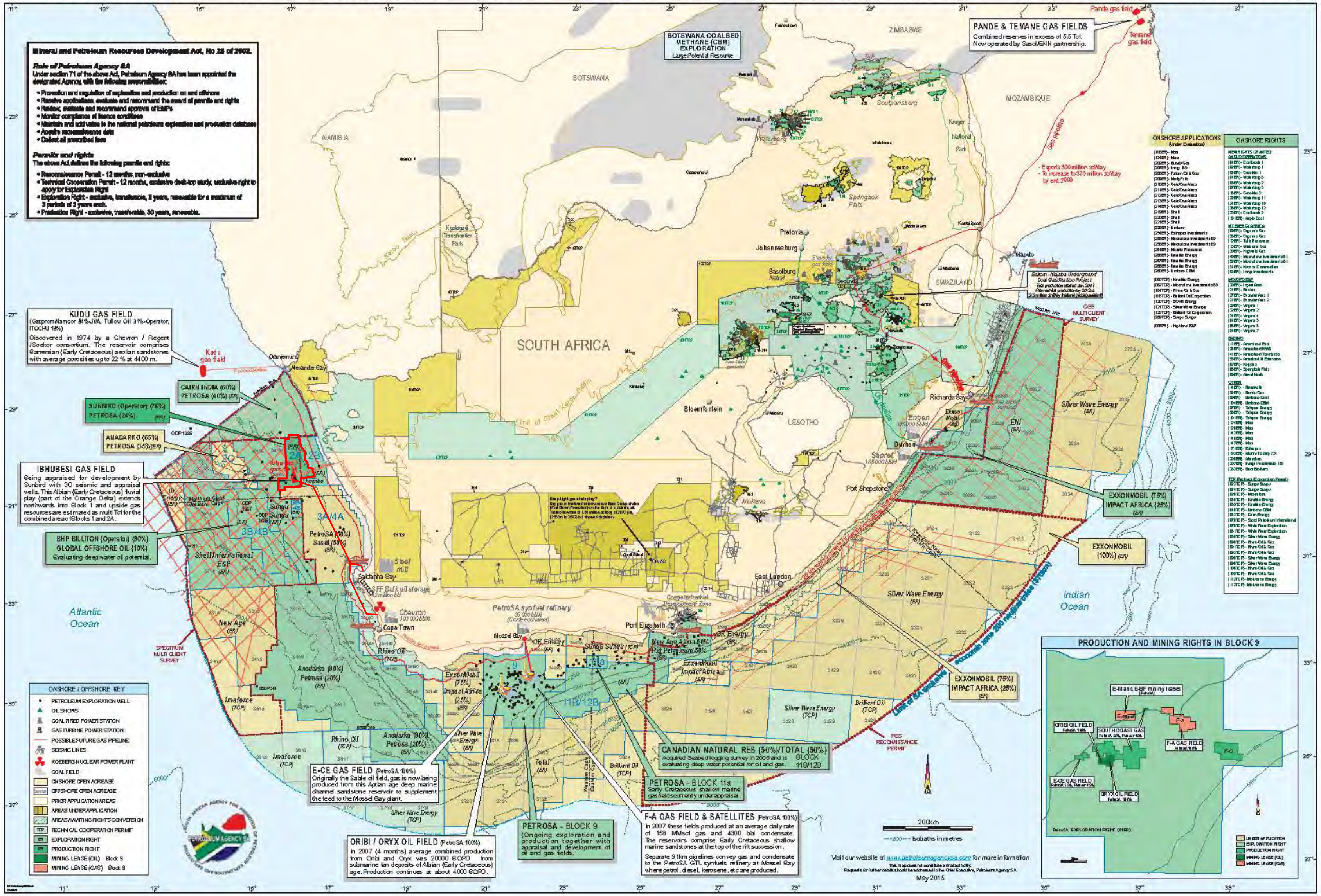


Figure 4.43: Petroleum licence blocks off the West, South and East coasts of South Africa (PASA, May 2015). Licence Block 2A and the proposed production pipeline are highlighted in red.

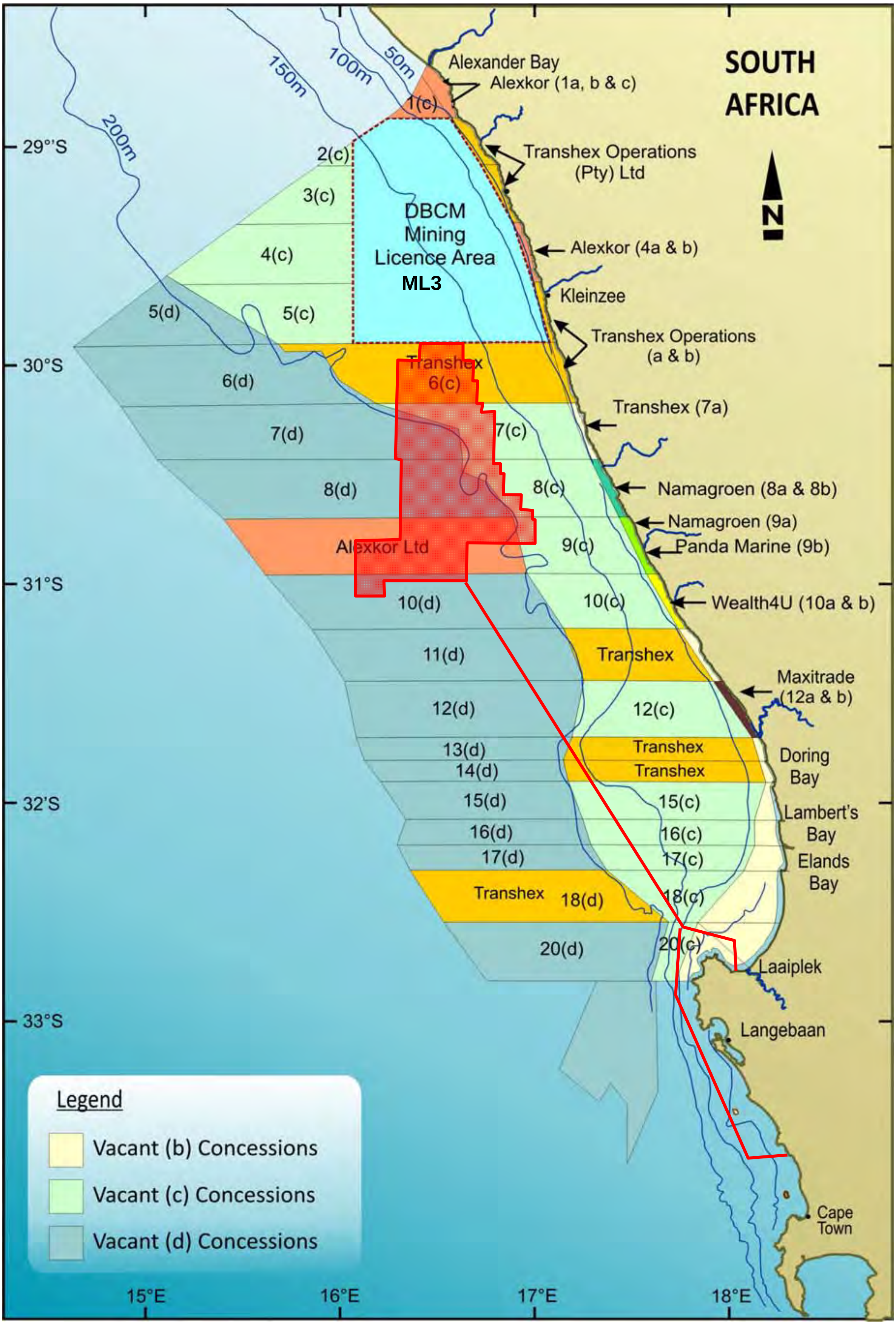


Figure 4.44: The approximately location of Licence Block 2A and the proposed production pipeline in relation to the South African Diamond Rights Holders off the West Coast (compiled by De Beers, 2011).

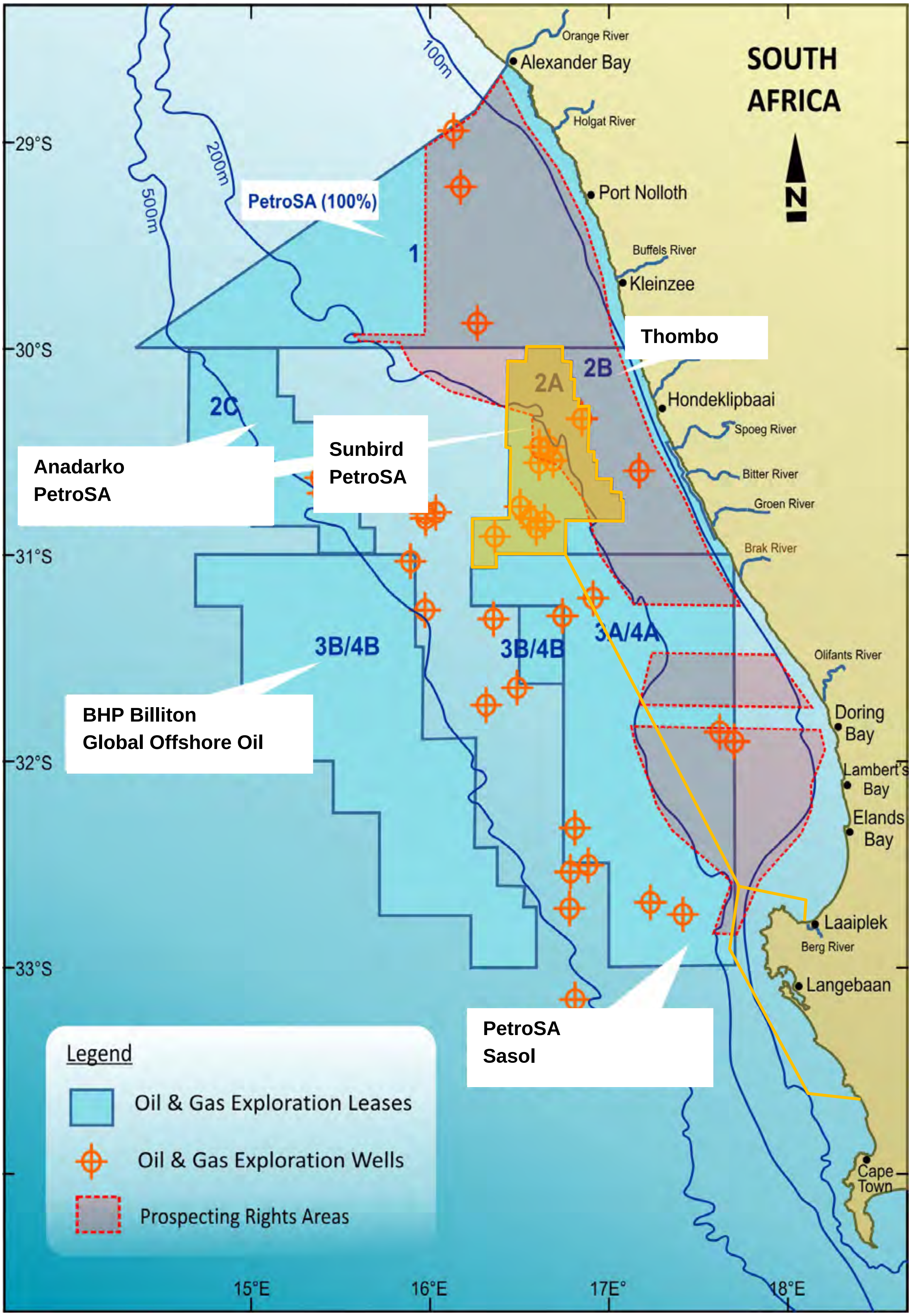


Figure 4.45: The location of Licence Block 2A and the proposed production pipeline in relation to De Beers Consolidated Mines' prospecting right area off the West Coast of South Africa (adapted from De Beers, 2012).

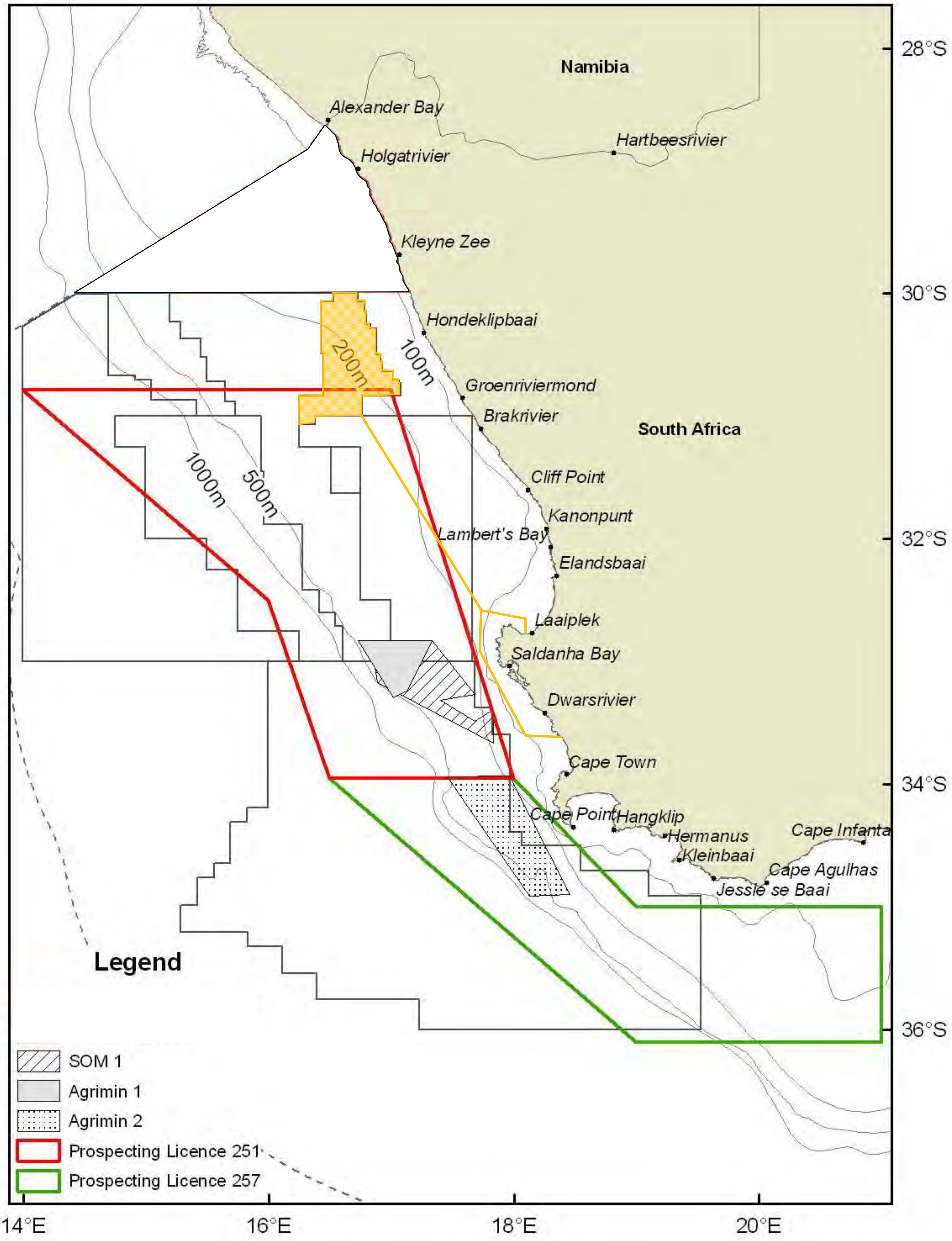


Figure 4.46: The location of Block 2A and the proposed production pipeline in relation to glauconite and phosphorite / phosphate prospecting areas of the West Coast.

4.4.5.3 Manganese nodules in ultra-deep water

Rogers (1995) and Rogers and Bremner (1991) report that manganese nodules enriched in valuable metals occur in deep water areas (>3 000 m) off the West Coast, well offshore of Block 2A and the proposed pipeline (see Figure 4.47). The nickel, copper and cobalt contents of the nodules fall below the current mining economic cut-off grade of 2% over most of the area, but the possibility exists for mineral grade nodules in the areas north of 33°S in the Cape Basin and off northern Namaqualand.

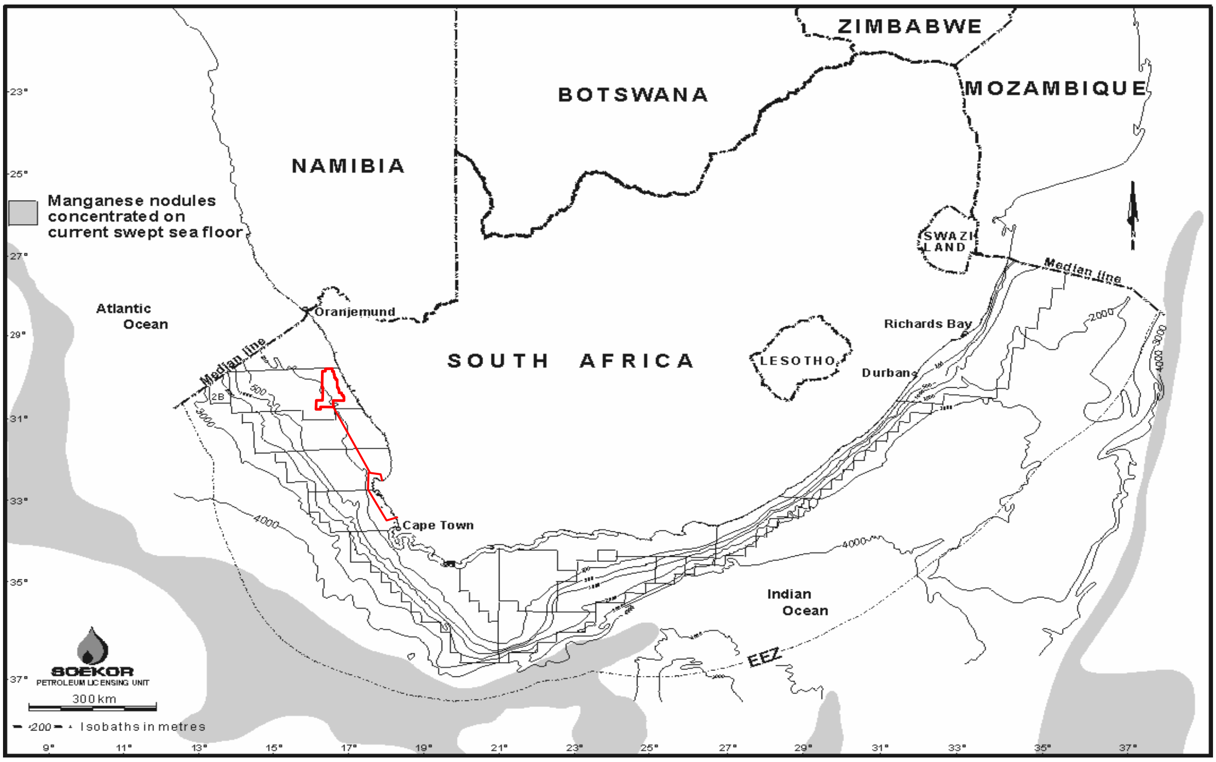


Figure 4.47: Schematic of location of manganese nodules off Southern Africa, showing petroleum licence blocks (Modified from Rogers 1995). The approximate location of Block 2A and the proposed production pipeline are also shown.

4.4.6 OTHER

Human use of the marine environment has resulted in the addition of numerous hazards on the seafloor. The Annual Summary of South African Notices to Mariners No. 5 and charts from the South African Navy or Hydrographic Office provides detailed information on the location of different underwater hazards along the West Coast.

4.4.6.1 Undersea cables

There are a number of submarine telecommunications cable systems across the Atlantic and the Indian Ocean (see Figure 4.48), including:

- South Atlantic Telecommunications cable No.3 / West African Submarine Cable / South Africa Far East (SAT3/WASC/SAFE): This cable system is divided into two sub-systems, SAT3/WASC in the Atlantic Ocean and SAFE in the Indian Ocean. The SAT3/WASC sub-system connects Portugal (Sesimbra) with South Africa (Melkbosstrand). From Melkbosstrand the SAT-3/WASC sub-system is extended via the SAFE sub-system to Malaysia (Penang) and has intermediate landing points at

Mtunzini South Africa, Saint Paul Reunion, Bale Jacot Mauritius and Cochin India (www.safe-sat3.co.za).

- Eastern Africa Submarine Cable System (EASSy): This is a high bandwidth fibre optic cable system, which connects countries of eastern Africa to the rest of the world. EASSy runs from Mtunzini (off the East Coast) in South Africa to Port Sudan in Sudan, with landing points in nine countries, and connected to at least ten landlocked countries.
- West Africa Cable System (WACS): WACS is 14 530 km in length, linking South Africa (Yzerfontein) and the United Kingdom (London). It has 14 landing points, 12 along the western coast of Africa (including Cape Verde and Canary Islands) and 2 in Europe (Portugal and England) completed on land by a cable termination station in London.
- African Coast to Europe (ACE): The ACE submarine communications cable is a 17 000 km cable system along the West Coast of Africa between France and South Africa (Yzerfontein).

There is an exclusion zone applicable to the telecommunication cables 1 nm (approximately 1.9 km) each side of the cable in which no anchoring is permitted. The proposed production pipeline passes over the cable landing at Yzerfontein (see Figure 4.49).

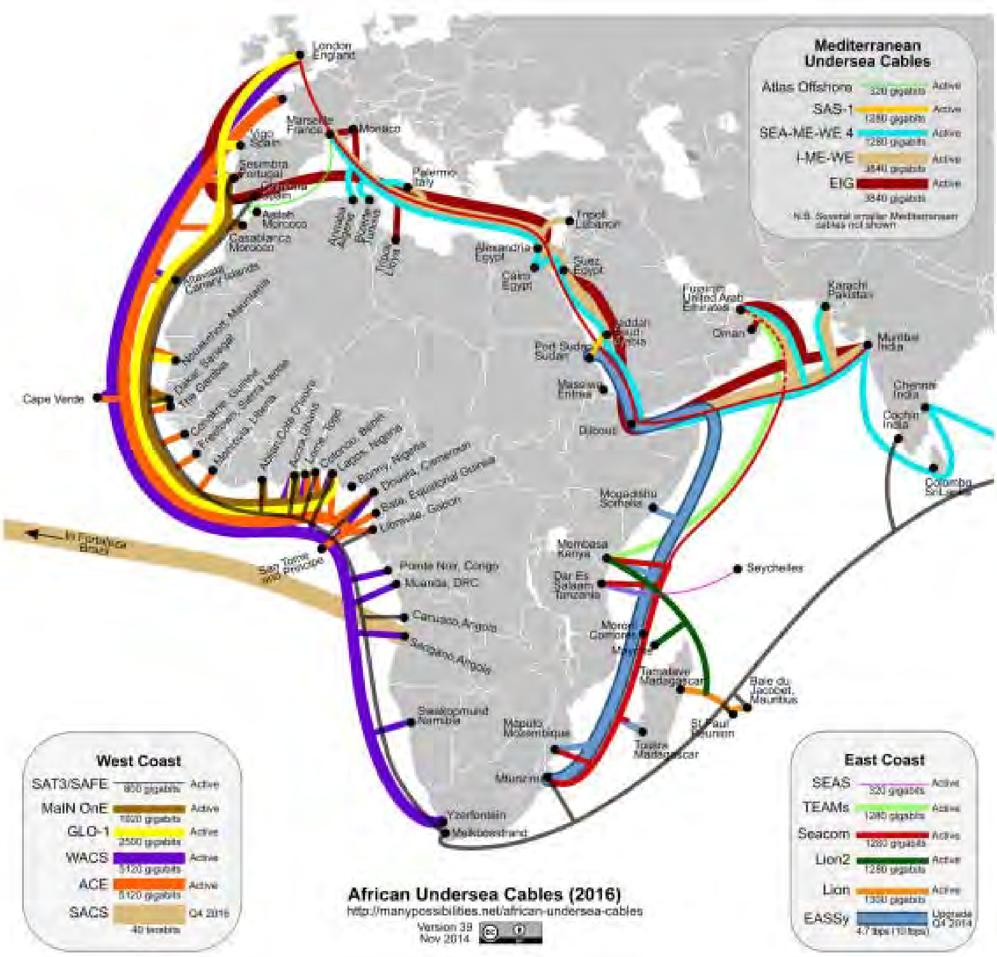


Figure 4.48: Configuration of the current African undersea cable systems, November 2014 (From http://www.manypossibilities.net).

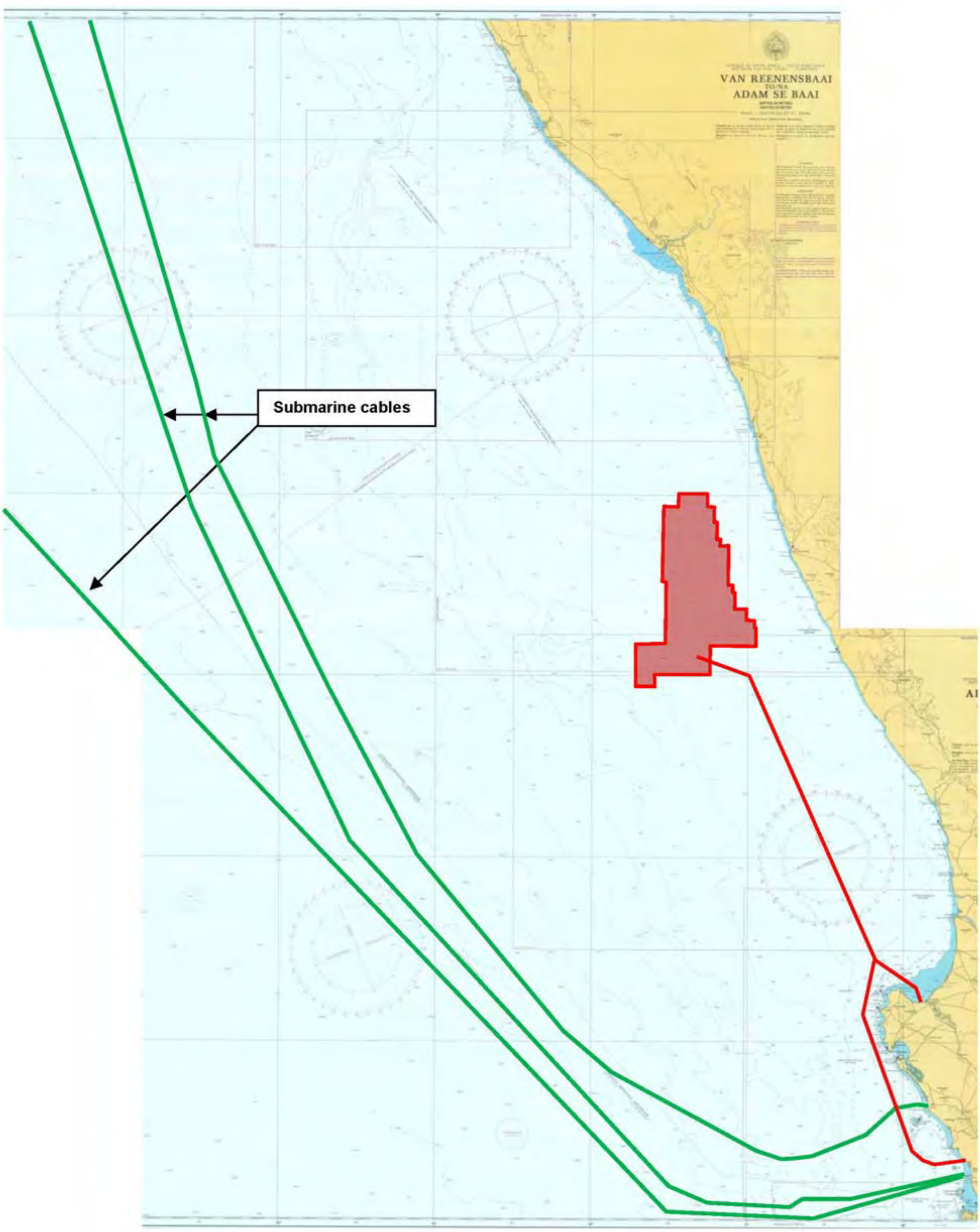


Figure 4.49: Location of Block 2A and the proposed production pipeline in relation to submarine cables (Adapted from SAN Charts SAN54 and SAN55).

4.4.6.2 Marine archaeological sites

National Heritage Resources Act (No. 25 of 1999), any wreck, being any vessel, aircraft or any part thereof, older than 60 years lying in South Africa's territorial waters or maritime cultural zone is protected. All known shipwrecks off the coast of South Africa occur in waters shallower than 100 m within 50 km of the coast. Thus, shipwrecks may be encountered where the pipeline approaches the shore-crossing locations.

There are no accounts of shipwrecks on the South African National Maritime database for the Grotto Bay, Silwerstroom Strand, Duynefontein and Noordwesbaai shore-crossings. However, the possibility of encountering historical shipwrecks cannot be excluded.

Two references are made to shipwrecks in the St Helena Bay area. These include:

- In 1691 the Gouden Buys (a Dutch East India Company ship) ran aground near St Helena Bay. The ship carried a cargo of silver. A rescue ship was sent from Cape Town to collect its valuable cargo and surviving crew members, however, it too foundered off Robben Island on its way home. The wreck of the Gouden Buys has never been found, although survivor accounts indicate a position close to the mouth of the Berg River or a little to the north (National Maritime Shipwreck database); and
- Reference is also made to a sailing cutter that grounded close to the Berg River Mouth in 1910, the precise location is unknown.

There are numerous references made in historic records to ships wrecked at Paternoster, however, so little information is provided on locations that this is only a broad reference. Effectively "Paternoster" can refer to the entire Vredenburg Peninsula – a radius of 50 km from the town known as Paternoster today.

4.4.6.3 Ammunition dump sites

Ammunition and explosive dumpsites off the South-West Coast are presented on SAN Chart 56. Such sites are located offshore and to the south of the proposed production pipeline (see Figure 4.50).

4.4.6.4 Mariculture industries

The following mariculture facilities can be found along the West Coast of South Africa (O'Sullivan 1998; DAFF 2011):

- Alexkor Diamond Mines has an oyster (*Crassostrea gigax*) growout system in the seawater reservoirs employed by diamond processing plants south of Alexander Bay, while a similar facility for oysters, perlemoen (*Haliotis midae*) and the red seaweed *Gracilaria gracilis* can be found at Kleinsee;
- A permit has been granted for perlemoen ranching within a 100 km long 0 to 20 m deep zone north and south of Port Nolloth. Oysters are also grown at Port Nolloth;
- A perlemoen aquaculture operation at Hondeklip Bay;
- Abalone, oysters and finfish are grown in Jacobs Bay;
- Abalone, mussels, seaweed, oysters, clams and scallops are grown in Paternoster;
- Oysters and seaweed are grown in St Helena Bay; and
- Mussels and oysters are grown within Saldanha Bay.

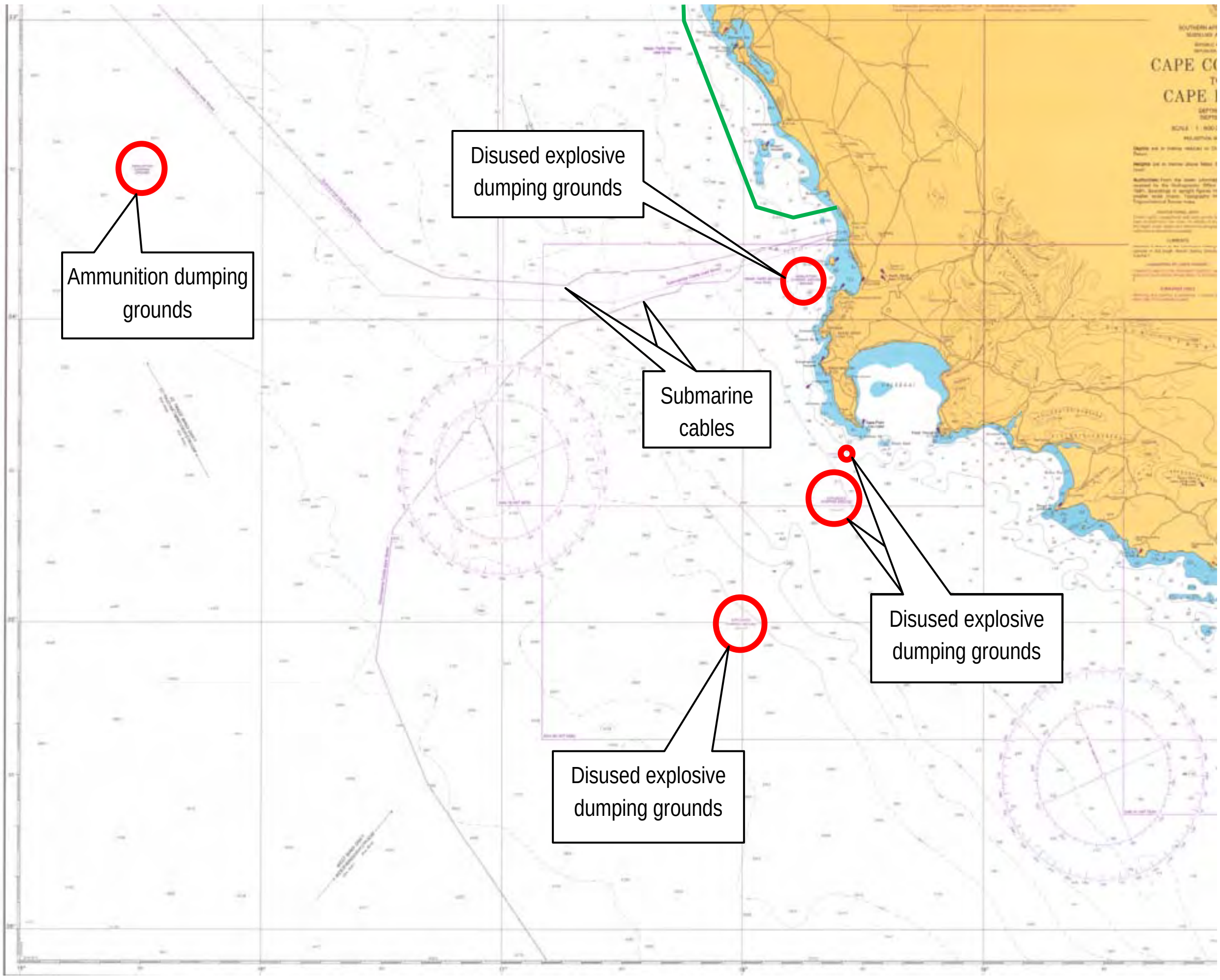


Figure 4.50: The location of the proposed production pipeline (green line) in relation to ammunition and explosive dumping grounds and subsea cable off the West Coast (from SAN Chart 56).

4.4.6.5 Recreational utilisation

Recreational use of the offshore areas is negligible. However, coastal recreation along the West Coast may be either consumptive or non-consumptive.

Consumptive recreational uses involve people collecting material from the sea for their own use. Recreational anglers (Brouwer, Mann, Lamberth, Sauer and Erasmus 1997) and divers (Mann, Scott, Mann-Lang, Brouwer, Lamberth, Sauer and Erasmus 1997) target linefish from either a boat or the shore, while shore-based divers also target perlemoen and West Coast rock lobsters. Rock lobsters are also exploited recreationally from boats with the use of hoop nets. The majority of recreational exploitation of marine resources occurs from inshore waters, and is not substantial compared to activities along the South and East Coasts.

Non-consumptive recreational uses of the marine environment include watersports, nature watching and beach recreation. Recreational practices are mostly undertaken near coastal settlements, and are largely practised for their aesthetic value. Recreational sites are listed by Jackson and Lipshitz (1984).

Although few resource economic studies exist for South African marine recreational use, the value of recreational coastal use and tourism should not be underestimated.

4.4.6.6 Marine outfall/intake pipes

Thirty-four outfalls, of which the majority are sewerage outfalls, and 17 intakes are located along the West Coast of South Africa. An important pipeline intake/outfall is the Koeberg Nuclear Power Station; a thermal outfall, discharging warmed cooling water into the cooler coastal waters rather than a chemical effluent. A 2 nm marine exclusion zone exists offshore of the nuclear power station.

4.4.6.7 Conservation Areas and Marine Protected Areas

Numerous conservation areas and Marine Protected Areas (MPAs) exist along the coastline of the Western Cape, none of which would be traversed by the proposed pipeline route (Figure 4.51). For the sake of completeness, they are briefly summarised in Table 4.9.

Using biodiversity data mapped for the 2004 and 2011 National Biodiversity Assessments, a systematic biodiversity plan has been developed for the West Coast with the objective of identifying coastal and offshore priority focus areas for MPA expansion (Sink et al. 2011; Majiedt et al. 2013). To this end, nine focus areas have been identified for protection on the West Coast between Cape Agulhas and the South African – Namibian border (see Figure 4.18). The Ibhubesi Gas Field is located on the eastern extent of the proposed “Childs Bank” area, while the proposed production pipeline passes through the proposed “West Coast Consolidation” area. It should be noted that Sunbird has been in consultation with the South African National Biodiversity Institute (SANBI) on the implications of the proposed MPAs.

Table 4.9: List of marine conservation areas along the West Coast of South African.

Bioregion	Marine Protected Area	Protection	Location
Namaqualand	McDougall’s Bay Rock Lobster Sanctuary: 2.5 km of coastline, 3 km south of Port Nolloth	No rock lobsters may be caught.	29°14’ S 16°52’ E
	Robeiland / Kleinzee Seal Colony Robeiland: 15 km north of Kleinzee	Island reserve for seabirds and seals, no access	29°33’ S 16°59’ E
	Elephant Rocks (Olifant’s River Mouth)	Island reserve for seabirds and seals, no access	31°38’ S 18°07’ E
	Penguin / Bird Island (Lambert’s Bay)	Island reserve for seabirds and seals, no access	32°05’ S 18°18’ E
	Rocherpan Marine Reserve: Adjacent to the Rocherpan Nature Reserve extending 500 m seaward, 2.75 km of coastline (in process of being registered as a declared reserve)	Exploitation limited to shore-based angling.	32°35’-37’ S 18°07’ E
	St Helena Bay Rock Lobster Sanctuary From Shelly Bay Point to Stompneus Point, extending three nautical miles seaward of the high-water mark; From Stompneus Point to SHBE/DR beacon, extending six nautical miles seaward of the high-water mark	No rock lobster may be caught	32°43’ S 18°00’-07’ E

Bioregion	Marine Protected Area	Protection	Location
South-Western Cape	Paternoster Rocks – Egg and Seal Island: Between Great Paternoster Point & Cape Columbine	Island reserve for seabirds and seals, no access.	32°44' S 17°51' E
	Jacob's Reef: Jacob's Baai	Island reserve for seabirds and seals, no access	32°57' S 17°51' E
	Malgas Island, Jutten Island and Marcus Island Marine Protected Areas: Saldanha Bay	No person permitted on the islands and no fishing allowed along the shores. Marcus Island is a 'no-take' MPA	33°02' S to 33°05' S
	West Coast National Park: Langebaan Lagoon north of a line drawn from beacon LB3 at Oesterwal to beacon LB4 at Preekstoel, south of Kraal Bay. Jutten, Malgas, Marcus and Schaapen. Langebaan Lagoon MPA Saldanha Bay	Only angling and bait collection are permitted Ramsar Site since 1988 and zoned MPA. Zone A: harvesting allowed; Zone B: no extractive removal; Zone C: no entry. No rock lobster fishing between North Head and South Head, No net, netting or long-line may be used.	33°02' S to 33°12' S
	Sixteen Mile Beach (including Vondeling Island): Plankies to Rooipan se Klippe (near Yzerfontein).	No fishing from the shore	33°08' S to 33°19' S
	Within 12 nautical miles seaward of the high water mark between Melkbos Punt and "Die Josie" at Chapmans Peak	No fishing, collecting or disturbing of rock lobsters	33°44'S to 34°05'S
	Within 12 nautical miles seaward of the high water mark between Klein Slangkop Point and Slangkop Point Lighthouse	No fishing, collecting or disturbing of rock lobsters by commercial permit holder	34°07'36S to 34°09'S
	Table Mountain National Park MPA	Fishing allowed in the majority of the MPA, subject Department of Agriculture, Fisheries and Forestry permits, regulations and seasons. Six "no-take" zones where no fishing or extractive activities are allowed.	33°54'S to 34°23'S

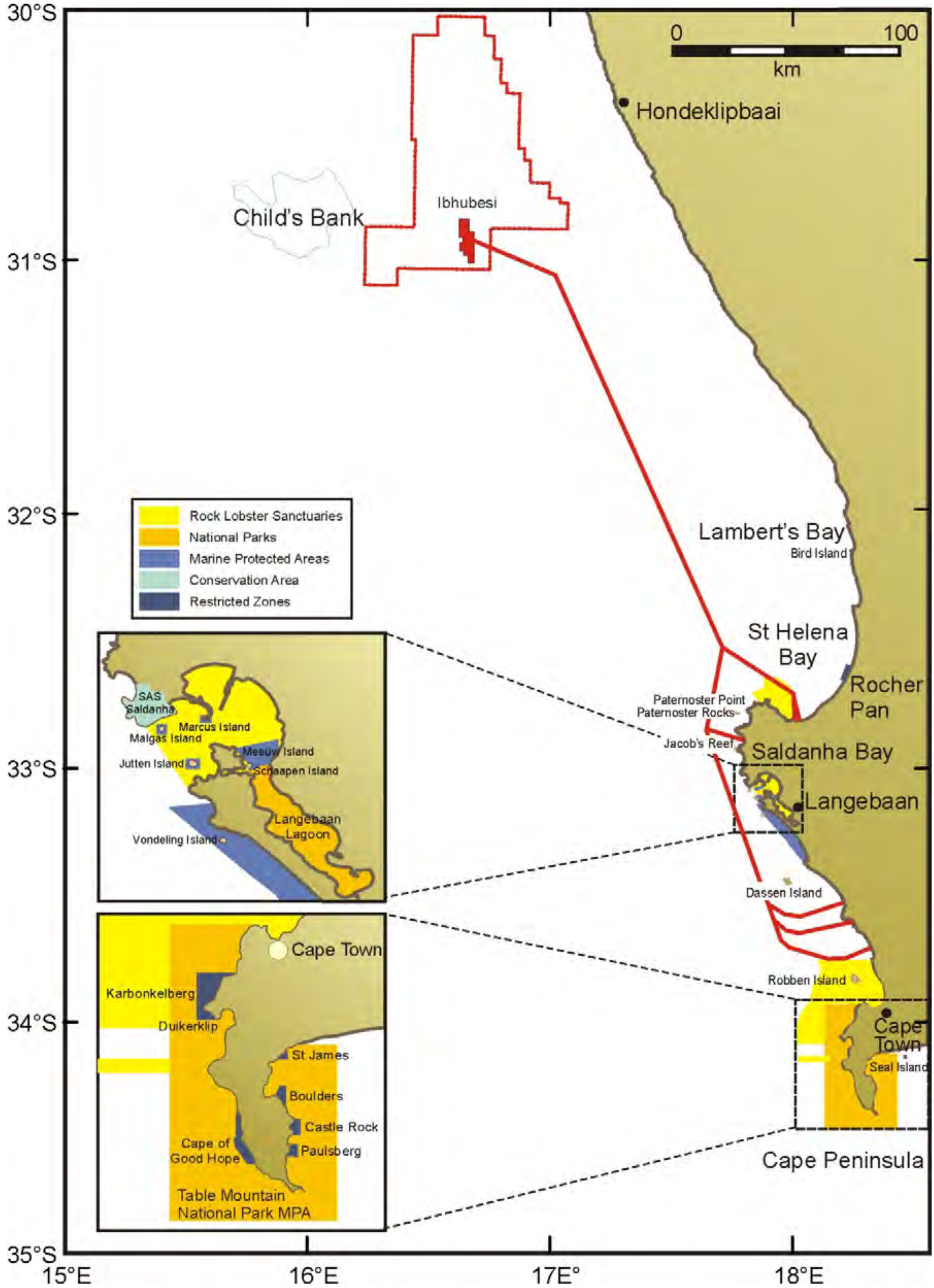


Figure 4.51: Ibhubesi Gas Field and proposed production pipeline route alternatives in relation to conservation areas and Marine Protected Areas on the West Coast.

5. DESCRIPTION OF THE ONSHORE TERRESTRIAL ENVIRONMENT

This section provides a general overview of the biophysical and socio-economic aspects of the environment associated with the proposed onshore pipeline routes. Where applicable, detailed descriptions are provided of the environment that may be directly affected by the proposed project components.

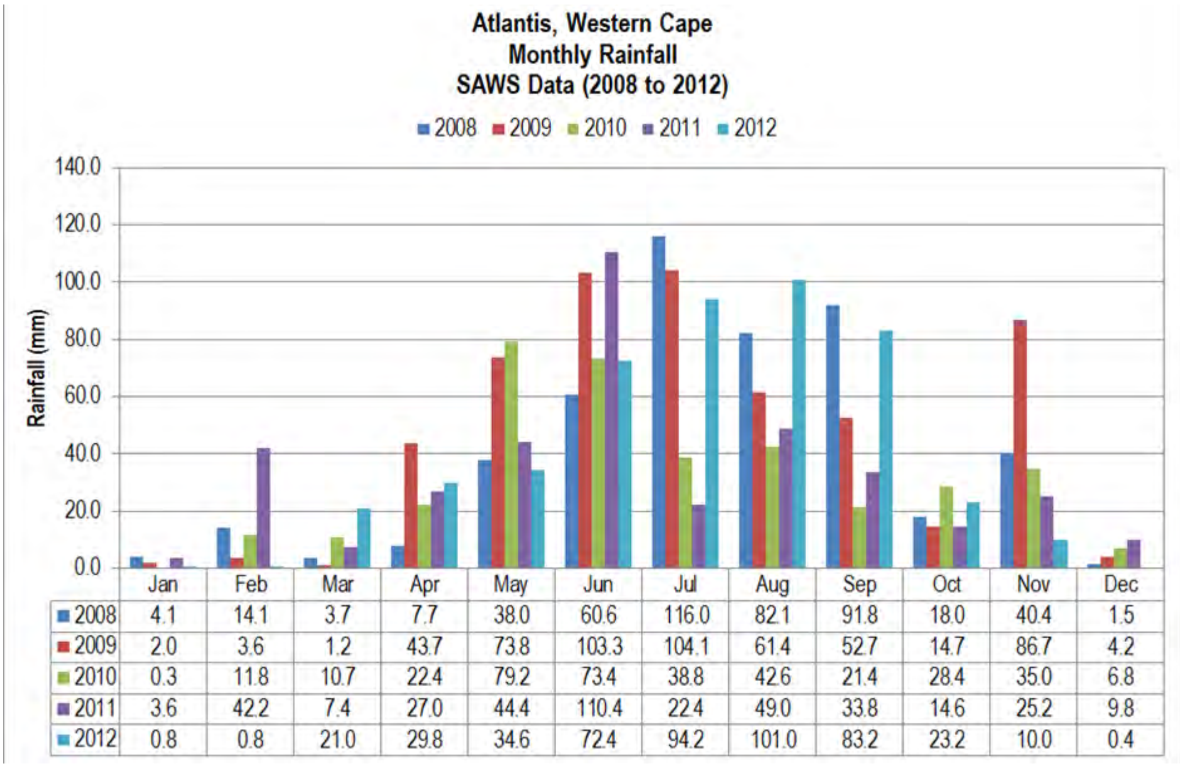
The target study area is essentially made up of two sections, referred to as the **southern shore-crossing route** between Grotto Bay and Duynefontein (see Section 5.2), and the **northern shore-crossing route** on the Saldanha Peninsula (see Section 5.3).

5.1 CLIMATE

5.1.1 RAINFALL

5.1.1.1 Southern study area

Rainfall data collected by the South African Weather Service (SAWS) at Atlantis from 2008 to 2012 indicates an annual rainfall of between 370 mm and 550 mm. On average the area receives 452 mm of rain per year. A summary of monthly rainfall recorded at Atlantis is provided in Figure 5.1. Most rain is received in the winter months (June to August). Summer months are the driest.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	4.1	14.1	3.7	7.7	38.0	60.6	116.0	82.1	91.8	18.0	40.4	1.5
2009	2.0	3.6	1.2	43.7	73.8	103.3	104.1	61.4	52.7	14.7	86.7	4.2
2010	0.3	11.8	10.7	22.4	79.2	73.4	38.8	42.6	21.4	28.4	35.0	6.8
2011	3.6	42.2	7.4	27.0	44.4	110.4	22.4	49.0	33.8	14.6	25.2	9.8
2012	0.8	0.8	21.0	29.8	34.6	72.4	94.2	101.0	83.2	23.2	10.0	0.4

Figure 5.1: Monthly rainfall at Atlantis between 2008 and 2012 (SAWS data).

5.1.1.2 Northern study area

Saldanha Bay falls within a winter rainfall region and receives most of its rain during June, July and August (see Table 5.1). The region, as observed at Langebaanweg, is relatively dry with an average annual rainfall of 278 mm. The annual average relative humidity is 50% and 76% for day and night, respectively, with ±10% variance over the yearly average. The annual average cloud cover is 35% and 29% for day and night, respectively

Table 5.1: Long-term rainfall at Langebaanweg.

Month	Average monthly (mm)	Average Number of days with >= 1mm	Highest 24-hr rainfall (mm)
January	8	1.9	14
February	4	1.2	10
March	11	2.2	21
April	24	3.9	30
May	40	6.3	30
June	41	6.4	27
July	47	7.1	35
August	45	6.8	57
September	24	4.9	29
October	12	2.8	40
November	12	2.4	23
December	10	2.4	14
Year	**278**	**48**	**57**

5.1.2 TEMPERATURE

5.1.2.1 Southern study area

Diurnal and average monthly temperature trends are presented in Figure 5.2. Monthly mean and hourly maximum and minimum temperatures are given in Table 5.2. Temperatures generally range between -1.8ºC and 40ºC. The highest temperatures occur in January, February and March. The lowest occur between June and September. During the day, temperatures increase to reach maximum at around 13h00. Ambient air temperature decreases to reach a minimum at around 07h00.

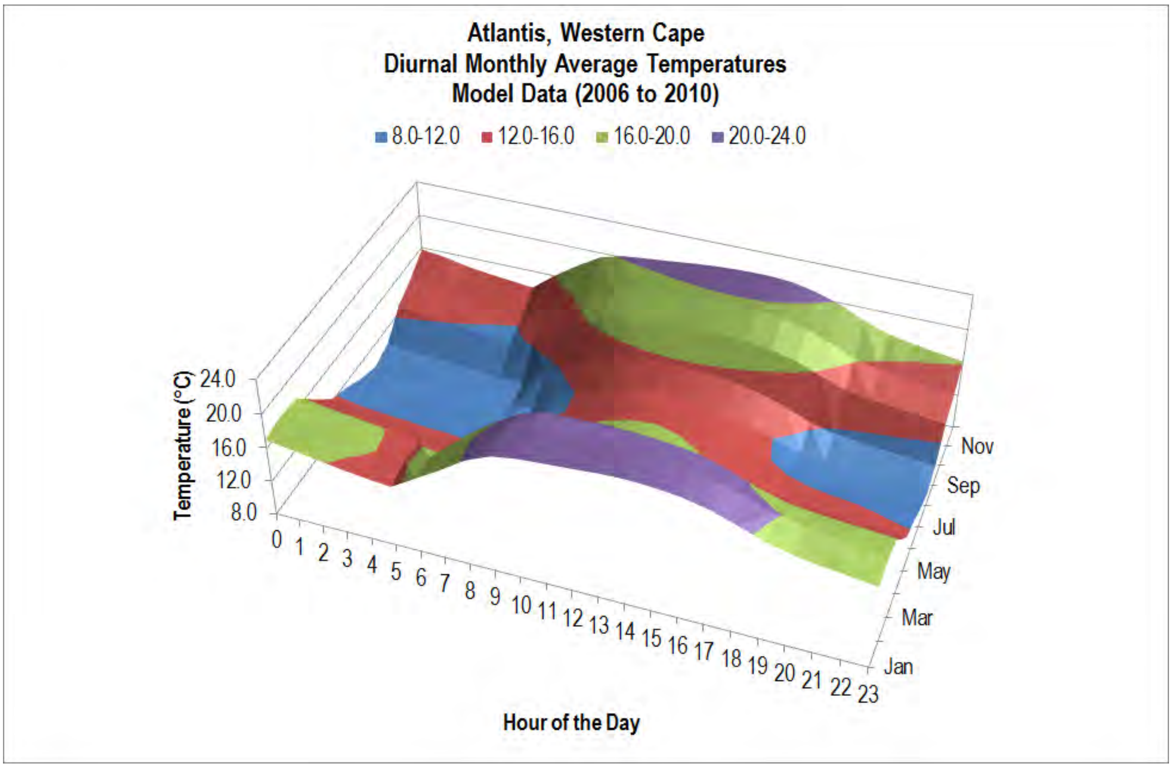


Figure 5.2: Diurnal temperature profile at Atlantis between 2006 and 2010.

Table 5.2: Monthly temperature summary for Atlantis between 2006 and 2010.

Hourly Minimum, Hourly Maximum and Monthly Average Temperatures (°C)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum	11.4	12.6	9.4	9.4	7.3	5.8	4.5	3.5	6.1	6.1	7.6	8.9
Maximum	40.0	40.9	37.7	36.6	32.5	30.0	28.0	29.9	38.6	37.5	37.5	39.9
Average	21.7	22.0	20.2	18.4	15.8	13.9	13.6	13.0	15.4	16.6	18.6	20.1

5.1.2.2 Northern study area

The Saldanha Peninsula experiences a temperate climate with temperatures reaching a maximum during the months of January and February. July and August are generally the coldest months. Monthly mean and hourly maximum and minimum temperatures are presented in Table 5.3. From observations made by SAWS in Vredenburg, hourly averaged temperatures generally ranged between a minimum of 6ºC - 7ºC during the winter months (May to August) to a maximum of 36.8ºC during February. February is also the month with the highest monthly average temperature of 20.4ºC, with the lowest monthly average occurring in August (12.9ºC).

The observations along the coast at Cape Columbine show lower temperatures with hourly averaged temperatures generally ranging between a minimum of 6.8ºC during August to a maximum of 33.7ºC during February. As with Vredenburg, February is also the month with the highest monthly average temperature of 18.4ºC, with the lowest monthly average occurring in August (13.9ºC).

Table 5.3: Monthly temperature summary for Atlantis between 2006 and 2010.

Hourly Minimum, Hourly Maximum and Monthly Average Temperatures (°C)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cape Columbine												
Minimum	12.2	12.2	11.0	11.0	10.9	8.8	6.8	8.9	8.7	9.9	11.6	12.4
Maximum	23.5	33.7	32.7	34.0	29.1	24.7	24.7	26.5	21.1	27.2	29.1	26.1
Average	17.7	18.4	17.1	16.3	15.5	15.1	14.9	13.9	14.4	16.3	17.7	18.0
Vredenburg												
Minimum	12.0	12.0	11.0	10.0	7.0	6.0	7.0	7.0	8.0	7.0	10.0	12.0
Maximum	36.0	36.8	40.0	37.0	30.0	27.0	24.0	26.0	24.0	31.0	34.0	36.0
Average	18.5	20.4	19.9	17.1	14.8	13.7	14.1	12.9	13.5	15.9	17.0	18.4

5.1.3 WIND

5.1.3.1 Southern study area

Predominant winds in the study area between 2006 and 2010 were from the north-west and east-south-east with an average wind speed of 4 m/s (see Figure 5.3). The strongest winds (> 10 m/s) were from the north and north-north-west. During this period calm conditions occurred 7.9% of the time. There is a distinct difference between the day and night-time wind field. The day-time wind field is dominated by winds from the west-north-west, an average wind speed of 4.1 m/s and 6.6% calm conditions. During the night the wind field is dominated by winds from the east-south-east, an average wind speed of 3.9 m/s and 9.2% calm conditions. Predominant winds in summer are from the south, with intermittent south-easterly and south-westerly winds. North-westerly winds dominate during winter months.

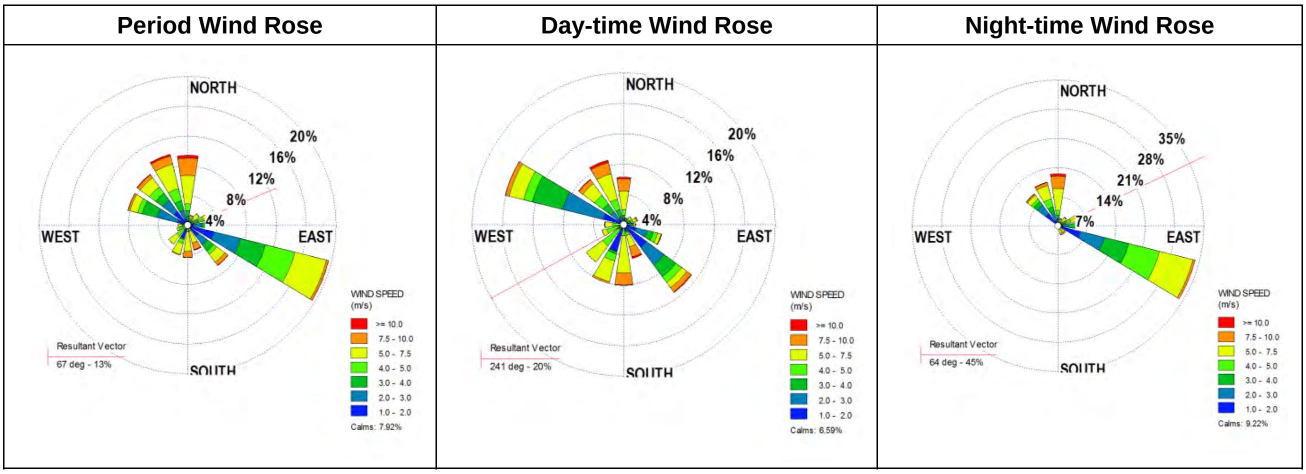


Figure 5.3: Period, day- and night-time wind roses for the onshore study area (2006-2010).

5.1.3.2 Northern study area

The northern study area is dominated by the southern wind sector at both Cape Columbine and Vredenburg) (see Figure 5.4). Cape Columbine has more frequent south-south-easterly winds than Vredenburg, where the south-south-westerly winds are more prevalent. Both the southerly (summer) and northerly (winter season) wind components are associated with frequent, strong wind speeds above 10 m/s. Whilst this is evident at both sites, the south-south-westerly winds at Vredenburg are not as strong as the south-south-easterly winds at Cape Columbine. There are also more calm wind conditions at Cape Columbine (9.9%) than at Vredenburg (3.5%). The land-sea breeze condition is clearly illustrated at Cape Columbine, where the frequency of westerly winds is high during the day, but nearly non-existent at night-time.

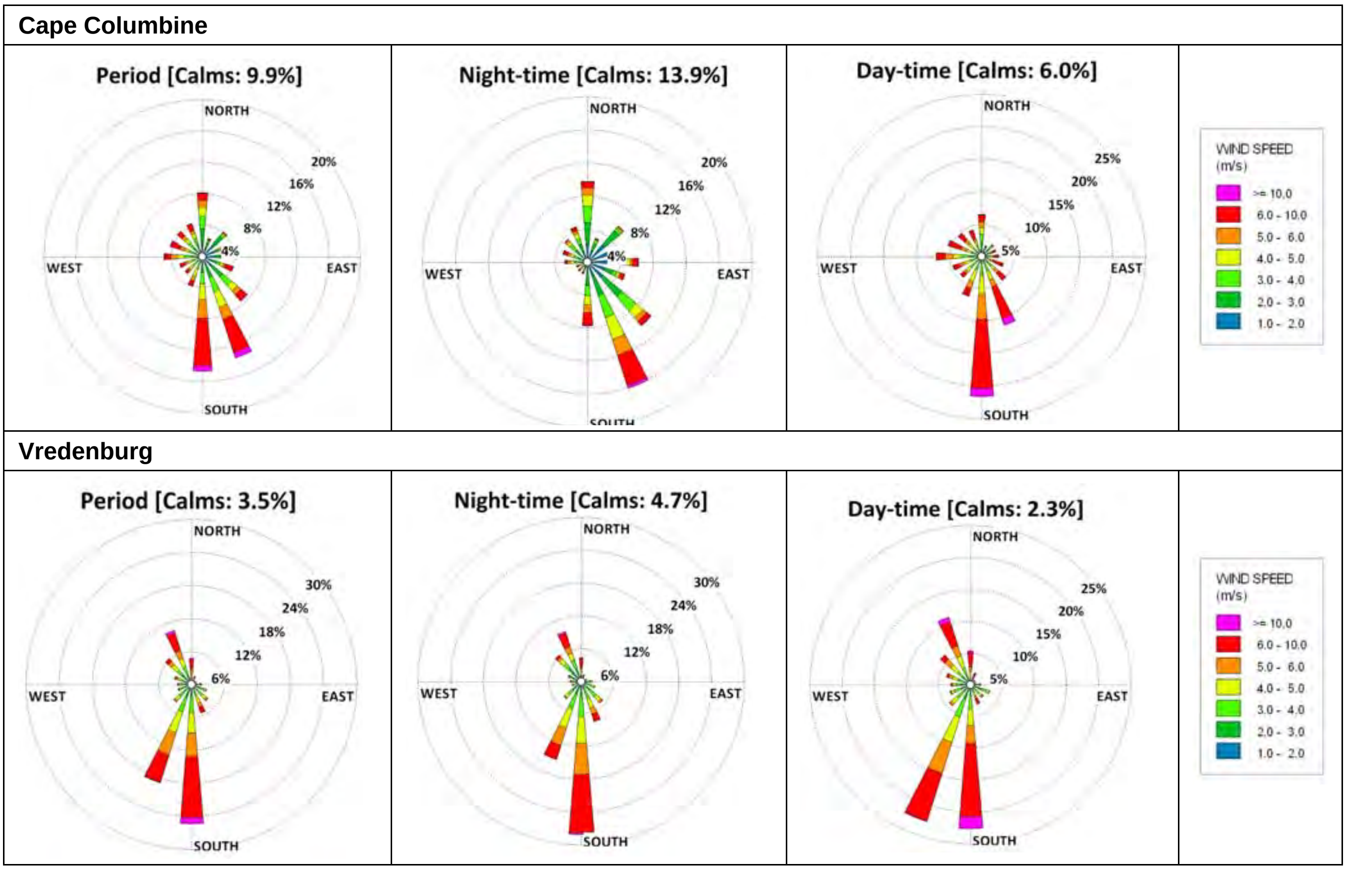


Figure 5.4: Wind roses for Case Columbine and Vredenburg.

5.2 SOUTHERN SHORE-CROSSING ROUTE (GROTTO BAY TO DUYNEFONTEIN)

5.2.1 TOPOGRAPHY

The general topography of the area is fairly flat, but more undulating towards the east and with dunes near the coast. The northern parts of the pipeline routes reaches ±100 metres above mean sea level (mamsl) and the southern part varies between 50 and 70 mamsl.

5.2.2 GEOLOGY, SOILS AND GROUNDWATER

Shales and greywacke of the Tygerberg Formation and Malmesbury Group are the older rocks that underlie the area. These rocks often weather to produce a substantial thickness of clay. The Tygerberg Formation outcrops in the eastern portion. The younger rocks of the Springfontein Formation, which is the main water-bearing formation, are predominant on the western side of the study area. The overlying unconsolidated sand layer increases in thickness to the north and west across the area.

The most dominant soil types for the study area tend to be imperfectly drained grey sandy soils. The soils tend to be highly calcareous at the coast, often underlain by calcrete and susceptible to wind erosion.

The study area falls within several protection zones of the Atlantis Aquifer (see Figure 5.5). This aquifer forms an important component of the water supply system for the City of Cape Town. Groundwater levels are between 2 - 12 m below natural ground level, although there are significant seasonal fluctuations. Groundwater flow is in a south-westerly direction.

5.2.3 FLORA

5.2.3.1 General description

The southern area lies at the boundary of the Swartland and Sandveld bioregions. Five vegetation types occur along the proposed pipeline route and at the onshore facility sites (see Figure 5.6), including:

- *Cape Seashore Vegetation (Least Threatened)*: This vegetation type is an azonal vegetation type associated with the mobile or semi-mobile dunes in a saline environment. It is described by Mucina *et al*. (2006) as grassy, herbaceous or sometimes dwarf-shrubby vegetation on beaches and coastal dunes.
- *Cape Flats Dune Strandveld (Endangered D1)*: The coastal dunes on the Cape West Coast at Silwerstroom Strand and the Atlantis dune plume support Cape Flats Dune Strandveld (Rebelo *et al.* 2006). This thicket-like vegetation with evergreen, hard-leaved shrubs, grasses and annuals was previously referred to as Dune Thicket (Low & Rebelo 1996) and Cape Flats Fynbos – Thicket Mosaic (Cowling & Heijnis, 2001).
- *Atlantis Sand Fynbos (Critically Endangered D1)*: This vegetation type is very similar to Cape Flats Sand Fynbos in appearance and is mainly restioid and proteoid fynbos with ericaceous fynbos and asteraceous fynbos in seepages (Rebelo *et al.* 2006). It differs from Cape Flats Sand Fynbos in species composition and is well-known for the endemic proteoid, *Leucospermum parile*, a threatened Red Data listed species. The loss of this vegetation is largely due to transformation by agriculture and sand mining.
- *Langebaan Dune Strandveld (Vulnerable* according to NSBA): This vegetation type is a shrubland formation strongly associated with calcareous dunes from Grotto Bay, approximately 60 km north of Cape Town, for approximately 100 km northwards to Elands Bay (Rebelo *et al.* 2006; Helme 2007). It is, therefore, not restricted to the Langebaan / Saldanha area although best expressed at Langebaan. This vegetation is similar to Cape Flats Dune Strandveld being an evergreen sclerophyllous shrubland up to 2 m tall, with a prominent annual spring flora.

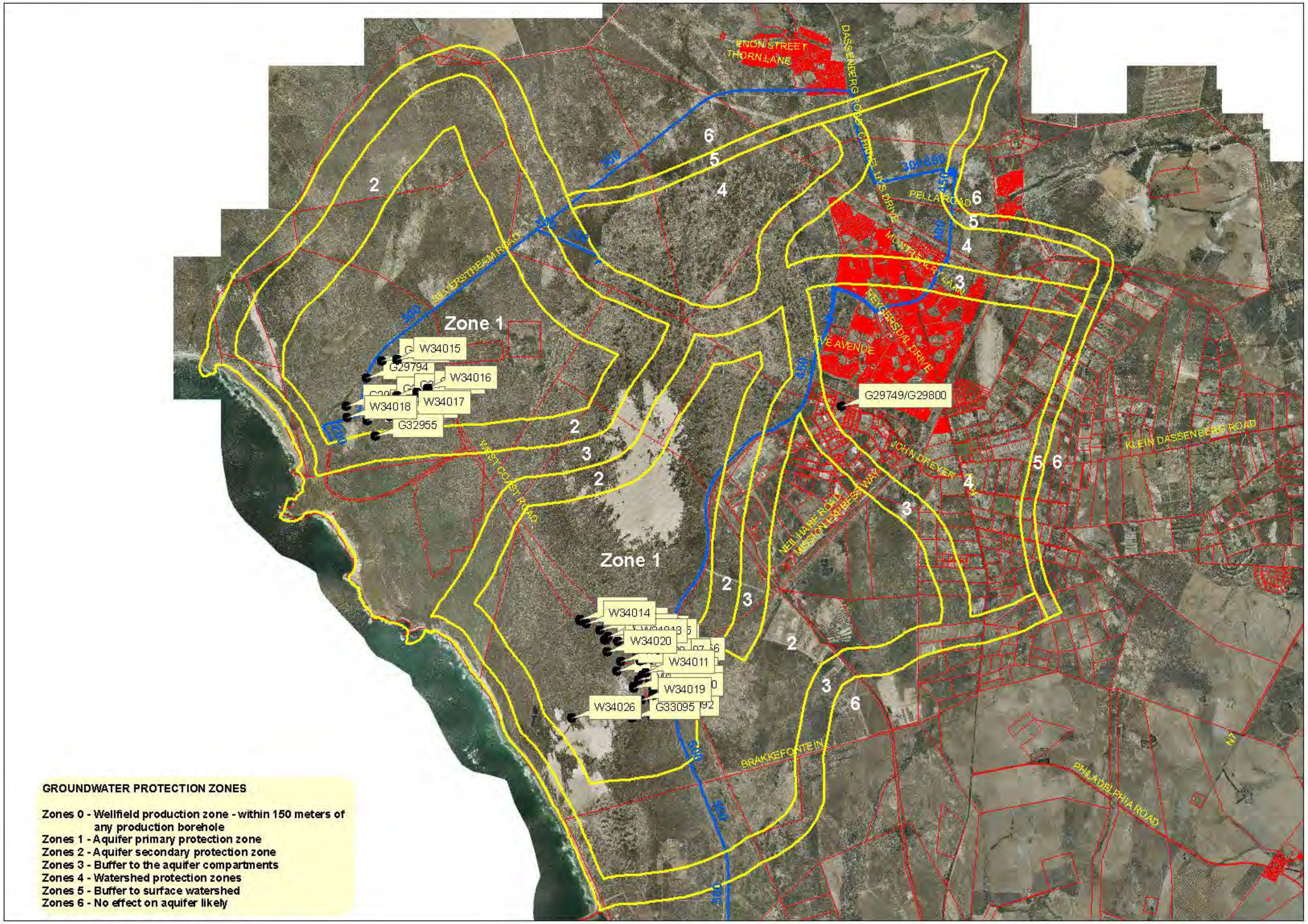


Figure 5.5: Groundwater Protection Zones (After CoCT: Water Demand Management & Strategy Branch).

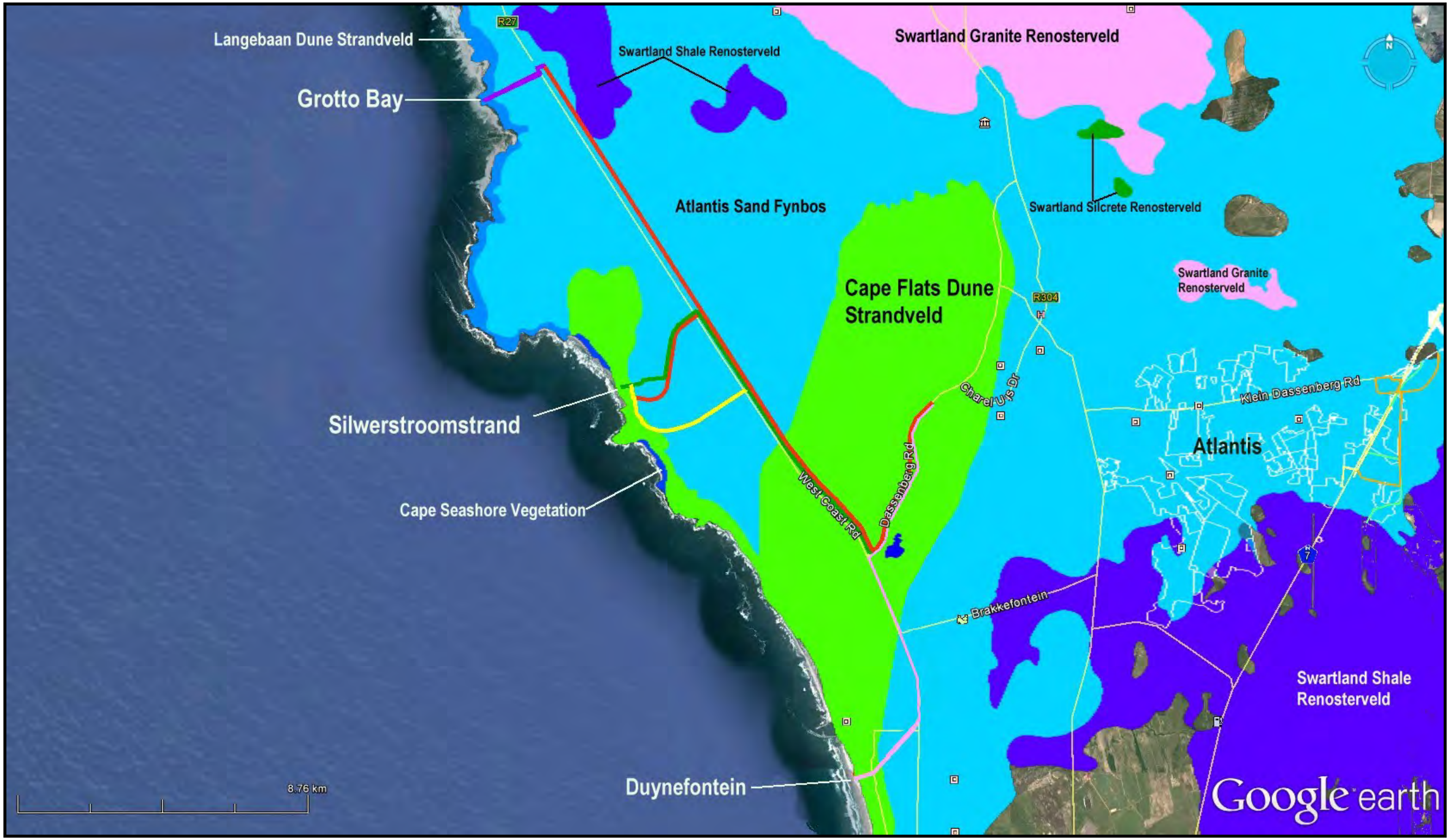


Figure 5.6: **Southern onshore pipeline route alternatives in relation to the vegetation types in the area (after Mucina *et al.* 2005).**

- *Swartland Shale Renosterveld (Critically Endangered A1 & D1)*: This vegetation type is found exclusively in the Western Cape and is one of the most endangered vegetation types in South Africa due to the arable nature of its clay-rich soils and the conversion of large proportions to agriculture. Only small areas of this annual and geophytic-rich shrubland vegetation, which generally has a wealth of plant species, with many endemic to this vegetation type, remain intact. Those areas are vital for its conservation.

Cape Inland Salt Pans (Vulnerable according to NSBA) are seasonal pans, typically supporting a saltmarsh community, are scattered throughout the study area.

Much of the area around Ankerlig and along the R27 that occurs within the City of Cape Town Municipality has been mapped as a Critical Biodiversity Area (CBA) (see Figure 5.7). Similarly, much of the area within the Swartland Municipality through which the pipeline routes pass is mapped as an ‘Endangered’ ecosystem (Job & Driver 2006) (see Figure 5.8).

5.2.3.2 Grotto Bay

Near the coast the proposed pipeline would pass through a short section of Cape Seashore Vegetation and Langebaan Dune Strandveld. Thereafter the pipeline would be aligned on the southern side of the Grotto Bay Road within an existing firebreak in Atlantis Sand Fynbos (see Plate 5.1). The vegetation within the firebreak is cut regularly and is, therefore, subjected to regular disturbance.

5.2.3.3 Silwerstroom Strand

The three Silwerstroom Strand pipeline alternatives would all traverse Cape Flats Dune Strandveld over a small distance close to the coast and then through Atlantis Sand Fynbos between the coastal zone and the R27 (see Figure 5.6). The whole of the Silwerstroom Strand area is included as a CBA (see Figure 5.7).

The first section of the pipeline would pass through the Silwerstroom Strand Resort, where there would be minimal impact on any natural vegetation (previously Cape Flats Dune Strandveld). The pipeline then would follow one of three routes. These are described briefly below.

- Alternative 1 (Northern Route) – Alignment via the existing Silwerstroom Water Treatment Plant: The pipeline would pass through Atlantis Sand Fynbos from the resort until the Water Treatment Plant. The pipeline would then follow the existing Water Treatment Plant gravel road (see Plate 5.2) and Silwerstroom Strand Road, resulting in the further loss of Atlantis Sand Fynbos vegetation.
- Alternative 2 (Central Route) - Alignment follows the existing Silwerstroom Strand Road: In this case the pipeline would run along the east boundary of the Silwerstroom Strand Resort in a disturbed area. It would then follow the Silwerstroom Strand Road on the north side and would impact Atlantis Sand Fynbos up to the R27 (see Plate 5.3).
- Alternative 3 (Southern Route) – This alignment would follow an existing gravel / sand road (see Plate 5.4) and fence line to the south of the resort: Although the route would follow an existing access road on the farm Groote Springfontein, it would directly affect Atlantis Sand Fynbos due to the required 15 – 20 m wide construction servitude.

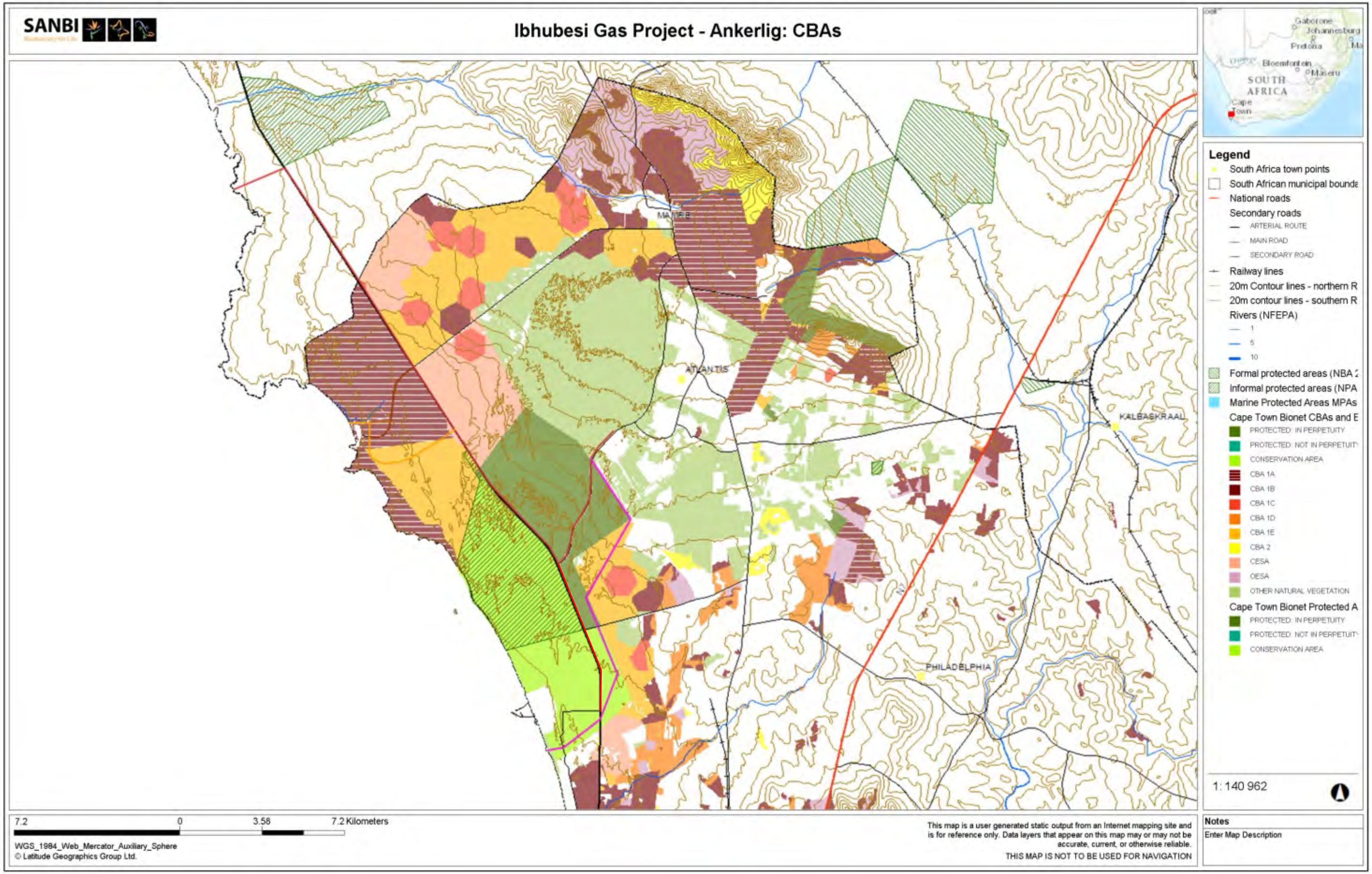


Figure 5.7: Southern onshore pipeline route alternatives in relation to the City of Cape Town's Critical Biodiversity Areas map (SANBI Biodiversity GIS, 2014).

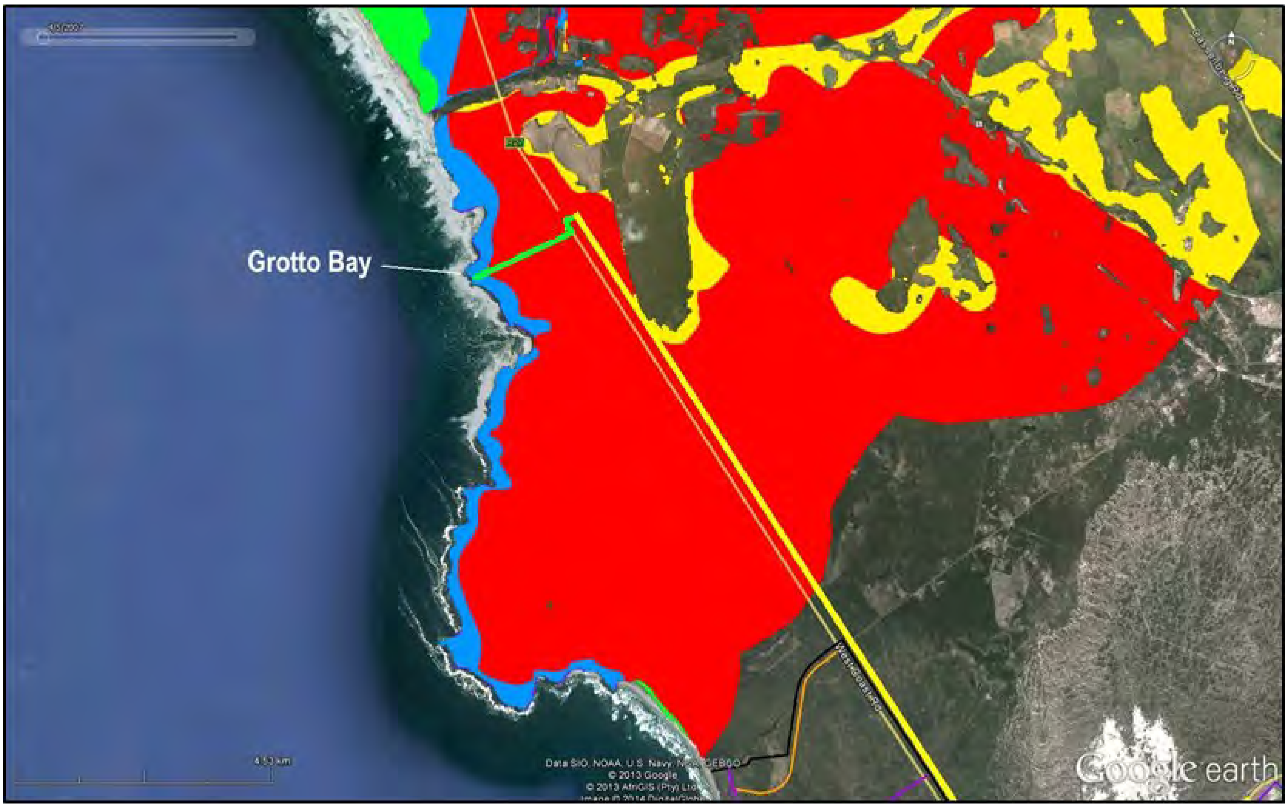


Figure 5.8: Ecosystem Status Map (after Job & Driver, 2005) showing the Grotto Bay route located within Vulnerable (blue) and Endangered (red) ecosystems.

Plate 5.1: Grotto Bay - Pipeline would be located within the existing firebreak (looking east).

Plate 5.2: Silwerstroom Strand Route 3 – Access road to the Silwerstroomstrand Water Works (looking east).

Plate 5.3: Silwerstroom Strand Route 1 - Atlantis Sand Fynbos along the northern side (left of fence) of the Silwerstroom Strand Road (looking east).

Plate 5.4: Silwerstroom Strand Route 2 – Sand track on Groot Springfontein with pristine Atlantis Sand Fynbos on either side (looking south).

5.2.3.4 Duynefontein

The Duynefontein alternative, which is aligned adjacent to an existing track, passes though the Koeberg Nature Reserve. Near the coast the alignment would pass through Cape Seashore Vegetation and then Cape Flats Dune Strandveld over a small distance (see Plate 5.5) before passing though through Atlantis Sand Fynbos between the coastal zone and the R27 (see Figure 5.6).

5.2.3.5 North-South Corridor (R27 or adjacent to Chevron pipeline)

The north-south alignment would either run parallel and just outside the eastern fence line of the R27 road reserve (see Plate 5.6) or run parallel to the Chevron pipeline (see Plate 5.7). All routes would pass mainly through Atlantis Sand Fynbos and Cape Flats Dune Strandveld. The alternative from Grotto Bay adjacent to the Chevron pipeline would pass through a small section of Swartland Shale Renosterveld.

5.2.3.6 East link to Ankerlig

From the R27 / Dassenberg Road intersection it is proposed to locate the pipeline on the south side of Dassenberg Road. It would traverse mainly Cape Flats Dune Strandveld and then Atlantis Sand Fynbos in the vicinity of Ankerlig Power Station. This area is significantly invaded by rooikrans (*Acacia cyclops*) and Port Jackson (*Acacia saligna*) (see Plate 5.8). The pipeline would also pass through a number of small wetlands, dominated by *Typha capensis* (bulrush), in the dunes near the R27 / Dassenberg Road intersection.

Plate 5.5: Cape Flats Dune Strandveld in the Koeberg Nature Reserve north of Duynefontein (looking north).

Plate 5.6: North-South link - Cape Flats Dune Strandveld adjacent to the R27 (looking north).

Plate 5.7: North-South link - Atlantis Sand Fynbos along the Chevron oil pipeline.

Plate 5.8: East link - Cape Flats Dune Strandveld along Dassenberg Road between the R27 and Ankerlig (looking south-west).

5.2.3.7 Ankerlig Gas Receiving Facility

The natural vegetation occurring at both sites in the industrial area is Atlantis Sand Fynbos. The vegetation has been heavily impacted by disturbance and invasion by woody alien invasive species (see Plate 5.9).

5.2.3.8 Silwerstroom Strand Gas Receiving Facility

The natural vegetation occurring at both sites adjacent to the Silwerstroom Water Treatment Plant is Cape Flats Dune Strandveld (see Plate 5.10) and is considered to be botanically sensitive.

Plate 5.9: Ankerlig facility site (Alternative 1b) - Atlantis Sand Fynbos heavily invaded by rooikrans and Port Jackson.

Plate 5.10: Silwerstroom facility site (Alternative 2a) – Pristine Cape Flats Dune Strandveld.

5.2.4 FAUNA

Sixty-one mammal species may occur within the larger study area (Friedmann & Daly, 2004). Only one species potentially occurring in the area is classified as a threatened Red Data species, namely the White-tailed Rat (*Mystromys albicaudatus*), which is listed as Endangered (Friedmann & Daly 2004). This species has a fairly wide distribution throughout South Africa and is known to favour sandy soils with good cover. It is not expected to occur in large numbers along the proposed pipeline routes or at the alternative gas receiving facility sites.

More than 130 bird species have been recorded in the area (South African Bird Atlas Project 2). Of these, the African Marsh Harrier is classified as Vulnerable. There are no Important Bird Areas (IBAs) in close proximity to the proposed pipeline routes.

Thirty-one reptile species have been recorded in the area (Bates *et al.* 2014). These include 19 lizard species, 11 snake species and one tortoise species. Of these, the following three species are currently listed as of conservation concern:

i) <u>Cape sand snake</u> (*Psammophis leightoni*) is listed as *Vulnerable* (Bates *et al.*, 2014). It potentially occurs in sand fynbos and strandveld habitats along all of the proposed pipeline routes. It is, however, of rare occurrence and is thus not expected to be encountered in significant numbers along any of the proposed pipeline routes or at the proposed gas receiving facility sites;

ii) <u>Cape dwarf chameleon</u> (*Bradypodion pumilum*) is listed as *Vulnerable* (Bates *et al.*, 2014). It is generally absent from agricultural landscapes, but occurs in a variety of habitats, including fynbos, renosterveld, thicket, riparian vegetation and exotic and native trees. It is unlikely that significant numbers of Cape dwarf chameleons would be encountered along any of the southern pipeline route alternatives as these routes are located along the northern edge of its known distribution range; and

iii) Bloubergstrand dwarf burrowing skink (lizard) (*Scelotes montispectus*) is listed as *Near Threatened* (Bates *et al.*, 2014). In the study area it is known from Bloubergstrand, Blaauwberg Conservation Area, Koeberg Nature Reserve, Mamre Nature Reserve and Melkbosstrand. It is known to inhabit sparsely-vegetated coastal dunes. It is only known from 10 recorded specimens and is thus not expected to occur in significant numbers along the coastal sections of the southern shore crossing alternatives.

Six frog species have been recorded in the area (Minter *et al.*, 2004). Of these only the Cape Caco (*Cacosternum capense*) is deemed to be of conservation concern, rated as Near Threatened (Measy, 2011).

No Red Data butterfly species have been recorded in the area.

5.2.5 FRESHWATER FEATURES

5.2.5.1 General description

There are few surface water features within the study area. The area lies within the quaternary catchments G21A and B, with the Modder River located just north of Grotto Bay and the Salt River just south of Duynefontein. The only rivers of note within the study area are the Buffels and Silverstroom Rivers, which are relatively small coastal rivers.

- The Silverstroom River (see Plate 5.11) is only approximately 2 km in length and lies within a CBA, which is linked with the Witsand Aquifer Protected Area. It is a perennial river that is both unique and important in terms of its habitat and the indigenous fish (Cape galaxias, *Galaxia zebratus*) that it supports. The river is considered to be in a moderately modified ecological condition as a result of water infrastructure that has been constructed within the river by the City of Cape Town.
- The Buffels River is a seasonal river that has been modified by agriculture and has a moderate infestation of alien *Acacia* trees.

The larger catchment of these rivers has been mapped as a Freshwater Ecosystem Priority Area (FEPA) river catchment (see Figure 5.9), with the management implication being that it should not be allowed to degrade but rather be rehabilitated where possible.

A number of small seeps and valley-floor depressions occur within the study area and are discussed in more detail under the specific routes below.

5.2.5.2 Grotto Bay

This route would cross the upper reaches of one small coastal stream approximately mid-way between the coast and the R27 (see Figure 5.10).

5.2.5.3 Silwerstroom Strand

All three route alternatives are located in a relatively sensitive area in terms of ground and surface water interaction. The northern-most alternative via the existing water works is located adjacent to a small branch of the Silverstroom River (see Figure 5.11 and Plate 5.11).

5.2.5.4 Duynefontein

The proposed route passes a number of smaller wetland areas (see Figure 5.12) that mostly occur within already disturbed areas along roads and are thus in an ecologically modified state.

5.2.5.5 North-South Corridor (R27 or adjacent to Chevron pipeline)

The central portion of the Grotto Bay and Silwerstroom Stand alternatives pass through the Witsand and Silverstroomstrand Protected Areas. The proposed route along the R27 from the Duynefontein shore-crossing passes through a number of smaller wetland areas (see Figure 5.12), mainly as it approaches the R27 / Dassenberg Road intersection. This wetland system is described in the “East link to Ankerlig” below.

5.2.5.6 East link to Ankerlig

Most of the wetland areas within the study area are associated with the rivers described above. The only wetland system that is of any significance that is not associated with these freshwater features is the wetland area at the R27 / Dassenberg Road intersection (see Figure 5.12 and Plate 5.12). This wetland system is associated with the City of Cape Town Wastewater Treatment Works at Atlantis and has been significantly impacted by the surrounding land use activities and changes to the topography in the area. Due to the high water table in winter as well as surface runoff, the wetlands tend to hold water for much of the year and be dominated by bulrushes *Typha capensis*.

5.2.5.7 Ankerlig Gas Receiving Facility

The proposed onshore gas receiving facility sites adjacent to the Ankerlig power station would have minimal impact on the surrounding freshwater features. There is a small wetland area to the south of Alternative 1a, which appears to have been created for stormwater attenuation purposes.

5.2.5.8 Silwerstroom Strand Gas Receiving Facility

The proposed onshore facility sites adjacent to the existing Silwerstroom Water Treatment Plant are situated close to the sensitive Silwerstroom River and are likely to have some additional impacts on the river system.

<table>
<tr><td></td><td></td></tr>
<tr><td>Plate 5.11: The Silwerstroom River Mouth.</td><td>Plate 5.12: Wetland area at the R27 / Dassenberg Road intersection.</td></tr>
</table>

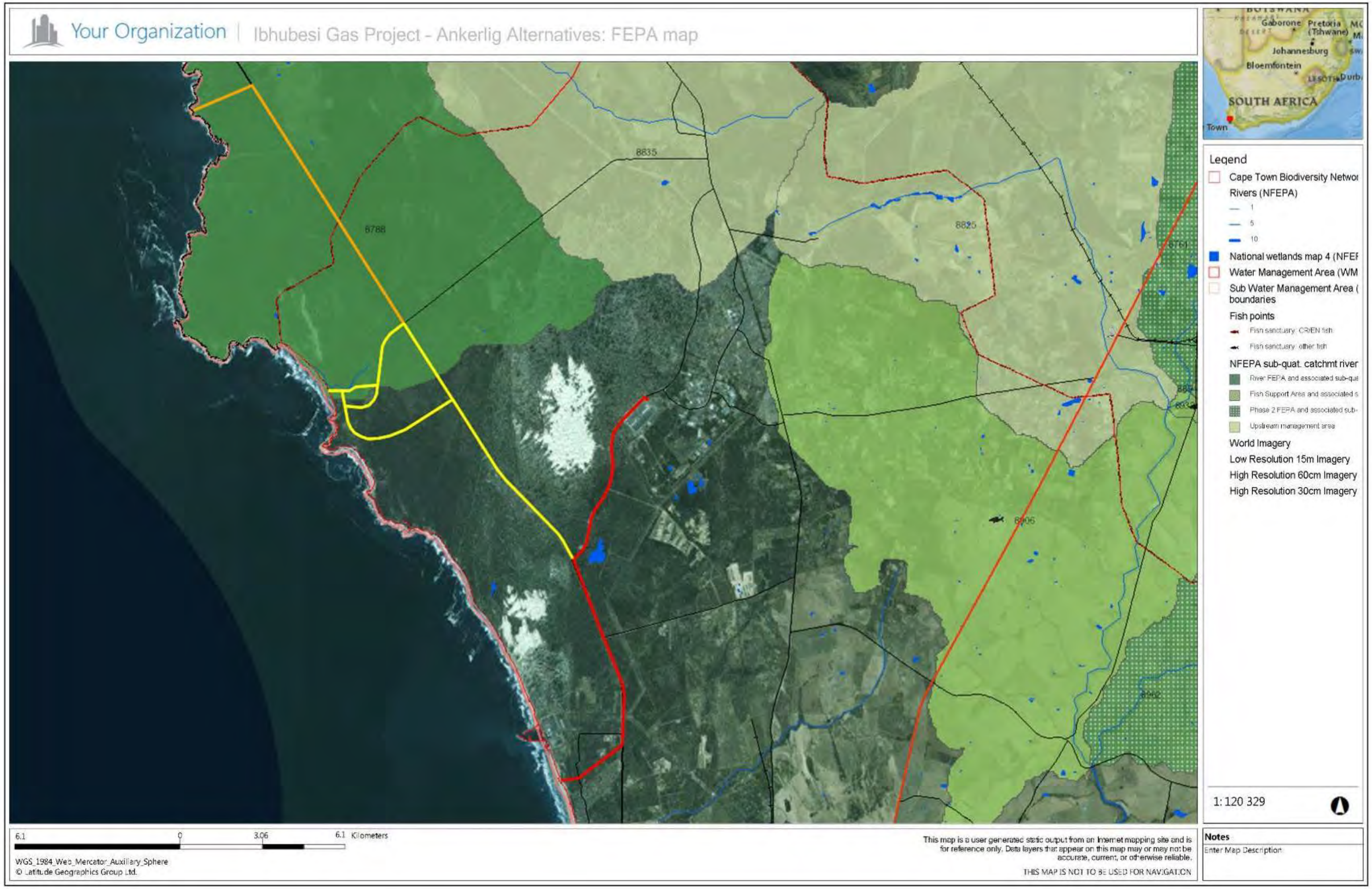


Figure 5.9: Southern onshore pipeline route alternatives in relation to the National Freshwater Ecosystem Priority Areas map (SANBI Biodiversity GIS, 2014).

Figure 5.10: **GoogleEarth image showing the proposed Grotto Bay route alignment in relation to rivers or streams (blue lines) and wetland areas (green areas).**

Figure 5.11: **GoogleEarth image showing the proposed Silwerstroom Strand route alignments in relation to rivers / streams (blue lines) and wetland areas (green areas).**

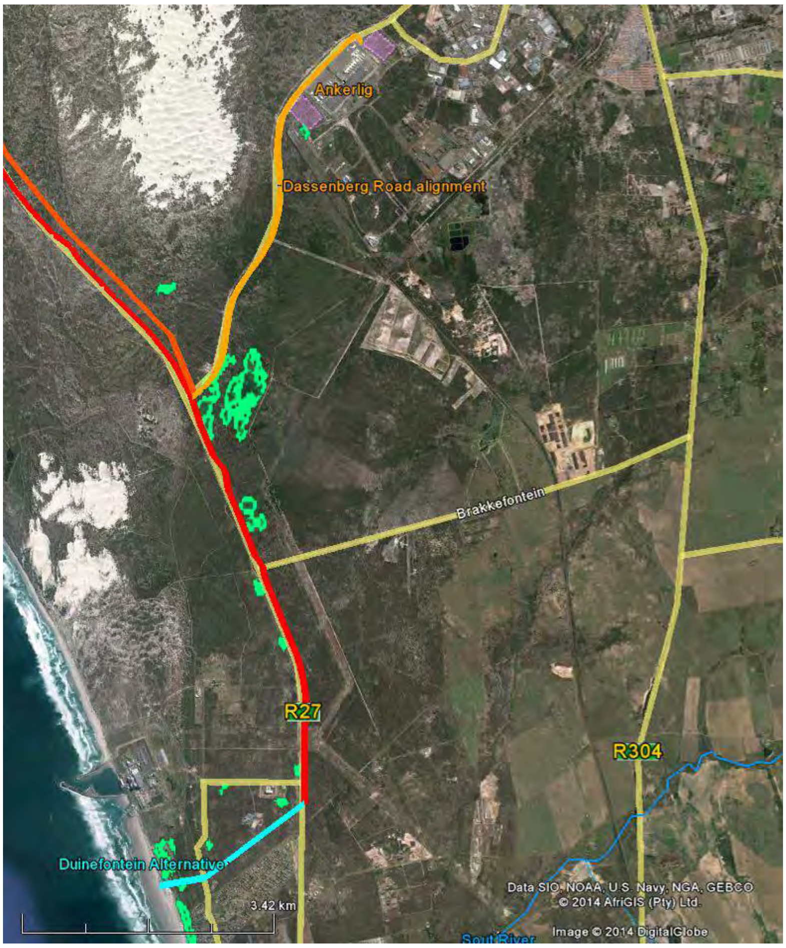


Figure 5.12: GoogleEarth image showing the proposed Duynefontein route and the east link to Ankerlig in relation to wetland areas (green areas).

5.2.6 HERITAGE

5.2.6.1 Grotto Bay

(a) Palaeontology

Apart from the Late Pleistocene hyena accumulations on the Modder River, little is known of the fossil potential along this proposed alignment. No fossils were observed on the surface during the site inspection. However, given the proximity to Duynefontein and Bokbaai, where there are pleistocene fossils in relatively shallow calcretised sands and Springfontein formation within the Koeberg Nature Reserve, palaeontological material could be encountered along this route.

(b) Archaeology

The headland has been heavily damaged by informal parking areas, secondary gravel deposits and various apparently *ad hoc* attempts to "formalise" the parking area. The presence of shell midden material manifesting itself at areas where the surface of the parking area had been disturbed indicates that there may be much more of this under the various layers of fill material. The material consists of a typical mixture of *Patella sp, C. Meridionalis, Burnupena sp*, (limpets, mussels and whelks).

Although no cultural material was noted, previous observations on the West Coast show that almost every headland is littered with Late Stone Age shell midden material. Thus finding such material at this site would not be unexpected.

5.2.6.2 Silwerstroom Strand

(a) Palaeontology

This is the same as described under Grotto Bay (see Section 5.2.6.1).

(b) Archaeology

The proposed shore-crossing site (beach) does not contain any evidence of surface archaeological material. The field inspection also revealed that all Silwerstroom Stand alternatives and the onshore gas facility sites (Alternatives 2a and 2b) do not contain any indications of surface archaeological material. However, there is always the possibility of buried archaeological material being unearthed during excavation of the pipeline trench.

5.2.6.3 Duynefontein

(a) Archaeology/palaeontology

The bulk of the heritage sensitive landscape, both aesthetically and in terms of material heritage lies to the north of the power station. In this area there are Pleistocene fossil beds throughout overlain by dune systems and coastal fynbos. However, indications in the southern area are far scarcer. Late Stone Age shell middens are uncommon at Duynefontein, none would be expected to be impacted by the proposed pipeline.

5.2.6.4 North-South Corridor and east link to Ankerlig

The R27 to Ankerlig and the Ankerlig site itself have been subject to a number of heritage surveys in the past, which have revealed that the site is not sensitive in terms of general heritage and little evidence of heritage has been found.

Since the proposed pipeline would be buried approximately 1 m to 1.5 m below ground it is unlikely that deep fossils of the Miocene and Pleistocene epochs would be impacted. However, there is a possibility that there could be occasional impacts of Pleistocene fossils in more recent sands.

5.2.7 SOCIO-ECONOMIC ENVIRONMENT

The proposed landing points for the southern pipeline routes fall under the jurisdiction of the Swartland Local Municipality (Grotto Bay) and the City of Cape Town Metropolitan Municipality (Silwerstroom Strand, Duynefontein and Atlantis) (see Figure 5.13).

5.2.7.1 Local municipalities and affected towns

(a) Swartland Local Municipality

The Grotto Bay shore-crossing falls within the Swartland Local Municipality, one of the main wheat producing areas within the winter rainfall region. The estimated population of the Swartland Local Municipality is 113 762 (Statistics South Africa 2011). The percentage population growth over ten years was 57.75% with an annual population growth rate of 4.56% (2001-2011). Afrikaans is the most spoken language (76.2%), followed by Xhosa at 8.2% and English at only 4.3% with other languages making up the remaining 9.9%. The official unemployment rate in the Swartland Municipality is 12.70% which is lower than some other municipalities within the province. Of the economically active youth (15–34 years) 17.9% are unemployed. Swartland has a lower population density than Atlantis and Saldanha and is largely a farming area.

Malmesbury is an important town in the region, having a diversified economic and infrastructure base and a high development potential, which supports not only agriculture but also well-developed industrial and commercial sectors. Other major towns include Darling, Moorreesburg, Riebeeck Kasteel, Riebeeck West and Yzerfontein.

Figure 5.13: Western Cape Municipalities.

(b) City of Cape Town Metropolitan

The estimated population of the City of Cape Town Metropolitan area is approximately 3.7 million (Statistics South Africa 2011), the second largest in South Africa by population size. The population growth rate between 2001 and 2011 was 29.3%. The population is predominantly Coloured (42.4%), followed by African (38.6%), White (15.7%) and Indian/Asian (1.4%). The predominant languages spoken are primarily Afrikaans (34.9%), IsiXhosa (29.2%) and English (27.8%). The main sectors in the metropolitan's economy are finance, insurance, property and business services (34.2%); wholesale and retail trade, catering and accommodation (16.3%); and manufacturing (14.3%). The poverty rate for the Metropolitan of 19.7% (percentage of people living in poverty) is the lowest in the province. The unemployment rate is slightly lower than the national average at 23.9%.

Atlantis and Duynefontein are the closest urban centres to the proposed southern shore-crossing pipeline routes and the gas receiving facility. Atlantis is an urban area located 45 km north of the Cape Town Central Business District (CBD). It has a population of approximately 67 491. The area is predominantly Coloured (85%), although some recent migration from the Eastern Cape has increased the size of the African community (12.9%). The community is predominantly Afrikaans speaking (79.5%), followed by English (9.4%) and isiXhosa (7.7%). Unemployment (26.6%), crime and lack of housing are major issues in the area.

Duynefontein is an upper middle-class area within the Melkbosstrand suburb and is located 33 km north of Cape Town. It was originally developed for housing during the construction of the Koeberg Nuclear Power Station. Melkbosstrand has a population of 11 303 and is predominantly White (82%). 94% of the labour force is employed and most of the dwellings (98%) are formal and have well-developed household services.

Silwerstroom Strand Resort is a City of Cape Town recreation facility with chalets, camping sites and picnic area, along with conference facilities. Silwerstroom Strand is mostly used by the residents of Atlantis and Mamre and is not a permanently occupied site.

5.2.7.2 Planning

(a) Draft Infrastructure Development Bill (2013) and Strategic Integrated Projects

The proposed project falls under SIP 5, SIP 8 and SIP 9 (see Section 3.1.1).

(b) National Development Plan (2030)

The development of the Ibhubesi Gas Field and the proposed Ibhubesi Gas Project would meet a number of the objectives in the National Development Plan 2030 (see Section 3.1.2).

(c) Western Cape: Provincial Spatial Development Framework (2014)

The Provincial Spatial Development Framework (PSDF) (2014) for the Western Cape provides the spatial agenda for all the provincial departments. It intends to promote effective public investment in the built and natural environment through:

- Adopting credible planning principles to underpin all capital investment programmes;
- Spatially targeting and aligning the various investment programmes; and
- Opening up opportunities for community and business development in targeted areas.

Growing the Western Cape economy is a primary objective of the provincial government. Policy R4 of the PSDF includes the following objectives related to energy:

- Pursue energy diversification and energy efficiency in order for the Western Cape to transition to a low carbon, sustainable energy future, and delink economic growth from energy use; and
- Investigate and develop the West Coast gas opportunity, with a focus on imported Liquid Natural Gas.

(d) Western Cape Infrastructure Framework (2013)

The Western Cape Infrastructure Framework (2013) quantifies the scale and nature of the infrastructure requirements in the Western Cape. The framework also sets out high-level transitions required to achieve the optimised development agenda and is broken down in sub-infrastructure sectors. The transitions related to the energy sector include, *inter alia*, the introduction of natural gas processing infrastructure to use gas as a transition fuel.

(e) Micro-Economic Development Strategy for the Western Cape (2006)

The Micro-Economic Development Strategy (MEDS) is a provincial industrial policy framework that aims to reduce the incidence of government failure, market failure and network failure in the Western Cape. The MEDS included an extensive research programme that identified a number of sectors that have the potential to contribute significantly to the growth of the Western Cape. One of the 25 sectors researched was the Oil and Gas industry. This sector was identified as one that had substantial opportunities in terms of growth and job creation. However, this potential was contingent on the achievement of an 8% new build fabrication market share over the next five years. It was noted that the Western Cape did not immediately offer any advantages from a production or sourcing perspective to the upstream oil and gas services sector. It was, therefore, recommended that Cape Oil and Gas Supply Initiative (COGSI) become a nationally identifiable brand that builds a national cluster. COGSI was subsequently renamed the South African Oil and Gas Alliance (SAOGA) to reflect the growing involvement of upstream suppliers from other regions and the fact that no other South African organisation focuses on the upstream supplier base. SAOGA has been instrumental in the coordination of oil and gas industry stakeholders and is, therefore, reflective of the provincial government's intention to support and promote this industry.

(f) One Cape 2040 (2012)

One Cape 2040 articulates a development vision for the Western Cape. It seeks to set a common direction to guide planning and action for the province. It is a long-term strategy rather than a government planning document. The document resonates with the thinking in the National Development Plan, ensuring alignment at a regional level with the national development strategies, while ensuring a narrower regional focus, taking into account the distinct provincial differences with the rest of the country.

The vision identifies six transitions that need to take place and 12 associated goals for those transitions (or two per transition) and for each goal a primary change lever has been identified. The goals and levers are quite high-level, but within the long-term change roadmap there are some shifts identified that are relevant for the proposed project. Directly relevant to the project is the development of "hard infrastructure", which includes energy infrastructure. Indirectly related to the proposed project is the focus on skills development and support for enterprise growth and innovation. So the proposed Ibhubesi Gas Project would be assisting with the development of energy infrastructure and be supported through the improvement of the skills base in the area.

(g) City of Cape Town's Integrated Development Plan (2012 – 2017)

An Integrated Development Plan (IDP) provides a strategic framework to guide the planning and budgeting over the course of each political term. The City of Cape Town's IDP views the oil and gas market as a key sector to develop the potential of. The City of Cape Town looks to attract the oil and gas industry in order to expand their foothold in Cape Town. However, the IDP does not provide details as to how this will be achieved beyond suggesting that the development of this sector will be investigated in partnership with the private sector.

Atlantis is identified in the IDP as the location for a green-technology cluster park, noting its location, good road access, well-priced industrial land and access to port facilities. This strategic focus for Atlantis is in alignment with the Special Economic Zone (SEZ) site for renewable energy manufacturing.

(h) Swartland Municipality IDP (2012 – 2017)

The development of the oil and gas sector is not seen as relevant for this municipality, although it views the development of the Saldanha IDZ as potentially boosting the manufacturing profile of the province and manufacturing is a significant contributor to the Swartland GDP. The IDZ would also improve infrastructure to and from the area, some of which may pass through the Swartland. Construction has been highlighted as an area that has the potential for significant growth as demand for residential and industrial developments continues. An effective, efficient, motivated and appropriately skilled work force is also envisioned as one of the seven key policy developments.

5.3 NORTHERN SHORE CROSSING ROUTE (SALDANHA PENINSULA)

5.3.1 TOPOGRAPHY

The surrounding area is characterised by a gently undulating coastal plain with low hills. The highest points in the area include Malgaskop (173 mamsl), Karringberg (175 mamsl) and Postberg on the Langebaan Peninsula (192.8 mamsl). Several smaller hills and outcrops of granite boulders are also evident in the surrounding area.

5.3.2 GEOLOGY, SOILS AND GROUNDWATER

The Saldanha Bay area is underlain by older bedrock of Malmesbury Shale and Cape Granite, which in turn are covered by Langebaan Formation limestones. The study area is mostly covered with recent sands with some outcrops of calcrete (limestone) and granite. In this area the Langebaan Formation is known for its fossil content (as evident in the West Coast Fossil Park).

The most dominant soil types for the study area tend to be imperfectly drained grey sandy soils. The soils tend to be highly calcareous at the coast, often underlain by calcrete and susceptible to wind erosion. The river valleys and greater floodplain of the Berg Estuary tend to consist of soils with a marked clay accumulation, which tend to have favourable water holding properties. Along the west coast of the Saldanha Peninsular the soils tend to be shallow overlying hard or weathering rock.

The area in the vicinity of the pipeline routes is underlain by the western section of the Langebaan Road Aquifer System, which extends regionally towards Vredenburg in the north-west, Velddrift in the north and Hopefield in the east.

5.3.3 FLORA

5.3.3.1 General description

Four vegetation types are mapped in the northern study area (see Figure 5.14), including:

- *Cape Seashore Vegetation (Least Threatened)*: Described in Section 5.2.3.
- *Langebaan Dune Strandveld (Vulnerable* according to NSBA*)*: Described in Section 5.2.3.
- *Saldanha Limestone Strandveld (Endangered* according to NSBA*)*: This vegetation type is a low shrubland consisting of succulent-stemmed and deciduous fleshy-leaved shrubs with geophytes and annuals being an important feature. It is restricted to shallow sandy soil over calcrete or limestone (hardpan) with annuals and geophytes found in cracks and shallow depressions in exposed limestone. One of the typical indicator species is *Thamnochortus spicigerus* (Restionaceae) and no Proteaceae or Ericaceae are found. Helme & Koopman (2007) consider this to be one of the two richest vegetation types in the Saldanha area in terms of regional habitat endemic species.
- *Saldanha Flats Strandveld (Endangered* according to Pence, 2014*)*: This vegetation type is a sclerophyllous shrubland with a low open shrub layer and emergent mid-high shrub stratum. It is species-rich and well-known for colourful displays of annuals in spring. Geophytes are common but are also usually only seen during the winter and spring season when they are growing and flowering. The upper shrub stratum is characterised by species such as *Euclea racemosa, Muraltia spinosa and Searsia glauca. Species of lower stature include Euphorbia mauritanica, Ruschia macowanii, Tetragonia decumbens, Tetragonia fruticosa, Zygophyllum cordifolium* and *Zygophyllum morgsana*. A wide array of low succulent 'vygies', annual Asteraceae and geophytic herbs make up the greater proportion of the species complement (Rebelo et al. 2006; Helme, 2006). *Aloe perfoliata* (Least Concern) occurs in occasional patches in Saldanha Flats Strandveld. Other endemic and rare species such as *Afrolimon capense* (Near Threatened) also occur in this vegetation type. Saldanha Flats Strandveld has been impacted by agriculture and around Saldanha by industrial development. Helme

(2006) estimated that about 59% of Saldanha Flats Strandveld still remains. Although it is listed as being Vulnerable (A1) in the List of Threatened Ecosystems of South Africa (Government Gazette, 2011), it is considered to be Endangered by Pence (2014).

Cape Inland Salt Pans (Vulnerable according to NSBA) are seasonal pans, typically supporting saltmarsh communities, are scattered throughout the study area.

5.3.3.2 St Helena East

At the St Helena East landing site the shoreline consists of a narrow strip of Cape Seashore vegetation and Saldanha Flats Strandveld (1 – 1.5 m tall), dominated by *Lycium spp*. (see Plate 5.13). The field stratum is low (< 20 cm) and dominated by *Galenia sarcophylla* and grasses. Plant species recorded include *Arctotheca calendula, Atriplex cinerea, Conicosia pugioniformis, Drosanthemum floribundum, Ehrharta villosa, Lebeckia sp*., Legume- exotic clover, *Lycium ferocissimum* – co-dominant, *Lycium tetrandrum* – co-dominant, *Mesembryanthemum guerichianum*, *Oxalis pes-caprae, Rapistrum rugosum, Septulina glauca, Trachyandra sp*. and *Zaluzianskya villosa*. Further inland the pipeline route would traverse completely transformed farm lands with a possibility of impinging on natural vegetation on the farm Nooitgedacht (see Figure 5.15 and Plate 5.14). The St Helena Bay East alternative does not traverse any CBA areas (see Figure 5.15).

5.3.3.3 St Helena West

The St Helena Bay West route would cross the shore where there is a narrow zone of coastal Cape Seashore Vegetation that is grassy (see Plate 5.15). It would then traverse low dunes supporting mid-dense Saldanha Flats Strandveld (see Plate 5.16) with the following additional species recorded, *Euphorbia mauritanica, Pteronia divaricata, Tetragonia fruticosa* and *Pelargonium gibbosum*. Inland of the low dunes the land has been converted to pastures (grazed by cattle) and wheat fields (see Plate 5.14). The only exception is the possibility of impinging on natural vegetation on the farm Nooitgedacht. The St Helena Bay West alternative does not traverse any CBA areas (see Figure 5.15).

Plate 5.13: St Helena East - Saldanha Flats Strandveld dominated by *Lycium spp*.

Plate 5.14: St Helena East and West - transformed agricultural fields south of the coast.

Plate 5.15: St Helena West - Cape Seashore Vegetation (looking west).

Plate 5.16: St Helena West - Saldanha Flats Strandveld (looking west).

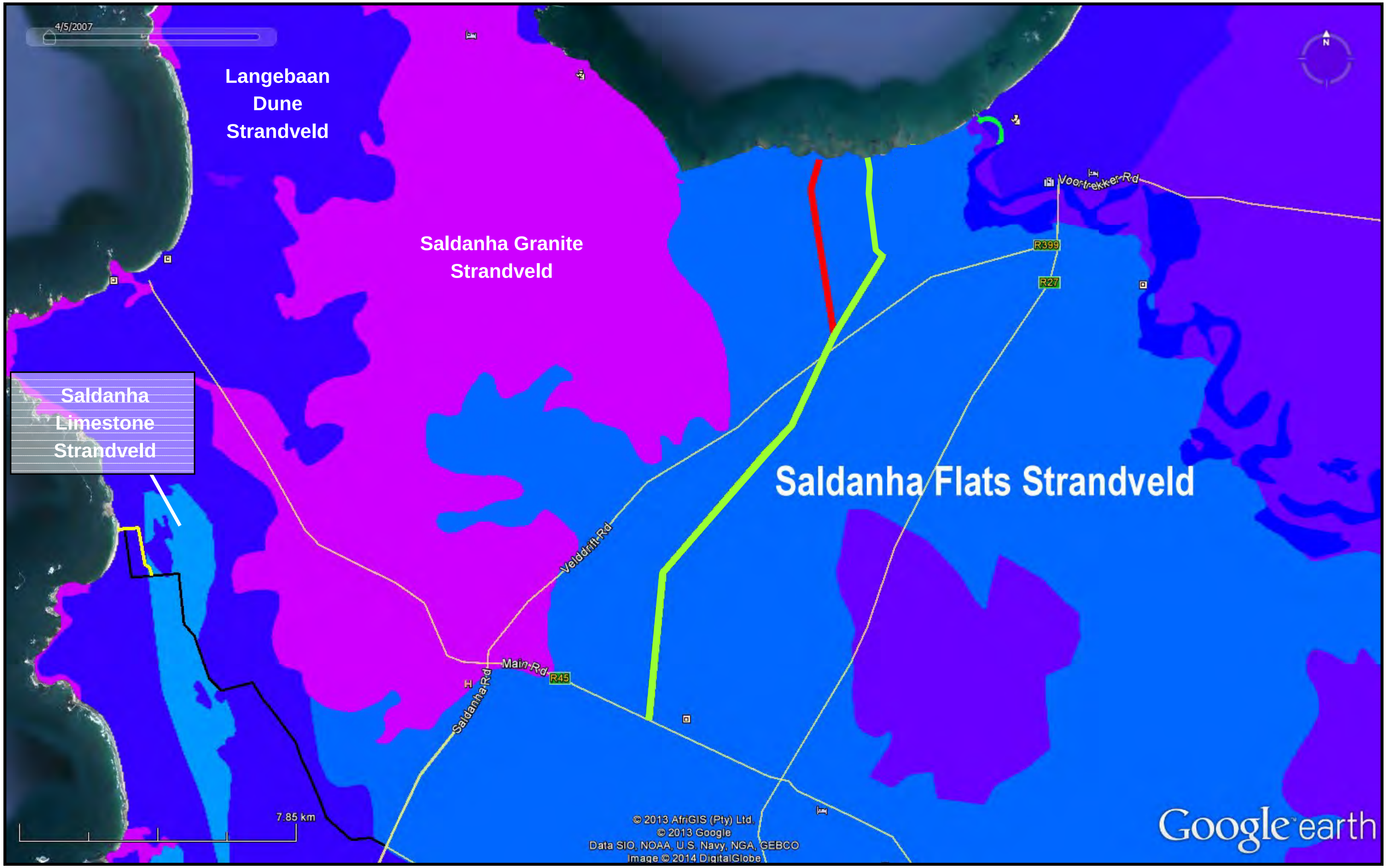


Figure 5.14: Northern onshore pipeline route alternatives in relation to the vegetation types in the area (after Mucina *et al.* 2005).

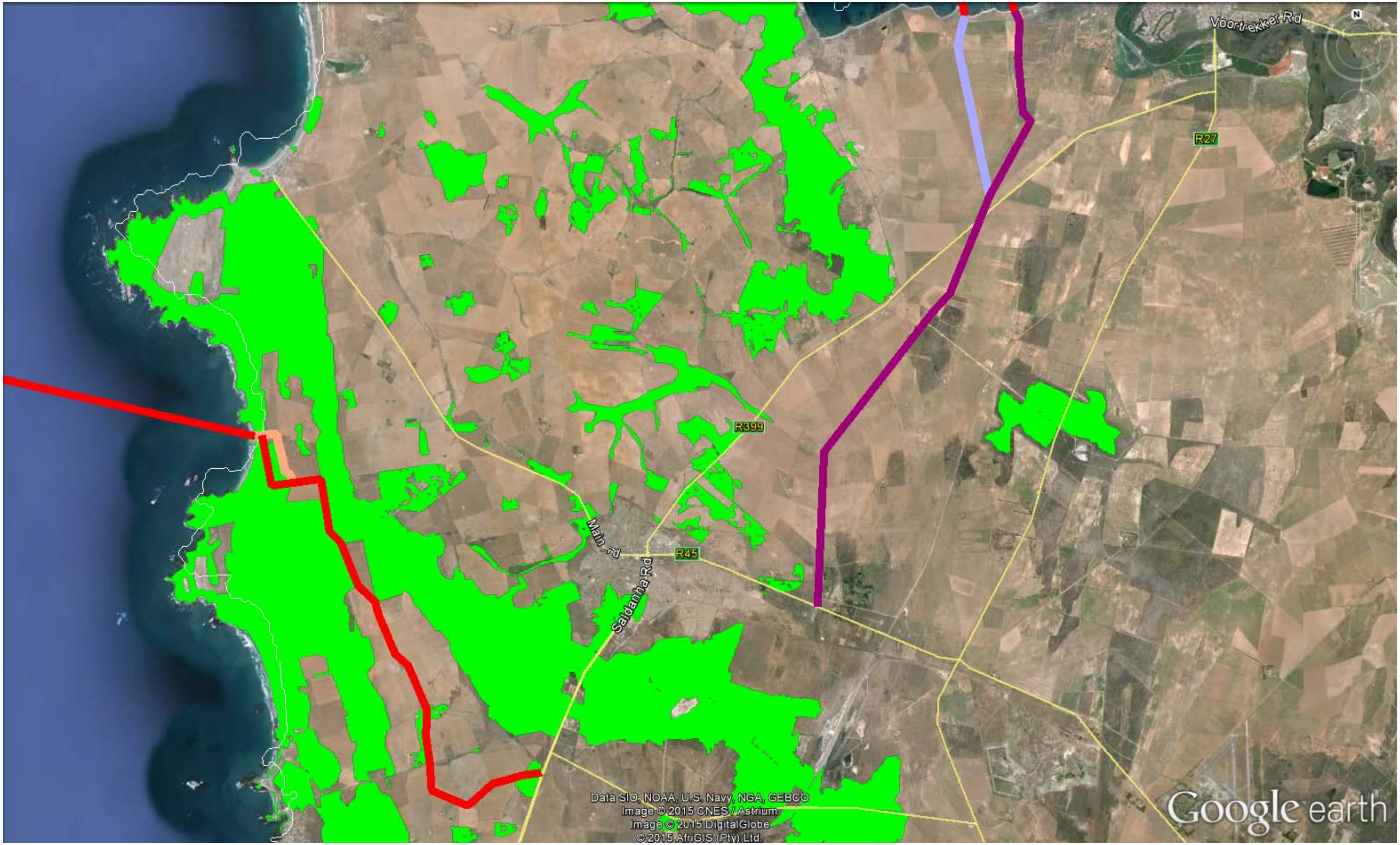


Figure 5.15: Northern onshore pipeline route alternatives in relation to Critical Biodiversity Areas (green).

5.3.3.4 Noordwesbaai

The first section of the pipeline route would follow an existing dirt track through Langebaan Dune Strandveld, which is mapped as a CBA (see Figures 5.14 and 5.15; Plate 5.17). In order to minimise the disturbance within the CBA, a second alternative is proposed (i.e. Noordwesbaai East), which is aligned to the east of the CBA. Where the two alternatives join up, the pipeline passes through Saldanha Limestone Strandveld (see Plate 5.18), which is also mapped as a CBA. Further east, on a south-east trajectory, the pipeline would mainly traverse areas that would have been Langebaan Dune Strandveld but have now been largely converted to agriculture.

Plate 5.17 Noordwesbaai – Dune habitat (Langebaan Dune Strandveld).

Plate 5.18: Noordwesbaai - Saldanha Limestone Strandveld inland of the shore-crossing.

5.3.4 FAUNA

Fifty-five mammal species may occur within the larger study area around Saldanha (Friedmann & Daly, 2004). Only one species potentially occurring in the area is classified as a threatened Red Data species, namely the White-tailed Rat (Mystromys albicaudatus) which is listed as Endangered (Friedmann & Daly 2004). This species has a fairly wide distribution throughout South Africa and is known to favour sandy soils with good cover. It is not expected to occur in large numbers along the proposed pipeline routes.

More than 200 bird species have been recorded in the area (South African Bird Atlas Project 2). Three of these are listed as threatened species, including:

i) African Marsh Harrier (*Circus ranivorus*) is listed as *Endangered* (Barnes 2000) and *Least Concern* (IUCN 2013). It is considered to be a waterbird, often nesting in extensive reedbeds with some breeding also taking place in short sedge areas and fynbos vegetation. It is known to forage over reeds, lake margins, floodplains and occasionally woodland in search of small mammals (Southern African Bird Atlas Project (SABAP) 1). It may be encountered where the pipeline routes traverse drainage lines or wetland areas;

ii) Ludwig's Bustard (*Neotis ludwigii*) is listed as *Vulnerable* (Barnes, 2000) and *Endangered* (IUCN, 2012). Its range is centred around the Nama-Karoo and Succulent Karoo biomes, but it has also been known to visit the agricultural regions of the south-western Cape in the Fynbos biome. Collision with overhead power lines has been identified as an important threat to this species. According to the SABAP2 data it has a very low recording rate in the Saldanha area and has not been recorded in the southern area. It is thus not expected that these birds would be encountered in notable numbers along any of the proposed pipeline routes; and

iii) Blue Crane (*Anthropoides paradisea*) is listed as regionally *Near Threatened* (2014 Red Data List) and as globally *Vulnerable* (IUCN 2013). It favours open grassland and cultivated fields, nesting on bare ground, often in moist places. Although they are not expected to occur in large flocks in the study area, they may be encountered where the pipeline routes cross cultivated fields.

Thirty-four reptile species have been recorded in the Saldanha area (Bates *et al.* 2014). These include 20 lizard species, 13 snake species and one tortoise species. Of these, the following species are listed as being of conservation concern.

i) Cape Sand Snake (see above description) is listed as *Vulnerable.* As no intact natural vegetation patches would be crossed by the St Helena route alternatives, this species is only expected to occur in strandveld habitat along the Noordwesbaai alternative. It is, however, not expected to occur in significant numbers.

ii) Black Girdled Lizard (*Cordylus niger*) is listed as *Near Threatened* (Bates *et al*. 2014). This species is restricted to rocky areas and is only known from four isolated subpopulations in the study area. None of these habitats occur along any of the proposed pipeline route alternatives.

iii) Burrowing skink (lizard) species: Three dwarf burrowing skink species (*Scelotes gronovii*, *S. kasneri* and *S. montispectus*) are listed as *Near Threatened*. All three species are known to occur in sandy coastal dune habitats. None of these are expected to occur in significant numbers along the coastal sections of the proposed pipeline route alternatives.

Six frog species have been recorded in the vicinity of Saldanha (Minter *et al.*, 2004). Of these only the Cape Caco (*Cacosternum capense*) is deemed to be of conservation concern, rated as Near Threatened (Measy, 2011).

No Red Data butterfly species have been recorded in the area. The closest Red Data species, the Atlantic Skollie (*Thestor dicksoni malagas,* Vulnerable) is known to occur at Kreef Bay on the Langebaan Peninsula (Henning *et al*., 2009) to the south of the proposed pipeline routes.

5.3.5 FRESHWATER FEATURES

The freshwater features within this area consist largely of valley bottom wetlands associated with streams.

5.3.5.1 St Helena East and West

During the Scoping Phase, the northern extent of the St Helena East route was repositioned approximately 1.2 km to the west in order to avoid the Berg River Ecosystem Priority Area (see Figure 5.16). It is still, however, located within the larger floodplain of the Berg River estuary which has been mapped as wetland area (see Figure 5.17).

The Berg River estuary is a river-dominated estuary that is one of only four perennial estuarine systems on the West Coast of South Africa. The estuary, including floodplain, is estimated to cover an area of 61 km^2 and to be about 65 km long, although seawater does not penetrate this far upstream. The main channel at Velddrift is about 100-200 m wide, becoming progressively narrower and shallower upstream. The estuary is rated among the top three estuaries in South Africa in terms of its conservation importance. It has been identified as a particularly important estuary for birds, as well as marine and estuarine fish. Approximately 92 water bird species are known to occur on the estuary, while a total of 35 fish species have been recorded in the Berg Estuary, of which nearly half can be regarded as either partially or completely dependent on the estuary for their survival.

Both routes cross or travel adjacent to smaller drainage channels, which are in general not well defined and seasonal to ephemeral in their flow patterns. As with the surrounding vegetation, most of these systems have also been highly modified by agricultural activities.

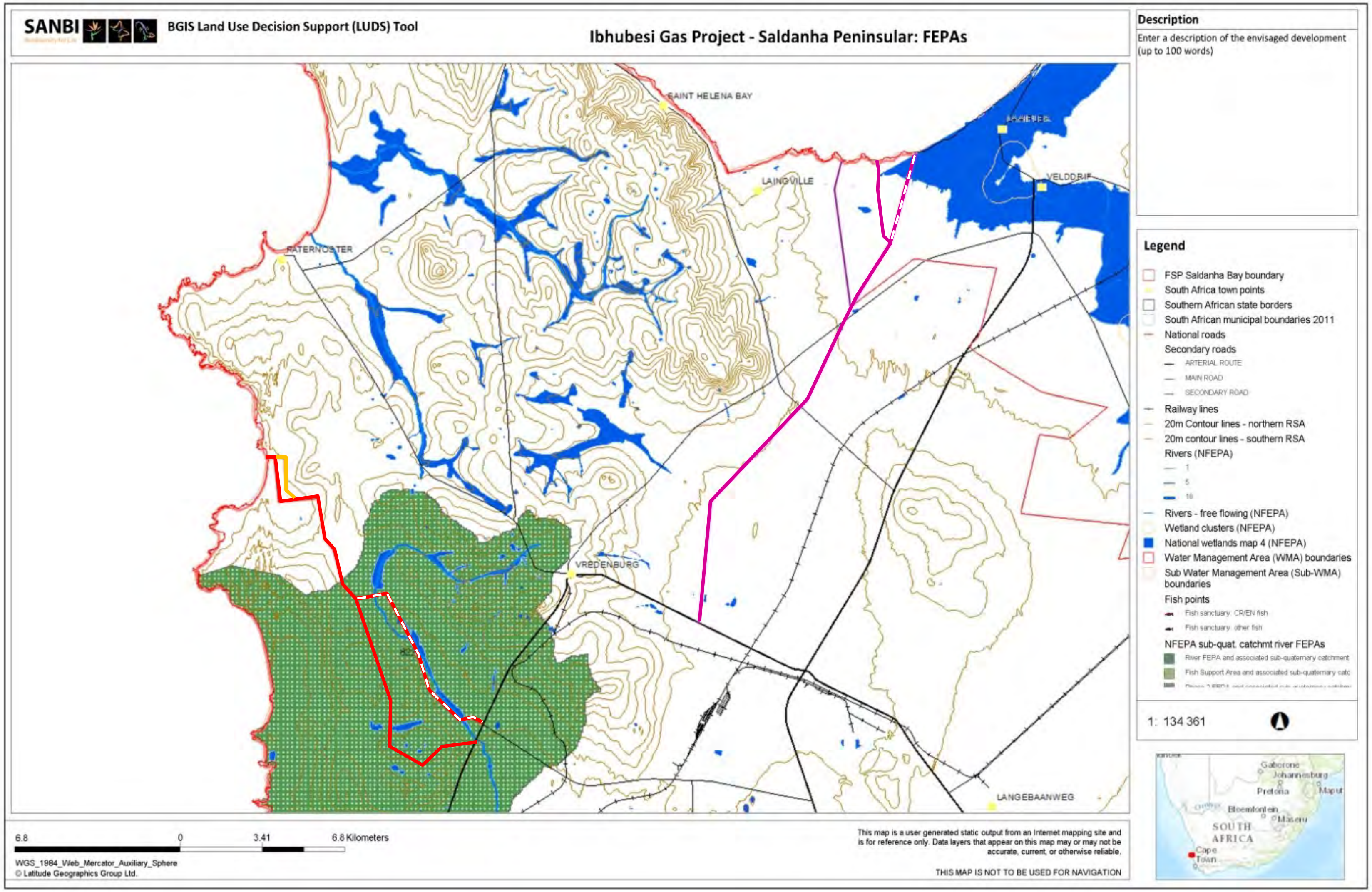


Figure 5.16: Proposed northern onshore pipeline routes in relation to the National Freshwater Ecosystem Priority Areas map (SANBI Biodiversity GIS, 2014). Note: the alternatives shown as stippled lines were dropped during the Scoping Phase and are no longer being considered.

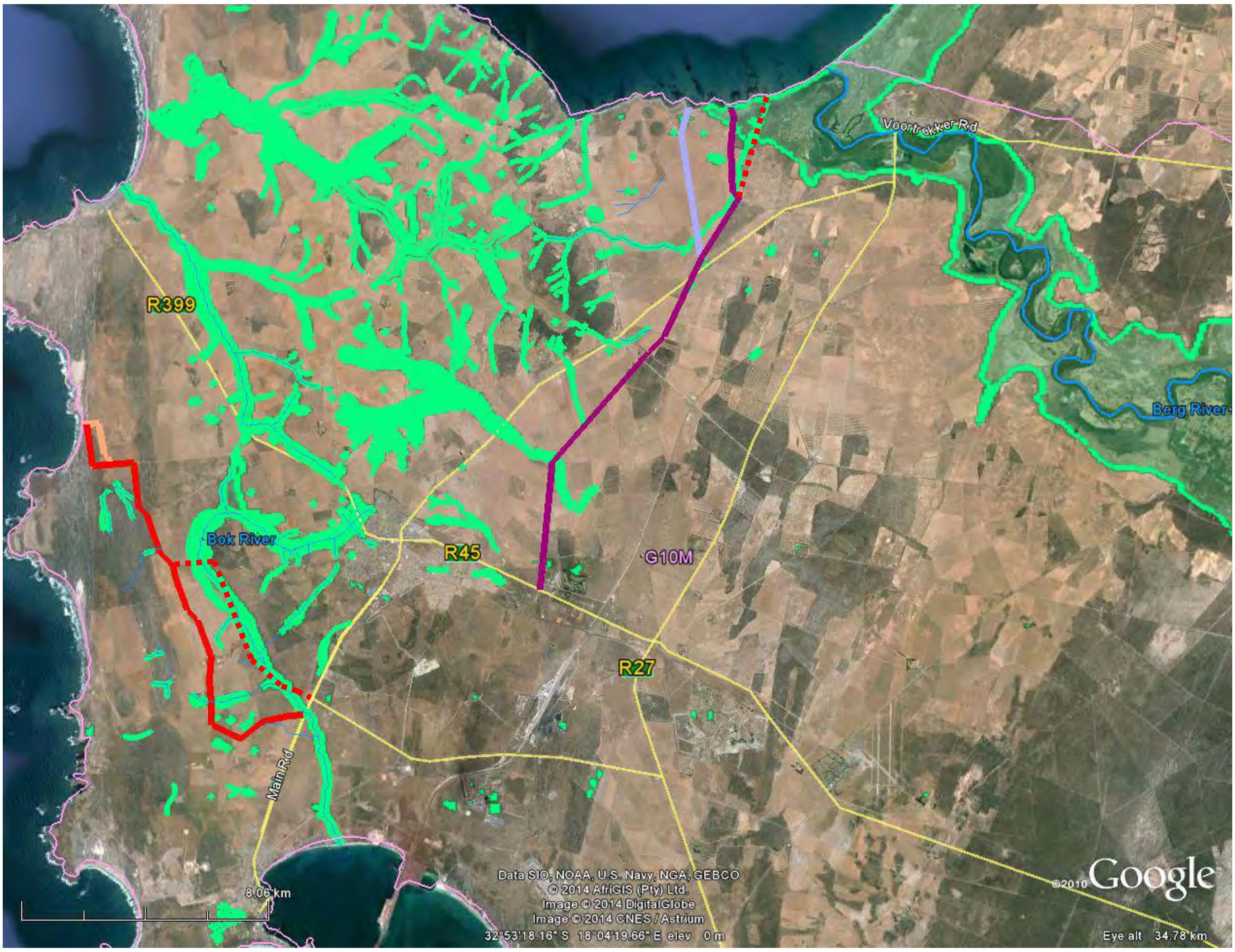


Figure 5.17: GoogleEarth image showing the northern onshore pipeline routes in relation to freshwater features (green areas). Note: the alternatives shown as stippled lines were dropped during the Scoping Phase and are no longer being considered.

5.3.5.2 Noordwesbaai

The only river of note within the vicinity of the Noordwesbaai alternative is the Bok River (see Figure 5.17 and Plate 5.19), which originates in Vredenburg at an elevation of 110 m. The river drains a relatively small catchment of approximately 66 km^2 that has largely been developed. The catchment is also very flat with a total river length of approximately 18 km. This low lying and flat catchment lends itself to the formation of Strandveld valley bottom wetland areas that occur mostly in the middle reaches of the river. The upper river and wetlands are highly seasonal in nature due to the low annual rainfall. Dry-land agriculture and some urban development have, however, not only altered the terrestrial vegetation in the catchment of the Bok River, but also resulted in the removal of much of the indigenous riparian vegetation and straightening of the river. Although the river is in a moderate to largely modified ecological state, it has been mapped as a Phase 2 FEPA (i.e. should not be degraded further).

The original route was located within the Bok River corridor and Ecosystem Priority Area (see stippled lines in Figures 5.16 and 5.17). However, during the Scoping Phase the route was repositioned approximately 1 km to the west in order to avoid the Bok River system and its associated Strandveld wetlands areas. The proposed pipeline would cross the river at the R399 where the river is significantly impacted due to the removal of much of the indigenous riparian vegetation and straightening of the river.

Plate 5.19: **Noordwesbaai – middle reaches of the Bok River.**

5.3.6 HERITAGE

There are numerous archaeological sites (associated with granite outcrops) on the Saldanha Peninsula, as the area was a major settlement point for the Khoikhoi population. The major archaeological site, “Kasteelberg”, has been nominated for Provincial Heritage Site status. Occasional historical buildings can also be found here.

The flat coastal plain on the edge of Saldanha Bay is used mainly for agriculture but has an increasingly industrial ambience. Its primary heritage significance is the fossil deposit associated with fluctuations of the Langebaan Lagoon complex and the proto-berg estuary. The main part of this fossil rich system is represented at the West Coast Fossil Park National Heritage Site. The coastal plain to the north of Saldanha Bay is not archaeologically sensitive.

5.3.6.1 St Helena West and East

(a) Palaeontology

The fossil record along these routes is relatively unknown. However, fossil sharks’ teeth and terrestrial fossils have been reported from deposits exposed on the banks of the Berg River estuary. Given the sedimentology of the region, it is likely that marine and/or terrestrial fossils would occur in Varswater, Springfontyn and Langebaan Lagoon Formation sediments should they be encountered during excavations. Indications are, however, that much of the proposed activity would take place in recent and more superficial surface deposits that are not as sensitive.

(b) Pre-colonial archaeology

Immediately west of the mouth of the Berg River are a series of at least nine early fish traps built into the shallow waters of the bay (Hart & Halkett 1992) (see Figure 5.18 and Plate 5.20). The unique shoreline topography west of the Berg River mouth is suited to the construction of traps – a shallow and long intertidal zone with plenty of rocks and boulders. The traps take the form of elliptical coffer dams. The walls are steep sided on the inside and gently sloping on the outsides. At times of spring tides these could be very effective at trapping fish that came inshore to feed. Initially it was thought that prehistoric people were responsible for building the traps. However, it is now known that stone wall fish traps were maintained throughout historical times by both farming and mission communities. The duration of use is unknown and may well have its origins in precolonial times. A survey of the area reports no other finds of archaeological material (Hart & Halkett 1992).

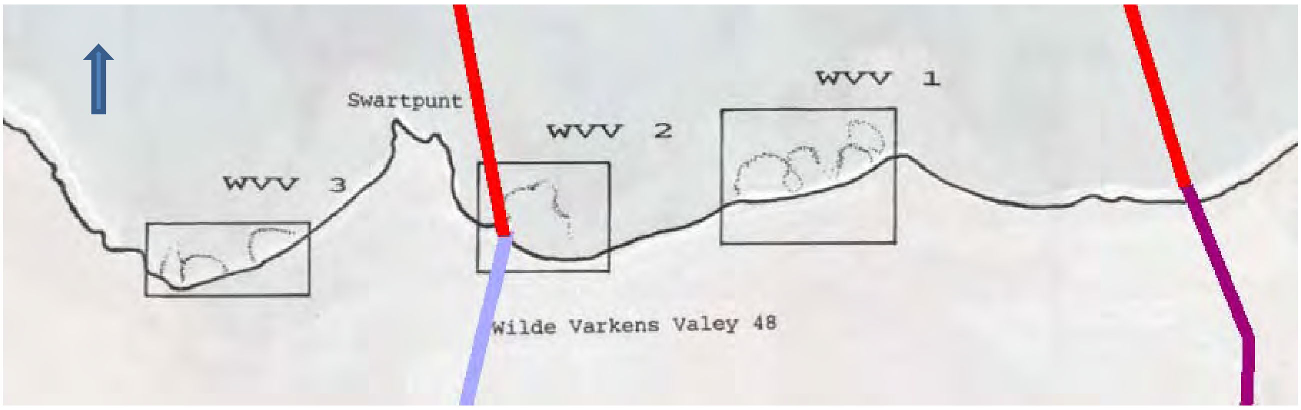


Figure 5.18: The location of the St Helena shore-crossing sites relative to fish trap clusters west of the Berg River mouth (adapted from Hart & Halkett 1992).

Plate 5.20: A fish trap located at Swartpunt near the St Helena West alternative.

5.3.6.2 Noordwesbaai

(a) Palaeontology

Given the sedimentology of the region, it is likely that marine and/or terrestrial fossils would occur in Varswater, Springfontyn and Langebaan Lagoon Formation sediments should they be encountered during excavations. However, it is doubtful if the pipeline excavation would penetrate deep enough to have any impacts. There may be occasional fossils within the calcretes that characterise this area.

(b) Archaeology

The proposed shore-crossing site avoids any surface manifestations of archaeological material. Similarly, the pipeline through the dunes would not impact surface archaeological material. Inland of the dunes agricultural land commences where the soils appear shallow and are strewn with chunks of calcrete ploughed up from below.

5.3.7 SOCIO-ECONOMIC ENVIRONMENT

The proposed landing points for the northern pipeline routes fall under the jurisdiction of the West Coast District Municipality (Saldanha) (see Figure 5.19).

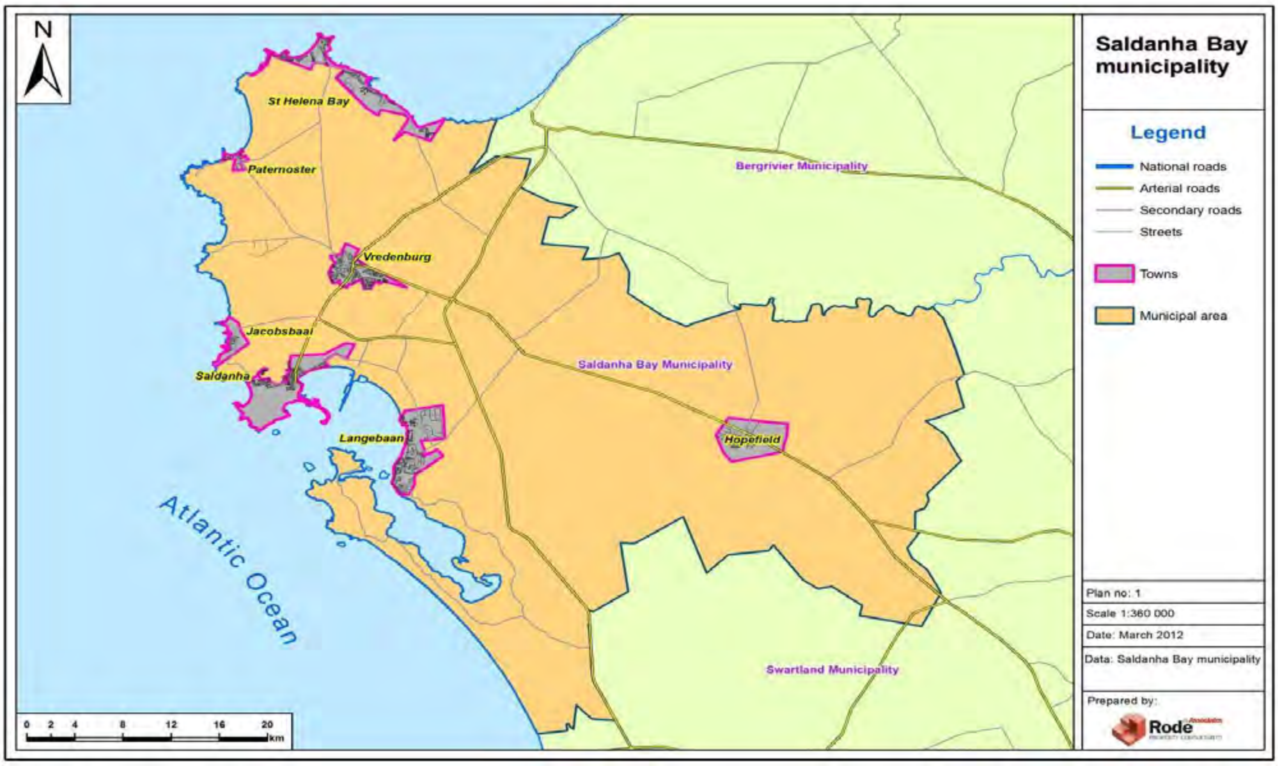


Figure 5.19: Map showing the municipal boundaries of the Saldanha Bay Municipality along the southwest coast of South Africa (IDP 2012-2017).

5.3.7.1 Local municipalities and affected towns

The estimated population of the West Coast District Municipality (WCDM) is 391 766 (Statistics South Africa, 2011). This equates to a population density of 12.6 persons/km^2. The population growth rate between 2001 and 2011 was 38.6%. This population increase was at a higher rate than any other district in the Western Cape. The key sectors in the district's economy are finance, insurance, property and business services; manufacturing; and agriculture, hunting, forestry and fishing. Despite agriculture, hunting, forestry and fishing only accounting for 16.7% of the contribution to the district's GDP, it employs significantly more of the labour force than any other sector at 27.9%. The poverty rate for the district was the second highest in the province, only second to the Central Karoo, at 30.4%. The unemployment rate is relatively low for South Africa at 15.5% (Western Cape Government, 2012).

The Saldanha Bay Local Municipality is one of five local municipalities occurring within the WCDM. It covers an area of 2 015 km² with a coastline of 238 km. The head office is located in Vredenburg, with satellite offices in Hopefield, St Helena Bay, Paternoster, Saldanha and Langebaan.

Saldanha Bay has the largest population in the WCDM, at the current census it was 99 193 with a growth rate between 2001 and 2011 of 40.8%. The population is made up of 14.3% Black, 56.9% Coloured and 28.2% White. Afrikaans is the most widely spoken (72.5%), followed by isiXhosa (16.4%) and English (6.6%). Saldanha Bay employs the largest percentage of the labour force in the West Coast district (29.3%) and has a relatively low unemployment rate of 17.9%, although this is higher than the district overall. The poverty rate for the municipality was the lowest in the district, at 23.9%. The key sectors in the municipality's economy are agriculture, hunting, forestry and fishing; community, social and personal services; and finance, insurance, property and business services.

The Saldanha Bay Local Municipality is predominantly urban and the major settlements in the area are Vredenburg, Saldanha and Langebaan. The area is very dry and arid. Therefore, despite Saldanha Bay having the deepest and largest natural harbour in the Southern Hemisphere, little large-scale industrial development has occurred until recently. A railway line was built from Sishen in the Northern Cape to Saldanha Bay in order to transport iron-ore and more recently, Saldanha was designated as an Industrial Development Zone (IDZ). The IDZ activities are specifically focused on the oil and gas sector, as the IDZ looks to capitalize on the growing oil and gas sectors on the East and West coast of Africa. The first phase of the IDZ will be the development of 128 ha of industrial land adjacent to the Port of Saldanha.

5.3.7.2 Planning

Refer to Section 5.2.7.2 for descriptions of the following:
- Draft Infrastructure Development Bill (2013) and Strategic Integrated Projects;
- National Development Plan (2030);
- Western Cape: Provincial Spatial Development Framework (2014);
- Western Cape Infrastructure Framework (2013);
- Micro-Economic Development Strategy for the Western Cape (2006); and
- One Cape 2040 (2012).

(a) West Coast District Municipality Integrated Development Plan (2012-2016) and Spatial Development Framework (2014)

A key objective of the WCDM Integrated Development Plan (IDP) (2012-2016) is “pursuing economic growth and the facilitation of job opportunities”. Economic development and progress with the implementation of the Saldanha Bay IDZ are identified as district-wide development issues and priorities. The IDP further states that the district is to be promoted as an investment destination and that projects which provide a catalyst for job creation and income should be supported.

The WCDM Spatial Development Framework (SDF) identifies the Vredenburg-Saldanha area as a major regional growth centre. The Saldanha Bay harbour is considered as a key economic centre and major growth node within the district for unlocking trade and manufacturing opportunities. The SDF also identifies as a priority the utilisation and optimisation of the Saldanha Bay harbour by making better use of the back of port areas and considering and promoting oil and gas industries within the port. The improvement and expansion of infrastructure at the Saldanha Bay IDZ area and iron ore railway line is identified as a key and strategic spatial objective in the WCDM SDF.

(b) Saldanha Bay Municipality IDP (2012– 2017) and SDF (2011)

The oil and gas industry is seen as an important growth sector for the Saldanha Bay Municipality, along with tourism, steel fabrication and aquaculture. Saldanha Bay’s importance as a development node comes from its natural and locational comparative advantages. The most significant of these natural advantages are:
- Best deep water harbour on the African Continent; and
- Close proximity to Cape Town

As noted earlier, Saldanha has been identified as an IDZ, which looks to capitalize on the growing oil and gas sectors on the East and West coast of Africa.

6. IMPACTS ON THE BIOPHYSICAL ENVIRONMENT

This chapter describes and assesses the significance of potential impacts on the biophysical environment (offshore and onshore) from the proposed Ibhubesi Gas Project and associated alternatives. All impacts are systematically assessed and presented according to predefined rating scales (see Appendix 3). Mitigation or optimisation measures are proposed which could ameliorate the negative impacts or enhance potential benefits, respectively. The status of all impacts should be considered to be negative unless otherwise indicated. The significance of impacts with and without mitigation is also assessed.

As indicated in Chapter 1 and 3, Sunbird has re-evaluated the original development proposal and is considering various additional and alternative project components from that originally approved / authorised. Since the original approvals will remain in place, this section only assesses the potential impacts related to the additional and alternative project components, namely:

- The installation of either a FPSO or a semi-submersible production facility in the licence area;
- An approximately 400 km offshore pipeline from the production facility to a shore-crossing site located between Grotto Bay and Duynefontein and one on the Saldanha Peninsula;
- An onshore pipeline between the shore-crossing site and Ankerlig and potential end users on the Saldanha Peninsula; and
- An onshore gas receiving facility, at a location adjacent to Ankerlig or the Silwerstroom Strand Water Treatment Plant.

Thus aspects relating to seismic surveys, well drilling, subsea in-field infrastructure, extraction and separation of well fluids, treatment and discharge of produced water, offshore support (vessels and helicopter operations) are not assessed in this S&EIA. Table 3.1 provides a summary of the project components for which approval is already in place.

Potential biophysical impacts are assessed in the following sections:

- Section 6.1: Offshore biophysical impacts
- Section 6.2: Onshore biophysical impacts
  - > Section 6.2.1: Vegetation impacts
  - > Section 6.2.2: Terrestrial fauna impacts
  - > Section 6.2.3: Freshwater ecology impacts

The specialist reports on which this chapter is based are presented in the following appendices:

- Marine Ecology Assessment (see Appendix 6, Vol. 2);
- Oil Spill Assessment (see Appendix 8, Vol. 2);
- Vegetation Assessment (see Appendix 9, Vol. 2);
- Freshwater Assessment (see Appendix 10, Vol. 2); and
- Terrestrial Faunal Assessment (see Appendix 11, Vol. 2).

6.1 OFFSHORE BIOPHYSICAL IMPACTS

6.1.1 PHYSICAL DAMAGE TO AND DISTURBANCE OF THE SEABED

Physical damage to and disturbance of the seabed could result from a number of activities, including:

- Installation of the production pipeline on the seabed;
- Installation of the proposed production pipeline through the intertidal and shallow subtidal zone at the shore-crossing locations; and
- Anchoring of platforms and pipe-laying / support vessels (e.g. impact depressions, scars, mounds and displacement from anchor deployment, tensioning, dragging or retrieval of anchors).

Physical damage to and disturbance of the seabed (many of which are analogous to natural processes associated with sediment mobilisation through wave action, tidal and surge currents) has the potential to affect relatively immobile or sedentary benthic species directly and indirectly (e.g. loss of benthic prey items for bottom feeding species).

Since these activities could result in a range of effects at various spatial and temporal scales, they are discussed separately below.

6.1.1.1 Installation of subsea pipeline on the seabed

Description of impact

The installation of the proposed production pipeline on the seafloor could potentially affect benthic communities through the physical crushing of relatively immobile / sedentary species within the structural footprint of the pipeline and disturbance of infauna through displacement of sediments in the immediate area of deployment. This in turn may have indirect effects on higher order bottom feeding consumers through the direct loss of benthic prey items.

Assessment

The proposed 400 km offshore pipeline would be laid on the seafloor from the production facility to the shore-crossing site. The pipeline would run roughly parallel to the coast between the 100 m and 250 m contour line (see Figure 3.5), with the final routing being determined by a subsea route and site survey. In order to provide some protection and help to reduce buoyancy and improve stability, the pipeline (or sections thereof) may be provided with concrete mattress protection.

In soft, unconsolidated substrata the pipeline would settle into the sediments, whereas over hard ground it would lie above the seabed. Where the pipeline settles into the sediment, it would have a maximum structure footprint of approximately 0.18 km^2 (i.e. 18 ha), which is considered to be an insignificant percentage of the Namaqua Bioregion as a whole. The impact would ultimately depend on the extent of the habitat types disturbed relative to the total available area of that particular habitat type. The majority of the proposed offshore production pipeline route coincides with benthic habitats mapped as 'least threatened' (see Figure 4.7). The pipeline would, however, traverse sensitive areas as it approaches the coast. All routes would traverse both "endangered" and "vulnerable" habitats (see Table 6.1; Figures 4.9 and 4.10). All pipeline routes, excluding the Grotto Bay alternatives, would also traverse "critically endangered" habitat.

Table 6.1: Number of times the proposed pipeline alternatives pass through the four habitat threat status categories on route to the coast.

Habitat Threat Status	Shore-crossing alternatives					
	Southern shore-crossings			Northern shore-crossings		
	Grotto Bay	Silwerstroom Strand	Duynefontein	St Helena East	St Helena West	Noord-wesbaai
Critically Endangered	0	1	1	2	2	1
Endangered	1	1	1	1	1	2
Vulnerable	2	1	1	1	1	2
Least Threatened	1	2	2	5	5	5

Deep reefs and other hard ground habitats in particular, which potentially occur along all the pipeline routes, may support fragile, structurally complex species that in turn provide habitat for other species. Many of the cold water corals, black corals, gorgonians and sponges typical of such habitats are long-lived and slow-growing, and as such have slow recovery times after disturbance. Of particular relevance on the shelf area inshore of the 200 m depth contour through which the pipeline would traverse, are areas of the habitat forming sponge, *Suberites sp*. As some types of sponge-dominated communities have been considered sensitive and potentially vulnerable, these sponge beds on the continental shelf off the West Coast have been identified as potential Vulnerable Marine Ecosystems (VMEs) (see Figure 4.14). Similarly, numerous slow-growing and potentially vulnerable species of seapen have been recorded from unconsolidated sediments beyond 75 m depth.

Once the gas pipeline has been laid, the affected seabed areas around the pipeline would with time be recolonised by benthic macrofauna. The rate of recovery/re-colonisation depends largely on the type of community that inhabits the affected benthic habitats, the extent to which the community is naturally adapted to high levels of disturbances, the sediment character (grain size) and physical factors such as depth and exposure (waves, currents). Recolonisation takes place by passive translocation of animals during storms or sediment influx from nearby unaffected areas, active immigration of mobile species, and immigration and settlement of pelagic larvae and juveniles.

In general, communities of short-lived species and/or species with a high reproduction rate (opportunists) 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. Re-colonisation by such species starts rapidly after a disturbance and species numbers may recover within periods of only a few weeks. The unconsolidated sediments on the Southern Benguela Sandy Outer Shelf are generally dominated by such short-lived macrofaunal communities. Therefore, provided the sediment characteristics of the impacted area are not dramatically altered, recovery of such communities following disturbance would be expected within five years. Conversely, more stable habitats (characterised by coarser sediments) are typified by large, often burrowing, slow growing and long-lived species. As long-lived species need longer to re-establish the normal age and size structure of the population, biomass often remains reduced for several years. Recovery times are not only dependent on sediment characteristics, but also local hydrodynamic conditions and depth. Since the proposed pipeline would be located between the 100 m and 250 m depth contour below the wave base, recovery would be expected to be comparatively slow. As the pipeline approaches the shore, where there are shallower water depths (<30 m depth), recovery can be expected to occurs within one year.

The intensity and duration of the potential impact for all alternatives depends on the substrate type with impacts on unconsolidated sediments being considered to be of medium intensity in the short-term as recolonisation would occur rapidly from adjacent undisturbed sediments, while impacts on hard grounds (deep water reefs, vulnerable sponge fields and sea pen populations) are considered to be of high intensity in the medium-term. As the impact would extend over a linear distance of at least 400 km across two bioregions, the impact is considered to range from local to regional in extent. Therefore, this impact is assessed to be of **medium** (unconsolidated sediments) to **high** (hard grounds) significance without mitigation regardless of the shore-crossing alternative. With careful routing of the proposed pipeline and the avoidance of sensitive habitats, the significance could reduce to **LOW** (see Table 6.2).

Mitigation

During the detailed design stage, an ROV (or similar device) should be used to survey the seafloor along the entire pipeline route in order to confirm the presence or absence of any significant topographic features (e.g. rocky outcrops) and potential vulnerable deep water habitats (e.g. deep water reefs, vulnerable sponge fields and sea pen populations). If detected, the final pipeline position should, as far as practically possible, be adjusted to avoid these sensitive benthic habitats, particularly areas of high sponge biomass (see Figure 4.14).

Table 6.2: Assessment of the potential impact on benthic communities as a result of physical damage and disturbance during pipeline installation on the seabed.

Rating scales	Without Mitigation	With Mitigation
Unconsolidated sediments		
Extent	Local to Regional	Local to Regional
Duration	Short-term	Short-term
Intensity	Medium	Medium
Significance	**Medium**	**LOW**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High
Hard grounds		
Extent	Local to Regional	Local to Regional
Duration	Medium-term	Short-term
Intensity	High	Medium
Significance	**High**	**LOW**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the benthic environment include demersal trawling, mining, oil and gas exploration / production and the installation of other subsea infrastructure (e.g. telecommunications cables, wells, etc.). Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Irreversible	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	Low	

6.1.1.2 Installation of the pipeline through the intertidal and shallow subtidal zone

<u>Description of impact</u>

The installation of the proposed production pipeline through the intertidal and shallow subtidal zone could affect benthic communities through the physical crushing of relatively immobile / sedentary species and disturbance of infauna through displacement of sediments in the immediate area of deployment.

The invertebrate macrofaunal species inhabiting beaches in the study area are important components of the detritus / beach-cast seaweed-based food chains. As such, they assimilate food sources available from the detritus accumulations typical of this coast and, in turn, become prey for surf zone fishes and migratory shorebirds that feed on the beach slope and in the swash zone. By providing energy input to higher trophic levels, they are important in nearshore nutrient cycling, and a significant reduction or loss of these macrofaunal assemblages may have cascade effects through the coastal ecosystem.

<u>Assessment</u>

The pipeline would be buried through the surf zone and the degree of disturbance and/or loss of benthic biota in the coastal zone would be dependent on which installation method is used, namely trenching and bottom tow or horizontal directional drilling. The selection and feasibility of each installation method is dependent on a number of factors, including geotechnical, metocean conditions (wind, waves and currents), beach characteristics and overall length of the shore-crossing. Table 3.3 presents the likely pipeline installation methods for each shore-crossing alternative. Based on the initial engineering site assessment, the Grotto Bay alternative is the only alternative that appears suitable for the horizontal directional drilling method. The other shore-crossing alternatives would more than likely require the trenching and bottom-tow method, including the St Helena West and East alternatives due to the fractured nature of the rock.

At Grotto Bay the horizontal directional drilling method would not affect intertidal and shallow subtidal habitats, as the pipeline passes below the seabed. However, at the seaward end of the borehole, the emergence of the drill bit and reamer would result in localised increased suspended sediment concentrations in the water column and potential smothering of seabed communities by re-depositing sediments.

In contrast to the horizontal directional drilling method, the installation of the pipeline via a trench through the surf zone (all alternatives except Grotto Bay) would involve considerable disturbance of the high shore, intertidal and shallow subtidal beach (and/or rocky shore) habitats during the construction and installation process. In addition, this installation method may also require the construction of a temporary sheet piled cofferdam and temporary jetty (or groin) to provide a working platform from which the work through the beach zone can be carried out. Although the activities on the shore would be localised and confined to within approximately 100 m of the pipeline, the beach sediments would be completely turned over in the process and the associated macrofauna would almost certainly be entirely eliminated. The excavation process would also result in increased suspended sediments in the water column and physical smothering of macrofauna by the discarded sediments. In the case of the rocky intertidal zone at the St Helena alternatives, the benthic biota would similarly be either removed through blasting or severely disturbed or eliminated through trampling and crushing. Blasting may also be required at Silwerstroom Strand and Noordwesbaai if the bedrock is shallow beneath the sand. Any shorebirds feeding and/or roosting in the area would also be disturbed and displaced for the duration of construction activities.

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. Nearshore waters on the West Coast are naturally turbid as a result of the high wave energy environment and riverine discharges (e.g. Berg River). Nonetheless, increased suspended sediments in the surf zone and nearshore can potentially affect light penetration and thus phytoplankton productivity and algal growth, load the water with inorganic suspended particles, which may affect the feeding and absorption efficiency of filter-feeders, and can cause scouring. The impact of the sediment plume is expected to be relatively localised and of short duration (only for the duration of construction activities below the low water mark). As 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. However, sand inundation of reef habitats has been found to directly affect species diversity whereby community structure and species richness appears to be controlled by the frequency, nature and scale of disturbance of the system by sedimentation.

Recolonisation would commence rapidly after cessation of trenching in unconsolidated sediments, and species numbers may recover within short periods (weeks), whereas biomass often remains reduced for several years. Studies on the disturbance of beach macrofauna communities on the West Coast by beach mining activities have ascertained that, provided physical changes to beach morphology are kept to a minimum, and sediment characteristics on the beach are not severely altered, biological ‘recovery’ of disturbed areas occur within two to five years. Disturbed subtidal communities within the wave base (<40 m water depth) might recover even faster. In the case of rocky shores (e.g. St Helena West and East alternatives), intertidal and subtidal organisms would be damaged or destroyed through the removal of rocks, and general movement of equipment and plant. Studies have shown that high intensity trampling can result in the removal of most of the rocky intertidal assemblages, although the effects are dependent on the community present. While recovery of the intertidal and subtidal communities is rapid, 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.

The impact on benthic communities for all shore-crossing alternatives except Grotto Bay, as a result of pipeline installation through the intertidal and shallow subtidal, would be of medium to high intensity. The impact is expected to endure over the short-term only, as communities within the wave-influenced zone are adapted to frequent natural disturbances, with recovery occurring within two to five years. The impact would be localised being confined to within 100 m of the pipeline through the intertidal and surf zone. Therefore, this impact is assessed to be of **low** significance without mitigation and **VERY LOW** significance with mitigation (see Table 6.3).

In the case of the horizontal directional drilling method used at Grotto Bay, the impact area would be confined to where the offshore pipeline enters the seabed and the localised increase in suspended sediment concentrations. This impact is considered to be **INSIGNIFICANT** with and with mitigation (see Table 6.3).

<u>Mitigation</u>

The following mitigation measures are recommended:

- The preferred method of installation is horizontal directional drilling. Although this method may only be suitable at Grotto Bay, it is recommended that a detailed geotechnical site investigation be undertaken to determine the possibility of using this installation method, specifically at St Helena Bay and Silwerstroom Strand where there is a rocky intertidal zone or potentially shallow bedrock beneath the sand. As far as practicably possible and where the geology allows it, the horizontal directional drilling method should be the preferred installation option;
- Final pipeline alignment should, as far as practicably possible, avoid sensitive benthic habitats in the coastal zone (see Figures 4.9 and 4.10);
- Once the design is finalised and the associated construction site is determined, the area located outside of the site should be clearly demarcated and regarded as a ‘no-go’ area;
- Heavy vehicle traffic within the coastal zone should be kept to a minimum. In this regard, construction vehicles should be restricted to clearly demarcated access routes and construction areas. These areas should be defined in consultation with a marine / coastal ecologist;
- A vehicle access permit must be obtained from DEA (Branch Oceans and Coasts) prior driving in the coastal zone;
- All artificial constructions or beach modifications (e.g. cofferdam, jetty or groin) must be removed after pipeline installation; and
- No accumulations of excavated beach sediments should be left above the high water mark. Any substantial sediment accumulations below the high water mark should be levelled to follow the natural beach profile.

Table 6.3: Assessment of the potential impact on benthic communities as a result of physical damage and disturbance during pipeline installation through the coastal zone.

Rating scales	Without Mitigation	With Mitigation
All shore-crossing alternatives, except Grotto Bay		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Medium to High	Medium
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High

Grotto Bay alternative		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the benthic environment include mining, installation of other infrastructure through the surf zone (e.g. telecommunications cables, outfalls, etc.) and subsistence harvesting. Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	Low	

6.1.1.3 Anchoring of production facility and support vessels

Description of impact

The production facility would be held in position by six to eight anchors, which would displace or disturb seabed materials (e.g. impact depressions, scars and mounds). In setting the anchors, benthic epifauna and infauna are thus likely to be disturbed and / or crushed, including the subsequent potential tensioning or dragging of the anchors and anchor chains. There would also be minor disturbance from the anchoring of support vessels. Physical damage and disturbance has the potential to affect relatively immobile or sedentary benthic species directly and indirectly (e.g. loss of benthic prey items for bottom feeding species).

Assessment

The area of disturbance would vary depending on the number of anchors used, the length of anchor chain on the seabed and the substrate type. A review of video footage from previous drilling operations in Block 2A has confirmed that the seabed is comprised of unconsolidated sediments, with some evidence of patches of shelly grit. Although the area in which the production facility would be anchored (see Figure 3.3) coincides with benthic habitats mapped largely as ‘least threatened’, isolated areas with vulnerable / sensitive species (e.g. vulnerable sponge, gorgonians and sea pen populations) have been observed in the gas field (see Figure 4.14).

The duration of impact would ultimately depend upon the nature of the sediments and associated fauna community. Observations of anchor scars and mounds following diamond mining activities in unconsolidated sediments off Namaqualand found that the scars did not persist for more than two years. Anchoring over hard grounds would, however, result in impacts over the medium-term as these communities are sensitive to disturbance due to their long generation times.

Considering the available area of similar habitat on the continental shelf in the Namaqua Bioregion, this minimal disturbance of and reduction in benthic biodiversity can be considered negligible, with no cascade effects on higher order consumers expected. The impacts of anchor deployments from the production facility (both alternatives) and support vessels would be highly localised and of low (unconsolidated sediments) to medium (hard grounds) intensity. Although recovery is expected to take place within two to five years, the impact would persist over the medium to long-term due to the anticipated life of the gas field (i.e. 15 years). Therefore, the impact on unconsolidated sediments is assessed to be of **VERY LOW** significance with and without mitigation, while the impact on hard grounds is assessed to be of **low** significance without mitigation and **VERY LOW** with mitigation (see Table 6.4). It should be noted that this impact is no different to the impact associated with the anchoring of a Tension Leg Platform, which was approved as part of the original project proposal.

Mitigation

A ROV (or similar device) should be used to survey the seafloor prior to platform installation in order to confirm the presence or absence of any significant topographic features (e.g. rocky outcrops), vulnerable habitats and / or species (e.g. cold-water corals, sponges) in the area. The ROV survey should comprise a grid of equally spaced transects over the full extent of the required anchor spread. If significant topographic features or vulnerable habitats are detected within the anchor spread area, the position of the production facility should be adjusted accordingly.

Table 6.4: Assessment of the potential impact on benthic communities due to anchoring of production facility and support vessels.

Rating scales	Without Mitigation	With Mitigation
Unconsolidated sediments		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Low	Very Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	High	High
Hard grounds		
Extent	Local	Local
Duration	Long-term	Medium-term
Intensity	Medium	Very Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the benthic environment include demersal trawling, mining, oil and gas exploration / production and the installation of other subsea infrastructure. Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Low	

6.1.2 PHYSICAL PRESENCE OF THE PIPELINE AND ASSOCIATED STRUCTURES

Description of impact

The presence of the production pipeline and associated structures (e.g. concrete mattress or rock protection) would effectively increase the amount of hard substrate that is available for the colonisation of benthic organisms (including alien species) resulting in faunal attraction to fish and mobile invertebrates. This may increase biodiversity and biomass in along the production pipeline. The presence of the production pipeline could also have an impact on demersal species that migrate through the area, having their migration routes disturbed or altered by the subsea infrastructure.

<u>Assessment</u>
Installation of the production pipeline and associated structures would effectively eliminate any sandy- or rocky-substrate biota within the structural footprint and reduce the area of seabed available for colonisation by marine benthic communities. The loss of substratum as a result of the pipeline installation would, however, be temporary, as the pipeline itself would provide an alternative substratum for colonising communities.

Assuming that the hydrographical conditions around the pipeline would not be significantly different to those on the seabed, a similar community to one on nearby hard grounds can be expected to develop. In areas where the pipeline is located primarily on unconsolidated sediments, the presence of the pipeline would effectively increases the diversity of habitat available for benthic organisms. The biota developing on the structures would be significantly different from the original soft sediment macrobenthic communities, resulting in increased biodiversity and biomass on, and in the vicinity of, the pipeline. As indicated in the previous section, video footage from Block 2A has confirmed that the seabed is comprised of unconsolidated sediments, with some evidence of patches of shelly grit and isolated areas with vulnerable / sensitive species (e.g. vulnerable sponge, gorgonians and sea pen populations). Thus the proposed pipeline could effectively increase the amount of hard substrate that is available for the colonisation of vulnerable / sensitive benthic species. Similarly, although less likely due to appropriate ballast management, it could also support the presence of alien species introduced with drilling units, production facility and / or subsea infrastructure in the gas field. On an otherwise relatively featureless seabed, the presence of the pipeline and its associated benthic communities would also likely result in the attraction and aggregation of fish and mobile invertebrates.

Since the pipeline would either be buried through the coastal / surf zone (and possibly for some of the distance offshore), it should not in any way hinder the longshore movement of invertebrates and fish (juvenile or adult) inhabiting the surf zone or shallow inshore areas. The presence of the pipeline is also unlikely to affect the migration of the West Coast rock lobster, which migrates inshore during the summer months in response to declining offshore bottom oxygen levels. This assumption is based on the fact that the majority of the pipeline is located beyond the 100 m water depth inhabited by the rock lobster and the pipeline diameter (14- to 18-inch) would not pose an obstacle to these mobile predators. Once succession communities have developed on the pipeline, it may in fact serve as a suitable artificial reef habitat and attract rock lobsters, particularly where it traverses the inner shelf to the shore-crossing sites.

The impacts on marine and coastal communities through the physical presence of the pipeline and associated structures would be of medium intensity. Although limited to the width of the pipeline, the impact would extend over the length of the pipeline (local to regional). As the pipeline would be abandoned on the seafloor during decommissioning, the impact would be permanent. The status of the impact could, however, be seen as positive as the pipeline would result in localised increase in benthic biodiversity and may serve to attract fish and mobile invertebrates (e.g. rock lobsters). The potential impact on marine biota for all pipeline alternatives is consequently deemed to be of **MEDIUM (positive)** significance both without and with mitigation (see Table 6.5).

<u>Mitigation</u>
No mitigation is considered necessary.

Table 6.5: Assessment of the potential impact on benthic communities due to the physical presence of the pipeline and associated structures.

Rating scales	Without Mitigation	With Mitigation
Extent	Local to Regional	Local to Regional
Duration	Permanent	Permanent
Intensity	Medium	Medium
Significance	**Medium**	**MEDIUM**
Status	Positive	Positive
Probability	Definite	Definite
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the benthic environment include the installation of other subsea infrastructure (e.g. wellheads and subsea production system, telecommunication cables, etc.). Cumulative impact is considered to be of LOW positive significance.	
Degree to which impact can be reversed	Irreversible	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	None	

6.1.3 NOISE, VIBRATIONS AND LIGHTING

6.1.3.1 Potential impacts related to noise, vibrations and blasting

Description of impact

During construction of the temporary jetty / groin and pipeline trenching operations (all alternative except Grotto Bay), noise and vibrations from pylon-drivers and excavation machinery may have an impact on surf zone biota, marine mammals and shore birds in the area. In addition, if the shore-crossing locations are proposed for sandy shorelines with subtidal reefs close to shore (e.g. St Helena West and East), trenching of the pipeline may require blasting. Some blasting may also be required further offshore should the shore-crossing traverse nearshore reefs or the bedrock be too shallow (e.g. Silwerstroom Strand and Noordwesbaai).

Potential impacts of noise, vibrations and blasting include mortality and injury, behavioural avoidance of construction area, masking of environmental sounds and communication and indirect impacts due to effects on predators or prey.

Assessment

Effects of underwater blasting on marine organisms have received extensive coverage in formal peer-reviewed scientific literature, as well as in various assessments for seismic surveys, underwater construction and weapons testing. 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 passes into the surrounding medium as a shock wave. The shock wave is the primary cause of 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 exploding material, and in shallow water gaseous products produce minor shock wave amplitudes. The nature of the shock wave generated by a blast depends on the type of explosive used. Relatively low energy explosives produce a shock wave with a shallow rise height. Dynamite and other high explosives have a rapid detonation velocity and produce a more abrupt shock wave. Consequently, high explosives have more dramatic effects on marine organisms.

Research on blast-effects on a variety of shallow water (<10 m) organisms has found the following:

- Any effects on macrophytes through blasting would be 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 to the immediate area of blasting;
- In fish, the swim bladder is the organ most frequently damaged through blasting, potentially leading to high mortality in the immediate area of blasting. In contrast, fish species that do not possess swim bladders seem to be largely immune to underwater explosions. Eggs and fish larvae may also be affected by underwater explosions, but impact ranges seem to be restricted to the immediate vicinity of the blast. Although injury or mortality of fish and/or their eggs and larvae in the immediate area of the blasting is likely to occur, blasting would be undertaken outside key spawning areas (see Figure 4.15). The probability of the blasting programme having a measurable effect at the population level on fish in the study area is thus judged to be unlikely, as surf-zone and nearshore species along the West Coast 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;
- Similar to fish, injuries to marine mammals generated by underwater explosions are primarily trauma of various levels to organs containing gas, and mortality can occur in the immediate area around the blasting. Given the generally low numbers of seals in the study area relative to the overall population size any population level mortality effects, or injuries that may be caused are judged to be insignificant. Seals and scavenging birds may, however, be attracted to the blasting area by stunned and dead fish following a blast. Those dolphin and whale species that occur in shallow waters (<50 m) (either seasonally or year-round) would be vulnerable to detonations.

Noise levels relating to other construction activities (e.g. pylon-drivers and excavation machinery) are generally at a frequency much lower than that used by marine mammals for communication and these are, therefore, unlikely to be significantly affected. Additionally, the maximum radius over which the noise may influence is very small compared to the population distribution ranges of surf zone fish species, coastal birds, resident cetacean species and the Cape fur seal. These animals are highly mobile and should easily be able to move out of the noise-affected area.

The impacts on marine and coastal communities as a result of noise, vibrations and blasting would be of medium to high intensity. The duration of the impact would range from a few months for general construction related noise to intermittent blasting (short-term). Marine blasting may potentially be required at all the alternative sites except Duynefontein and Grotto Bay. Where blasting is necessary, the impact would be localised to within a few 100 m of the blast site. Pile driving would be required at all site alternatives except Grotto Bay. Where pile driving would occur, the impact would similarly be localised to within a few 100 m of the jetty/groin construction site. The potential impacts on marine organisms from construction noise, vibrations and blasting is consequently deemed to be of **low** to **medium** significance without mitigation and **VERY LOW** significance with the implementation of mitigation measures (see Table 6.6). The impact at Grotto Bay is considered **INSIGNIFICANT** as there would be not marine blasting or piling required at this shore-crossing site.

<u>Mitigation</u>

The following mitigation measures are recommended:

- During the detailed design stage, a detailed geotechnical site investigation should be undertaken (specifically at St Helena Bay and Silwerstroom Strand) to determine the possibility of using the horizontal directional drilling installation method. As far as practicably possible and where the geology allows it, the horizontal directional drilling method should be the preferred installation option;
- The pipeline alignment should be adjusted, where possible, to avoid nearshore reefs and rocky outcrops *en route* to the landing point;
- The blasting programme should be scheduled so as to avoid cetacean migration periods or winter

breeding concentrations (beginning of June to end of November). In addition, the summer breeding season of shore birds (primarily oystercatchers, gulls and terns) should also, where possible, be avoided.

- The number of blasts should be restricted to the absolute minimum required and to smaller, quick succession blasts directed into the rock using a time-delay detonation;
- All blasting activities should be conducted in accordance with recognised standards and safety requirements;
- Pre-blast surveys should be undertaken to ensure the impact zone is clear of marine mammals and diving seabirds (large flocks) and only once the impact zone and an associated buffer zone (i.e. within a 2-km radius of blasting point) have been declared free of marine mammals and diving seabirds should blasting commence. It is also recommended that:
  - > Observer teams are stationed some distances to the north and south of the blasting point (possibly just outside the impact zones) to monitor coastal dolphin movements immediately prior to any blasting. Observers are to be positioned at suitable vantage points (at some altitude) along the coast; and
  - > Observers on land should record and report all sensitive fauna, their positions, occurrence of calves and direction of movement to the Operations Manager.
- Passive Acoustic Monitoring (PAM) should be considered to detect the presence of small cetaceans in the impact area prior to blasting. Such acoustic monitoring would support that undertaken visually from the land, and has the advantage monitoring during periods of poor visibility; and
- As a blasting event may attract seals and scavenging birds to stunned or dead fish, the blasting programme should be scheduled to allow seals to leave the area before the next blasts commences.

Table 6.6: Assessment of the impact on marine fauna due to noise, vibrations and blasting.

Rating scales	Without Mitigation	With Mitigation
All shore-crossing alternatives, except Grotto Bay		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Medium to High	Medium
Significance	**Low to Medium**	**VERY LOW**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	Medium	Medium
Grotto Bay alternative		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Very Low	Very Low
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the benthic environment include inshore mining, installation of other infrastructure through the surf zone (e.g. telecommunications cables, outfalls, etc.). Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	Low	

6.1.3.2 Potential impacts related to noise from the production facility

Description of impact

Noise from machinery (including generators, motors and pumps) and subsurface infrastructure (including pipeline maintenance and operation) associated with the production facility (both alternatives) may be conveyed to the marine environment where it could potentially either disturb or attract marine fauna.

Assessment

Production noise is unlikely to extend beyond the vicinity of the platforms. Although the proposed project would be medium-term in duration, the extent of this impact is highly localised. The intensity of impact is likely to be low as natural, functions and processes are unlikely to be affected. This impact is considered to be of **VERY LOW** significance with and without mitigation (see Table 6.7). It should be noted that this impact is no different to the impact associated with the operation of a Tension Leg Platform, which was approved as part of the original project proposal.

Mitigation

No measures are deemed necessary to mitigate noise impacts from the production facility.

Table 6.7: Assessment of the potential impact of noise from production facility.

Rating scales	Without Mitigation	With Mitigation
Extent	Local	No mitigation is proposed
Duration	Medium-term	
Intensity	Low	
Significance	**Very Low**	
Status	Negative	
Probability	Highly Probable	
Confidence	High	
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on marine fauna include noise from other vessels passing through the area. Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	None	

6.1.3.3 Potential impacts related to lighting from the production facility

Description of impact

Marine fauna may be attracted to the production facility for a number of reasons, including structural stimuli, protection, illumination and food availability. The attraction of fauna may impact species through both the ingestion of oil or contaminants from the sea surface or within prey tissues and nocturnal kills from birds flying into flares or lighting structures.

Assessment

Seabirds, fish, cephalopods (squids), seals and cetaceans may be attracted to the strong operating lights required during operating activities and to flaring. Potential attraction may increase during fog when greater illumination is caused by refraction of light by moisture droplets. The Ibhubesi Gas Field lies well outside of the visual range of terrestrial birds and attraction of terrestrial birds is not expected.

Attraction to food supply may result from both the disposal of human wastes (leading to an extreme local increased productivity or a direct supply of food), the production facility acting as a local reef (enhancing food supply) and through indirect attraction of prey species. Many seabird species forage at night on bioluminescent plankton prey and any light would result in obvious attraction.

The extent of impact is likely to be limited to the visual stimulus of the platform (both alternatives), while the duration would be for the entire project and consequently medium-term. The intensity of impact is likely to range from altered distribution and behaviour to mortality impacts and it consequently ranges from very low to high. The significance of the impact is deemed **very low to medium** without mitigation, and **VERY LOW to LOW** after mitigation (see Table 6.8). It should be noted that this impact is no different to the impact associated with the operation of a Tension Leg Platform, which was approved as part of the original project proposal.

Mitigation

The following mitigation measures are recommended:

- Light shielding should be implemented, as it can greatly reduce seabird mortalities;
- Non-essential lighting should be minimised on all platforms to reduce nocturnal attraction. However, such measure should not undermine work safety aspects or concerns; and
- A monitoring programme of faunal attraction should be implemented where all seabird mortalities are logged.

Table 6.8: Assessment of the potential impact of faunal attraction to the production facility.

Rating scales	Without Mitigation	With Mitigation
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Very Low to High	Low
Significance	**Very Low to Medium**	**VERY LOW to LOW**
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on marine fauna include lighting from other vessels passing through the area. Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	Low	

6.1.4 POLLUTION AND OIL SPILLS

6.1.4.1 Potential impacts related to normal discharges from the pipe-lay vessel and discharge of hydrotest water

Description of impact

Normal discharges from the pipe-lay vessel to the marine environment would occur from a variety of sources during pipeline installation, including deck drainage, machinery space drainage, sewage and galley wastes. After pipeline installation, the pipe would be hydrotested in order to check for leaks, where after it would be dewatered. This process would result in wastes and pollution being discharged into the marine environment, which could have an impact on marine fauna and associated habitats.

Assessment

Discharges from the pipe-lay vessel would be minimal for a very limited period, i.e. approximately three to four months. These discharges would be regulated by onboard waste management plans and would be compliance with MARPOL 73/78 standards. Since the proposed pipeline would follow the 200 m depth contour, the majority of the discharges would occur far offshore (>50 km) in a high energy sea environment, which would ensure rapid dilution.

Prior to tie-in the pipeline would be flooded with inhibited seawater. It is envisaged that the pig train would be launched from a vessel at the lay down head in the Ibhubesi Gas Field, resulting in the water being pumped from the vessel towards the beach. The pig train would be pumped to an overflow pond on the beach where the pigs would be retrieved. The volume of treated seawater that would be discharged during this process would be small relative to the total volume in the pipeline (in the order of 50 m^3). Pipeline dewatering operations would then be performed after successful leak testing of the pipeline. The entire pig train would be driven by dry air. The volume of treated seawater that would be discharged in the gas field during the dewatering phase would be in the order of 34 000 m^3.

The potential impact on the marine environment of the discharge of hydrotesting fluids onto the beach or into the gas field would be a once-off and highly localised occurrence. As the volumes discharged would be low and dilution rapid, the impact is considered to be of low intensity. The potential impact of discharging hydrotest water on the marine environment is therefore considered to be of **VERY LOW** significance with or without mitigation (see Table 6.9).

Mitigation

The following mitigation measures are recommended:

- Discharges must comply with MARPOL 73/78 standards; and
- A Coastal Water Discharge Permit (CWDP) or a General Discharge Authorisation (GDA) must be obtained from DEA (Coastal Pollution Management) prior to discharging the hydrotest water. The need for a CWDP or GDA would depend on exactly where the discharge takes place (nearshore, surf zone or beach), volumes and constituents.

Table 6.9: Assessment of the potential impact related to normal discharges from the pipe-lay vessel and discharge of hydrotest water.

Rating scales	Without Mitigation	With Mitigation
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on marine fauna include discharges from other vessels passing through the area. Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

6.1.4.2 Potential impacts related to spills and pollution in the coastal zone during construction

Description of impact

Construction activities in the intertidal zone would involve extensive traffic on the shore by heavy vehicles and machinery, which has the potential to result in accidental spillages or leakages of fuel, chemicals or lubricants. Any release of liquid hydrocarbons has the potential for direct, indirect and cumulative effects on the marine environment through contamination of the water and/or sediments. Concrete spills and construction-related litter would also contribute to the impact on the marine environment.

Assessment

Petroleum products can have a number of effects on the marine environment, including physical oiling and toxicity impacts to marine fauna and flora, localised mortality of plankton, pelagic eggs and fish larvae, and habitat loss or contamination. Oil contamination would potentially have the greatest impact on sessile filter feeders (e.g. mussels) and grazers (e.g. abalone), as they have no means to escape the contamination.

Concrete work may be required in the intertidal and shallow subtidal zones during construction and installation of the pipelines at all site alternatives except Grotto Bay where pipeline would be installed by horizontal directional drilling. Excessive spillage of cement in the intertidal area may potentially increase the alkalinity of the water column with potential sublethal or lethal effects on marine organisms.

During construction, litter can enter the marine environment. Inputs can be either direct by discarding garbage into the sea, or indirectly from the land when litter is blown into the water by wind.

Potential hydrocarbon spills and pollution in the intertidal zone during the installation of the pipeline is deemed of medium intensity within the immediate vicinity of the construction sites, with impacts persisting over the short- to medium-term. The impact is, therefore, assessed to be of **low** significance without mitigation and **VERY LOW** with mitigation (see Table 6.10).

Mitigation

- A comprehensive Environmental Awareness Programme must be conducted amongst construction personnel;
- Where reasonably practical, maintenance activities shall only be undertaken in a demarcated maintenance area above the high water mark;
- All vehicles and equipment should be kept in good working order and serviced regularly to ensure no there are no oils, diesel, fuel or hydraulic fluid leaks;
- The Contractor shall ensure that there is always a supply of absorbent material (spill kit) readily available to absorb / breakdown spills. The quantity of such materials shall be able to handle the total volume of the hydrocarbon / hazardous substance stored on site;
- No concrete should be mixed in the intertidal zone;
- Spilled concrete should be cleaned up on a regular basis;
- No waste should be burnt or buried on site; and
- Good house-keeping should form an integral part of the construction operations.

Table 6.10: Assessment of the potential impact related to spills and pollution in the coastal zone during construction.

Rating scales	Without Mitigation	With Mitigation
Extent	Local	Local
Duration	Short- to Medium-term	Short-term
Intensity	Medium	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on marine fauna include discharges from other vessels passing through the area, marine outfalls, contaminated stormwater, etc. Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	Low	

6.1.4.3 Potential impacts related to operational discharges from the production facility

<u>Description of impact</u>

Normal discharges to the marine environment occur from a variety of sources, including deck drainage, machinery space drainage, sewage and galley wastes from the production facility. Deck and machinery space drainage may result in small volumes of oils, lubricant, grease, solvents or cleaners being introduced into the marine environment. Sewage and galley waste pose an organic and bacterial loading on the natural degradation processes of the sea, resulting in an increased biological oxygen demand.

<u>Assessment</u>

During production, normal discharges from the production facility (both alternatives) occur from a variety of sources as indicated above. These discharges would be regulated by onboard waste management plans and would be compliance with MARPOL 73/78 standards. Although no different from those associated with a Tension Leg Platform approved as part of the original project proposal, they are listed and briefly discussed below for the sake of completeness:

- *Deck drainage:* Oils, solvents and cleaners could be introduced into the marine environment in small volumes through spillage and drainage of deck areas. The discharge into the sea of any oil or oily mixture that may originate from a platform is prohibited in terms of Regulation 21 of MARPOL (Annex I) except when the oil content of the discharge without dilution does not exceed 15 ppm. To ensure MARPOL compliance all deck drainage from work spaces should be collected and piped into a sump tank on-board the production facility for treatment prior to discharge. Drainage from marine (weather) deck spaces would be discharged directly overboard. Oily waste substances would be shipped to land for treatment and disposal;
- *Machinery space drainage*: All operations would comply fully with international agreed standards regulated under MARPOL 73/78. All machinery space drainage would pass through an oil/water filter to reduce the oil in water concentration to 15 mg/l, in accordance with MARPOL 73/78 requirements;
- Sewage: The volumes of sewage wastes released from production platforms would be small and comparable to volumes produced by vessels of similar crew compliment (48 – 72 people). All sewage would be treated to the required MARPOL 73/78 standard prior to release into the marine environment, where the high wind and wave energy is expected to result in rapid dispersal; and

- Galley (food) waste: The volume of galley waste from the drill rig and production platforms would be small and comparable to wastes from any vessel of a similar crew compliment (48 – 72 people). The daily volume of discharge from the production facility is expected to be <0.5 m^3. Discharges of galley wastes, according to MARPOL 73/78 standards, would be comminuted to particle sizes smaller than 25 mm prior to disposal to the marine environment. Such disposal would not take place within 12 nautical miles (± 22 km) from the coast.

Based on the small volumes, distance offshore and high energy sea conditions, the potential impact of operational discharges from the production facility (both alternatives) on the marine environment would be of low intensity, medium-term duration and essentially limited to the immediate area around the production facility. The potential impact of operational discharges on the marine environment is, therefore, considered to be of **VERY LOW** significance with or without mitigation (see Table 6.11).

Mitigation

The following mitigation measures are recommended:

- Ensure compliance with MARPOL 73/78 standards;
- Develop a waste management plan using waste hierarchy;
- A Shipboard Oil Pollution Emergency Plan (SOPEP) must be prepared for the production platform unit and all other vessels and be in place at all times during operation;
- Deck drainage should be routed to a separate drainage system (oily water catchment system) for treatment to ensure compliance with MARPOL (15 ppm);
- All process areas should be bunded to ensure drainage water flows into the closed drainage system;
- Drip trays should be used to collect run-off from equipment that is not contained within a bunded area and the contents routed to the closed drainage system;
- Low-toxicity biodegradable detergents should be used in the cleaning of all deck spillages;
- All hydraulic systems should be adequately maintained and hydraulic hoses should be frequently inspected; and
- Spill management training and awareness should be provided to crew members of the need for thorough cleaning-up of any spillages immediately after they occur in order to minimise the volume of contaminants washing off decks.

Table 6.11: Assessment of the potential impact related to operational discharges from the production platform unit.

Rating scales	Without Mitigation	With Mitigation
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the marine environment include other mining, exploration and production projects, other fishing and maritime activities, etc. Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

6.1.4.4 Potential impacts of an accidental condensate and diesel spill during operation

Description of impact

The first processing step on the production facility would consist mainly of the separation of liquids, in the form of condensate and any produced water, from the gas. The condensate would be stored on-board for later offloading by tanker for export to market. A spillage of liquid hydrocarbons could occur during normal operations, specifically during the transfer of condensate from the production facility to the tanker and during fuel bunkering, which could have an impact on marine fauna (and associated habitats) and the fishing industry in the offshore, nearshore and shoreline environs.

Assessment

Various factors determine the impacts of oil released into the marine environment. The physical properties and chemical composition of the oil, local weather and sea state conditions and currents greatly influence the transport and fate of the released product. As soon as oil is spilled, it is subject to the following weathering processes: spreading, evaporation, dissolution, vertical oil dispersion, settling, biodegradation, dissolution and photo-oxidation. These weathering processes are illustrated in Figure 6.1, while the relative importance of these processes over time is schematised in Figure 6.2. As small operational spills would typically occur near the sea surface and involve the light volatile fraction of aromatics and other oil components with a low molecular weight, such spills would disperse rapidly from the point source and remain at the sea surface for no more than a few days. The dominant weathering processes for small and medium size spills are evaporation and dispersion.

Oil spilled in the marine environment would have an immediate detrimental effect on water quality. Most of the toxic effects are associated with the monoaromatic compounds and low molecular weight polycyclic hydrocarbons, as these are the most water-soluble components of the oil. Oil is most toxic in the first few days after the spill, losing some of its toxicity as it begins to weather and emulsify.

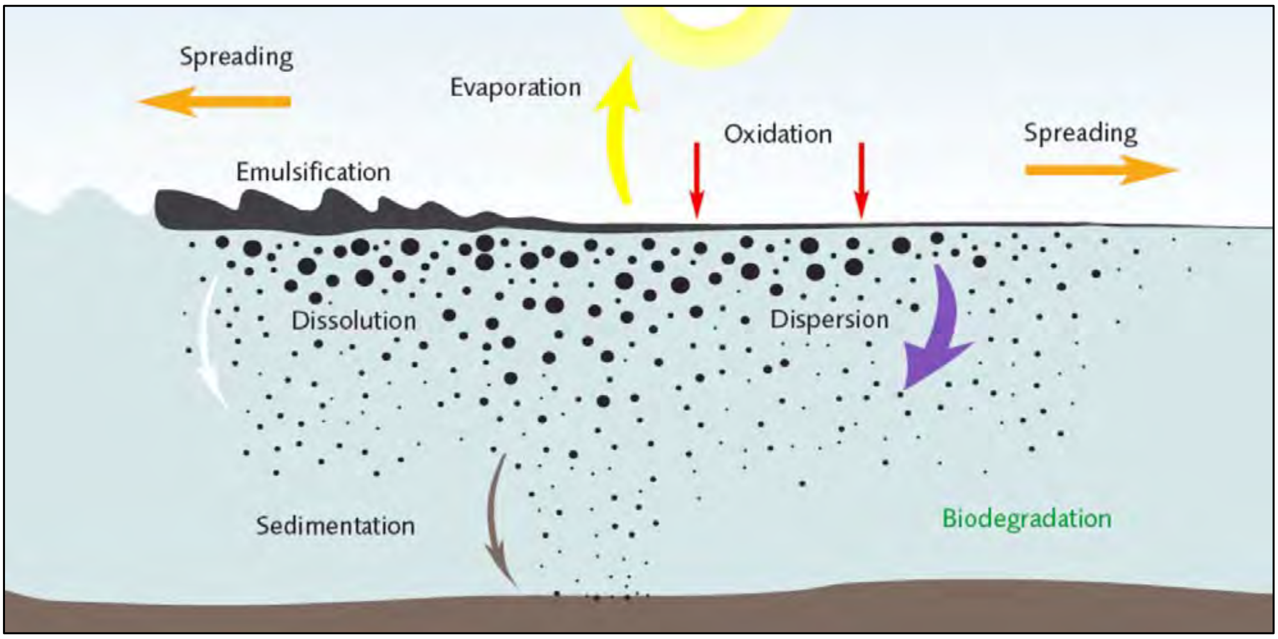


Figure 6.1: Oil weathering processes (ITOPF, 2002).

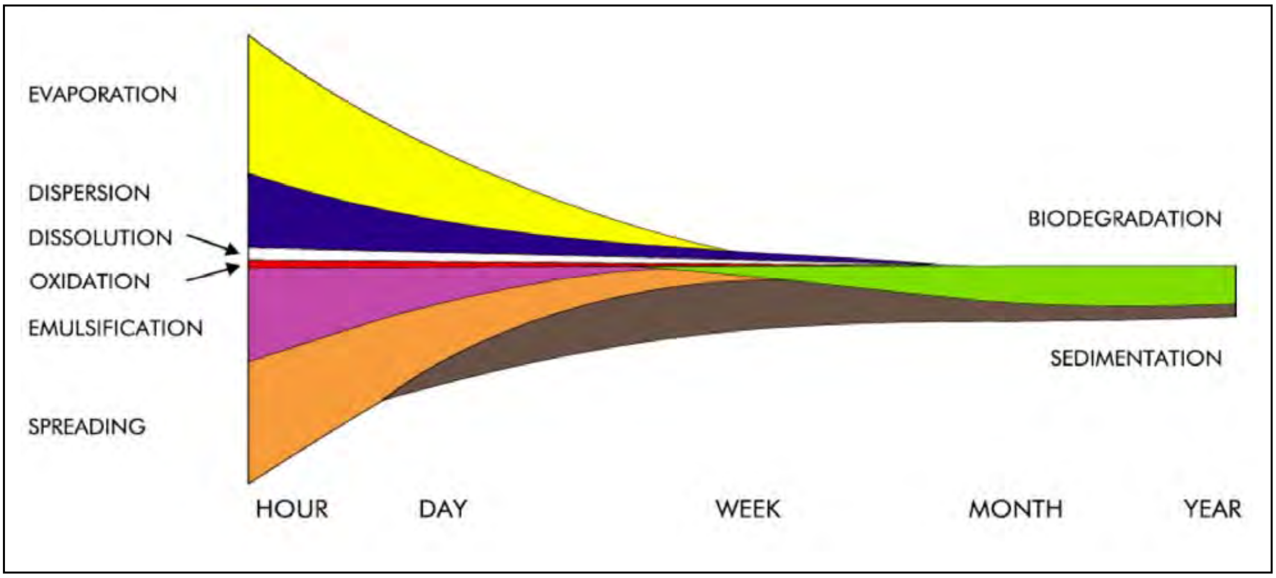


Figure 6.2: A schematic representation of the fate of a crude oil spill showing changes in the relative importance of weathering processes with time - the width of each band indicates the importance of the process (ITOPF, 2002).

Any release of liquid hydrocarbons has the potential for direct, indirect and cumulative effects on the marine environment. These effects include physical oiling and toxicity impacts to marine fauna and flora, localised mortality of plankton (particularly copepods), pelagic eggs and fish larvae, and habitat loss or contamination.

A desktop study (see Appendix 8, Vol. 2) was undertaken to determine the likely trajectory, extent and fate of two oil spill scenarios in Block 2A, including:

1) Small instantaneous spills of diesel (12 m^3) at the water surface through a hose rupture during fuel transfer, where the dominant weathering processes are evaporation and dispersion. This spill scenario is predicted to travel in a north-westerly direction away from the coast during both the summer and winter for approximately 1.5 to 4 days before dissipating due to evaporation and dispersion processes. A small diesel spill is not predicted to reach the coast located approximately 85 km away.
2) Medium instantaneous spill of condensate (160 m^3) at the water surface due to failure of the fuel tank during off-take transfer, where the dominant weathering processes are evaporation and dispersion. This spill scenario, which could remain on the water surface for up to 16 days depending on the wind speed, is expected to sweep a greater area and could potentially reach the coast, especially during the winter months. The section of coast most at risk to shoreline oiling, based on the modelling results in Block 2B, extends from approximately Hondeklipbaai to Strandfontein. During summer the strong south-easterly winds would reduce the risk of shoreline oiling.

Plankton (comprising phytoplankton and zooplankton)

Heavy loss of pelagic eggs and fish larvae can occur if they were present in the area of oil spill. The time of year during which a large spill takes place would greatly affect the degree of impact that would result. Should it coincide with a major spawning peak, it could result in severe mortalities and hence a reduction in recruitment. However, it should be pointed out that spawning and recruitment success is subject to variability in environmental conditions that have a far greater impact than would be posed by a single large spill.

Benthic fauna
Surface spills in the offshore environment are unlikely to have an effect on the seabed.

Fish
Impacts of oil on juvenile and adult fish can be lethal, as gills may become coated with oil. Sub-lethal and long-term effects can include disruption of physiological and behavioural mechanisms, reduced tolerance to stress, and incorporation of carcinogens into the food chain. However, being mobile, fish are likely to be able to avoid a small or large spill. A pollution event in a nursery area, which extend from Saldanha Bay northwards to the Namibian border, could have a potentially critical impact on juvenile commercial and other fin fish species using the inshore and bay areas as nursery grounds. These species (juveniles) are unlikely to be able to move out of the area and depending on the scale of the event, finfish mortality is expected with a resulting impact on the fishery. The peak nursery period for juvenile finfish occurs from December through to March. Thereafter, most juvenile small pelagic species migrate southwards out of the bays.

Birds
Birds, both at sea and along the coast, are vulnerable to oil spills. Individual pelagic seabirds, which become oiled, almost certainly would die as a result of even moderate oiling which damages plumage and eyes. Even if oiled seabirds are collected for cleaning and rehabilitation the success rate is low. Ingestion of oil in an attempt to clear oil from plumage can also result in anaemia, pneumonia, intestinal irritation, kidney damage, altered blood chemistry, decreased growth, impaired osmoregulation, and decreased production and viability of eggs.

Turtles
The impact of oil spills on turtles is thought to primarily affect hatchling survival. Turtles encountered in the project area would mainly be migrating adults and vagrants.

Seals
Little work has been done on the effect of an oil spill on fur seals, but they are expected to be particularly vulnerable as oil would clog their fur and they would die of hypothermia (or starvation, if they had taken refuge on land).

Cetaceans (dolphins and whales)
The impact of oil pollution on cetaceans is poorly understood. The most likely immediate impact is the risk of inhalation of volatile, toxic benzene fractions, which may be absorbed into the circulatory system or result in mild irritation or permanent damage to sensitive tissues such as membranes of eyes, mouth and respiratory tract. Direct oiling of cetaceans is not considered a serious risk to their thermoregulatory capabilities. Baleen whales may experience fouling of the baleen plates, resulting in temporary obstruction of the flow of water between the plates and, consequently, reduce feeding efficiency. Oil pollution in areas of critical cetacean habitat (areas important to the survival of the population), such as the extreme near-shore calving grounds of the Southern Right whale or summer feeding grounds in the Cape Columbine – Yzerfontein area, would be the most likely to impact populations. However, a small spill of diesel or a medium spill of condensate are not expected to extend into any critical cetacean habitat areas. In addition, it is assumed that the majority of cetaceans would be able to avoid oil pollution, though effects on the population could occur where the region of avoidance is critical to population survival, but this is unlikely.

Commercial and recreational fishing
There are several probable impacts of large oil spills on fisheries. These include:
- Displacement of species from normal feeding areas;
- Physical contamination of animals (including eggs and lave) resulting in mortality and / or physiological effects such as clogging of gills;
- Exclusion of fisheries from polluted areas; and
- Gear damage due to oil contamination.

Summary

The environmental consequences of a nearshore spill are potentially far greater than a major offshore spill, although the severity would depend on where the spill takes place. If a spill occurs in port while bunkering/loading the impact would most likely be easily managed and the risk / impact would be low. If the spill occurs offshore at the production facility, it may be more difficult to contain and would more readily disperse, but would be unlikely to reach the shore. An operational diesel spill *en route* to the production facility would only occur in the unlikely event of a vessel collision.

In the unlikely event of an oil spill due to the transfer of condensate from the production facility to the tanker and during fuel bunkering, the impact on marine fauna is considered to be regional, of zero (e.g. benthic) to high (e.g. birds) intensity depending on the faunal group in the short-term (1.5 to 16 days). Collectively the impact on marine fauna is considered to be of **medium** significance before mitigation and of **LOW** significance with mitigation. Collectively the impact on the fishing industry is considered to be of to be localised, of very low to low intensity in the short-term. Thus this impact is considered to range from **INSIGNIFICANT** to **VERY LOW** significance before and after mitigation (see Table 6.12).

<u>Mitigation</u>

The following mitigation should also be implemented:

- A project-specific oil spill contingency plan must be prepared and be in place at all times during the operation. The oil spill contingency plan should include or address, but not be limited to, the following:
  - Alert procedure;
  - Initial / immediate actions;
  - Oil Spill Response Options / Strategies;
  - Roles and responsibilities (including Emergency Directory);
  - Response Actions;
  - Response termination procedure;
  - Oil Spill Modelling Report;
  - Oil Spill Risk Assessment (environmental sensitivities and priorities for protection);
  - Oil Spill Response Equipment Inventory;
  - Response technical guidelines and limitations;
  - Response equipment and maintenance / Inspection plan;
  - Facilities (including specification) and products (including MSDS manual); and
  - Drills and training.
- A Shipboard Oil Pollution Emergency Plan (SOPEP) must be prepared for all support vessels and be in place at all times during operation;
- Training and exercise programmes must be established to ensure that the response activity can be effectively executed; and
- Onboard spill equipment and spill containment materials must be in place, maintained and positioned in clearly identified locations.

Table 6.12: Assessment of the potential impact related to an accidental condensate and diesel spill.

Rating scales	Without Mitigation	With Mitigation
Marine Fauna		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Zero to High	Zero to Medium
Significance	**Medium**	**LOW**
Status	Negative	Negative
Probability	Improbable to Probable	Improbable to Probable
Confidence	High	High

Fishing		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Very Low to Low	Very Low to Low
Significance	**Insignificant to Very Low**	**INSIGNIFICANT to VERY LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium to High	Medium to High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the marine environment include other mining, exploration and production projects, other fishing and maritime activities, etc.. Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	Low to None	

6.2 ONSHORE BIOPHYSICAL IMPACTS

6.2.1 VEGETATION IMPACTS

6.2.1.1 Southern shore-crossing route (Grotto Bay to Duynefontein)

Description of impact

The installation of the onshore portion of the pipeline, construction of the onshore gas receiving facility and associated laydown areas would result in the removal of vegetation (indigenous and alien invasive) within the development footprint and associated construction area. After construction the pipeline servitude would be rehabilitated, except for an access track, which would be required for maintenance, testing and inspection purposes during operation.

Assessment

The onshore portion of the pipeline would be laid by normal pipe-laying methods after the route is cleared of vegetation and any other obstacles. The area of disturbance along the onshore pipeline route would ultimately be determined by the geotechnical characteristics of the proposed route, e.g. sandy soils would require a wider trench and would thus have a greater area of disturbance. It is estimated that the width of the construction servitude would be approximately 15 to 20 m along the entire length of the pipeline route.

The southern pipeline route alternatives pass through five vegetation types, some of which are classified as Vulnerable, Endangered or Critically Endangered (see Table 6.13 for a breakdown of the vegetation types per alternative and the estimated vegetation loss). The onshore gas processing facility at Silwerstroom Strand and Ankerlig would be located in Atlantis Sand Fynbos and Cape Flats Dune Strandveld, respectively.

Table 6.13: Southern pipeline route and onshore facility alternatives in relation of the different vegetation types located in the area and the estimated vegetation loss (in hectares).

Vegetation type (Ecosystem Threat Status)	Route alternatives								
	Coast to R27 / Chevron pipeline			North-South corridor			East to Ankerlig	Onshore facility	
	Grotto Bay	Silwerstroom Strand	Duynefontein	Grotto Bay	Silwerstroom Strand	Duynefontein		Silwerstroom Strand	Ankerlig
Cape Seashore Vegetation (Least Threatened)	0.1 ha		0.7 ha						
Cape Flats Dune Strandveld (Endangered)		Alt 2: 1.3 ha Alt 3: 4.0 ha	1.0 ha	8.6 ha	8.3 ha	5.0 ha	11.6 ha		1.8 ha
Atlantis Sand Fynbos (Critically Endangered)		Alt 1: 7.0 ha Alt 2: 7.6 ha Alt 3: 6.2 ha	3.0 ha	26.4 ha	Alt 1: 9.5 ha Alt 2: 9.5 ha Alt 3: 4.1 ha	6.6 ha		1.8 ha	
Swartland Shale Renosterveld (Critically Endangered)				1 ha					
Langebaan Dune Strandveld (Vulnerable)	0.9 ha								
Disturbed / Firebreak	3.5 ha	0.3 ha							
TOTAL	**4.5 ha**	**Alt 1: 7.3 ha Alt 2: 9.2 ha Alt 3: 10.5 ha**	**4.7 ha**	**36.0 ha**	**Alt 1: 17.8 ha Alt 2: 17.8 ha Alt 3: 12.4 ha**	**11.6 ha**	**11.6 ha**	**1.8 ha**	**1.8 ha**

(a) Shore-crossing to R27 or Chevron pipeline

The Grotto Bay shore-crossing route would initially cross a short coastal section of Cape Seashore Vegetation and Langebaan Dune Strandveld and then follows an existing disturbed firebreak on the southern side of the Grotto Bay Road until the R27 (in what would have been Atlantis Sand Fynbos). This localised impact is considered to be of medium intensity in the medium-term. The significance of this impact is therefore assessed to be **low** without mitigation and **VERY LOW** with mitigation (see Table 6.14).

The Silwerstroom Strand shore-crossing route would initially pass through the Silwerstroom Strand Resort, which would have minimal impact on natural vegetation, after which it would follow one of three routes to the R27, all of which would result in the loss of Atlantis Sand Fynbos vegetation. This impact for all three alternatives is considered to be localised, of high intensity in the medium-term. The significance of this impact is deemed **medium** without mitigation and **LOW** after mitigation (see Table 6.14). Although the impact is assessed to be of similar significance for all three alternatives, the southern route via Farm Groote Springfontein to the south would result in the least disturbance (based on pipeline length) to Atlantis Sand Fynbos, which is Critically Endangered (see Table 6.13).

The Duynefontein shore-crossing route would initially pass through Cape Seashore Vegetation at the coast and then Cape Flats Dune Strandveld over a small distance before passing through Atlantis Sand Fynbos between the coastal strip and the R27. This impact is considered to be localised, of high intensity in the medium-term. The significance of this impact is deemed **medium** without mitigation and **LOW** after mitigation (see Table 6.14).

(b) North-South corridor

The north-south alignment to Dassenberg Road would either follow an alignment east of the R27 road reserve or parallel to the Chevron pipeline. All routes would pass mainly through Atlantis Sand Fynbos and Cape Flats Dune Strandveld. The alternative adjacent to the Chevron pipeline between the Grotto Bay and Silwerstroom shore-crossings would pass through a small section of Swartland Shale Renosterveld, the majority of which has already been converted to agriculture. This impact related to the north-south corridor from all three shore-crossings is considered to be localised, of high intensity in the medium-term. The significance of this impact is deemed **medium** without mitigation and **LOW** after mitigation (see Table 6.14). Although the impact is assessed to be of similar significance for all three shore-crossing alternatives, the shorter routes would result in less vegetation disturbance (see Table 6.13).

(c) East to Ankerlig

From the R27 / Dassenberg Road intersection the pipeline would be located on the south side of Dassenberg Road. It would traverse mainly Cape Flats Dune Strandveld and then Atlantis Sand Fynbos in the vicinity of the Ankerlig Power Station. This area is significantly invaded by rooikrans and Port Jackson. The pipeline would also pass through a number of small wetlands (dominated by the bulrush *Typha capensis*) in the dunes near the R27 / Dassenberg Road intersection. This impact is considered to be localised, of high intensity in the medium-term. The significance of this impact is deemed **medium** without mitigation and **LOW** after mitigation (see Table 6.14).

(d) Onshore gas processing facility

The natural vegetation occurring at both sites in the industrial area is Cape Flats Dune Strandveld. The vegetation has been heavily impacted by disturbance and invasion by woody alien invasive species. This impact for both Ankerlig alternatives is considered to be localised, of high intensity in the long-term. Due to the location within and existing industrial area and the disturbed nature of the site, the significance of this impact is **MEDIUM** with and without mitigation (see Table 6.14).

The natural vegetation occurring at both sites adjacent to the Silwerstroom Water Treatment Plant is Atlantis Sand Strandveld and is considered to be botanically sensitive. The impact for both Silwerstroom Strand alternatives is considered to be localised, of high intensity and long-term. The significance of this impact is deemed **HIGH** with and without mitigation (see Table 6.14).

<u>Mitigation</u>

The key issue regarding the rehabilitation success of the pipeline route is the management and replacement of topsoil (and associated seedbank), as this would increase the probability of germination of seeds and establishment of the vegetation type that existed prior to pipeline installation. The following mitigation measures are recommended:

- The ‘working zone’ should be kept to a minimum and no arbitrary movement of vehicles through undisturbed vegetation should be permitted. Once the design is finalised and the associated construction site is determined, the area located outside of the site should be clearly demarcated and regarded as a ‘no-go’ area;
- An application would need to be made to CapeNature prior to commencement of any construction for a permit to disturb (and clear) indigenous vegetation;
- The following mitigation is specific to topsoil:
  - Topsoil (top 300 – 400 mm) should be removed from areas to be disturbed along the entire pipeline servitude, including temporary activities such as storage and stockpiling, and stockpiled separately from the subsoil for rehabilitation purposes to ensure there is no contamination;
  - Stockpiles should be demarcated to minimise the risk of disturbance and contamination;
  - Stockpiles should not be compacted;
  - Stockpiles should be monitored regularly to identify any alien invasive plants, which should be removed when they germinate to prevent contamination of the seed bank;

   > Stockpiling should be for as short a period as possible. Thus topsoil should be replaced as the excavation and pipeline installation work progresses; and
   > Topsoil should be replaced after the subsoil has been replaced and compacted.
- Laydown areas should be scarified to a depth of 100 mm to break up any compacted soil prior to topsoil replacement. This may, however, not be necessary in very sandy areas or where hard calcrete is found at the surface; and
- Seed, collected from adjacent areas in the same vegetation type, may be used during rehabilitation. However, no ‘foreign-sourced’ seed should be introduced, e.g. during hydroseeding.

It should be noted that the ‘Search & Rescue’ of sensitive plant species, which is often advocated as a mitigation measure, is not recommended for the southern shore-crossing route. The rational for this is that, although it appears feasible, in practice it often fails for a number of reasons (e.g. low success rate of translocated species and intensive management after translocation) and there was not an overabundance of geophytes, which generally stand a better chance of survival, in the southern study area. This is, however, a recommendation for the Noordwesbaai alternative (see Section 6.2.1.2).

Table 6.14: Assessment of the potential impact on vegetation in the southern study area.

Rating scales	Without Mitigation	With Mitigation
Grotto Bay shore-crossing		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Medium	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High
Silwerstroom Strand and Duynefontein shore-crossings, North-South corridor and East Link to Ankerlig		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	High	Medium
Significance	**MEDIUM**	**LOW**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High
Gas receiving facility adjacent to Ankerlig		
Extent	Local	Local
Duration	Long-term	Long-term
Intensity	High	High
Significance	**Medium**	**MEDIUM**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High
Gas receiving facility adjacent to the Silwerstroom Strand Water Treatment Plant		
Extent	Local	Local
Duration	Long-term	Long-term
Intensity	High	High
Significance	**High**	**HIGH**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High

Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the vegetation include the loss of further vegetation through agriculture, wind farms, residential and industrial development, etc. Cumulative impact is considered to be of LOW to MEDIUM significance depending on the vegetation type lost.
Degree to which impact can be reversed	Partially reversible (pipeline route) to Irreversible (onshore facility)
Degree to which impact may cause irreplaceable loss of resources	Low
Degree to which impact can be mitigated	Low (pipeline route) to None (onshore facility)

6.2.1.2 Northern shore-crossing route (Saldanha Peninsula)

Description of impact

The installation of the onshore portion of the pipeline and associated laydown areas would result in the removal of vegetation (indigenous and alien invasive) within the development footprint and associated construction area. After construction the pipeline servitude would be rehabilitated, except for an access track, which would be required for maintenance, testing and inspection purposes during operation.

Assessment

As with the southern pipeline route, the onshore portion of the pipeline would be laid after the route is cleared of vegetation and any other obstacles. It is estimated that the width of the construction servitude would be approximately 15 to 20 m along the entire length of the pipeline route.

The northern pipeline routing alternatives pass through four vegetation types, some of which are classified as Vulnerable or Endangered (see Table 6.15 for a breakdown of the vegetation types per alternative and the estimated vegetation loss).

Table 6.15: Northern pipeline route alternatives in relation of the different vegetation types located in the area and the estimated vegetation loss (in hectares).

Vegetation type (Ecosystem Threat Status)	Route alternatives			
	St Helena West	St Helena East	Noordwesbaai	
			West	East
Cape Seashore Vegetation (Least Threatened)	0.1 ha	0.1 ha		
Saldanha Flats Strandveld (Endangered)	3.0 ha	4.0 ha		
Langebaan Dune Strandveld (Vulnerable)			8.4 ha	4.8 ha
Saldanha Limestone Strandveld (Endangered)			6.0 ha	6.0 ha
Cultivated lands	30.9 ha	30.9 ha	16.2 ha	19.4 ha
TOTAL	**34 ha**	**35 ha**	**30.6 ha**	**30.2**

(a) St Helena West and East shore-crossings

The St Helena West shore-crossing route would initially cross the shore through a narrow zone of coastal Cape Seashore Vegetation. It would then traverse low dunes supporting mid-dense Saldanha Flats Strandveld. Inland of the Saldanha Flats Strandveld the pipeline would traverse mainly disturbed agricultural land along its entire length. This localised impact is considered to of medium intensity in the medium-term. The significance of this impact is therefore assessed to be **low** without mitigation and **VERY LOW** with mitigation (see Table 6.16). The St Helena East shore-crossing route is similar to the St Helena West alternative, but would impact slightly more Saldanha Flats Strandveld vegetation. For this reason, the significance of this impact is assessed to be **low to medium** without mitigation and **LOW** with mitigation (see Table 6.16). Thus St Helena West would be a better alternative from a vegetation perspective than St Helena East.

(b) Noordwesbaai shore-crossings

The Noordwesbaai shore-crossing route would initially follow an existing dirt track through Langebaan Dune Strandveld, which is mapped as a CBA. In order to minimise the disturbance within the CBA, a second alternative is proposed (i.e. Noordwesbaai East), which is aligned to the east of the CBA. Where the two alternatives join the pipeline would traverse Saldanha Limestone Strandveld. Further east, to the south-east, the pipeline would mainly traverse areas that would have been Langebaan Dune Strandveld but have now been converted to agriculture. The Noordwesbaai West alternative would have a localised impact, of high intensity in the medium-term. The significance of this impact is therefore assessed to be **high** without mitigation and **MEDIUM** with mitigation. The Noordwesbaai East alternative, which avoids the CBA area near the coast, would result in a lower intensity impact. The significance of this impact is therefore assessed to be **low** without mitigation and **VERY LOW** with mitigation (see Table 6.16).

Mitigation

Recommendations to mitigate the potential impact on the vegetation are similar to those recommended for the southern pipeline route alternatives (refer to Section 6.2.1.2). In addition, it is recommended that a 'Search and Rescue' operation be undertaken, mainly for geophytes, in the CBAs along the Noordwesbaai alternative (see Figure 5.13).

Table 6.16: Assessment of the potential impact on vegetation in the northern study area.

Rating scales	Without Mitigation	With Mitigation
St Helena West		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Medium	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High
St Helena East		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Medium	Low
Significance	**Low to Medium**	**LOW**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High

Noordwesbaai West		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	High	Medium
Significance	**High**	**MEDIUM**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High
Noordwesbaai East		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Medium	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the vegetation include the loss of further vegetation through agriculture, wind farms, residential and industrial development, etc. Cumulative impact is considered to be of LOW to MEDIUM significance depending on the vegetation type lost.	
Degree to which impact can be reversed	Partially reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Low	

6.2.2 TERRESTRIAL FAUNA IMPACTS

6.2.2.1 Southern shore-crossing route (Grotto Bay to Duynefontein)

<u>Description of impact</u>

Potential faunal impacts relating to the proposed project include the following:

- Direct mortality of faunal species during construction: Those species that cannot effectively vacate the area by themselves during the construction phase may suffer direct mortality during site clearing and trench excavation activities;
- Loss of faunal habitats: The clearing of vegetation and excavation activities may result in the loss or disturbance to habitats of faunal significance; and
- Barrier effect of pipeline: The pipeline could pose an obstacle for terrestrial animals and thus create a barrier effect. This would be experienced during the construction period where the open pipeline trench creates a linear obstacle, as well as during the operational phase where the pipeline could create a barrier for fossorial animal species.

<u>Assessment</u>

(a) Direct mortality of faunal species

Birds, large snakes and medium-sized mammals would be able to flee at the start of site clearing. However, many reptiles and small mammals (rodents and insectivores) may hide underground and may be directly impacted by site clearing and excavations. Although construction activities may lead to direct mortality of individuals that cannot safely flee the construction site, it is not expected that any species of conservation concern would be encountered in large numbers along any of the pipeline route alternatives or at the proposed gas receiving facility sites, and there would thus not be a permanent impact on any population/species as a whole.

The impact of direct mortality on faunal species of conservation concern is considered to be localised, of short duration and of low intensity for all pipeline route and facility site alternatives. The impact is, therefore, rated to be of **VERY LOW** significance with and without mitigation (see Table 6.17).

(b) Loss of faunal habitats

There are large stretches along all route options that would cross intact patches of natural vegetation that could provide suitable habitat for terrestrial faunal species. No significant rock outcrop areas that could provide shelter for small mammals and rock-dwelling reptiles were observed along any of the pipeline route options. Small wetland areas that could provide breeding sites for amphibians were, however, recorded in the vicinity of the R27 and Dassenberg Road intersection. The gas receiving facility sites adjacent Ankerlig have also been disturbed in the past and invaded by alien trees (Port Jackson). It is unlikely that any species of conservation concern would occur in significant numbers along any of the pipeline routes and at the gas receiving facility site alternatives. Similarly, no unique faunal habitats in relation to the surrounding environments were identified along the pipeline route alternatives and at the gas receiving facility sites that could be regarded as important for species of conservation concern.

The impact associated with the loss of faunal habitats is considered to be similar for all pipeline and facility alternatives. When assessed in terms of the loss of faunal habitats that may be important for species of conservation concern, the impact is rated as of medium intensity, of local extent and short- (pipeline) to long-term (onshore facility) duration. The impact is thus rated to be of overall **low** significance without mitigation and **VERY LOW** with mitigation (see Table 6.17).

(c) Barrier effect of pipeline

Should long sections of the pipeline trench be kept open for extended periods during construction, it could present a barrier or linear obstacle for faunal species. Depending on the steepness of the trench excavations, this could result in animals such as tortoises being trapped, which could lead to mortality. This impact would, however, only apply to individual animals and would not affect any species or population as a whole. The transitory nature of a pipeline construction project would also ensure that the impact is of very short-term duration. The impact for all pipeline route options is considered to be of very low intensity, local extent and **INSIGNIFICANT TO VERY LOW** significance with and without mitigation (see Table 6.17).

Burrowing lizards of conservation concern which may be present along the pipeline corridor routes are known to only occur to depths of approximately 15 cm. It is thus not expected that the proposed new pipeline would impact on these species by creating a barrier effect, as the pipeline would be buried along its full length at a depth of approximately 1 to 1.5 m below ground level. Small fossorial mammal species like golden moles may burrow deeper than the lizard species but also usually occur close to the surface where they forage on insects. It is also unlikely that the pipeline would impact on their movement at that depth. The potential impact of a barrier effect would thus be of very low intensity, of local extent and long-term duration. The overall significance of this impact for all pipeline route options is thus rated as **INSIGNIFICANT** with and without mitigation (see Table 6.17).

<u>Mitigation</u>

The following mitigation measures are recommended:

- The 'working zone' should be kept to a minimum and no arbitrary movement of vehicles through wetland areas should be permitted. Once the design is finalised and the associated construction site is determined, the area located outside of the site should be clearly demarcated and regarded as a 'no-go' area;

- Every effort should be made to save and relocate any amphibian, reptile, bird or mammal that cannot flee of its own accord, encountered during site preparation. These animals should be relocated to a suitable area immediately outside the construction footprint in a similar faunal habitat;
- Excavations should be backfilled, as soon as practically possible, in order to avoid keeping long sections of trench open for extended periods;
- Excavations should be inspected for trapped animals every morning. Any animal encountered within the trench excavation that cannot safely exit by its own accord should be removed to a suitable area immediately outside the construction footprint in a similar faunal habitat. If any snake species are encountered in the excavations it would be advisable to rather contact an experienced snake handler to safely remove the animal; and
- Disturbed areas should be rehabilitated after construction (see Section 6.2.1.1).

Table 6.17: Assessment of the potential impact on terrestrial fauna in the southern study area.

Rating scales	Without Mitigation	With Mitigation
Direct mortality of faunal species		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High
Loss of faunal habitats		
Extent	Local	Local
Duration	Short- (pipeline) to Long-term (onshore facility)	Short- (pipeline) to Long-term (onshore facility)
Intensity	Medium	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium
Barrier effect of pipeline		
Extent	Local	Local
Duration	Short- (trench) to Long-term (pipeline)	Short- (trench) to Long-term (pipeline)
Intensity	Very Low	Very Low
Significance	**INSIGNIFICANT to Very Low**	**INSIGNIFICANT TO VERY LOW**
Status	Negative	Negative
Probability	Probable (trench) to Improbable (pipeline)	Probable (trench) to Improbable (pipeline)
Confidence	Medium to High	Medium to High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on fauna include the loss of further vegetation through agriculture, wind farms, residential and industrial development, etc. Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Partially reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Low	

6.2.2.2 Northern shore-crossing route (Saldanha Peninsula)

Description of impact

Potential faunal impacts relating to the proposed project are as described in Section 6.2.1.2 and include:

- Direct mortality of faunal species during construction;
- Loss of faunal habitats; and
- Barrier effect of pipeline.

Assessment

(a) Direct mortality of faunal species

The impact of direct mortality on faunal species of conservation concern for all pipeline routes is considered to be localised, of short duration and of low intensity for all pipeline route alternatives. The impact is, therefore, rated to be of **VERY LOW** significance with and without mitigation (see Table 6.18).

(b) Loss of faunal habitats

Large stretches of the St Helena West and East alternatives, as well as inland portions of the Noordwesbaai alternative, would pass through farmland where faunal habitats are largely in a transformed state. There are, however, large stretches along the coastal section of the Noordwesbaai alternative that would cross intact patches of natural vegetation that could provide suitable habitat for terrestrial faunal species. It is unlikely that species of conservation concern would occur in significant numbers along any of the pipeline routes and no unique faunal habitats in relation to the surrounding environments were identified that could be regarded as important for species of conservation concern.

The impact associated with the loss of faunal habitats for the Noordwesbaai alternative is considered to be of medium intensity, of local extent and short-duration. The impact is thus rated to be of overall **low** significance without mitigation and **VERY LOW** with mitigation. Since the St Helena West and East alternatives are routed mainly through farmland the impact is considered to be of **VERY LOW** significance with and without mitigation (see Table 6.18).

(c) Barrier effect of pipeline

Should long sections of the pipeline trench be kept open for extended periods during construction, it could present a barrier or linear obstacle for faunal species. The transitory nature of a pipeline construction project would ensure that the impact is of very short-term duration. The impact for all pipeline route options is considered to be of very low intensity, local extent and **INSIGNIFICANT TO VERY LOW** significance with and without mitigation (see Table 6.18).

It is also unlikely that the pipeline would impact on their movement at a depth of 1 – 1.5 m below the ground. The potential impact of a barrier effect would thus be of very low intensity, of local extent and long-term duration. The overall significance of this impact for all pipeline route options is thus rated as **INSIGNIFICANT** with and without mitigation (see Table 6.18).

Mitigation

Recommendations to mitigate the potential impact on terrestrial fauna are similar to those recommended for the southern pipeline route alternatives (refer to Section 6.2.2.1).

Table 6.18: Assessment of the potential impact on terrestrial fauna in the northern study area.

Rating scales	Without Mitigation	With Mitigation
Direct mortality of faunal species		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High
Loss of faunal habitats		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low (St Helena alternatives) to Medium (Noordwesbaai)	Low
Significance	**Very Low** (St Helena alternatives) **to Low** (Noordwesbaai)	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium
Barrier effect of pipeline		
Extent	Local	Local
Duration	Short- (trench) to Long-term (pipeline)	Short- (trench) to Long-term (pipeline)
Intensity	Very Low	Very Low
Significance	**INSIGNIFICANT to Very Low**	**INSIGNIFICANT TO VERY LOW**
Status	Negative	Negative
Probability	Probable (trench) to Improbable (pipeline)	Probable (trench) to Improbable (pipeline)
Confidence	Medium to High	Medium to High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on fauna include the loss of further vegetation through agriculture, wind farms, residential and industrial development, etc. Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Partially reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Low	

6.2.3 FRESHWATER ECOLOGY IMPACTS

6.2.3.1 Southern shore-crossing route (Grotto Bay to Duynefontein)

<u>Description of impact</u>

The proposed onshore pipeline could impact on freshwater features located in or adjacent to the pipeline. Potential impacts of the pipeline include the following:

- Loss of wetland and riparian habitat and bed/bank modification within the pipeline footprint and associated construction area;
- Temporary impedance or diversion of flow; and

- Increased sedimentation and turbidity of freshwater features as a result of disturbance of bed and banks, as well as from contaminated runoff from the construction site.

Assessment
As indicated in the previous section, the area of disturbance along the onshore pipeline route would ultimately be determined by the geotechnical characteristics of the proposed route. It is estimated that the width of the construction servitude would be approximately 15 to 20 m along the entire length of the pipeline route. In the southern study area only a few surface water features occur. The only rivers of note are the Buffels and Silverstroom Rivers, which are relatively small coastal rivers.

(a) Shore-crossing to R27 or Chevron pipeline
The Grotto Bay shore-crossing route would cross the upper reaches of one small coastal stream approximately mid-way between the coast and the R27. The potential impact on freshwater features is considered to be localised, of low intensity and of short-term duration. The potential impact is, therefore, assessed to be of **very low** significance without mitigation and **INSIGNIFICANT** with mitigation (see Table 6.19).

The Silwerstroom Strand shore-crossing route (all three alternatives) would pass through a relatively sensitive area in terms of ground and surface water interaction. The northern alternative via the existing water works is located adjacent to a small branch of the Silverstroom River. The potential impact for all three alternatives is considered to be localised, of medium intensity and of short- to long-term duration. The impact is, therefore, assessed to be of **medium** significance without mitigation and **LOW to MEDIUM** with mitigation (see Table 6.19).

The Duynefontein shore-crossing route passes through a few smaller wetland areas on route to the R27. This impact is considered to be localised, of low to medium intensity and of short-term duration. The impact is, therefore, assessed to be of **very low** significance without mitigation and **INSIGNIFICANT to VERY LOW** with mitigation (see Table 6.19).

(b) North-South corridor
There are no freshwater features along the north-south corridor from the Grotto Bay and Silwerstroom Strand shore-crossing alternatives. The proposed route along the R27 from the Duynefontein shore-crossing passes through a number of smaller wetland areas, mainly as it approaches the R27 / Dassenberg Road intersection. The impact on this wetland system is assessed in the "East link to Ankerlig" below.

(c) East link to Ankerlig
The only wetland that is of any significance along this section is the wetland system at the R27 / Dassenberg Road intersection. This wetland system is associated with the City of Cape Town Wastewater Treatment Works at Atlantis and has been significantly impacted by the surrounding land use activities and changes to the topography in the area. Due to the high water table in winter as well as surface runoff, it tends to hold water for much of the year and be dominated by bulrushes *Typha capensis*. This impact is considered to be localised, of medium intensity in the short- to medium-term. The significance of this impact is deemed to be **low** without mitigation and **VERY LOW** after mitigation (see Table 6.19).

(d) Onshore gas processing facility
The proposed onshore gas receiving facility sites adjacent to the Ankerlig power station would have minimal impact on the surrounding freshwater features. There is a small wetland area to the south of Alternative 1a, which appears to have been created for stormwater attenuation purposes. For this reason, the impact associated with Alternative 1a is considered to be localised, of low intensity and of long-term duration. The impact is, therefore, assessed to be of **LOW** significance with and with mitigation. The impact associated with Alternative 1b is considered to be of **VERY LOW** significance (see Table 6.19).

The onshore facility sites adjacent to the Silwerstroom Water Treatment Plant are located in a relatively sensitive area in terms of ground and surface water interaction. This impact for both Silwerstroom Strand alternatives is considered to be localised, of medium intensity and of long-term duration. The impact is, therefore, assessed to be of **medium** significance without mitigation and **LOW to MEDIUM** with mitigation (see Table 6.19).

Mitigation

The following mitigation measures are recommended:

- As far as is reasonably possible, the final pipeline alignment (including associated construction area) and onshore facility should be located at least 30 m outside of the delineated edge of any significant freshwater features. Where the pipeline route crosses streams or drainage lines, it should be aligned perpendicular to the watercourse in order to minimise the area of disturbance;
- Any measures required to protect the pipeline below the ground should, as far as possible, be designed so as not to impede any subsurface flow that may exist;
- Construction in or adjacent to freshwater features should take place during a period of low flow (summer);
- The 'working zone' should be kept to a minimum and no arbitrary movement of vehicles through wetland areas should be permitted. Once the design is finalised and the associated construction site is determined, the area located outside of the site should be clearly demarcated and regarded as a 'no-go' area;
- Contaminated runoff from construction areas should, where possible, be prevented from directly entering rivers / streams. Measures may include the use of sandbags, leaving a "natural berm" between a river and the excavation for as long as possible, cut-off trenches, straw bales or geofabric siltation barriers;
- All materials near watercourses must be properly stored and contained;
- All rubble associated with construction activities should be removed after construction;
- Ablution facilities must be located at least 30 m away from the river systems and wetland areas; and
- Disturbed areas should be reshaped back as close to the original profile as possible, and then rehabilitated (see Section 6.2.1.1).

Table 6.19: Assessment of the potential impact on freshwater features in the southern study area.

Rating scales	Without Mitigation	With Mitigation
Grotto Bay shore-crossing		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Very Low
Significance	**Very Low**	**INSIGNIFICANT**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium to High	Medium to High
Silwerstroom Strand shore-crossing and associated gas receiving facility		
Extent	Local to Regional	Local
Duration	Short- to Long-term	Short- to Long-term
Intensity	Medium	Low
Significance	**MEDIUM**	**LOW TO MEDIUM**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium to High	Medium to High

Rating scales	Without Mitigation	With Mitigation
Duynefontein shore-crossing		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low to Medium	Low
Significance	**Very Low**	**INSIGNIFICANT to VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium to High	Medium to High
East Link to Ankerlig		
Extent	Local	Local
Duration	Short- to Medium-term	Short- to Medium-term
Intensity	Medium	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium to High	Medium to High
Gas receiving facility adjacent to Ankerlig (Alternative 1a)		
Extent	Local	Local
Duration	Long-term	Long-term
Intensity	Low	Low
Significance	**Low**	**LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium to High	Medium to High
Gas receiving facility adjacent to Ankerlig (Alternative 1b)		
Extent	Local	Local
Duration	Long-term	Long-term
Intensity	Very Low	Very Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium to High	Medium to High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on freshwater features include increased development and agriculture within the study area. Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Low	

6.2.3.2 Northern shore-crossing route (Saldanha Peninsula)

<u>Description of impact</u>

Potential impacts relating to the proposed pipeline include the following:

- Loss of wetland and riparian habitat and bed/bank modification within the pipeline footprint and associated construction area;
- Temporary impedance or diversion of flow; and

- Increased sedimentation and turbidity of freshwater features as a result of disturbance of bed and banks, as well as from contaminated runoff from the construction site.

Assessment

As indicated in the previous section, it is estimated that the width of the construction servitude would be approximately 15 to 20 m along the entire length of the pipeline route. The freshwater features within the northern study area consist largely of valley bottom wetlands associated with streams.

(a) St Helena West shore-crossing

This alternative crosses or lies adjacent to smaller drainage channels, which are in general not well defined and seasonal to ephemeral in their flow patterns. The potential impact on freshwater features is considered to be localised, of low to medium intensity and of short- to long-term duration. The potential impact is, therefore, assessed to be of **low** significance without mitigation and **VERY LOW** significance with mitigation (see Table 6.20).

(b) St Helena East shore-crossing

During Scoping the St Helena East alternative was realigned in order to mitigate the potential impact on the Berg River Ecosystem Priority Area. The impact associated with the realigned route is considered to be localised, of low intensity and of short-term duration. The potential impact is, therefore, assessed to be of **very low** significance without mitigation and **INSIGNIFICANT** with mitigation (see Table 6.20).

(c) Noordwesbaai shore-crossing

During the Scoping Phase the Noordwesbaai alternative was realigned in order to mitigate the potential impact on the Bok River and its associated Strandveld wetlands areas. The proposed pipeline would only cross the Bok River at the R399 (Saldanha – Vredenburg Road) where the river is significantly impacted due to the removal of much of the indigenous riparian vegetation and straightening of the river. The potential impact on freshwater features is considered to be localised, of low to medium intensity and of short- to long-term duration. The potential impact is, therefore, assessed to be of **low** significance without mitigation and **VERY LOW** significance with mitigation (see Table 6.20).

Mitigation

Recommendations to mitigate the potential impact on freshwater features are similar to those recommended for the southern pipeline route alternatives (refer to Section 6.2.3.1).

Table 6.20: Assessment of the potential impact on freshwater features in the northern study area.

Rating scales	Without Mitigation	With Mitigation
St Helena West and Noordwesbaai shore-crossings		
Extent	Local	Local
Duration	Short- to Long-term	Short-term
Intensity	Low to Medium	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium to High	Medium to High
St Helena East shore-crossing		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Very Low
Significance	**Very Low**	**INSIGNIFICANT**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium to High	Medium to High

Rating scales	Without Mitigation	With Mitigation
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on freshwater features include increased development and agriculture within the study area. The cumulative impact is considered to be LOW.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Low	

7. IMPACTS ON THE SOCIO-ECONOMIC ENVIRONMENT

This chapter describes and assesses the significance of potential impacts of the proposed Ibhubesi Gas Project and associated alternatives on the socio-economic environment. All impacts are systematically assessed and presented according to predefined rating scales (see Appendix 3). Mitigation or optimisation measures are proposed which could ameliorate the negative impacts or enhance potential benefits, respectively. The status of all impacts should be considered to be negative unless otherwise indicated. The significance of impacts with and without mitigation is also assessed.

The following potential socio-economic impacts are assessed below:

- Section 7.1: Fishing industry impacts;
- Section 7.2: Cultural impacts;
- Section 7.3: Aesthetic impacts;
- Section 7.4: Social impacts; and
- Section 7.5: Economic impacts.

The specialist reports on which this chapter is based are presented in the following appendices:

- Fisheries Assessment (see Appendix 7, Vol. 2);
- Heritage Assessment (see Appendix 12, Vol. 3);
- Visual Assessment (see Appendix 15, Vol. 3);
- Social Assessment (see Appendix 16, Vol. 3); and
- Economic Assessment (see Appendix 17, Vol. 3).

7.1 FISHING INDUSTRY IMPACTS

<u>Description of impact</u>

The proposed project could impact the fishing industry as a result of the presence of the pipe-laying vessel, production facility and subsea production pipeline.

The pipe-laying vessel and production facility are protected by a 500 m safety zone, where it is an offence for an unauthorised vessel to enter, and thus could impact all sectors operating in the area. The impact associated with the production facility is no different to the impact associated with the anchoring of a Tension Leg Platform, which was approved as part of the original project proposal.

Although the production pipeline is not be protected by a 500 m safety zone, it is afforded some protection in terms of the Marine Traffic Act, 1981 (e.g. a vessel is not permitted to drop anchor or demersal trawl within 500 m of a pipeline). The pipeline would, however, only impact those sectors that have gear that comes into contact with the seafloor (namely demersal trawl, demersal long-line and West Coast rock lobster).

Impacts could include disruption to fishing activities and increased fishing effort; loss-of-access to fishing grounds; and the subsequent loss of catch.

<u>Assessment</u>

(a) Demersal trawl sector

Demersal trawl is South Africa's most valuable fishery accounting for approximately half of the income generated from commercial fisheries. The deep sea trawl sector on the West Coast operates mainly in a continuous band along the shelf edge between the 300 m and 1 000 m bathymetric contours. Trawl nets are generally towed along depth contours (thereby maintaining a relatively constant depth) running parallel to the depth contours in a north-westerly or south-easterly direction. The Block 2A, the proposed offshore pipeline route and nearshore shore-crossing alternatives in relation to the spatial distribution of demersal trawl fishing effort (2000 to 2012) are shown in Figure 4.21. The production facility in Block 2A does not coincide with fishing grounds. The proposed offshore pipeline only passes through one commercial fisheries grid block along its length (i.e. Grid Block 441 offshore of Saldanha Bay). Records show that approximately 0.02% and 0.07% of the national catch and effort, respectively, has been recorded in Grid Block 441.

The impact during pipe-laying is considered to be localised and of very low intensity in the short-term. This impact is, therefore, assessed to be **INSIGNIFICANT** with and without mitigation for all proposed pipeline routes (see Table 7.1). The impact during operation and decommissioning is assessed to be permanent due to pipeline abandonment, regional in extent and of low intensity. The overall impact is assessed to be of **VERY LOW** significance with and without mitigation for all proposed pipeline routes (see Table 7.2).

(b) Small pelagic purse-seine sector

South African small pelagic purse-seine fishery is the largest fishery by volume and the second most important in terms of value. Fishing grounds occur primarily along the Western Cape and Eastern Cape coast up to a distance of 100 km offshore, but usually closer inshore. The proposed offshore pipeline route and nearshore shore-crossing alternatives in relation to the reported annual effort expended by the small pelagic purse-seine sector for the period 2000 to 2012 are shown in Figures 4.23 and 4.24. Although there is no effort recorded in Block 2A, fishing activity is evident along the majority of the length of the proposed offshore pipeline. Since the fishery is pelagic in nature, fishing operations would not be affected by the presence of a pipeline on the seafloor. The fishery could, however, be affected during pipeline installation due to the 500 m safety zone around the pipe-laying vessel. Effort recorded by this fishery over the period 2000 to 2012 indicates that the safety zone would coincide with between 0.06% and 0.48% of the total number of fishing events recorded by the fishery, depending on the landing site selected (see Table 4.8 in Chapter 4).

The impact during pipe-laying is considered to be localised and of low intensity in the short-term. This impact is, therefore, assessed to be **VERY LOW** with and without mitigation for the proposed offshore pipeline route and nearshore shore-crossing alternatives (see Table 7.1). Since the fishery targets pelagic fish species and gear does not come into contact with the seabed, the installed pipeline would not impact this sector. The production facility in Block 2A also does not coincide with fishing grounds, thus there would be **NO IMPACT** associated with the safety zone around the production facility (see Table 7.2).

(c) Hake-directed demersal long-line sector

Demersal long-line fishing grounds are similar to those targeted by the hake-directed trawl fleet. Figure 4.27 shows the spatial distribution of hake-directed long-line effort recorded off the West Coast. During the period 2000 to 2013, while some effort was recorded within grid blocks through which the pipeline passes, there is only one recorded fishing event that coincides with the proposed pipeline (see Grid Block 414 in Figure 4.28). Although fishing effort in the vicinity of the proposed pipeline is low, fishing is likely to occur. In terms of the Marine Traffic Act, 1981, demersal long-line vessels would not be permitted to set lines with the anchor being located within 500 m of the proposed pipeline, as anchoring could damage the pipeline. It is, however, conceivable that a line could be set over the pipeline. The proposed abandonment of the pipeline on the seafloor would not have a permanent impact on this fishery as vessels would be permitted to set lines over the abandoned pipeline.

The impact during pipe-laying is considered to be localised and of very low intensity in the short-term. This impact is, therefore, assessed to be **INSIGNIFICANT** with and without mitigation for the proposed offshore pipeline route and nearshore shore-crossing alternatives (see Table 7.1). The impact during operation due to the exclusion zone around the pipeline is considered to be regional, of low intensity in the medium-term. The overall impact is assessed to be of **VERY LOW** significance with and without mitigation for the proposed offshore pipeline route and nearshore shore-crossing alternatives (see Table 7.2).

(d) Shark -directed demersal long-line sector

On the West Coast, fishing grounds of this sector are centred predominantly in coastal waters inshore of the 200 m isobaths around the South-Western Cape coastline and extending up to Saldanha Bay. The proposed production pipeline in relation to the spatial distribution of effort expended by the shark-directed demersal long-line fishery is shown in Figure 4.29.

Since the production facility in Block 2A, the majority of the offshore pipeline and northern shore-crossing alternatives do not coincide with fishing grounds, there would be **NO IMPACT** on this sector in these areas. There have, however, been several fishing events in close proximity to the proposed southern pipeline routes and the fishery could thus be expected to operate within these areas. As mentioned for the hake-directed fishery above, demersal long-line vessels would not be permitted to set lines with the anchor being located within 500 m of the proposed pipeline. It is, however, conceivable that a line could be set over the pipeline. The area would open up to fishing after decommissioning. The level of fishing effort in the vicinity of the southern shore-crossing locations is relatively low compared with that expended by the fishery on a national level. For this reason, the impact during pipe-laying is considered to be localised and of very low intensity in the short-term. This impact is, therefore, assessed to be **INSIGNIFICANT** with and without mitigation (see Table 7.1). During operation, the impact on this sector is considered to be localised, of low intensity over the medium-term. The overall impact is thus considered to be of **VERY LOW** significance with and without mitigation for the southern pipeline route alternatives (see Table 7.2).

(e) Large pelagic long-line sector

This fishing activity is concentrated at the shelf break, predominantly seawards of the 500 m isobath but with incidental records closer inshore. Block 2A and the production pipeline in relation to the spatial distribution of catch reported by the large pelagic long-line sector are shown in Figure 4.31. There is very limited catch record from Block 2A and there is no evidence of fishing activity having taken place within 500 m of the proposed offshore pipeline route over the period 2000 to 2012.

The impact during pipe-laying is considered to be localised and of very low intensity in the short-term. This impact is, therefore, assessed to be **INSIGNIFICANT** with and without mitigation for all proposed pipeline routes (see Table 7.1). Since the fishery targets pelagic fish species and gear does not come into contact with the seabed, the installed pipeline would not impact this sector. There may, however, be an impact during the operational phase due to the presence of the production facility in Block 2A. This impact is considered to be localised, of very low intensity in the medium-term. The overall impact is assessed to be **INSIGNIFICANT** with and without mitigation for all proposed pipeline routes (see Table 7.2).

(f) Tuna pole sector

Fishing activity occurs along the entire West Coast beyond the 200 m bathymetric contour. Activity would be expected to occur along the shelf break with favoured fishing grounds including areas north of Cape Columbine and between 60 km and 120 km offshore from Saldanha Bay. Block 2A, the proposed offshore pipeline route and nearshore shore-crossing alternatives in relation to the spatial distribution of tuna pole catch are shown in Figure 4.33. While some catches have been recorded within grids through which the proposed pipeline passes, over the period 2003 to 2012, there have been no recorded fishing events that have occurred within 500 m of the proposed pipeline and only a few fishing events have been in close proximity to the pipeline (see Figure 4.34).

The impact during pipe-laying is considered to be localised and of very low intensity in the short-term. This impact is, therefore, assessed to be **INSIGNIFICANT** with and without mitigation for all proposed pipeline routes (see Table 7.1). Since the fishery targets pelagic fish species and gear does not come into contact with the seabed, the installed pipeline would not impact this sector. There may, however, be an impact during the operational phase due to the 500 m safety zone around the production facility in Block 2A. This impact is considered to be localised, of very low intensity in the medium-term. The overall impact is assessed to be **INSIGNIFICANT** with and without mitigation for all proposed pipeline routes (see Table 7.2).

(g) Traditional line-fish sector

This fishery includes commercial, subsistence and recreational sectors. The fishery operates year-round and records of fishing activity off the West Coast are predominantly coastal up to the 200 m isobath. During the period 2000 to 2012, while some effort is recorded within grid blocks through which the pipeline passes (Figure 4.35), there is only one recorded fishing event that coincides with the proposed pipeline at the Grotto Bay pipeline landing site (Figure 4.36). Although fishing effort in the vicinity of the proposed production platform and pipeline is low, it can be expected to occur. There are several small-scale fishing communities in the St Helena Bay area, at Saldanha Bay, Langebaan and Mamre/Atlantis, close to Silwerstroom Strand. Since the fishery is pelagic in nature, fishing operations would not be affected by the presence of a pipeline on the seafloor. The fishery could, however, be affected during pipeline installation due to the 500 m safety zone around the pipe-laying vessel.

The impact during pipe-laying is considered to be localised and of very low intensity in the short-term. This impact is, therefore, assessed to be **INSIGNIFICANT** with and without mitigation for all proposed pipeline routes (see Table 7.1). Since the fishery targets pelagic fish species and gear does not come into contact with the seabed, the installed pipeline would not impact this sector. There may, however, be an impact during the operational phase due to the 500 m safety zone around the production facility in Block 2A. This impact is considered to be localised, of very low intensity in the medium-term. The overall impact is assessed to be **INSIGNIFICANT** with and without mitigation for all proposed pipeline routes (see Table 7.2).

(h) West Coast rock lobster sector

In South Africa this fishery is divided into two sectors, namely the offshore sector which operates in a water depth range of 30 m to 100 m and the inshore fishery which is restricted by the type of gear used in waters shallower than 30 m in depth. Figure 4.37 shows the spatial distribution of catch taken by the inshore and offshore West Coast rock lobster fisheries over the period 1969 to 2012. Although there is no effort recorded for the majority of the proposed pipeline, fishing activity can be expected for the pipeline and inshore alternatives inshore of the 100 m isobath (see Figure 4.38 and Figure 4.39). In terms of the Marine Traffic Act, 1981, vessels could potentially set traps within 500 m of the pipeline. However, due to possible risk of pipeline damage traps may not be allowed to be set over or in very close proximity to the pipeline. The proposed abandonment of the pipeline on the seafloor would not have a permanent impact on this fishery as vessels would be permitted to set lines over the abandoned pipeline.

The impact during pipe-laying is considered to be localised and of low intensity in the short-term. This impact is, therefore, assessed to be **VERY LOW** with and without mitigation for all proposed pipeline routes (see Table 7.1). The impact during operation due to the exclusion zone around the pipeline is considered to be regional, of very low (Noordwesbaai, Silwerstroom Strand and Duynefontein) to low (Grotto Bay and St Helena Bay) intensity in the medium-term. The overall impact is assessed to be of **VERY LOW** significance with and without mitigation for the Noordwesbaai, Silwerstroom Strand and Duynefontein shore-crossings and of **LOW** significance with and without mitigation for the Grotto Bay and St Helena Bay alternatives (see Table 7.2).

(i) Fisheries research

Surveys of demersal and pelagic fish resources are carried each year by DAFF in order to set the annual TACs for fisheries. The demersal surveys are carried out in January (West Coast survey) and May (South Coast survey), whereas the pelagic surveys are undertaken bi-annually (mid-May to mid-June and mid-October to mid-December). Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1 000 m bathymetric contour. Approximately 120 trawls are conducted during each survey. The spatial distribution of research trawls undertaken in relation to the proposed project development area is shown below in Figure 4.40.

The impact during pipe-laying is considered to be localised and of low intensity in the short-term. This impact is, therefore, assessed to be **very low** significance without mitigation and **INSIGNIFICANT** with mitigation (see Table 7.1). Although abandonment of the production pipeline could result in a permanent impact on the demersal research surveys, the location of the pipeline would be recorded on the South African Navy Hydrographic charts. Thus minor adjustments could be made to the demersal sampling programme to avoid the abandoned pipeline. The impact during operation and decommissioning is assessed to be permanent due to pipeline abandonment, regional in extent and of low intensity. The overall impact is assessed to be of **VERY LOW** significance with and without mitigation for all proposed pipeline routes (see Table 7.2).

<u>Mitigation</u>

The mitigation measures listed below are unlikely to reduce the significance level of the potential impact, however, they are nevertheless important as they would minimise any likely disruptions to pipeline installation and fishing operations.

- Prior to pipeline installation the following key stakeholders should be consulted and informed of the installation programme (including navigational co-ordinates of production facility and pipeline, timing and duration of proposed activities) and the likely implications thereof (specifically the 500 m safety / exclusion zone around the pipe-lay vessel, production platform and subsea pipeline):
    - Fishing industry / associations: South African Tuna Long-line Association, South African Deep-sea Trawling Industry Association, South African Tuna Association, Fresh Tuna Exporters Association, South African Commercial Linefish Association, West Coast and Peninsula Commercial Skiboat Association, and South African West Coast Rock Lobster Association; and
    - Other key stakeholders: DAFF, DEA, PASA, Transnet National Ports Authority (ports of Cape Town and Saldanha Bay), South African Maritime Safety Authority (SAMSA) and South African Navy Hydrographic office.

  These stakeholders should again be notified when installation activities are complete and the pipe-laying vessel is off location;
- Sunbird must request, in writing, the South African Navy Hydrographic office to release Radio Navigation Warnings and Notices to Mariners throughout the pipeline installation period. The Notice to Mariners should give notice of (1) the co-ordinates of the pipeline alignment, (2) an indication of the proposed installation timeframes, and (3) an indication of the 500 m safety zone around the pipe-ley vessel. These Notices to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible;
- Any fishing vessels located at a radar range of 12 nm from the pipe-laying vessel should be called via radio and informed of the navigational safety requirements; and
- Pipeline must be surveyed and accurately recorded on the South African Navy Hydrographic charts.

Table 7.1: Assessment of the potential impact on commercial fishing activities due to the 500 m safety zone around the pipe-lay vessel.

Rating scales	Without Mitigation	With Mitigation
Demersal trawl, Demersal long-line, Large pelagic long-line, Tuna pole, Traditional Line-fish		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Very Low	Very Low
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High

Rating scales	Without Mitigation	With Mitigation
Small pelagic purse-seine, West Coast Rock Lobster		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High
Fisheries research		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Very Low
Significance	**Very Low**	**INSIGNIFICANT**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on fisheries include mining, oil and gas exploration / production and the installation of other subsea infrastructure (e.g. telecommunications cables, wells, etc.). Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None to Low	

Table 7.2: Assessment of the potential impact on commercial fishing activities due to the 500 m safety zone around the production facility and subsea pipeline.

Rating scales	Without Mitigation	With Mitigation
Demersal trawl		
Extent	Regional	Regional
Duration	Permanent	Permanent
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High
Small pelagic purse-seine		
NO IMPACT		
Demersal long-line		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High

Rating scales	Without Mitigation	With Mitigation
Large pelagic long-line, Tuna pole, Traditional Line-fish		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Very Low	Very Low
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High
West Coast rock lobster		
Extent	Regional	Regional
Duration	Medium-term	Medium-term
Intensity	Very Low (Noordwesbaai, Silwerstroom Strand and Duynefontein) to Low (Grotto Bay and St Helena Bay)	Very Low (Noordwesbaai, Silwerstroom Strand and Duynefontein) to Low (Grotto Bay and St Helena Bay)
Significance	**Insignificant (**Noordwesbaai, Silwerstroom Strand and Duynefontein) to **Very Low** (Grotto Bay and St Helena Bay)	**INSIGNIFICANT (**Noordwesbaai, Silwerstroom Strand and Duynefontein) to **VERY LOW** **(**Grotto Bay and St Helena Bay)
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High
Fisheries research		
Extent	Regional	Regional
Duration	Permanent	Permanent
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on fisheries include mining, oil and gas exploration / production and the installation of other subsea infrastructure (e.g. telecommunications cables, wells, etc.). Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Irreversible (pipeline) to Fully reversible (production facility)	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None to Low	

7.2 CULTURAL IMPACTS

7.2.1 OFFSHORE PIPELINE

7.2.1.1 SOUTHERN SHORE-CROSSING ROUTE (GROTTO BAY TO DUYNEFONTEIN)

Description of impact

The installation of the proposed production pipeline on the seabed from the production platform to the southern shore-crossing site could disturb historical shipwrecks.

Assessment

All known shipwrecks off the coast of South Africa occur in waters shallower than 100 m within 50 km of the coast. Thus, the majority of the offshore pipeline, which would be located between 100 m and 250 m water depth, is unlikely to encounter any historical shipwrecks. Offshore of the southern pipeline shore-crossing sites there are no accounts of any historical shipwrecks on the South African National Maritime database. However, the possibility of encountering historical shipwrecks off the coast cannot be excluded. Thus the final pipeline alignment may, although unlikely, disturb historical shipwrecks where the pipeline approaches the shore-crossing locations.

The impact associated with all three southern shore-crossing alternatives is considered to be of a permanent nature, localised in extent and of low intensity. This potential impact is, therefore, assessed to be of **LOW** significance with and without mitigation (see Table 7.3).

Mitigation

A detailed geotechnical site investigation should be undertaken. If any shipwreck material or unexplained seabed anomalies are discovered during this detailed survey, the final position of the pipeline should be adjusted to avoid such features. Should the realignment of the pipeline not be technically feasible, an application would need to be made to the South African Heritage Resources Agency (SAHRA) for a heritage permit in order to disturb cultural heritage material older than sixty years. Sunbird would also need to comply with any conditions specified by SAHRA.

Table 7.3: Assessment of the potential impact on historical shipwrecks in the southern study area.

Rating scales	Without Mitigation	With Mitigation
Extent	Local	Local
Duration	Permanent	Permanent
Intensity	Low	Low
Significance	**Low**	**LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on historical shipwrecks include demersal trawling, mining, oil and gas exploration / production and the installation of other subsea infrastructure (e.g. telecommunications cables, wells, etc.). Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Irreversible	
Degree to which impact may cause irreplaceable loss of resources	High	
Degree to which impact can be mitigated	None	

7.2.1.2 NORTHERN SHORE-CROSSING ROUTE (SALDANHA PENINSULA)

Description of impact

The installation of the proposed production pipeline on the seabed from the production platform to the northern shore-crossing site could disturb historical shipwrecks.

Assessment

As mentioned in the section above, the depth at which the majority of the offshore pipeline would be located (100 m to 250 m), it is unlikely that any historical shipwrecks would be encountered. Closer inshore there are no accounts of shipwrecks on the South African National Maritime database for the Noordwesbaai shore-crossing. However, the possibility of encountering historical shipwrecks off Noordwesbaai cannot be excluded. There are two references to shipwrecks in the St Helena Bay area. These include:

- In 1691 the Gouden Buys ran aground near St Helena Bay. The wreck of the Gouden Buys has never been found, although survivor accounts indicate a position close to the mouth of the Berg River or a little to the north; and
- Reference is also made to a sailing cutter that grounded close to the Berg River Mouth in 1910, the precise location is unknown.

There is thus a remote possibility that shipwreck material may be encountered offshore in the St Helena Bay area.

The impact associated with all three northern shore-crossing alternatives is considered to be of a permanent nature, localised in extent and of low intensity. This potential impact is, therefore, assessed to be of **LOW** significance with and without mitigation (see Table 7.4).

Mitigation

Recommendations to mitigate the potential impact on historical shipwrecks are similar to those recommended for the southern pipeline route alternatives (refer to Section 7.2.1.1).

Table 7.4: Assessment of the potential impact on historical shipwrecks in the northern study area.

Rating scales	Without Mitigation	With Mitigation
Extent	Local	Local
Duration	Permanent	Permanent
Intensity	Low	Low
Significance	**Low**	**LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on historical shipwrecks include demersal trawling, mining, oil and gas exploration / production and the installation of other subsea infrastructure (e.g. telecommunications cables, wells, etc.). Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Irreversible	
Degree to which impact may cause irreplaceable loss of resources	High	
Degree to which impact can be mitigated	None	

7.2.2 ONSHORE PIPELINE

7.2.2.1 SOUTHERN SHORE-CROSSING ROUTE (GROTTO BAY TO DUYNEFONTEIN)

Description of impact

The installation of the proposed pipeline through the coastal zone to the onshore facility could disturb cultural heritage material, including fossils, shell middens and other archaeological material. Similarly, the construction of the onshore gas receiving faculty could also disturb cultural heritage material.

Assessment

Although no archaeological material was noted along any of the onshore pipeline routes and onshore facility sites, previous observations on the West Coast indicate that the coastline, especially headlands, is littered with Late Stone Age shell midden material. This is supported by the identification of shell midden material in the vicinity of the Grotto Bay parking area. The probability of encountering shell middens at the Duynefontein and Silwerstroom Strand alternatives is, however, considered to be less likely. The proposed installation method at Grotto Bay (i.e. horizontal directional drilling) would to a large extent mitigate the potential impact on any shell middens occurring in the vicinity of the parking area.

Due to the presence of pleistocene fossils in relatively shallow calcretised sands and the Springfontein Formation within the Koeberg Nature Reserve, it is anticipated that palaeontological material could be encountered along all routes and at the onshore facility sites. Since the depth of trench excavation would be in the order of 1 to 1.5 m, it is unlikely that deep fossil fauna of the Miocene and Pleistocene epochs would be impacted.

The coastline is the main scenic feature along the pipeline routes. However, the scenic value at the Duynefontein and Silwerstroom Stand alternatives has been compromised due to the presence of the Koeberg Power Station and the resort, respectively.

The potential heritage impact associated with the Grotto Bay alternative is considered to be of a permanent nature, localised in extent and of medium intensity. This potential impact is, therefore, assessed to be of **medium** significance without mitigation. The impact associated with the other two alternatives and the onshore facilities would be of lower intensity, and consequently of **low** significance. The significance of all alternatives after mitigation is considered to be of **LOW** significance (see Table 7.5).

Mitigation

The following mitigation measures are recommended:

- While continuous monitoring of pipeline excavation for palaeontological and archaeological material is not considered necessary for the entire pipeline route, it is recommended that the first 500 m from the coast be monitored by an archaeologist, where after spot checks should be carried out once every two weeks; and
- Should any human remains be disturbed, exposed or uncovered during excavation, these must immediately be reported the South African Police Service and, if suspected that the remains are older than 60 years, Heritage Western Cape (HWC).

Table 7.5: Assessment of the impact on cultural heritage material in the southern study area.

Rating scales	Without Mitigation	With Mitigation
Grotto Bay alternative		
Extent	Local	Local
Duration	Permanent	Permanent
Intensity	Medium	Low
Significance	**Medium**	**LOW**
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	High	High
Silwerstroom Stand and Duynefontein alternatives, Gas receiving facility sites		
Extent	Local	Local
Duration	Permanent	Permanent
Intensity	Low	Low
Significance	**Low**	**LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative heritage impact include increased development and agriculture within the study area. The cumulative impact is considered to be of VERY LOW significance as most of the heritage that could be impacted is well represented.	
Degree to which impact can be reversed	Irreversible	
Degree to which impact may cause irreplaceable loss of resources	High	
Degree to which impact can be mitigated	None to Low	

7.2.2.2 NORTHERN SHORE-CROSSING ROUTE (SALDANHA PENINSULA)

<u>Description of impact</u>

The installation of the proposed pipeline through the coastal zone to the onshore termination could disturb cultural heritage material, including early fish traps, fossils, shell middens and other archaeological material.

<u>Assessment</u>

Immediately west of the mouth of the Berg River are a series of at least nine early fish traps built into the shallow waters of the bay. The proposed St Helena West shore-crossing would pass through a fish trap, which has a heritage grading of Grade lllA.

Onshore all northern pipeline alternatives avoid any surface manifestations of archaeological material. Inland of the coastal dunes the proposed routes traverse mainly transformed landscapes (agricultural lands) that have a low palaeontological and archaeological potential. There is unfortunately no guarantee that buried archaeological material would not be encountered. Archaeological sites in the area are, however, generally considered to be of low to moderate archaeological significance.

Given the sedimentology of the region, it is likely that marine and/or terrestrial fossils occur in Varswater, Springfontyn and Langebaan Lagoon Formation sediments. It is, however, unlikely that pipeline excavations would penetrate deep enough to have an impact on any palaeontological material. There may, however, be occasional fossils within the calcretes that characterise the northern study area.

Although the coastline is the main scenic feature of the area, all sites occur on private property with no or limited access to the coast.

Due to the presence of the fish trap at St Helena West, the potential impact associated with this alternative is considered to be slightly more significant than the other two alternatives before mitigation. The potential heritage impact associated with the St Helena West alternative is considered to be of a permanent nature, localised in extent and of medium intensity. This potential impact is, therefore, assessed to be of **medium** significance without mitigation. The impact associated with the other alternatives would be of lower intensity, and consequently of **low** significance. The significance of all alternatives after mitigation is considered to be of **LOW** significance (see Table 7.6).

Mitigation

Recommendations to mitigate the potential heritage impact are similar to those recommended for the southern pipeline route alternatives (refer to Section 7.2.2.1). In addition, it is recommended that the final routing of the St Helena West alignment should, if technically possible, avoid the fish trap located within the intertidal zone. Should the avoidance of the fish trap not be possible, localised demolition of a fish trap may be necessary, which would also require a heritage permit from SAHRA. Sunbird would also need to comply with any conditions specified by SAHRA.

Table 7.6: Assessment of the potential impact on cultural heritage material in the northern study area.

Rating scales	Without Mitigation	With Mitigation
St Helena West alternative		
Extent	Local	Local
Duration	Permanent	Permanent
Intensity	Medium	Low
Significance	**Medium**	**LOW**
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	High	Medium
St Helena East and Noordwesbaai alternatives		
Extent	Local	Local
Duration	Permanent	Permanent
Intensity	Low	Low
Significance	**Low**	**LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	Medium to High
Nature of cumulative impact	Other activities that may contribute to the cumulative heritage impact include increased development and agriculture within the study area. The cumulative impact associated with the St Helena East and Noordwesbaai shore-crossings is considered to be of VERY LOW significance as most of the heritage that could be impacted is well represented. The impact at St Helena West would be more significant due to the rarity of the fish trap (LOW significance).	
Degree to which impact can be reversed	Irreversible	
Degree to which impact may cause irreplaceable loss of resources	High	
Degree to which impact can be mitigated	None to Low	

7.3 AESTHETIC IMPACTS

7.3.1 SOUTHERN SHORE-CROSSING ROUTE (GROTTO BAY TO DUYNEFONTEIN)

Description of impact

The proposed pipeline and onshore gas receiving facility would potentially alter the visual landscape, which would have a visual impact in the immediate surrounding area.

Assessment

The pipeline would be buried through the surf zone and along its full onshore length approximately 1 m to 1.5 m below ground until it reaches the proposed onshore gas receiving facility. Thus the pipeline would only be visible during construction and until pipeline servitude has been rehabilitated.

The onshore facility is likely to include all or some of the following: an office / warehouse building, a workshop, electrical substation, a control building, a site security building and parking. The tallest part of the gas processing facility would be the flues and cold vent stacks, which would be 10 m high, and the water bath heaters, which would be 5 m high. All other buildings would be single storey in height. The onshore facility would, however, be visual until decommissioning.

(a) Pipeline routes

The proposed Grotto Bay route would pass adjacent to the Grotto Bay residential area. The rocky headlands and small coves are a valuable scenic and amenity resource on the West Coast. Other than Grotto Bay, the inland areas are sparsely populated along this route. Pipeline excavations during construction would be visible to residents and visitors of Grotto Bay and users of the R27 and Dassenberg roads.

The proposed Silwerstroom Strand route passes through the Silwerstroom Strand resort, which has chalets and campsites. A Water Treatment Plant and wetland lie to the east and north of the resort, respectively. The sandy beach, dunes, streams and wetlands of the coastal area have high landscape and amenity value. The coastal plain is visually exposed, but sparsely populated. Pipeline excavations and construction activities could potentially affect visitors to the Silwerstroom Strand resort, which serves Atlantis and the larger region, and users of the R27 and Dassenberg roads.

The proposed Duynefontein route would pass through the Koeberg Private Nature Reserve between the Koeberg Power Station and Duynefontein residential area. The dunes and wetlands of the shore-crossing area have high landscape value and are generally sensitive, although access is limited due to this being a restricted area. The area surrounding the Koeberg Power Station is not inhabited and the pipeline construction works would probably not be overtly visible to residents of Van Riebeeckstrand. The construction works would be visible to users of the R27 and Dassenberg roads.

The potential visual impact for all pipeline route alternatives is considered to be localised, of medium intensity and of short-term duration. The potential impact is, therefore, assessed to be of **LOW** significance with and without mitigation (see Table 7.7).

(b) Onshore gas processing facility

The proposed gas receiving facility at Silwerstroom Strand would be located adjacent to the existing Water Treatment Plant, about 250 m east of the resort area, and would be visible to users in the northern part of the resort (see Plates 7.1 and 7.2). The potential visual impact is considered to be localised, of medium to high intensity and of medium-term duration. The potential impact is, therefore, assessed to be of **medium to high** significance without mitigation and **MEDIUM** significance with mitigation (see Table 7.7).

The proposed gas receiving facility locations adjacent to Ankerlig are located within the Atlantis Industrial Area. As such these sites have a moderately high visual absorption capacity. The proposed facility at both sites would be partly visible to users of Dassenberg Road and Charel Uys Drive, and possibly a few of the adjacent industrial sites (see Plates 7.3 and 7.4). The potential visual impact is considered to be localised, of medium intensity and of medium-term duration. The potential impact is, therefore, assessed to be of **low to medium** significance without mitigation and **LOW** significance with mitigation (see Table 7.7).

Plate 7.1: **Photomontage of the Silwerstroom Strand gas processing facility (Alternative 2a) looking in a south-westerly direction towards the resort in the background.**

Plate 7.2: **Photomontage of the Silwerstroom Strand gas processing facility (Alternative 2b) looking in a north-westerly direction.**

Plate 7.3: **Photomontage of the gas processing facility adjacent to Ankerlig (Alternative 1a) looking in a southerly direction from Dassenberg Road.**

Plate 7.4: Photomontage of the gas processing facility adjacent to Ankerlig (Alternative 1b) looking in a south-westerly direction towards Ankerlig.

Mitigation

The following mitigation measures are recommended for the pipeline:

- Final design should, where possible, take the following into consideration:
  - > Natural rock gullies and low points of dunes should be preferred for pipeline alignment;
  - > Damage to exposed rock outcrops and blasting should be minimised;
  - > Stream and wetland areas should be avoided; and
  - > Access and haul roads should follow existing roads and firebreaks as far as possible.
- Construction during the peak holiday/tourism season (Dec-Jan) should be avoided, especially at Grotto Bay and Silwerstroomstrand;
- Good house-keeping should form an integral part of the construction operations;
- All spoil stockpiles should be removed after construction; and
- Disturbed areas should be reshaped back as close to the original profile as possible, and then rehabilitated (see Section 6.2.1.1 in Chapter 6).

The following mitigation measures are recommended for the onshore facility:

- Final design should, where possible, take the following into consideration:
  - > Silwerstroom Strand:
    - Stream and wetland areas near the waste treatment facility should be avoided;
    - A planted earth berm (approximately 6 m) should be constructed to screen the facility from the resort, based on an approved landscape plan;
    - Earthy colours should be used to blend the structures with the natural surroundings; and
    - Outdoor lighting should be minimised. Low-level lighting and fit reflectors should preferably be used to avoid light spillage.
  - > Ankerlig:
    - Development should be set back from main routes to allow for planted buffer strip;
    - A planted earth berm (approximately 3 m) should be constructed along Dassenberg Road and Charel Uys Drive;
    - Appropriate colours should be used to blend structures with the existing power station; and
    - Reflectors should be fitted to avoid light spillage.
- Parking should be located under shade structures or shade trees;
- Wire mesh fencing with a dark green or black finish should be used. Palisade-type fencing with timber or metal pales, or repetitive brick piers, should be avoided; and
- External signage should be confined to the entrance gate and signs intruding on the skyline should be avoided. Signage should be grouped and limited in size (<2 m^2).

Table 7.7: Assessment of the potential visual impact in the southern study area.

Rating scales	Without Mitigation	With Mitigation
Pipeline routes		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Medium	Medium
Significance	**Low**	**LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	Medium
Gas receiving facility adjacent to the Silwerstroom Strand Water Treatment Plant		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Medium to High	Medium
Significance	**Medium to High**	**MEDIUM**
Status	Negative	Negative
Probability	Highly Probable	Probable
Confidence	Medium	Medium
Gas receiving facility adjacent to Ankerlig		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Medium	Low to Medium
Significance	**Low to Medium**	**LOW**
Status	Negative	Negative
Probability	Highly Probable	Probable
Confidence	Medium	Medium
Nature of cumulative impact	Other activities that may contribute to the cumulative visual impact include increased industrial development in the study area. Cumulative impact for all alternatives, except the onshore facility at Silwerstroom Strand, is considered to be of LOW. The cumulative impact associated with the Silwerstroom Strand alternative is considered to be of MEDIUM significance.	
Degree to which impact can be reversed	Fully reversible (pipeline) to Partially reversible (onshore facility)	
Degree to which impact may cause irreplaceable loss of resources	Low (pipeline) to Medium to High (onshore facility)	
Degree to which impact can be mitigated	Low	

7.3.2 NORTHERN SHORE-CROSSING ROUTE (SALDANHA PENINSULA)

<u>Description of impact</u>

The proposed pipeline would potentially alter the visual landscape, which would have a visual impact in the immediate surrounding area.

<u>Assessment</u>

The pipeline would be buried through the surf zone and along its full onshore length approximately 1 m to 1.5 m below ground until it reaches the proposed onshore gas receiving facility. Thus the pipeline would only be visible during construction and until pipeline servitude has been rehabilitated.

The St Helena West and East route alternatives are located on St Helena Bay on the Saldanha Peninsula. The township of Laingville lies 2.2 km to the west, while Laaiplek and Velddrift on the Berg River lie 4.3 km to the east. Although the coastline is the main scenic feature of the area, there is no public road access to the shore-crossing sites. The shore-crossing and pipeline routes are characterised by a flat low-lying coastal plain and rocky shoreline, below 20 m elevation. Other than Farm Varkvlei, there is little habitation in the area. The potential visual impact is considered to be localised, of low to medium intensity and of short-term duration. The potential impact is, therefore, assessed to be of **VERY LOW** significance with and without mitigation (see Table 7.8).

The Noordwesbaai shore-crossing lies south of Cape Columbine, about 7 km south of Paternoster and 10 km north-west of Vredenburg. Gravel roads provide access to the area, while a sandy track through the dunes provides access to the shore-crossing point. Pipeline excavations would be visible to the Trekoskraal farmstead, as well as recent residential development during construction. The pipeline would also cross under the Jacobsbaai road and the R399 between Vredenburg and Saldanha. The potential visual impact is considered to be localised, of medium intensity and of short-term duration. The potential impact is, therefore, assessed to be of **LOW** significance with and without mitigation (see Table 7.8).

<u>Mitigation</u>
Recommendations to mitigate the potential visual impact are similar to those recommended for the southern pipeline route alternatives (refer to Section 7.3.1).

Table 7.8: Assessment of the potential visual impact in the northern study area.

Rating scales	Without Mitigation	With Mitigation
St Helena West and East shore-crossing alternatives		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Medium	Low to Medium
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	Medium
Noordwesbaai shore-crossing alternative		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Medium	Medium
Significance	**Low**	**LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	Medium
Nature of cumulative impact	Other activities that may contribute to the cumulative visual impact include increased industrial and residential development in the study area. Cumulative impact is considered to be of VERY LOW to LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Low	

7.4 SOCIAL IMPACTS

7.4.1 CREATION OF EMPLOYMENT, EMPOWERMENT AND LOCAL EXPENDITURE

Description of impact

The proposed development would stimulate direct and indirect employment opportunities over the duration of the proposed project. The indirect employment opportunities would likely be generated through the increased expenditure in the relevant project areas and the provision of support services (e.g. transport services, catering, security, etc.), while the direct employment opportunities relate to the jobs directly created as a result of proposed project.

Assessment

While the proposed project would be a relatively small employer, any job opportunities would undoubtedly have a positive impact in the project area. Direct employment associated with the proposed project is projected as follows:

- 775 - 907 jobs during the design and construction phase;
- 100 - 141 jobs during the operational phase; and
- 60 - 80 jobs during the decommissioning phase.

Jobs created during the construction phase would be very short-term in duration (8 to 10 months for onshore pipeline installation). Moreover, a large portion of the jobs (280 to 300 jobs) associated with the construction phase are associated with the offshore pipeline installation, which would take in the order to 3 to 6 months to complete. Due to the very short duration, it is considered unlikely that many new jobs would be created. Although the capacity to manufacture and lay pipes, similar to those proposed, exists in South Africa, it is not known whether a local or foreign contractor would be used. Although the operational phase is expected to continue into the medium term (15 years), it entails far fewer jobs. Many of the direct jobs associated with the proposed project seem likely to go to people either from abroad or already in employment elsewhere in the country.

While the impact on employment is undoubtedly positive and regional in extent, the intensity of the impact is expected to be low. The significance of this impact is considered to be of **very low (positive)** significance during construction and decommissioning and of **low (positive)** significance during operation. With mitigation the impact is considered to be **LOW (positive)** during construction and decommissioning and **MEDIUM (positive)** during operation (see Table 7.9).

Mitigation

The following mitigation measures are recommended:

- Sunbird should promote jobs that are to be made available locally in advance in order to allow educational facilities and development agencies to develop or facilitate the development of more highly skilled and technical training;
- Initiatives such as the Atlantis Industrial Initiative should be utilised to understand the skills profiles of local communities and to match them with possible employment; and
- A proactive and comprehensive skills development programme should be implemented during the pre-construction phase of the proposed project and should focus on developing direct and indirect skills and capacity in the local communities, so as to ensure that a high level of local content in resources, goods and services procurement is achieved over an extended period of time.

Table 7.9: Assessment of the potential impact on employment, empowerment and local expenditure.

Rating scales	Without Mitigation	With Mitigation
Construction and decommissioning		
Extent	Regional	Regional
Duration	Short-term	Medium-term
Intensity	Low	Medium
Significance	**Very Low**	**LOW**
Status	Positive	Positive
Probability	Probable	Probable
Confidence	High	High
Operation		
Extent	Regional	Regional
Duration	Medium-term	Medium-term
Intensity	Low	Medium
Significance	**Low**	**MEDIUM**
Status	Positive	Positive
Probability	Highly Probable	Highly Probable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on employment, empowerment and local expenditure include increased economic development, e.g. Saldanha Industrial Development Zone, Atlantis Special Economic Zone, etc. Cumulative impact is considered to be of MEDIUM positive significance.	
Degree to which impact can be reversed	Partially reversible (construction / decommissioning) to Fully reversible (operation)	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Low	

7.4.2 SKILLS AND SMME DEVELOPMENT

Description of impact

The proposed project could result in skills and SMMEs being developed in the study area that supports an industry that is new to the West Coast of South Africa. This could result in the development of an exportable skills base that would have other benefits, such as stimulating interest in technical career development and learnerships in the project area.

Assessment

Skills development opportunities exist both in terms of direct and indirect jobs being created, as well as in terms of a wider based procurement requirement such as within the fabrications industry, although the latter is likely to be further developed in the Saldanha and Cape Town harbour areas. However, the gas and oil industry is a relatively new in South Africa and, therefore, the specialist skills do not currently exist locally.

Educational facilities and development agencies are interested in developing relevant curricula and stimulating career interest in the local communities in opportunities in the oil and gas sector. These skills would be important for future oil and gas-related projects, especially considering that Saldanha and Cape Town have been identified as regional oil and gas service hubs.

The development of SMMEs as a result of the proposed project could occur through the targeted application of local content procurement and beneficiation policies. This is particularly feasible for the supply of catering and security services. However, SMME development would in most instances require proactive policies from Sunbird to realise this impact.

The impact on skills and SMME development is considered to be regional and of low intensity in the medium-term. This impact is, therefore, assessed to be **low (neutral)** significance without mitigation and **MEDIUM (positive)** significance with mitigation (see Table 7.10).

Mitigation

The following mitigation measures are recommended:

- Sunbird should work closely with industry organisations (e.g. SAOGA) to identify relevant business development and educational institutions with which to work;
- Sunbird should promote skills development, local content and beneficiation in their project policies; and
- Skills development should also focus on developing skills in previously disadvantaged groups.

Table 7.10: Assessment of the potential impact on skills and SMME development.

Rating scales	Without Mitigation	With Mitigation
Extent	Regional	Regional
Duration	Medium-term	Long-term
Intensity	Low	Low
Significance	**Low**	**MEDIUM**
Status	Neutral	Positive
Probability	Probable	Probable
Confidence	Medium	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on skills and SMME development include increased economic development, e.g. Saldanha Industrial Development Zone, Atlantis Special Economic Zone, etc. Cumulative impact is considered to be of MEDIUM positive significance.	
Degree to which impact can be reversed	Partially reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Low	

7.4.3 INCOME AND RELATED ECONOMIC DEPENDENCY

Description of impact

Income in the form of State taxes and royalties, revenue to suppliers, contractors and local SMMEs and salaries, would be generated at international, national, regional and local levels from pre-commissioning to the end of the life of the gas field. This income creates economic dependency.

Assessment

Since the proposed project constitutes a new economic activity for the study area and beyond, all salary and related revenue generated by the proposed project would be additional. This income would, however, be lost once the project goes into decommissioning.

The impact of income and related economic dependency is considered to be national and of low intensity in the medium-term. This impact is, therefore, assessed to be **medium (positive)** significance without mitigation and **HIGH (positive)** significance with mitigation (see Table 7.11).

Mitigation

The following mitigation measures are recommended:

- Sunbird should aim for as high a level of local content as possible during all project phases; and
- Sunbird should develop a parallel economies programme in the development of its skills development programme, which considers alternate or replacement economic activities after gas field closure. The parallel economies programme should form part of Sunbird's Social and Labour Plan.

Table 7.11: Assessment of the potential impact of income and related economic dependency.

Rating scales	Without Mitigation	With Mitigation
Extent	National	National
Duration	Medium-term	Medium-term
Intensity	Low	Medium
Significance	**Medium**	**HIGH**
Status	Positive	Positive
Probability	Highly Probable	Highly Probable
Confidence	Medium	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact of income and related economic dependency include increased economic development, e.g. Saldanha Industrial Development Zone, Atlantis Special Economic Zone, etc. Cumulative impact is considered to be of HIGH positive significance.	
Degree to which impact can be reversed	Partially reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Low	

7.4.4 GENDER BALANCE

Description of impact

Developments, such as the proposed project, affect men and women differently as they often face different constraints and opportunities, and they typically fulfil different roles with differing responsibilities. These are influenced, to a great extent, by cultural contexts and deeply embedded social norms, which often work to the disadvantage of women. The employment of women would have an impact on the income and economic dependency of women in the area.

Assessment

While Sunbird is an equal opportunity employer and does not discriminate in terms of gender, the technical roles would be primarily dominated by men for the following reasons:

- Construction often requires manual labour;
- The existing skills base in the oil and gas industry is skewed towards male-dominated fields such as engineering; and
- Women typically have more family responsibilities than men and are, therefore, less able to travel for work and perform shift work.

The proposed project would likely perpetuate existing gender patterns within the study area as the labour force would be largely male-dominated. Men are more likely to be employed than women and their earnings are also higher than women on average. This implies that without a proactive gender equity strategy, women could likely miss out on opportunities offered by the proposed project. Women may, however, find indirect employment as a result of the project or through the development of SMMEs.

The potential impact on the gender balance is considered to be regional, of low intensity in the medium-term. This impact is, therefore, assessed to be **low (neural)** significance without mitigation and **LOW (positive)** significance with mitigation (see Table 7.12).

Mitigation

The following mitigation measures are recommended:

- Sunbird should proceed with a gender equity programme, which would form part of the Social and Labour Plan. The previous operator established a gender-based equity target of 10% and it is recommended that Sunbird target a similar level; and
- Sunbird should work closely with industry organisations (e.g. Women in Oil and Energy South Africa) to achieve their gender equity target.

Table 7.12: Assessment of the potential impact on the gender balance.

Rating scales	Without Mitigation	With Mitigation
Extent	Regional	Regional
Duration	Medium-term	Medium-term
Intensity	Low	Low
Significance	**Low**	**LOW**
Status	Neutral	Positive
Probability	Highly Probable	Probable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the gender balance include increased economic development, e.g. Saldanha Industrial Development Zone, Atlantis Special Economic Zone, etc. Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Partially reversible	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	Medium	

7.4.5 CULTURAL IMPACT DUE TO IN-MIGRATION

Description of impact

The proposed project could introduce new cultural impacts (e.g. changes in cultural values, changes to demographic profile of the area and communities could be culturally marginalised) and cause disharmony in the region. These impacts could be as a result of the employment of people from outside the region or the in-migration of people seeking employment opportunities.

Assessment

The potential of additional jobs in the study area due, in particular, to the construction phase of the onshore pipeline, as well as the onshore gas receiving facility, may result in migration to the area. This could exacerbate the tensions already evident in Atlantis, as migrants have recently moved from the Eastern Cape and are living in Witsands (an informal settlement in Atlantis). A similar situation exists in Saldanha due to the inflow of migrants into the area as a result of the Saldanha Steel development. The construction of Saldanha Steel saw the influx of people from poor, neighbouring provinces such as the Eastern Cape. The result was a change to the demographic profile of Saldanha with consequent cultural conflict. Once construction was complete, the employment opportunities in the longer-term operations could not cope with the demand for work. The competition for jobs resulted in racial tensions and community division.

The project is, however, not labour intensive and onshore construction is short-term. In addition, there is considered little need for outside construction labour (other than what sub-contractors may need to bring in terms of skills) as the labour pool in the project area is sufficient. However, there is a possibility that in-migration would be more significant during construction due to the requirement for a larger number of unskilled labour. The offshore labour requirements may be sourced nationally, or even internationally, and working on the offshore production platform would not be seen as a viable option for most impoverished job seekers, nor would it be a visible development as it is far off the coastline.

The impact associated with the employment of people from outside the region or in-migration during the construction phase is considered to be a localised impact of high intensity in the short-term. This impact during construction, therefore, assessed to be **low** significance without mitigation and **VERY LOW (neutral)** significance with mitigation. The impact during operation is considered to be a localised impact of low intensity in the medium-term, and is therefore assessed to be **low** significance without mitigation and **LOW (neutral)** significance with mitigation (see Table 7.13). The impact during decommissioning is considered to be of **VERY LOW (neutral)** significance.

Mitigation

The following mitigation measures are recommended:

- The number of jobs available should be effectively communicated to all potential job seekers and procurement policies and procedures should be implemented in order to manage in-migration and to ensure that local cultures are not marginalised; and
- Sunbird should use reputable labour brokers.

Table 7.13: Assessment of the potential impact due to in-migration.

Rating scales	Without Mitigation	With Mitigation
Construction		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	High	Medium
Significance	**Low**	**VERY LOW**
Status	Negative	Neutral
Probability	Probable	Probable
Confidence	High	High
Operation		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Low	Medium
Significance	**Low**	**LOW**
Status	Negative	Neutral
Probability	Probable	Probable
Confidence	High	High

Rating scales	Without Mitigation	With Mitigation
Decommissioning		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Neutral
Probability	Probable	Probable
Confidence	Medium	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on in-migration include increased economic development, e.g. Saldanha Industrial Development Zone, Atlantis Special Economic Zone, etc. Cumulative impact is considered to be of LOW (neutral) significance.	
Degree to which impact can be reversed	Partially reversible (construction) to Fully reversible (operation / decommissioning)	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	Medium	

7.5 ECONOMIC IMPACTS

7.5.1 MACRO-ECONOMIC IMPACTS

Description of impact

Macro-economic risks typically emerge when potentially large projects result in changes to exchange rates, fiscal flows, unemployment, national income, growth rate, gross domestic product, inflation and price levels.

Assessment

There is no reason to believe that the proposed project would have any macro-economic consequences for the economy or engender any marked benefits. The project is not of a size that would have an impact on the exchange rate or on the interest rate. There is also too little information to determine whether the project would generate a net inflow of foreign funds, as it is not known if funds would be sourced locally or internationally. If obtained within South Africa the stimulatory effects of the spending would merely be displacing the stimulatory effects of any alternative project, which those funds could have financed. The impact is, therefore, not only small, but neutral. On the other hand if the funding was to be sourced from abroad this would constitute a positive financial injection into the economy. Although the capacity to manufacture and lay pipes, similar to those proposed, exists in South Africa, it is not known whether a local or foreign contractor would be used. The cost of the pipeline may, therefore, be an injection or a withdrawal from the national income.

Since these details are not known at this stage, the direction of the macro-economic impact (positive, negative or neutral) remains uncertain. The intensity of the impact in national terms the macro-economic impact would be very low in the medium-term. This impact is, therefore, assessed to be **LOW** with and without mitigation (see Table 7.14).

Mitigation

No mitigation is considered necessary.

Table 7.14: Assessment of the potential macro-economic impact.

Rating scales	Without Mitigation	With Mitigation
Extent	National	No mitigation is proposed
Duration	Medium-term	
Intensity	Very Low	
Significance	**Low**	
Status	Uncertain	
Probability	Unknown	
Confidence	Medium	
Nature of cumulative impact	Other activities that may contribute to the cumulative macro-economic impact include increased development, e.g. Saldanha Industrial Development Zone, Atlantis Special Economic Zone, etc. The cumulative impact is considered to be of MEDIUM positive significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

7.5.2 REGIONAL ECONOMIC IMPACTS

<u>Description of impact</u>
There are two matters of relevance to the regional economy that are worth considering. The first is whether the proposed project fits in with the development plan for the region and, secondly, the development of a gas industry and contribution of natural gas as an additional energy source to the South African energy economy, specifically in its supply to the likely end user at Ankerlig.

<u>Assessment</u>
The national government in its planning framework has designated SIPs that support economic growth. The proposed Ibhubesi Gas Project meets several SIP criteria. In terms of regional planning the proposed project supports SIP 5 (Saldanha-Northern Cape Development Corridor), which includes developing the region in an integrated manner through a range of infrastructural and industrial capacity and strengthening maritime support capacity to create economic opportunities from the gas and oil activities along the African West Coast. Saldanha Bay is already an Industrial Development Zone (IDZ) and is also set to be designated as a Special Economic Zone as part of the Department of Trade and Industry's programme to target specific regions for accelerated economic development through the provision of various economic incentives. Atlantis has also been proposed for designation as a Special Economic Zone for the manufacture of renewable energy and clean technologies, the proposed project and its provision of a cleaner fuel in the form of natural gas serve this agenda. While there is no indication that this development would be a major job creator, the presence of a new investor in this region may improve investor confidence in the area. This would certainly be positive though its extent is uncertain.

The proposed Ibhubesi Gas Project could also have a positive impact on energy security and diversification of the country's energy mix (see Section 7.5.3 below).

Since the proposed project is line with the planning frameworks for the region and the development of the gas industry, it is thus expected to have positive impact. The potential regional impact is considered to be of low intensity in the medium-term. This impact is, therefore, assessed to be **LOW (positive)** with and without mitigation (see Table 7.15).

Mitigation

No mitigation is considered necessary.

Table 7.15: Assessment of the potential regional economic impact.

Rating scales	Without Mitigation	With Mitigation
Extent	Regional	No mitigation is proposed
Duration	Medium-term	
Intensity	Low	
Significance	**Low**	
Status	Positive	
Probability	Improbable	
Confidence	Medium	
Nature of cumulative impact	Other activities that may contribute to the cumulative regional economic impact include increased development, e.g. Saldanha Industrial Development Zone, Atlantis Special Economic Zone, etc. The cumulative impact is considered to be of MEDIUM positive significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

7.5.3 ENERGY IMPACTS

Description of impact

Energy provision is crucial to overall economic development. The diversification of energy resources to other energy forms, such as natural gas, is in line with government policy objectives of improving energy security, flexibility of supply and environmental performance. The proposed Ibhubesi Gas Project could have a positive impact on energy security and diversification of the country's energy mix, with added benefit to Eskom in the form of lower energy costs and reduced carbon emissions.

Assessment

South Africa's energy supply is currently dominated by coal and diversifying South Africa's energy mix (in this case to natural gas) has also been identified as an important national strategy. As an energy project the proposed development of the Ibhubesi Gas Field supports SIP 8 (Green energy in support of the South African economy) and SIP 9 (Electricity generation to support socio-economic development).

The most likely end-user of gas from the Ibhubesi Gas Field is Ankerlig. The existing Ankerlig plant was intended to be gas fired, but is currently being run on diesel. This is widely acknowledged as being both an expensive and inefficient use of fuel. Over current five-year multi-year price determination period (MYPD3), Eskom applied for R 12.5 billion to buy diesel to run both its Ankerlig and Gourikwa power plants, of which R 2.5 billion is for the current financial year. However, in 2014 Eskom used approximately R 11 billion to buy diesel to operate these two power stations. Eskom is thus seeking to convert both power plants to gas. Eskom has already expressed interest in the proposed project and Sunbird has signed a memorandum of understanding with them to investigate the feasibility of supplying gas to Ankerlig.

The supply of gas directly to Ankerlig would reduce the need for diesel, and hence reduce the marginal cost of peak load power, though this would not be sufficient to influence the prices charged to consumers. In addition, there is no reason to believe that additional power would be generated, merely that gas would be a substitute for the more expensive diesel currently used. Presently the gas supply is expected to displace diesel in five of Ankerlig's nine turbines, but since these were designed to operate for up to five hours per day and are currently operating roughly twelve hours a day (i.e. as base load rather than peaking units), these may not generate more electricity without upgrading the power station.

An external benefit of using gas at Ankerlig would be reduced carbon emissions. Currently South Africa is one of the most carbon intensive economies in the world relying on coal-powered energy to meet almost 90% of its energy needs. The conversion of Ankerlig from diesel to gas would certainly reduce carbon emissions (27% less CO_2 per kilojoule of energy compared to the use of diesel). Additionally, there would be a further reduction of pollution associated with the transportation diesel to Ankerlig.

Sunbird has indicated that there are 540 Bcf of proven and probable reserves. While it might not be sufficient to attract new users to the area, if a larger and stable supply of gas were to be found in the region it could benefit existing large industrial enterprises in the Saldanha area as well as Eskom.

Notwithstanding the uncertainties, the proposed Ibhubesi Gas Project would have a positive impact on energy security and diversification of the country's energy mix, with added benefit to Eskom in the form of lower energy costs. The potential impact is considered to be national, of low intensity in the medium-term. This impact is, therefore, assessed to be **LOW (positive)** with and without mitigation (see Table 7.16).

The impact associated with the generation of "clean" energy is considered to be national, of medium intensity in the medium-term. This impact is, therefore, assessed to be **HIGH (positive)** with and without mitigation (see Table 7.16).

Mitigation
No mitigation is considered necessary.

Table 7.16: Assessment of the potential energy impact.

Rating scales	Without Mitigation	With Mitigation
Energy security and diversification of energy mix		
Extent	National	No mitigation is proposed
Duration	Medium-term	
Intensity	Low	
Significance	**Low**	
Status	Positive	
Probability	Uncertain	
Confidence	Medium	
Generation of "clean" energy		
Extent	National	No mitigation is proposed
Duration	Medium-term	
Intensity	Medium	
Significance	**High**	
Status	Positive	
Probability	Probable	
Confidence	Medium	
Nature of cumulative impact	Other activities that may contribute to the cumulative energy impact include energy increased security and diversification of the country's energy mix. The cumulative impact is considered to be of MEDIUM positive significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

7.5.4 IMPACT ON INDUSTRY AND MINING

Description of impact

The safety / exclusion zone around the proposed production facility and production pipeline (onshore and offshore) could have an impact on other activities in the area (including general industry, prospecting, mining, exploration and production), as certain activities may effectively be excluded from taking place within the safety / exclusion zone.

Assessment

Onshore the West Coast is positioning itself as a major hub for the oil and gas industry and thus the proposed project fits in with the development plan for the region. The various project alternatives are not expected to negatively impact any industry in the area. In fact the proposed project could provide opportunities for other industries to use the gas for operational activities, especially in the Saldanha area, where an end-user has not been identified.

The proposed offshore production pipeline passes through a number of areas with existing rights, including:

- De Beers Consolidated Mines holds a prospecting right (including heavy minerals, platinum group metals, gold and sapphire) for three areas inshore of the 200 m bathymetric contour. The proposed pipeline passes through their southern prospecting area;
- Green Flash Trading holds a prospecting right for phosphates for two areas off the West Coast. The proposed pipeline passes through Licence Area 251; and
- Transhex has two diamond mining concession areas through which the pipeline passes.

These rights areas are generally very large where a resource is yet to be identified, and as such none of these areas are currently being mined. The pipeline is also located in relatively deeper water (100 m and 250 m water depth) where mining is considered less economically viable. Several other mining companies have operations along and off the West Coast (including Gariep Diamond Mining, Tronox Namakwa Sands and NDC Mining Company). However, the operations occur closer inshore and are not in the vicinity of the proposed pipeline.

Exploration for oil and gas is currently undertaken in a number of licence blocks off the West Coast (see Figure 4.43). The proposed production pipeline passes through three other licence blocks, including Block 2B (Thombo Petroleum), 3A/4A (PetroSA and Sasol) and an inshore licence area (Rhino Oil). These blocks currently have exploration rights or rights that are pending. There are, however, no current development or production activities being undertaken in the South African West Coast offshore.

The proposed offshore pipeline could have an impact on future prospecting, mining, exploration and production activities. This impact is considered to be localised, of low to high intensity in the medium-term. The significance of this impact is, therefore, assessed to be **LOW** with and without mitigation (see Table 7.17).

Mitigation

The following mitigation measures are recommended:

- Sunbird should engage with adjacent right holders to discuss the final pipeline alignment and scheduling of pipeline installation in order to reduce the risk of interference with future mining or exploration and the installation programme; and
- Any dispute arising should be referred to the Department of Mineral Resources or PASA for resolution.

Table 7.17: Assessment of the potential impact on industry and mining.

Rating scales	Without Mitigation	With Mitigation
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Low to High	Low to Medium
Significance	**Low**	**LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on industry and mining include other possible future development projects off the West Coast. The cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Partially reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Very Low	

7.5.5 IMPACT ON TOURISM

7.5.5.1 Southern shore-crossing route (Grotto Bay to Duynefontein)

Description of impact

The construction of the pipeline with its visual and noise impacts would have an impact on tourism during the establishment phase.

Assessment

Tourism is another growing economic sector for the region. The area is marketed to international and local tourists for its natural rustic beauty. Tourism is particularly important for small businesses who service this sector providing accommodation, recreational and leisure activities and other hospitality services (restaurants, spas, etc.). Construction activities could affect tourism, however, the impact would be temporary and highly localised. Since onshore staff numbers during operational would be relatively small, it is unlikely that the tourism and hospitality sectors would derive any significant benefit from the proposed project.

The Grotto Bay shore-crossing is in close proximity to the Grotto Bay residential development, which also attracts tourists for holiday accommodation and outdoor recreation activities. Similarly, the Silwerstroom shore-crossing is a recreational area attracting local tourists from the Atlantis and Mamre areas. Furthermore some of the campsite resort facilities may need to be demolished and the resort, or portion thereof, would need to be closed during construction. The construction of the pipeline with its visual and noise impacts would have a negative impact on tourism during the establishment phase after which the pipeline would be buried and any negative impacts ameliorated. The impact on tourism at Grotto Bay and Silwerstroom Strand is considered to be highly localised, of high intensity during construction (short-term). The overall impact on tourism for these alternatives is assessed to be of **low** significance without mitigation and of **VERY LOW** significance with mitigation (see Table 7.18).

The Duynefontein shore-crossing is located within the Koeberg Nature Reserve, which is a restricted area. While the Duynefontein residential area is approximately 250 m away, this is mainly residential not tourist. The impact on tourism at Duynefontein is considered to be highly localised, of zero to very low intensity during construction (short-term). The overall impact on tourism for this alternative is assessed to be **INSIGNIFICANT** with and without mitigation (see Table 7.18).

Mitigation

The following mitigation measures are recommended:

- Construction during the peak holiday/tourism season (Dec-Jan) should be avoided at Grotto Bay and Silwerstroom Strand; and
- Damaged facilities should be reconstructed / repaired.

Table 7.18: Assessment of the potential impact on tourism in the southern study area.

Rating scales	Without Mitigation	With Mitigation
Grotto Bay and Silwerstroom Strand shore-crossings		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	High	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	High	High
Duynefontein shore-crossing		
Extent	Local	No mitigation is proposed
Duration	Short-term	
Intensity	Zero to Very Low	
Significance	**Insignificant**	
Status	Negative	
Probability	Highly Probable	
Confidence	High	
Nature of cumulative impact	Other activities that may contribute to the cumulative heritage impact include increased industrial development within the study area. The cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None to Low	

7.5.5.2 Northern shore-crossing route (Saldanha Peninsula)

Description of impact

The construction of the pipeline with its visual and noise impacts would have an impact on tourism during the establishment phase.

Assessment

As indicated in the previous section, tourism is a growing economic sector in the region due to its natural rustic beauty. St Helena Bay is a tourist destination, particularly during the spring wild flower season, as well as during August to November during the Southern right whale breeding season. Visitors also come for relaxation and recreation and to enjoy the beaches and views of the bay. However, both the St Helena West and East alternatives occur on private property with no or limited access to the coast. The impact on tourism at St Helena Bay is considered to be localised, of low intensity during construction (short-term). Any impact on tourism at St Helena Bay is considered **VERY LOW** with and without mitigation (see Table 7.19).

Although Noordwesbaai shore-crossing is on a remote beach on private land, it is a popular camping area during holiday periods. The impact on tourism at Noordwesbaai is considered to be localised, of high intensity during construction (short-term). The overall impact on tourism for this alternative is assessed to be **low** without mitigation and **VERY LOW** with mitigation (see Table 7.19).

Mitigation

Construction during the peak holiday/tourism season (Dec-Jan) should be avoided at Noordwesbaai.

Table 7.19: Assessment of the potential impact on tourism in the northern study area.

Rating scales	Without Mitigation	With Mitigation
Noordwesbaai shore-crossing		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	High	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	High	High
St Helena West and East shore-crossings		
Extent	Local	No mitigation is proposed
Duration	Short-term	
Intensity	Low	
Significance	**Very Low**	
Status	Negative	
Probability	Highly Probable	
Confidence	High	
Nature of cumulative impact	Other activities that may contribute to the cumulative heritage impact include increased industrial development within the study area. The cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None to Low	

7.5.6 IMPACT ON FARMING

7.5.6.1 Southern shore-crossing route (Grotto Bay to Duynefontein)

Description of impact

The proposed pipeline may impact on farming in the region due to the possible disruption to farming activities along the pipeline route.

Assessment

There is no anticipated risk to farming or livestock along the southern pipeline route alternatives as the pipeline does not pass through grazing or farming land. Thus disruptions are considered to be localised, of zero to very low intensity and short-term duration. The overall impact on farming for all southern alternatives is assessed to be **INSIGNIFICANT** with and without mitigation (see Table 7.20). The pipeline is also not expected to affect the future land use since farming can recommence once the pipeline has been laid. There is thus no economic (opportunity) cost.

Mitigation
No mitigation is considered necessary.

Table 7.20: Assessment of the potential impact on farming in the southern study area.

Rating scales	Without Mitigation	With Mitigation
Extent	Local	No mitigation is proposed
Duration	Short-term	
Intensity	Zero to Very Low	
Significance	**Insignificant**	
Status	Negative	
Probability	Probable	
Confidence	High	
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on farming include further infrastructure, residential and industrial development. The cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

7.5.6.2 Northern shore-crossing route (Saldanha Peninsula)

Description of impact
The proposed pipeline may impact on farming in the region due to the possible disruption to farming activities along the pipeline route.

Assessment
Agriculture in the West Coast District Municipality is primarily centred around wheat, rooibos tea, fruit, grape and wine and vegetables; animal products account for 45.3% of the agriculture income and include milk and dairy products, poultry, beef, mutton, lamb and pork products. In 2010, the agricultural sector (including hunting, forestry and fishing) contributed 15% to GDP.

All northern routes cross mainly farmland, and as a result pipeline installation could have an impact on farming activities. It is estimated that the width of the construction servitude would be approximately 15 to 20 m along the entire length of the pipeline route, and that pipeline installation would take in the order of 8 to 10 months. As such, disruptions to farming activities along the pipeline would be very short-term. The pipeline is also not expected to affect the future land use since farming can recommence once the pipeline has been laid. There is thus no economic (opportunity) cost.

Thus disruptions during construction are considered to be localised, of medium intensity and short-term duration. The overall impact on farming for all northern alternatives is assessed to be **low** without mitigation and **VERY LOW** with mitigation (see Table 7.21).

Mitigation
The following mitigation measures are recommended:
- Sunbird should engage timeously with all affected landowners to discuss the scheduling of proposed pipeline installation in order to reduce the interference with farming activities (e.g. sowing, harvesting, etc.). Where possible, pipeline installation should be scheduled at a time that least interferes with farming practices;

- Landowners should be compensated for any lost crops, exclusion, etc. as required by law; and
- Agricultural land should be rehabilitated in consultation with the landowner.

Table 7.21: Assessment of the potential impact on farming in the northern study area.

Rating scales	Without Mitigation	With Mitigation
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Medium	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on farming include further infrastructure, residential and industrial development. The cumulative impact is considered to be of MEDIUM significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Low	

7.5.7 IMPACT ON FUTURE LAND USE OPTIONS

7.5.7.1 Southern shore-crossing route (Grotto Bay to Duynefontein)

<u>Description of impact</u>
Other land uses could be excluded over and / or adjacent to the proposed onshore pipeline for the operational life of the gas field due to the risks associated with a natural gas pipeline (see Section 8.2). There should be appropriate physical separation between future development and the pipeline in order to reduce the probabilities and the consequences of incidents. Possible land use techniques include, for example, establishing setbacks, regulating or prohibiting certain types of uses and structures (e.g. schools, hospitals and apartment buildings) near the pipeline and encouraging other types of activities or facilities (e.g. linear parks and recreational paths) within or in the vicinity of the pipeline servitude.

<u>Assessment</u>
(a) Pipeline routes
The Grotto Bay shore-crossing presents a potential opportunity cost, as the proposed pipeline may restrict future development, although unlikely, to the south side of Grotto Bay Drive. However, with the appropriate buffer future residential development could still take place. This opportunity cost is considered to be localised, of low to medium intensity and medium-term duration. The overall impact is assessed to be **LOW** with and without mitigation (see Table 7.22).

Silwerstroom Strand is a recreational / camping area and is not permanently occupied. Future recreational activities would be able to continue once the pipeline has been installed and land/facilities have been restored. Thus there are no identifiable opportunity costs. The southern route (Alternative 3) could, however, impact future development on the southern side of Silwerstroom Strand. Thus there is a potential opportunity cost. This opportunity cost is considered to be localised, of medium intensity and medium-term duration. The overall impact is assessed to be **LOW** with and without mitigation (see Table 7.22). The impact associated with the other two alternatives at Silwerstroom Strand (i.e. Alternative 1 and 2) is considered to be **INSIGNIFICANT** (see Table 7.22).

The Duynefontein shore-crossing is located within the Koeberg Nature Reserve, which is a restricted area. There is, therefore, no opportunity cost. The potential impact on future land use is considered to be **INSIGNIFICANT** (see Table 7.22).

(b) Onshore gas processing facility

The proposed onshore facility adjacent to Ankerlig would be located in the Atlantis Industrial Area and is in accordance with the current and future land use planning / zoning. Thus there are no identifiable opportunity costs. The impact associated with the Ankerlig alternatives is considered to be **INSIGNIFICANT**. If the onshore facility is located adjacent to the Silwerstroom Strand Water Treatment Plant there could be an opportunity cost relating to the expansion of the treatment works and the Silwerstroom Strand resort. This opportunity cost is considered to be localised, of medium intensity and medium-term duration. The overall impact is assessed to be **LOW** with and without mitigation (see Table 7.22).

Mitigation

No mitigation is considered necessary.

Table 7.22: Assessment of the potential impact on future land use options in the southern study area.

Rating scales	Without Mitigation	With Mitigation
Grotto Bay shore-crossing		
Extent	Local	No mitigation is proposed
Duration	Medium-term	
Intensity	Low to Medium	
Significance	**Low**	
Status	Negative	
Probability	Probable	
Confidence	Medium	
Silwerstroom Strand shore-crossing (Alternative 3)		
Extent	Local	No mitigation is proposed
Duration	Medium-term	
Intensity	Medium	
Significance	**Low**	
Status	Negative	
Probability	Highly probable	
Confidence	Medium	
Silwerstroom Strand (Alternative 1 and 2) and Duynefontein shore-crossings, Gas receiving facility adjacent to Ankerlig		
Extent	Local	No mitigation is proposed
Duration	Medium-term	
Intensity	Zero to Very Low	
Significance	**Insignificant**	
Status	Negative	
Probability	Highly probable	
Confidence	High	
Gas receiving facility adjacent to the Silwerstroom Strand Water Treatment Plant		
Extent	Local	No mitigation is proposed
Duration	Medium-term	
Intensity	Medium	
Significance	**Low**	
Status	Negative	
Probability	Highly probable	
Confidence	Medium	

Rating scales	Without Mitigation	With Mitigation
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on future land uses include further infrastructure, residential and industrial development, conservation areas, agriculture, etc. The cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Partially reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

7.5.7.2 Northern shore-crossing route (Saldanha Peninsula)

Description of impact
Other land uses could be excluded over and / or adjacent to the proposed onshore pipeline for the operational life of the gas field due to the risks associated with a natural gas pipeline. There should be appropriate physical separation between future development and the pipeline in order to reduce the probabilities and the consequences of incidents.

Assessment
All northern routes cross mainly farmland. However, farming can recommence once the pipeline has been laid. There is thus no economic (opportunity) cost (see Section 7.5.5.2).

Although a portion of the Noordwesbaai shore-crossing was realigned during the Scoping Phase to avoid a proposed residential development (Solar City), it could still have an impact on future land use on Farm Trekoskraal, which has been earmarked for future residential development. Thus there could be an economic (opportunity) cost should any residential development be approved in future. This said future residential planning can, however, still take place around the pipeline routes, albeit with slight modification (e.g. further away from the pipeline area).

The St Helena Bay West and East routes pass through Farm Nooitgedacht, which has been identified for a renewable energy project (wind turbines). Thus the proposed pipeline could affect the final location of wind turbines.

The impact associated with all northern pipeline route alternatives on future land use is considered to be localised, of low to high intensity and medium-term duration. The overall impact is assessed to be **medium** without mitigation and **LOW to MEDIUM** with mitigation (see Table 7.23).

Mitigation
The final pipeline alignment should avoid proposed wind turbine locations on Farm Nooitgedacht. Sunbird should engage with Mainstream Renewable Power to discuss the final pipeline alignment and scheduling of pipeline installation in order to reduce the risk of interference with their operations.

Table 7.23: Assessment of the impact on future land use options in the southern study area.

Rating scales	Without Mitigation	With Mitigation
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Low to High	Low to Medium
Significance	**Medium**	**LOW TO MEDIUM**
Status	Negative	Negative
Probability	Highly probable	Highly probable
Confidence	High	High

Rating scales	Without Mitigation	With Mitigation
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on future land uses include further infrastructure, residential and industrial development, conservation areas, agriculture, etc. The cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Partially reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

8. IMPACTS ON HUMAN HEALTH

This chapter describes and assesses the significance of potential human health impacts on employees and surrounding communities from the proposed Ibhubesi Gas Project and associated alternatives. All impacts are systematically assessed and presented according to predefined rating scales (see Appendix 3.1). Mitigation or optimisation measures are proposed which could ameliorate the negative impacts or enhance potential benefits, respectively. The status of all impacts should be considered to be negative unless otherwise indicated. The significance of impacts with and without mitigation is also assessed.

Potential health impacts are assessed in the following sections:
- Section 8.1: Air quality impacts
- Section 8.2: Risk impacts

The specialist reports on which this chapter is based are presented in Appendix 13 (Air Quality Assessment) and Appendix 14 (Risk Assessment) of Volume 3.

8.1 AIR QUALITY IMPACTS

8.1.1 OFFSHORE ACTIVITIES

Description of impact

The air pollutants associated with the operational of the offshore production facility has been identified as airborne particulates, NO_x and SO_2 from combustion of gas, and Volatile Organic Compounds (VOCs) from fugitive sources (storage, filling and emptying). Emissions from the offshore stacks arise mainly from the flare, power generation, the inert gas system/boilers and an incinerator.

These emissions could have potential health risks to employees and contractors on the production facility.

Assessment

Air quality standards are fundamental tools to assist in air quality management. The National Ambient Air Quality Standards (NAAQS) are intended to reduce harmful effects on health of the majority of the population, including the very young and the elderly. The Air Quality Assessment compared simulated ambient concentrations of criteria pollutants, including PM_{10} (daily and annual), $PM_{2.5}$ (daily and annual), SO_2 (hourly, daily and annual) and NO_2 (hourly and annual), at specific sensitive receptors against the promulgated NAAQS.

The assessment found that no emission standards were exceeded and all simulated “ground” level concentrations comply with NAAQS. There were no offsite exceedances of the inhalation screening criteria for non-criteria pollutants (including VOCs, Hydrogen Chloride, Hydrogen Fluoride and Mercury).

During operation the potential impact from criteria and non-criteria pollutants is considered to be localised, of low intensity in the medium-term. The overall impact is assessed to be of **VERY LOW** significance with and without mitigation (see Table 8.1).

Mitigation

No mitigation is considered necessary.

8.1.2 ONSHORE ACTIVITIES

8.1.2.1 Construction activities

Description of impact

Atmospheric emissions and air quality impacts would occur during the construction phase of the proposed gas receiving facility and pipeline. Fugitive particulate matter would be emitted as a result of land clearing, excavations grading, bulldozing, compaction, etc. Fugitive dust may also be emitted during material loading and hauling, and stockpiling. Furthermore, mobile diesel generators would be used to supply power during construction and these would emit combustion gases such as NO_x, SO_2, PM_{10} and CO.

The emission of inhalable particulates during construction could have potential health risks (e.g. respiratory problems due to the deposition of fine particles in the lower airways and gas-exchanging portions of the lung) to employees, surrounding residential communities and visitors to the area.

Assessment

As noted in the section above, the Air Quality Assessment compared simulated ambient concentrations of criteria pollutants ($PM_{2.5}$ and PM_{10}) at specific sensitive receptors against the promulgated NAAQS. For unmitigated construction activities, the NAAQS are expected to be exceeded up to approximately 50 m from the onshore facility construction site to the west and south of operations (see Figure 8.1) and a maximum of 80 m from the pipeline construction area to the south of operations (see Figure 8.2). Although it is expected that there would be exceedances of the daily limits for $PM_{2.5}$ and PM_{10}, it is unlikely that the standards (annual and daily) would be exceeded as the construction activities would take place for a short period at any one location, as pipeline installation progresses forward.

During construction the potential impact related to criteria pollutants ($PM_{2.5}$ and PM_{10}) is considered to be localised, of high intensity in the short-term. The overall impact is assessed to be of **low** significance without mitigation and **VERY LOW** significance for all proposed pipeline routes and onshore facilities sites (see Table 8.1).

Mitigation

Since the particulates impacts are expected to be limited during construction, continuous particulate monitoring and fallout buckets are not considered necessary at any of the construction site alternatives. However, the following mitigation measures are recommended:

- Vegetation clearing should, where possible, take place in a phased manner in order to retain vegetation cover for as long as possible;
- A dust control programme (e.g. water sprays) should be implemented to maintain a safe working environment, minimise nuisance for surrounding residential areas / dwellings and protect damage to natural vegetation, crops, etc. Exposed areas and material stockpiles should be adequately protected against the wind (e.g. wetting exposed soil / gravel areas during windy conditions, covering of material stockpiles, etc.);
- Hauling distances should be minimised; and
- Subsoil and topsoil should be stockpiled for as short a period as possible. Thus subsoil and topsoil should be replaced as the excavation and pipeline installation work progresses forward.

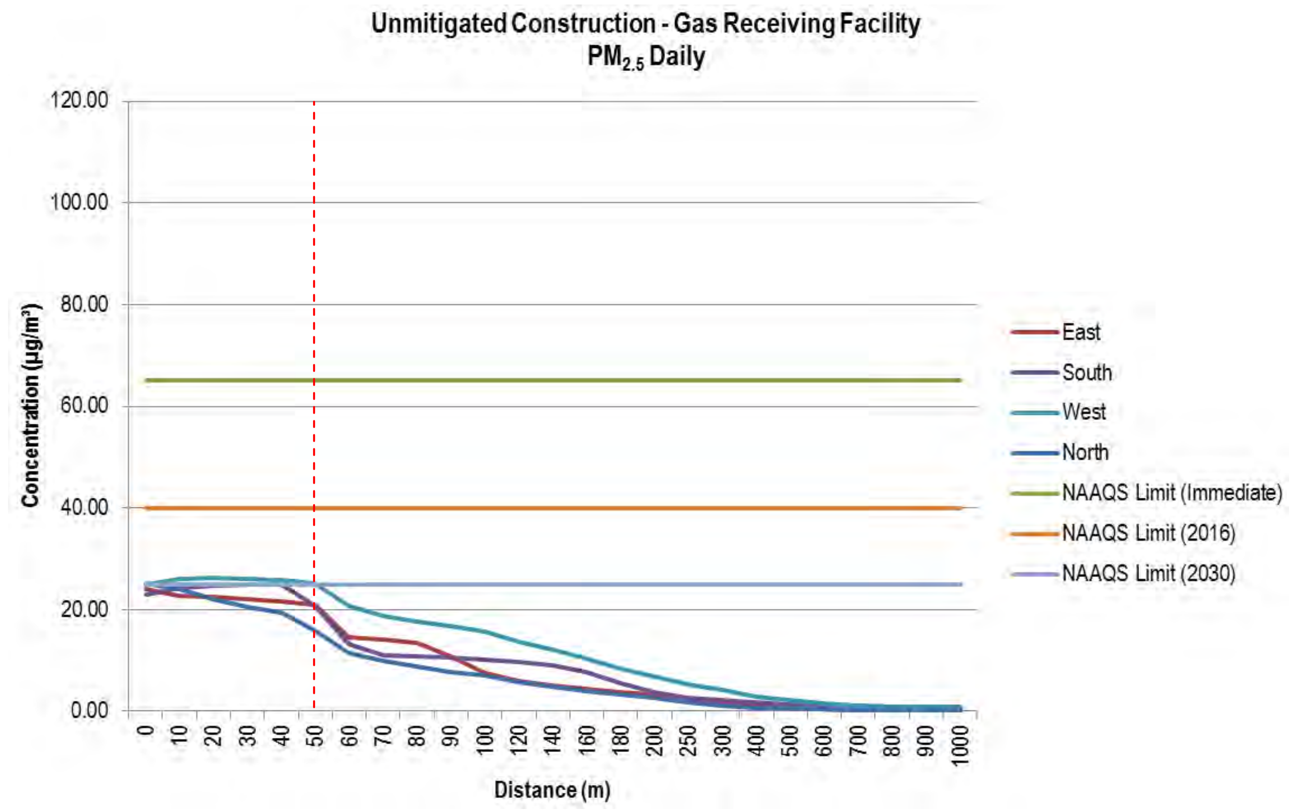


Figure 8.1: **Simulated daily $PM_{2.5}$ concentration change with distance from source due to construction of the onshore facility in the Atlantis Industrial Area.**

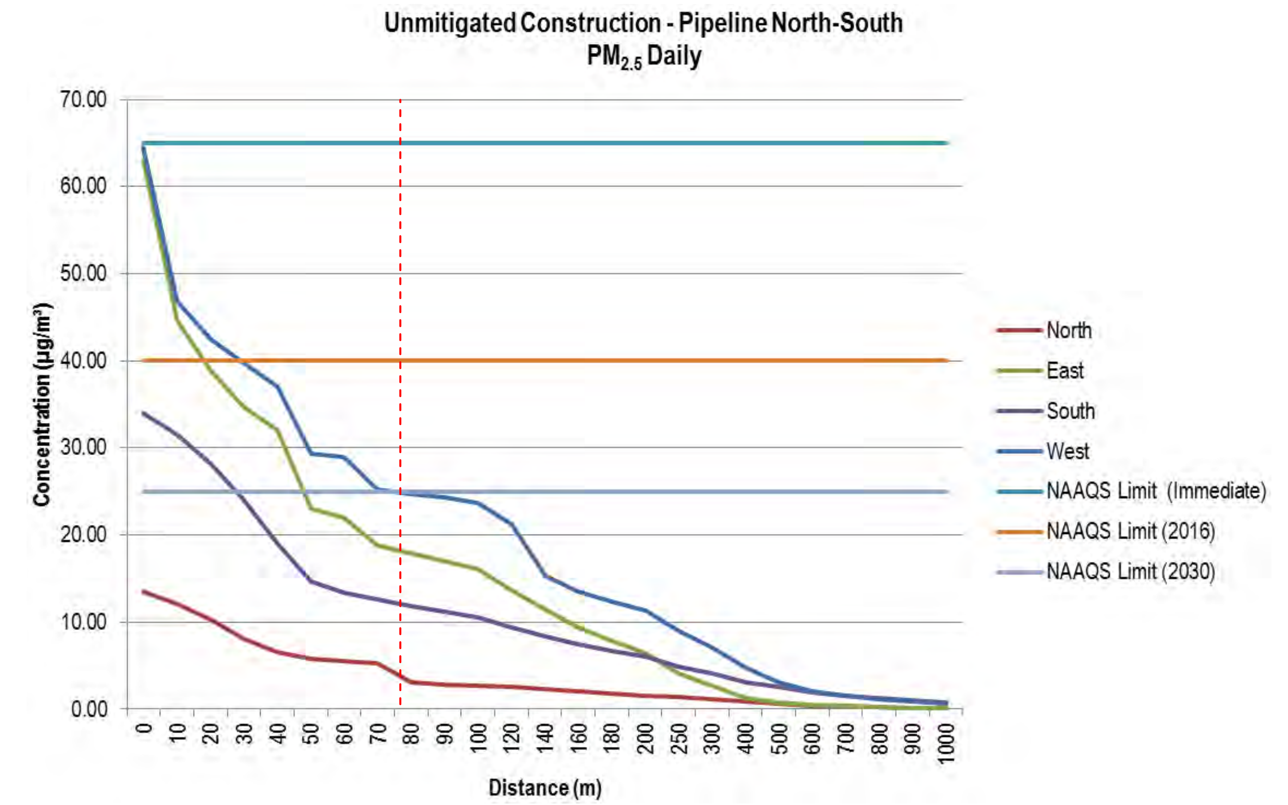


Figure 8.2: **Simulated annual $PM_{2.5}$ concentration change with distance from source due to construction of the pipeline.**

8.1.2.2 Operational activities

<u>Description of impact</u>

Air pollutants associated with the operational phase of the proposed project have been identified as airborne particulates, NO_x and SO_2 from combustion of gas, and Volatile Organic Compounds (VOCs) from fugitive sources (storage, filling and emptying). These emissions from the onshore stacks arise mainly from the water bath heaters.

These emissions could have potential health risks to employees, surrounding residential communities and visitors to the area.

<u>Assessment</u>

The Air Quality Assessment found that no emission standards were exceeded for all onshore operations at all site alternatives and all simulated ground level concentrations comply with NAAQS, including PM_{10} (daily and annual), $PM_{2.5}$ (daily and annual), SO_2 (hourly, daily and annual) and NO_2 (hourly and annual). There were also no offsite exceedances of the inhalation screening criteria for non-criteria pollutants (including VOCs).

During operation the potential impact from criteria and non-criteria pollutants is considered to be localised, of low intensity in the medium-term. The overall impact is assessed to be of **LOW** significance with and without mitigation and for all proposed onshore facilities sites (see Table 8.1).

<u>Mitigation</u>

Since no emission standards were exceeded and the impacts is predicted to be of low significance, continuous particulate monitoring and fallout buckets are not considered necessary at any of the onshore facility sites. However, even though the facilities are predicted to result in low ground level concentrations of NO_2 and SO_2, it is recommended that a relatively short monitoring campaign (three months) be undertaken using passive diffusive sampling methods to establish the trend in NO_2 and SO_2 air concentrations during operation. The proposed sampler locations are shown in Figures 8.3 and 8.4.

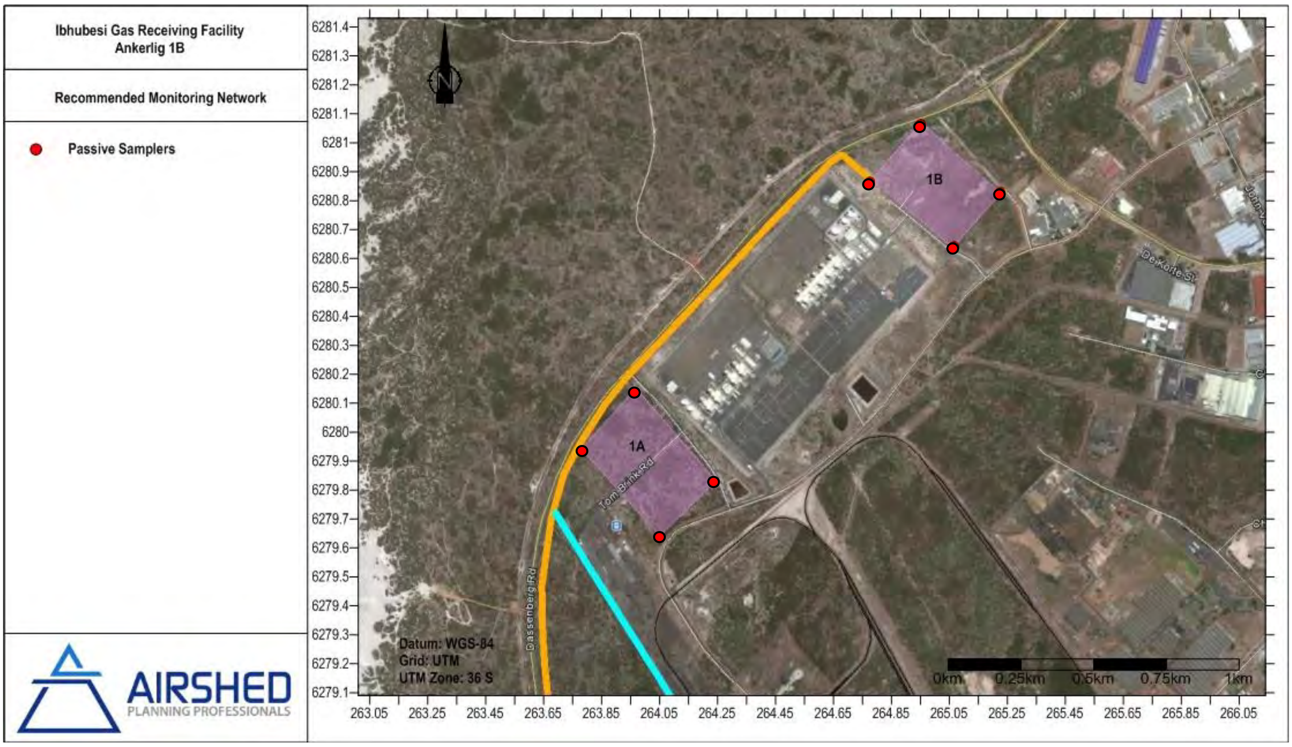


Figure 8.3: Recommended monitoring network for the onshore gas receiving facility sites adjacent to Ankerlig in the Atlantis Industrial Area.

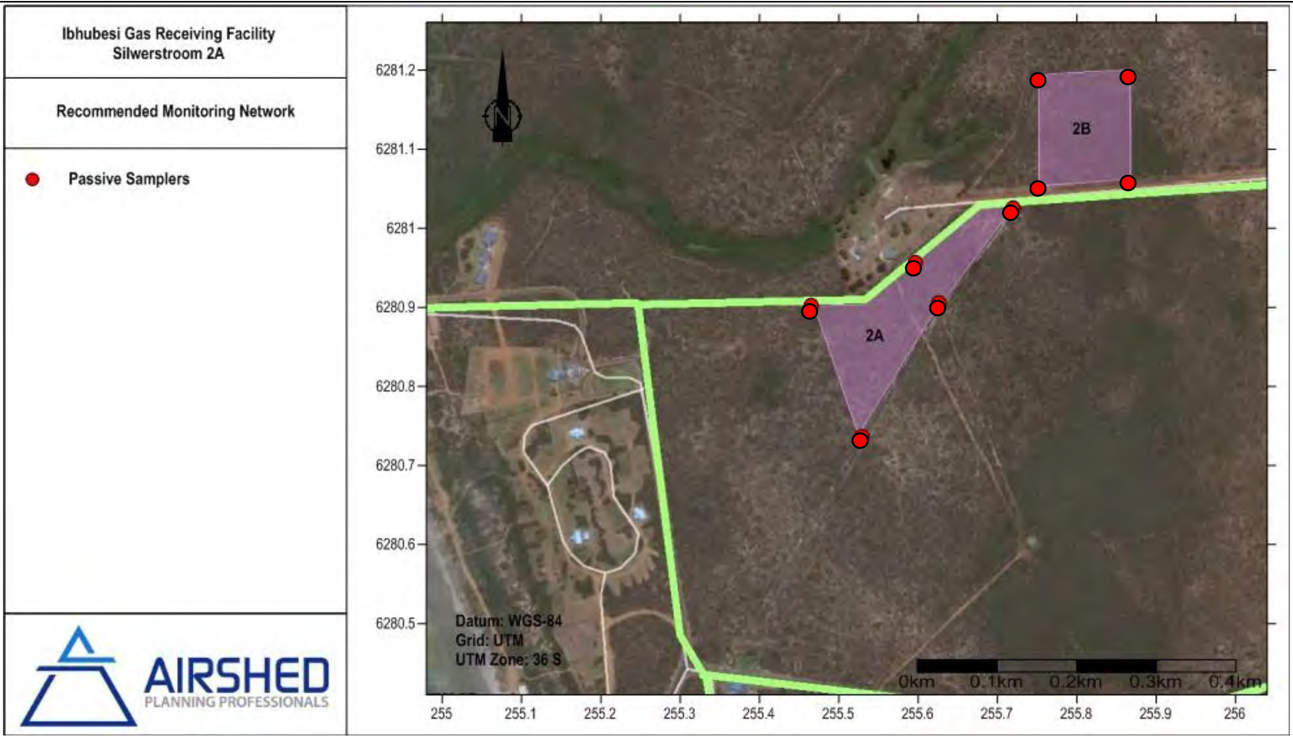


Figure 8.4: **Recommended monitoring network for the onshore gas receiving facility sites adjacent to the Silwerstroom Strand Water Treatment Plant.**

Table 8.1: **Assessment of potential air quality impacts during construction and operation.**

Rating scales	Without Mitigation	With Mitigation
Offshore operation		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium
Onshore construction		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	High	Medium
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Onshore operation		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Low	Very Low
Significance	**Low**	**LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

Rating scales	Without Mitigation	With Mitigation
Nature of cumulative impact	Other activities that may contribute to the cumulative air quality impact include industries, Ankerlig Power Station, Koeberg Power Station, vehicle entrainment on roads, vehicle exhaust emissions and infrequent household fuel burning. Cumulative impact is considered to be of Low (Silwerstroom Strand) to MEDIUM (Ankerlig) significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	None to Low	

8.2 RISK IMPACTS

8.2.1 SOUTHERN SHORE-CROSSING ROUTE (GROTTO BAY TO DUYNEFONTEIN)

Description of impact

The proposed production pipeline would contain a relatively large volume of flammable material (namely natural gas). The main risk associated with the proposed onshore pipeline and gas receiving facility relate to a loss of containment of natural gas. Natural gas releases, if large enough, would create a crater above / around the pipeline, with a subsequent cloud or jet release. The release would normally take the form of a mushroom-shaped gas cloud which would then grow in size and rise due to discharge momentum and buoyancy. This cloud would, however, disperse rapidly and a gas jet or plume would establish itself. The main hazards associated with a loss of containment include:

- Thermal radiation from jet or flash fires:
  - > Jet fires occur when flammable material of a high exit velocity ignites soon after release. Ejection of flammable material from a pipe or pipe flange could give rise to a jet fire and in some instances the jet flame could have substantial "reach". Depending on wind speed, the flame may tilt and impinge on nearby pipelines, equipment and / or structures. The thermal radiation from these fires may cause injury or fatality to people or damage equipment some distance from the source of the flame.
  - > Flash fires or an explosion occur when flammable materials mix with air and form a flammable mixture, which is ignited after some delay. An ignition within a flammable cloud could result in an explosion if the front is propagated by pressure, which compresses the mixture beyond its auto-ignition temperature. If the front is propagated by heat, then the fire moves across the flammable cloud at the flame velocity and is called a flash fire. A flash fire may cause injury or fatality to people or damage equipment.
- Overpressure from Vapour Cloud Explosions (VCEs):
  - > A release of flammable material into the atmosphere could result in the formation of a flash fire, as described above, or a VCE. The concentration of the combustible component decreases from the point of release to below the lower explosive limits (LEL), at which concentration the component can no longer ignite. The material contained in a vapour cloud between the higher explosive limits (HEL) and the LEL, if it ignites, could have explosive impacts. The sudden detonation of the explosive mass of material would cause overpressures that can result in injury or damage to property. An explosion may give rise to any of the following effects: blast damage, thermal damage, missile damage, ground tremors, crater formation and personal injury. Obviously, the nature of these effects depends on the pressure waves and the proximity to the actual explosion.

Although natural gas (as methane) is not considered an acutely toxic material, it could also displace oxygen causing asphyxiation. A large release of natural gas would not, however, have offsite impacts and is thus not assessed in this section.

At least five different forms and sizes of leaks are possible (see Figure 8.5), including:

(a) Splitting of the pipeline in a tangential direction, mostly caused by earth movements or by being passed over by heavy construction equipment or similar machines;

(b) Splitting of the pipeline in an axial direction over a relatively short section with simultaneous widening crosswise to the pipe axis (fish mouth rupture);

(c) Splitting of the pipeline in the upper vertex over several metres:

(d) A pipe segment bursts out, i.e. the entire pipe cross-section is exposed (guillotine break); and

(e) An oval or circular penetration of the pipeline caused by excavator shovels or earth borers.

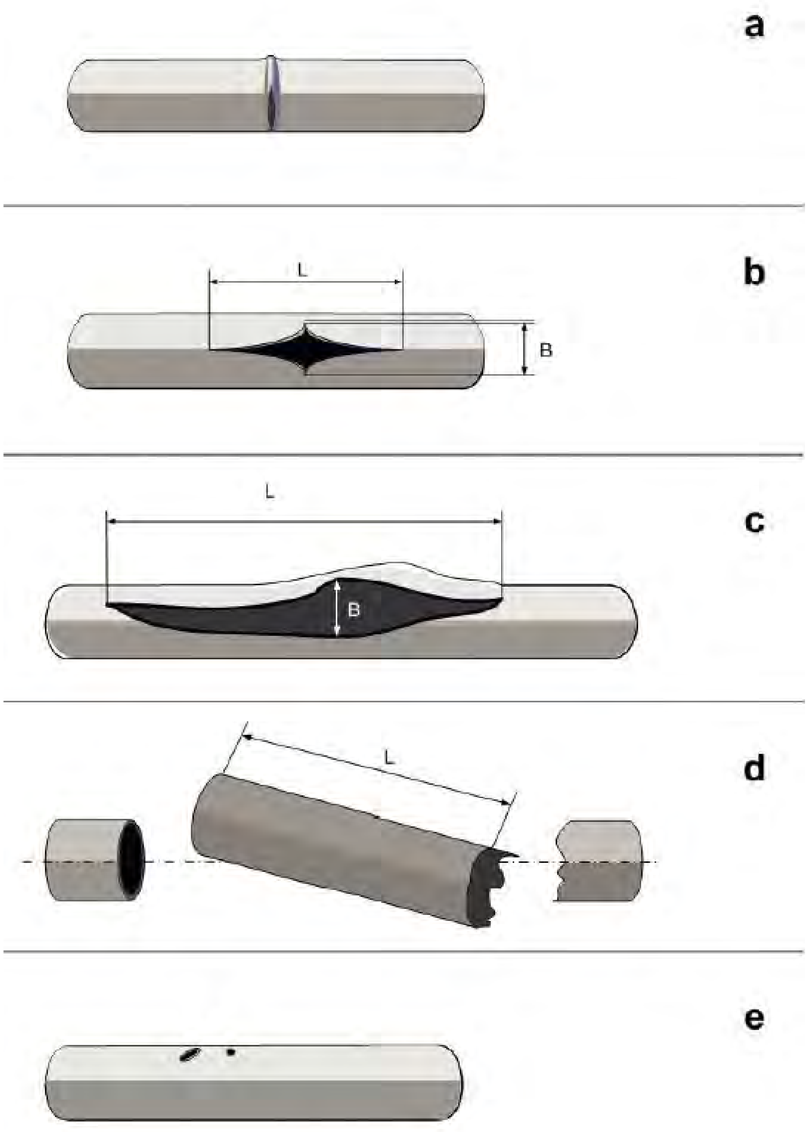


Figure 8.5: Typical types of leaks in high pressure pipelines: (a) splitting of the pipeline in a tangential direction; (b) Splitting of the pipeline in an axial direction; (c) Splitting of the pipeline in the upper vertex; (d) A guillotine break; and (e) an oval or circular penetration (after Konersmann *et al.* 2009).

<u>Assessment</u>

Since the onshore pipeline would be buried it is expected that the cover may offer some resistance to natural gas releases, especially small leaks. Nevertheless, the Risk Assessment assumed that every leak would find its way to the surface with equal ease and release rates. However, in reality smaller leaks would have less likelihood of discharge than a full-bore rupture. The findings of the Risk Assessment are summarised below.

(i) Jet fires

- Full-bore pipeline rupture: the 1% fatality from a jet fire (short exposure to 10 kW/m²) could occur up to a distance of approximately 65 m downwind of the point of release, if people are not able to escape during calm wind conditions. With strong wind speeds up to 20 m/s, the downwind impact distance increases to 160 m. The 100% fatality (short exposure to 35 kW/m²) could occur up to a distance of approximately 25 m downwind of the jet fire during calm wind conditions, for wind speeds up to 20 m/s, the downwind impact distance increases to 75 m.
- Release from a 20 mm hole in pipeline: The thermal radiation consequences for a release from a 20 mm hole are significantly less severe than a full-bore rupture. The 1% fatality from a jet fire could occur up to a distance of approximately 5 m downwind of the point of release during calm wind conditions. With strong wind speeds up to 20 m/s, the downwind impact distance increases to 20 m. During calm conditions a 100% fatality would be very close to the point of release (<1 m). With strong wind conditions of 20 m/s, the downwind distance increases to 10 m.
- Onshore facility: Downwind distances to the 1% and 100% lethality ranged from 100 m to 180 m for the 1% fatality and 30 m to 75 m for the 100% fatality. Apart from buildings and structures within the Ankerlig Power Station, no other buildings were found to be within these distances at the four options for locating the onshore facility.

Table 8.2 below provides an indication of the number of buildings within the calculated distances to the thermal radiation levels of 10 kW/m² and 35 kW/m² for both full-bore and 20 mm hole scenarios.

The maximum risk of fatality per person per year due to jet fires is calculated to be approximately $1x10^{-6}$ per person per year (i.e. a tolerable risk in terms of the ALARP triangle – refer to Box 8.1) for all pipeline alternatives and would occur immediately above the pipeline.

Table 8.2: Number of buildings in the jet fire impact zones (southern study area).

Scenario	Pipeline alternative	Number of buildings					
		Clam		5 m/s		10 m/s	
		Rupture	Small hole	Rupture	Small hole	Rupture	Small hole
1% Fatality	Duynefontein	1	0	3	0	3	0
	Silwerstroom South	10	0	11	3	12	2
	Silwerstroom Central	12	1	12	3	12	3
	Silwerstroom North	9	0	9	2	9	2
	Grotto Bay	22	0	40	0	46	0
100% Fatality	Duynefontein	0	0	0	0	0	0
	Silwerstroom South	4	0	5	0	7	0
	Silwerstroom Central	6	0	7	0	9	0
	Silwerstroom North	3	0	4	0	6	0
	Grotto Bay	0	0	1	0	12	0

Box 8.1: Risk comparison.

The distinction between risks, which are assumed voluntarily, and those, which are borne involuntarily, is a crucial one. The risk to which a member of the public is exposed from an industrial activity is an involuntary one. In general, people are prepared to tolerate higher levels of risk for hazards to which they expose themselves voluntarily. Kletz (1976) compiled some death rates for some voluntary and involuntary risks resulting from well-studied risks (see table below).

Risk	Fatality Rate *(Deaths Per Person Per Year)*
VOLUNTARY RISK:	($x\ 10^{-5}$)
Taking contraceptive pill	2
Playing football	4
Rock climbing	4
Car driving	17
Cigarette Smoking (20/day)	500
INVOLUNTARY RISK:	($x\ 10^{-7}$)
Meteorite	0.0006
Transport of petrol and chemicals (UK)	0.2
Aircraft crash (UK)	0.2
Explosion of pressure vessel (USA)	0.5
Lightning (UK)	1
Release from nuclear power station (at 1 km) (UK)	1
Run over by road vehicle	600
Leukaemia	800

Once the risk level is determined, it is important to determine whether the outcome is acceptable or not. In an attempt to account for risks in a manner similar to those used in everyday life, the UK Health and Safety Executive (HSE) developed the risk ALARP (as low as reasonably practicable) triangle. Applying the triangle involves deciding: (1) Whether a risk is so high that something must be done about it (Intolerable); (2) Whether the risk is or has been made so small that no further precautions are necessary (Acceptable or Trivial); or (3) A risk falls between these two states that it has been reduced to levels as low as reasonably practicable (Tolerable).

Generally, people accept the relatively higher degree of risk of $1x10^{-5}$ per person per year (or 1 in a 100 000 chance) involved in many of the voluntary activities indicated in the table above. Involuntary risks at the levels of $1x10^{-6}$ per person per year (or 1 in a 1 000 000 chance) for natural disasters and $1x10^{-7}$ per person per year (or 1 in a 10 000 000 chance) for man-made events appear to be acceptable. The involuntary risk rates suggest a level of risk to the public of between $1x10^{-6}$ and $1x10^{-7}$ per person per year as a possible criterion. This risk parameter may be compared with a statistically derived "acceptable" risk level. Although there is no clear-cut, acceptable involuntary risk, an evaluation of information presented above, suggests a risk of $1x10^{-4}$ and more chance of death per person per year could be considered "unacceptable" and must be reduced regardless of cost. A risk below $1x10^{-7}$ chance of death per person per year would be considered "acceptable" without further investigation or action.

(ii) Flash fires

Due to the momentous and buoyant plume resulting from a pipeline rupture, the maximum downwind distance at ground level was calculated to be 24 m (Lower Flammable Limit, LFL) and 25 m (½ LFL). The maximum crosswind extent was calculated to be 40 m (LFL) and 55 m (½ LFL) from the centre of the pipeline. Due to the buoyant nature of a cloud release, it is estimated that flash fires would not impact on any buildings adjacent to the onshore facilities sites.

Table 8.3 below provides an indication of the number of buildings within the calculated distances to the ½ LFL concentration levels.

The maximum risk of fatality per person per year of flash fires is considerable less at $3x10^{-8}$ per person per year (i.e. a trivial risk in terms of the ALARP triangle) for all pipeline alternatives.

Table 8.3: Number of buildings in the flash fire impact zones (southern study area).

Pipeline alternative	Number of buildings
Duynefontein	0
Silwerstroom South	4
Silwerstroom Central	6
Silwerstroom North	3
Grotto Bay	0

(iii) Vapour Cloud Explosion

The 0.1 bar overpressure radius (which corresponds to the distance at which 10% of the houses would be severely damaged and a probability of death indoors equal to 2.5%) was calculated to extend to a maximum distance of 740 m beyond the pipeline during calm, stable night-time atmospheric conditions and a total pipeline rupture with delayed ignition. During well-ventilated conditions (neutral atmospheres), this distance extends to approximately 450 m. No lethal effects are expected below 0.1 bar overpressure for people in the open.

Since the likelihood for VCEs is considered to be remote due to the open exposure of the pipeline and the buoyant nature of the release to form a confined cloud, the highest lethal risk was calculated to be less than $1x10^{-7}$ per person per year (i.e. a trivial risk in terms of the ALARP triangle) for all pipeline alternatives, and would occur immediately above the pipeline.

(iv) Maximum Individual Risk (refer to Box 8.1 for a comparison of risk)

The combined lethal risk value for jet fires, flash fires and VCE is approximately $1.1x10^{-6}$ per person per year (i.e. a tolerable risk in terms of the ALARP triangle) and occurs immediately above the pipeline. The area enclosed by the risk of $1x10^{-6}$ per person per year isoline (i.e. broadly acceptable), excluding the pipe bends, varies only slightly along the pipeline and is between 4 m and 8 m from the centre of the pipeline. The risk of $3x10^{-7}$ fatalities per person per year (i.e. trivial risk in terms of the ALARP triangle) was predicted to reach a maximum distance of up to 42 m from the centre of the pipeline. There are no buildings along the Grotto Bay and Duynefontein alternatives which fall in this zone. Two to five buildings associated with the Silwerstroom Strand alternatives fall within this zone, with the northern alternative having the fewer number of affected buildings.

The risk levels at the onshore facility appear to be within acceptable risk levels at all site alternatives. At the Ankerlig sites, most of the $1x10^{-6}$ per person per year risk isoline (i.e. broadly acceptable) falls within the fence line with the trivial risk extending up to a distance of about 80 m from the facility. At the Silwerstroom Strand sites, the broadly acceptable isolines extend about 70 – 125 m from the facility. The trivial risk isolines at Silwerstroom Strand extend further than Ankerlig, about 170 m – 185 m from the facility, due to the more elongated shape of Alternative 2a.

(v) Societal Risks

The shore-crossing at Silwerstroom Strand passes through the least populated sections in the southern study area. The Duynefontein shore-crossing and pipeline alignment approaches the residential areas of Duynefontein and Melkbosstrand; however, there is a separation of more than 200 m. The Grotto Bay shore-crossing, passes relatively close to the Grotto Bay residential area (approximately 40 m at closest point) and it is, therefore, expected to yield a slightly higher societal risk than Duynefontein and Silwerstroom Strand.

(a) Onshore pipeline routes

The impact associated with the risk of the Grotto Bay and Silwerstroom Strand alternatives is considered to be a localised, medium-term impact of high intensity. The overall impact is assessed to be of **medium** significance without mitigation and **LOW** significance with mitigation (see Table 8.4).

The impact associated with the risk of the Duynefontein alternative is considered to be a localised, medium-term impact of low intensity. The overall impact is assessed to be of **LOW** significance with and without mitigation (see Table 8.4).

The impacts associated with the risk of the north-south corridor and east link to Ankerlig are considered to be a localised, medium-term impact of low intensity. The overall impact is assessed to be of **LOW** significance with and without mitigation (see Table 8.4).

Although all routes are assessed to be of **LOW** significance after mitigation the pipeline route alternatives were ranked according to four criteria, namely:

- The proximity of the alignment to buildings at different distances from the pipeline centreline;
- The consequences, i.e. the number of buildings impacted negatively by thermal radiation (jet fires) and explosions (flash fires and VCEs);
- Maximum individual risk levels; and
- Societal risks.

According to this qualitative ranking process, the pipeline risk ranking is as follows (lowest to highest risk):

- Duynefontein;
- Silwerstroom Strand (northern route) along the Chevron servitude;
- Silwerstroom Strand (central route) along the Chevron servitude;
- Silwerstroom Strand (southern route) along the Chevron servitude;
- Silwerstroom Strand (northern route) along the R27;
- Silwerstroom Strand (central route) along the R27;
- Silwerstroom Strand (southern route) along the R27;
- Grotto Bay along the Chevron servitude; and
- Grotto Bay along the R27.

(b) Onshore gas processing facility

Since the risk levels at all onshore facility sites fall within acceptable risk levels, they thus do not pose a significantly high risk to the surrounding areas. The impact is considered to be a localised, medium-term impact of medium intensity. The overall impact is assessed to be of **LOW** significance with and without mitigation (see Table 8.4).

<u>Mitigation</u>

All designs should be in full compliance (but not necessarily limited) with the Occupational Health and Safety Act, 1993 (No. 85 of 1993) and its regulations, the National Buildings Regulations and the Buildings Standards Act, 1977 (No. 107 of 1977) as well as local bylaws. The following design considerations are recommended:

- The minimum pipeline depth should be 1.2 m (i.e. soil cover over the top of the pipeline), unless rock prevents this depth. Under these circumstances, the American Society of Mechanical Engineers (ASME) 31.8 code should be followed;
- Pipeline alternatives:
  - > The location of the pipeline adjacent to the Chevron servitude should have a minimum separation distance of 0.75 m from the servitude boundary;
  - > The portion of the Grotto Bay pipeline route adjacent to the Grotto Bay residential area should have a design factor of at least 0.5 or lower (which would require thicker pipe walls) to ensure that the proposed pipeline would be suitable for Class 2 (design factor = 0.5) or Class 3 (design factor = 0.4), as defined by the ASME 31 code; and
  - > Similarly, in anticipation of possible future development at or adjacent to Silwerstroom Strand, it is recommended to implement a design factor of at least 0.5 or lower.
- Surface Markers:
  - > Conspicuous concrete surface markers (or similar) should be erected along the onshore pipeline. These markers should be within visible distance of one another or when there is a change in direction;
  - > The marker should state at least the following on a background of sharply contrasting colours:
    - The word "Warning", "Caution" or "Danger" followed by the words "Natural Gas Pipeline". All letters should be at least 30 mm high with an approximate stroke of 10 mm;
    - The name of the operator and a telephone number (including area code) where the operator can be reached at all times; and
    - All information on markers should be in English and a local language of preference.
- Since the proposed pipeline would be considered a Major Hazard Installation (MHI), it is recommended that the risk assessment be reviewed and reassessed where necessary, with "as-built" engineering information. In preparation thereof, the following provisions are made:
  - > A recognised process hazard analysis (HAZOP, FMEA, etc.) should be completed for the proposed option prior to construction;
  - > A safety document detailing safety and design features reducing the impacts from fires, explosions and flammable atmospheres should be prepared. The built facility can then be audited against the safety document to ensure compliance;
  - > The risk assessment should be verified after completion of the final designs and layout, but prior to construction; and
  - > Emergency response documentation should be finalised with input from local authorities.

The following operational measures are recommended:

- Early detection and leak detection:
  - > A regular visual survey of the pipeline servitude should be implemented, so as to be aware of all activities taking place in the vicinity of this servitude. This would provide an early warning of risky activities (e.g. unauthorised excavations in servitude) and preventative risk management actions can be implemented timeously;

- An effective leak detection programme should be developed to ensure that leaks are identified; and
- The following cathodic protection monitoring procedures are recommended:
    - Monthly checks should be undertaken on the condition and performance of the transformer rectifier units supplying cathodic protection to the pipeline;
    - Every six months, 24-hour continuous electro-potential recordings should be taken at appropriate intervals along the line to ascertain the adequacy of the cathodic protection;
    - Checks on the corrosion rate using corrosion coupons and corrosometer probes at the terminal end of the line should performed on an annual basis; and
    - If and where there are indications that the cathodic protection is inadequate, continuous over line surveys should be carried out to detect any breaks in the coating and to have a closer inspection of the levels of cathodic protection over the suspect parts of the pipeline. Direct Current (DC) Voltage Gradient and Close Interval Potential survey techniques should be used.

- Operating procedures:
    - Operating procedures should emphasise the need to eliminate gas from the pipelines after commissioning, maintenance or launcher opening. Failure to degas the lines prior to commissioning would increase the risk of gasket leak or line failure;
    - Predictive maintenance should be scheduled for the maintenance of emergency shutoff and isolation valves;
    - A formal planned maintenance programme, including pig launchers/receivers, should be adhered to;
    - Operating procedures should highlight the risks associated with pigs becoming stuck, due to incorrect line-up/incompletely opened valves. It is recommended that a pig register be implemented; and
    - Pig position indicators should be maintained in an operating condition.
- Authority awareness:
    - The contents of the risk assessment should be communicated with the relevant authorities to ensure awareness of, and control over, future developments near the pipeline servitude. There should be appropriate physical separation between future development and the pipeline in order to reduce the probabilities and the consequences of incidents. Possible land use techniques include, for example, establishing setbacks, regulating or prohibiting certain types of uses and structures (e.g. schools, hospitals and apartment buildings) near the pipeline and encouraging other types of activities or facilities (e.g. linear parks and recreational paths) within or in the vicinity of the pipeline servitude; and
    - A programme of regular (e.g. annual) communication with the local authorities should be considered to ensure an ongoing awareness of pipeline servitude risks.
- Emergency Planning:
    - The local Disaster Management Plans must be updated with the Emergency Response Plan specifically developed for the pipeline;
    - Regular exercise of the Emergency Response Plan should be implemented; and
    - The Emergency Response Plan must contain the most recent information on responsible persons and contact details.

Table 8.4: Assessment of potential impacts related to jet fires, flash fires and Vapour Cloud Explosions in the southern study area.

Rating scales	Without Mitigation	With Mitigation
Grotto Bay and Silwerstroom Stand shore-crossings		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	High	Low
Significance	**Medium**	**LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Duynefontein shore-crossing, North-South corridor and East link to Ankerlig		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Low	Low
Significance	**Low**	**LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Onshore facility sites		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Medium	Low
Significance	**Low**	**LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Nature of cumulative impact	Other activities that may contribute to the cumulative risk impact include other industry, e.g. Ankerlig Power Station, Koeberg Power Station. Cumulative impact is considered to be of Low to MEDIUM significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	Very Low	

8.2.2 NORTHERN SHORE-CROSSING ROUTE (SALDANHA PENINSULA)

Description of impact

As with the southern pipeline route (see Section 8.2.2), the main hazards associated with a loss of containment include (1) the thermal radiation from jet or flash fires; and (2) overpressure from VCEs.

Assessment

The findings of the Risk Assessment are summarised below.

(i) Jet fires

Table 8.5 below provides an indication of the number of buildings within the calculated distances to the thermal radiation levels of 10 kW/m² and 35 kW/m² for both full-bore and 20 mm hole scenarios.

The maximum risk of fatality per person per year due to jet fires is calculated to be approximately $1x10^{-6}$ per person per year (i.e. a tolerable risk in terms of the ALARP triangle) for all pipeline alternatives and would occur immediately above the pipeline.

Table 8.5: Number of buildings in the jet fire impact zones (northern study area).

Scenario	Pipeline alternative	Number of buildings					
		Clam		5 m/s		10 m/s	
		Rupture	Small hole	Rupture	Small hole	Rupture	Small hole
1% Fatality	Noordwesbaai West	5	1	8	1	9	1
	Noordwesbaai East	0	0	3	0	4	0
	St Helena West	0	0	0	0	0	0
	St Helena East	0	0	0	0	0	0
100% Fatality	Noordwesbaai West	1	0	2	0	3	0
	Noordwesbaai East	0	0	0	0	0	0
	St Helena West	0	0	0	0	0	0
	St Helena East	0	0	0	0	0	0

(ii) Flash fires
Table 8.6 below provides an indication of the number of buildings within the calculated distances to the ½ LFL concentration levels.

The maximum risk of fatality per person per year of flash fires is considerable less at $3x10^{-8}$ per person per year (i.e. a trivial risk in terms of the ALARP triangle) for all pipeline alternatives.

Table 8.6: Number of buildings in the flash fire impact zones (northern study area).

Pipeline alternative	Number of buildings
Noordwesbaai West	1
Noordwesbaai East	0
St Helena West	0
St Helena East	0

(iii) Vapour Cloud Explosion
Since the likelihood for VCEs is considered to be remote due to the open exposure of the pipeline and the buoyant nature of the release to form a confined cloud, the highest lethal risk was calculated to be less than $1x10^{-7}$ per person per year (i.e. a trivial risk in terms of the ALARP triangle) for all pipeline alternatives, and would occur immediately above the pipeline.

(iv) Maximum Individual Risk
The combined lethal risk value for jet fires, flash fires and VCE is approximately $1.1x10^{-6}$ per person per year (i.e. a tolerable risk in terms of the ALARP triangle) and occurs immediately above the pipeline. The area

enclosed by the risk of $1x10^{-6}$ per person per year isoline (i.e. broadly acceptable), excluding the pipe bends, varies only slightly along the pipeline and is between 4 m and 8 m from the centre of the pipeline. The risk of $3x10^{-7}$ fatalities per person per year (i.e. trivial risk in terms of the ALARP triangle) was predicted to reach a maximum distance of up to 42 m from the centre of the pipeline. There are no buildings which fall in this zone along all pipeline alternatives, except Noordwesbaai West. Along the Noordwesbaai West alterative only one building falls within this zone.

(v) Societal Risks

The northern shore-crossings are all considered to have the same societal risks. The only significant difference between the alignments is in the lengths of the pipelines.

(a) Shore-crossings and pipeline

The impact associated with the risk of all northern pipeline routes is considered to be a localised, medium-term impact of low intensity. The overall impact is assessed to be of **LOW** significance with and without mitigation (see Table 8.7).

Although all routes are assessed to be of **LOW** significance after mitigation the pipeline route alternatives were ranked according to four criteria (see Section 8.2.1). According to this qualitative ranking process, the pipeline risk ranking is as follows (lowest to highest risk):

- St Helena Bay East route,
- St Helena West route;
- Noordwesbaai East; and
- Noordwesbaai West.

<u>Mitigation</u>

Recommendations to mitigate the potential risk impacts are the same as to those recommended for the southern pipeline route alternatives (refer to Section 8.2.1).

Table 8.7: Assessment of potential impacts related to jet fires, flash fires and Vapour Cloud Explosions in the northern study area.

Rating scales	Without Mitigation	With Mitigation
St Helena West and East shore-crossings		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Low	Low
Significance	**Low**	**LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Noordwesbaai-crossing		
Extent	Local	Local
Duration	Medium-term	Medium-term
Intensity	Medium	Low
Significance	**Low**	**LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium

Rating scales	Without Mitigation	With Mitigation
Nature of cumulative impact	N/A	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	Very Low	

9. CONCLUSIONS AND RECOMMENDATIONS

Sunbird and its partner, PetroSA, currently have in place an Environmental Authorisation and hold a Production Right to develop the Ibhubesi Gas Field. Sunbird is now, however, considering various additional and alternative project components, from what was originally approved, in order to supply indigenous gas feedstock to Ankerlig and potential end users on the Saldanha Peninsula. The key additions / alternatives include the following:

- The installation of either a FPSO or a semi-submersible production platform in the licence area;
- An approximately 400 km offshore pipeline from the production facility to a shore-crossing site located between Grotto Bay and Duynefontein (i.e. the southern pipeline alternatives) and one on the Saldanha Peninsula (i.e. the northern pipeline alternatives), in the Western Cape;
- An onshore pipeline between the shore-crossing site and Ankerlig and potential end users on the Saldanha Peninsula; and
- An onshore gas receiving facility, at a location adjacent to Ankerlig or adjacent to the Silwerstroom Strand Water Treatment Plant.

This revised project is referred to as the "*Ibhubesi Gas Project*". Since the original approvals will remain in place, this S&EIA only assesses the potential impacts related to the additional and alternative project components.

The proposed Ibhubesi Gas Project requires authorisation in terms of both NEMA and the MPRDA. CCA has been appointed by Sunbird to undertake a S&EIA process in terms of NEMA and compile an EMPr Addendum in terms of the MPRDA. Specialists have been appointed to address the key issues that required further investigation, namely:

1. Vegetation;
2. Freshwater;
3. Terrestrial fauna;
4. Marine fauna;
5. Heritage;
6. Oil spill assessment;
7. Air quality;
8. Risk;
9. Visual;
10. Fisheries;
11. Social; and
12. Economic.

The findings of the specialist studies and other relevant information have been integrated and synthesised into this report. The two main objectives of this report are, firstly, to assess the significance of environmental impacts resulting from the proposed project and to suggest ways of mitigating negative impacts and enhancing benefits, and secondly to provide I&APs with an opportunity to comment on the proposed project.

This chapter summarises the key findings of the S&EIA and presents mitigation measures that should be implemented in the authorisation consideration of the proposed project.

9.1 CONCLUSIONS

A summary of the assessment of potential environmental impacts associated with the proposed project is provided in Tables 9.1 (biophysical), 9.2 (socio-economic) and 9.3 (human health).

Table 9.1: Summary of the significance of the potential biophysical impacts associated with the proposed Ibhubesi Gas Project (Note: * indicates that no mitigation is possible and / or considered necessary, thus significance rating does not change).

Potential impact		Alternative (where applicable)	Significance	
			Without mitigation	With mitigation
1. Offshore biophysical impacts:				
1.1 Production pipeline				
Physical damage to and disturbance of benthic communities due to installation of pipeline on the seabed	Unconsolidated sediments	All pipeline routes	M	**L**
	Hard grounds		H	**L**
Physical damage to and disturbance of benthic communities due to installation of pipeline through the intertidal and shallow subtidal zone		Grotto Bay	INSIG	**INSIG**
		Other shore-crossing alternatives	L	**VL**
Construction noise, vibrations and blasting		Grotto Bay	INSIG	**INSIG**
		Other shore-crossing alternatives	L-M	**VL**
Effects on benthic species diversity and numbers due to physical presence of the pipeline		All pipeline routes	M (+ve)	**M (+ve)**
Normal discharges from the pipe-lay vessel and discharge of hydrotest water		All pipeline routes	VL	**VL**
Spills and pollution in the coastal zone during construction		All pipeline routes	L	**VL**
1.2 Production facility				
Physical damage to and disturbance of benthic communities due to anchoring	Unconsolidated sediments	Both production facility alternatives	VL	**VL**
	Hard grounds		L	**VL**
Noise from production facility			VL	**VL***
Lighting from production facility			VL-M	**VL-L**
Normal discharges from production facility			VL	**VL**
Accidental condensate and diesel spill during operation			M	**L**
2. Onshore biophysical impacts:				
2.1 Southern shore-crossing route (Grotto Bay to Duynefontein)				
Loss of vegetation due to clearing		Grotto Bay	L	**VL**
		Silwerstroom Strand and Duynefontein	M	**L**
		North-south corridor and east link to Ankerlig	M	**L**
Direct mortality of faunal species		All pipeline routes	VL	**VL**
Loss of faunal habitats			L	**VL**
Barrier effect of pipeline	Trench		INSIG-VL	**INSIG-VL**
	Pipeline		INSIG	**INSIG**

Potential impact		Alternative (where applicable)	Significance	
			Without mitigation	With mitigation
Loss of wetland and riparian habitat, temporary impedance of low and increased sedimentation		Grotto Bay	VL	**INSIG**
		Silwerstroom Strand	M	**L-M**
		Duynefontein	VL	**INSIG-VL**
		East link to Ankerlig	L	**VL**
2.2 Northern shore-crossing route (Saldanha Peninsula)				
Loss of vegetation due to clearing		St Helena West and Noordwesbaai East	L	**VL**
		St Helena East	L-M	**L**
		Noordwesbaai West	H	**M**
Direct mortality of faunal species		All pipeline routes	VL	**VL**
Loss of faunal habitats			L	**VL**
Barrier effect of pipeline	Trench		INSIG-VL	**INSIG-VL**
	Pipeline		INSIG	**INSIG**
Loss of wetland and riparian habitat, temporary impedance of low and increased sedimentation		St Helena West	L	**VL**
		St Helena East	VL	**INSIG**
		Noordwesbaai	L	**VL**
2.3 Onshore gas receiving facility				
Loss of vegetation due to clearing		Ankerlig facility	M	**M**
		Silwerstroom Strand facility	H	**H**
Loss of wetland and riparian habitat, temporary impedance of low and increased sedimentation		Ankerlig facility	L	**VL**
		Silwerstroom Strand facility	M	**L-M**
Direct mortality of faunal species		All alternatives	VL	**VL**
Loss of faunal habitats			L	**VL**

VH=Very High	H=High	M=Medium	L=Low	VL=Very low	Insig = insignificant	N/A = Not applicable

Table 9.2: Summary of the significance of the potential socio-economic impacts associated with the proposed Ibhubesi Gas Project (Note: * indicates that no mitigation is possible and / or considered necessary, thus significance rating does not change).

Potential impact	Alternative (where applicable)	Significance	
		Without mitigation	With mitigation
1. Cultural impacts:			
1.1 Offshore pipeline			
Disturbance of historical shipwrecks	Southern shore-crossing routes	L	**L**
	Northern shore-crossing routes	L	**L**

Potential impact		**Alternative (where applicable)**	**Significance**	
			Without mitigation	**With mitigation**
1.2 Southern shore-crossing route (Grotto Bay to Duynefontein)				
Disturbance of cultural heritage material, including fossils, shell middens and other archaeological material		Grotto Bay	M	**L**
		Other pipeline routes	L	**L**
1.3 Northern shore-crossing route (Saldanha Peninsula)				
Disturbance of cultural heritage material, including early fish traps, fossils, shell middens and other archaeological material		St Helena West	M	**L**
		St Helena East and Noordwesbaai	L	**L**
2. Visual impacts:				
2.1 Southern shore-crossing route (Grotto Bay to Duynefontein)				
Visual impact due to pipeline		All pipeline routes	L	**L**
2.2 Northern shore-crossing route (Saldanha Peninsula)				
Visual impact due to pipeline		St Helena West and East	VL	**VL**
		Noordwesbaai	L	**L**
2.3 Onshore gas receiving facility				
Visual impact due to onshore facility		Silwerstroom Strand facility	M-H	**M**
		Ankerlig facility	L-M	**L**
3. Fishing industry impacts:				
Disruption to fishing activities due to 500 m safety zone around pipe-lay vessel	Small pelagic purse-seine and West Coast rock lobster	All pipeline routes	VL	**VL**
	Other fishing sectors		INSIG	**INSIG**
Disruption to fishing activities and increased fishing effort and loss-of-access to fishing grounds due to presence of production facility and subsea pipeline	Demersal trawl	All pipeline routes	VL	**VL**
	Small pelagic purse-seine		**NO IMPACT**	
	Hake-directed demersal long-line		VL	**VL**
	Shark -directed demersal long-line		VL	**VL**
	Large pelagic long-line		INSIG	**INSIG**
	Tuna pole		INSIG	**INSIG**
	Traditional line-fish		INSIG	**INSIG**
	West Coast rock lobster	Noordwesbaai, Silwerstroom Strand and Duynefontein	VL	**VL**
		Grotto Bay and St Helena Bay	L	**L**
	Fisheries research	All pipeline routes	VL	**VL**
Accidental condensate and diesel spill during operation	All sectors	All pipeline routes	INSIG-VL	**INSIG-VL**

Potential impact		Alternative (where applicable)	Significance	
			Without mitigation	With mitigation
3. Social impacts:				
Creation of employment, empowerment and local expenditure	Construction	All pipeline routes and facility sites	VL (+ve)	**L (+ve)**
	Operation		L (+ve)	**M (+ve)**
	Decommissioning		VL (+ve)	**L (+ve)**
Skills and SMME development			L (neutral)	**M (+ve)**
Income and related economic dependency			M (+ve)	**H (+ve)**
Gender balance			L (neutral)	**L (+ve)**
Cultural impact due to in-migration	Construction		L	**VL (neutral)**
	Operation		L	**L (neutral)**
	Decommissioning		VL	**VL (neutral)**
4 Economic impacts:				
4.1 General				
Macro-economic impacts		All pipeline routes and facility sites	L (unkown)	**L (unkown)***
Compliance with planning frameworks for the region and the development of the gas industry			L (+ve)	**L (+ve)***
Energy security and diversification of the country's energy mix			L (+ve)	**L (+ve)***
Generation of "clean" energy			H (+ve)	**H (+ve)***
Impact on industry and mining			L	**L**
4.2 Southern shore-crossing route (Grotto Bay to Duynefontein)				
Impact on tourism		Grotto Bay and Silwerstroom	L	**VL**
		Duynefontein	INSIG	**INSIG***
Impact on farming		All pipeline routes	INSIG	**INSIG***
Impact on future land use options		Grotto Bay and Silwerstroom Strand (Alt 3)	L	**L***
		Silwerstroom Strand (Alt 1 & 2) and Duynefontein	INSIG	**INSIG***
		Ankerlig facility	INSIG	**INSIG***
		Silwerstroom Stand facility	L	**L***
4.3 Northern shore-crossing route (Saldanha Peninsula)				
Impact on tourism		St Helena West and East	VL	**VL***
		Noordwesbaai	L	**VL**
Impact on farming		All pipeline routes	L	**VL**
Impact on future land use options		All pipeline routes	M	**L-M**

VH=Very High	H=High	M=Medium	L=Low	VL=Very low	Insig = insignificant	N/A = Not applicable

Table 9.3: Summary of the significance of the potential human health impacts associated with the proposed Ibhubesi Gas Project (Note: * indicates that no mitigation is possible and / or considered necessary, thus significance rating does not change).

Potential impact	Alternative (where applicable)	Significance	
		Without mitigation	With mitigation
1. Air quality impacts:			
1.1 Offshore operational activities			
Emissions from the offshore stacks arise mainly from the flare, power generation, the inert gas system/boilers and an incinerator	Both production facility alternatives	VL	**VL***
1.2 Onshore construction activities			
Fugitive dust may also be emitted during material loading and hauling, and stockpiling	All pipeline routes	L	**VL**
1.3 Onshore operational activities			
Emissions from the onshore stacks arise mainly from the water bath heaters.	Both onshore facility alternatives	L	**L**
2. Risk impacts:			
2.1 Southern shore-crossing route (Grotto Bay to Duynefontein)			
Thermal radiation from jet or flash fires and overpressure from Vapour Cloud Explosions	Duynefontein	L	**L**
	Grotto Bay and Silwerstroom Strand	M	**L**
	North-south corridor and east link to Ankerlig	L	**L**
	Both onshore facility alternatives	L	**L**
2.2 Northern shore-crossing route (Saldanha Peninsula)			
Thermal radiation from jet or flash fires and overpressure from Vapour Cloud Explosions	All pipeline routes	L	**L**

VH=Very High	H=High	M=Medium	L=Low	VL=Very low	Insig = insignificant	N/A = Not applicable

9.1.1 BIOPHYSICAL ENVIRONMENT

9.1.1.1 Offshore marine environment

Offshore production pipeline

The majority of the impacts associated with the operation of the pipe-lay vessel and pipeline installation would be highly localised, of very short-term duration (3 - 4 months) and of low intensity, and are considered to be of **VERY LOW** significance after mitigation. These short-term impacts are mitigated by ensuring that vessels comply with MARPOL 73/78 standards and providing prior notification (including navigation warnings) to key stakeholders.

One of the key issues associated with pipeline installation relates to the physical damage and disturbance of vulnerable or sensitive benthic communities. Although the majority of the proposed offshore production pipeline route coincides with benthic habitats mapped as ‘least threatened’, it would traverse more sensitive habitats nearer the coast. Deep reefs and other hard ground habitats in particular, which potentially occur along the pipeline route, may support fragile, structurally complex species (e.g. cold water corals, black corals, gorgonians and sponges). These species are generally long-lived and slow-growing, and as such have slow recovery times after disturbance. With careful routing of the pipeline and the avoidance of any sensitive habitats identified during a pre-construction subsea route survey (using a ROV or similar device), the significance could be reduced to **LOW** for all pipeline route alternatives.

The extent of disturbance through the coastal zone would ultimately depend on which installation method is used to install the pipeline, namely trenching and bottom tow or horizontal directional drilling. The horizontal directional drilling method would have minimal effect on intertidal and shallow subtidal habitats, as the pipeline would pass below the seabed, and as such would have an **INSIGNIFICANT** impact. This method, would however, require a lined sump or containment dam onshore for returned drilling muds. In contrast to the horizontal directional drilling method, the installation of the pipeline via a trench through the surf zone would involve considerable disturbance of the high shore, intertidal and shallow subtidal beach habitats. In addition, this installation method may also require blasting and the construction of a temporary sheet piled cofferdam and temporary jetty (or groin) to provide a working platform from which the work through the beach zone can be carried out. Although trenching would involve considerable disturbance to the coastal zone, recolonisation would commence rapidly after cessation of trenching in unconsolidated sediments. This is due to the fact that communities within the wave-influenced zone being adapted to a high wave energy environment and frequent natural disturbances. Research studies following completion of coastal mining have shown that biological ‘recovery’ of disturbed areas can occur within two to five years. The impact associated with the trenching and bottom tow installation method is considered to be of **VERY LOW** significance with mitigation. Although the initial engineering site assessment indicated that the Grotto Bay alternative is the only alternative that appears suitable for the horizontal directional drilling method, it is recommended that a detailed geotechnical site investigation be undertaken to determine the possibility of using the horizontal directional drilling installation method, specifically at St Helena Bay and Silwerstroom Strand where there is a rocky intertidal zone or potentially shallow bedrock beneath the sand.

The **INSIGNIFICANT** to **LOW** impacts associated with pipeline installation should be weighed up against the potential biophysical benefits that may result from the presence of the pipeline on the seabed. Once the pipeline has been laid, the affected seabed areas around the pipeline would with time be recolonised by benthic macrofauna. The pipeline itself would provide an alternative substratum for colonising communities. Thus the proposed pipeline could effectively increase the amount of hard substrate that is available for the colonisation of vulnerable / sensitive benthic species, which potentially occur along the pipeline route. The potential increase in biodiversity and biomass, especially of vulnerable / sensitive species, associated with the abandonment of the pipeline on the seabed is deemed to be of **MEDIUM (positive)** significance.

Production facility

The majority of the impacts associated with the operation of the production facility (e.g. anchoring, lighting and normal discharges) would be localised, of medium term duration (15 years) and of low intensity, and are considered to be of **VERY LOW to LOW** significance after mitigation. It should be noted that these impacts are no different to those associated with the operation of a Tension Leg Platform (a vertically moored floating structure), which was approved as part of the original project proposal.

Operational spills

This is considered to be an abnormal operation and relates to the unlikely event of a hydrocarbon spillage (e.g. during fuel bunkering or during the transfer of condensate from the production facility to the tanker). A small instantaneous spill of diesel (12 m^3) would be relatively short-lived on the water surface (1.5 -

4 days) before dissipating and is predicted to travel in a north-westerly direction away from the coast during both the summer and winter. A small diesel spill is not predicted to reach the coast located approximately 85 km away. A medium instantaneous spill of condensate (160 m^3) could remain on the water surface for up to 16 days depending on the weather conditions. The section of coast most at risk to shoreline oiling extends from approximately Hondeklipbaai to Strandfontein. During summer the strong south-easterly winds would reduce the risk of shoreline oiling. The impact of a small to medium-sized operational spill on marine fauna and fishing is considered to range from **INSIGNIFICANT** and **LOW** significance with implementation of project-specific oil spill contingency plan.

9.1.1.2 Onshore terrestrial environment

Onshore production pipeline

The key impacts on the onshore biophysical environment relate to the clearing of vegetation within the construction servitude (15 - 20 m wide) and trench excavation (1 - 1.5 m deep). These activities would have potential impacts on the vegetation, terrestrial fauna and freshwater resources. Many of these impacts are considered to be of short duration (8 to 10 months), as the pipeline would be backfilled and rehabilitated as the construction operation progresses. The duration of the impact on the vegetation would be longer as it is anticipated that successful revegetation would only be achieve over the medium-term, based the success of the revegetation of Atlantis Sand Fynbos vegetation along the existing Chevron pipeline.

The majority of the indigenous vegetation in the southern study area is Endangered or Critically Endangered, and as such much of the area around Ankerlig and along the R27 has been mapped as a CBA. The estimated extent of indigenous vegetation that would be cleared per alternative is presented in the table below. The vegetation impact ranges from **VERY LOW** to **LOW** significance with mitigation depending on which shore-crossing alternative is selected, and of **LOW** significance with mitigation for impact associated with the north-south corridor and east link to Ankerlig. Obviously the shorter the route the less vegetation would be affected.

Alternative	Estimated indigenous vegetation cleared	Main vegetation types
Grotto Bay to Ankerlig	47 ha	Cape Flats Dune Strandveld and Atlantis Sand Fynbos
Silwerstroom Stand to Ankerlig (three alternatives)	34 – 38 ha	
Duynefontein to Ankerlig	28 ha	Cape Flats Dune Strandveld

All the northern routes cross mainly farmland, although portions of the Noordwesbaai alternative pass through areas mapped as CBAs. In order to avoid the CBA area near the coast, the Noordwesbaai East alternative was proposed. The estimated extent of indigenous vegetation that would be cleared per alternative is presented in the table below. The vegetation impact ranges from **VERY LOW** (Noordwesbaai East and St Helena Bay West) to **LOW** (St Helena East) to **MEDIUM** (Noordwesbaai West) significance with mitigation depending on which pipeline route alternative is selected.

Alternative	Estimated indigenous vegetation loss	Main vegetation types
St Helena West	3 ha	Saldanha Flats Strandveld
St Helena East	4 ha	
Noordwesbaai (two alternatives)	11 – 14 ha	Langebaan Dune Strandveld and Saldanha Limestone Strandveld

Potential impacts on freshwater resources include the loss of wetland and riparian habitat, bed modifications, temporary impedance or diversion of flow, and increased sedimentation and turbidity of freshwater. The key aquatic features in the southern study area include the Silwerstroom / Buffels River System and its associated valley bottom wetlands, and in the northern study area the Bok River and the associated valley bottom wetlands, and the wider floodplain area of the Berg River Estuary. Due to the fact that much of the surrounding landscape has been developed either for agriculture or for urban activities, most of the freshwater features in the study area are already in a largely modified state. With regard to the southern pipeline routes, the Silwerstroom Strand alternatives are located in a relatively sensitive area in terms of ground and surface water interaction and as such the impact is considered to be of **LOW to MEDIUM** significance with mitigation. The impact associated with the Grotto Bay and Duynefontein alternatives are considered to be **INSIGNIFICANT to VERY LOW** with mitigation. With regard to the northern pipeline routes, the potential freshwater impact ranges from **INSIGNIFICANT** (St Helena East) to **VERY LOW** (St Helena West and Noordwesbaai) depending on which pipeline route alternative is selected.

The impact on terrestrial fauna is assessed to be of similar significance for all pipeline route alternatives (**INSIGNIFICANT to VERY LOW** significance with mitigation).

Onshore gas receiving facility

The onshore facility would occupy an area of approximately 1.85 ha. The potential impacts related to the onshore gas receiving facility are considered to range from medium- to long-term duration based on an anticipated field life of 15 years.

In general, the sites located adjacent to Ankerlig within the Atlantis Industrial Area are deemed to be less sensitive than the sites adjacent to the Silwerstroom Strand Water Treatment Plant. The vegetation impact ranges from **MEDIUM** significance for the Ankerlig sites (located in highly disturbed Cape Flats Dune Strandveld) to **HIGH** significance for the Silwerstroom Strand sites (located in Atlantis Sand Fynbos).

The onshore facility sites adjacent to the Silwerstroom Strand Water Treatment Plant are located in a relatively sensitive area in terms of ground and surface water interaction. The potential impact on freshwater resources in this area is thus considered to be of **LOW to MEDIUM** significance with mitigation, compared to the impact of **VERY LOW** significance for the site adjacent to Ankerlig.

The impact on terrestrial fauna is assessed to be of similar significance for all site alternatives (**INSIGNIFICANT to VERY LOW** significance with mitigation).

9.1.2 SOCIO-ECONOMIC ENVIRONMENT

Overall project

There is no reason to believe that the proposed project would have any macro-economic consequences for the economy or engender any marked benefits. The project is not of a size that would have an impact on the exchange rate or on the interest rate. There is also too little information to determine whether the project would generate a net inflow of foreign funds, as it is not known if funds would be sourced locally or internationally. If obtained within South Africa the stimulatory effects of the spending would merely be displacing the stimulatory effects of any alternative project, which those funds could have financed. On the other hand if the funding was to be sourced internationally this would constitute a positive financial injection into the economy. Although the capacity to manufacture and lay pipes, similar to those proposed, exists in South Africa, it is not known whether a local or foreign contractor would be used. The cost of the pipeline may, therefore, be an injection or a withdrawal from the national income. The macro-economic impact is, therefore, considered to be of **LOW (positive, negative or neutral)** significance depending of where the finds are sourced and local content. On a regional level the proposed project is line with the planning frameworks for the region and the development of the gas industry in the Western Cape, and as such is expected to have positive impact of **LOW (positive)** significance.

The proposed project could also have a positive impact on energy security and diversification of the country's energy mix, with added benefit to Eskom in the form of lower energy costs and reduced carbon emissions. This impact is assessed to be **LOW (positive)** significance. An external benefit of using gas at Ankerlig would be reduced carbon emissions. Currently South Africa is one of the most carbon intensive economies in the world relying on coal-powered energy to meet almost 90% of its energy needs. The conversion of Ankerlig from diesel to gas would reduce carbon emissions. The impact associated with the generation of "clean" energy is assessed to be **HIGH (positive)**.

The proposed development would stimulate direct and indirect employment opportunities over the duration of the proposed project, as well as result in skills and SMMEs being developed in the study area. Although the proposed project would be a relatively small employer, any job opportunities would undoubtedly have a positive impact in the project area. Direct employment associated with the proposed project is projected as follows:

- 665 - 772 jobs during the design and construction phase (**LOW positive** significance with mitigation);
- 100 - 141 jobs during the operational phase (**MEDIUM positive** significance with mitigation); and
- 60 - 80 jobs during the decommissioning phase (**LOW positive** significance with mitigation).

Since the proposed project constitutes a new economic activity for the study area and beyond, all salary and related revenue generated by the proposed project would be additional. The impact of income and related economic dependency is considered to be of **HIGH (positive)** significance with mitigation.

Offshore production pipeline

The impact on the various fishing sectors active along the proposed pipeline route during installation would be limited to the 500 m safety zone around the pipe-lay vessel, which would be highly localised and of very short-term duration (3 - 4 months). This potential impact ranges from **INSIGNIFICANT** (demersal trawl, demersal long-line, large pelagic long-line, tuna pole, traditional line-fish) to **VERY LOW** (small pelagic purse-seine, West Coast rock lobster). Key mitigation includes ensuring that prior notification is provided to the fishing industry and that Radio Navigation Warnings and Notices to Mariners are released throughout the installation period.

The installation of the proposed production pipeline on the seabed from the production platform to the shore-crossing sites could disturb historical shipwrecks. However, since all known shipwrecks off the coast occur in waters shallower than 100 m and within 50 km of the coast, it is unlikely that the majority of the offshore pipeline would encounter any historical shipwrecks. Offshore of the southern pipeline shore-crossing sites there are no accounts of any historical shipwrecks on the South African National Maritime database. In the northern study area, there are two references to shipwrecks in the St Helena Bay area, although the exact positions of these shipwrecks are not known. With careful routing of the pipeline and the avoidance of any identified shipwrecks during a pre-construction geotechnical survey, the significance is considered to be **LOW** for all pipeline route alternatives.

Although the proposed pipeline would not be protected by a 500 m safety zone, it is afforded some protection in terms of the Marine Traffic Act, 1981 (e.g. a vessel is not permitted to drop anchor or demersal trawl within 500 m of a pipeline). Thus during the operational phase, the pipeline would only potentially affect those sectors that have gear that comes into contact with the seafloor, namely:

- Demersal trawl: The pipeline would pass through one grid block along its length (i.e. Grid Block 441 offshore of Saldanha Bay), which equates to approximately 0.02% and 0.07% of the national catch and effort, respectively. The impact is thus considered to be permanent (due to abandonment of pipeline) and of **VERY LOW** significance.

- Demersal long-line: Although anchors may not be dropped within 500 m of the pipeline, it is conceivable that a line could be set over the pipeline. During the period 2000 to 2013, some effort was recorded within grid blocks through which the pipeline would pass. The impact is considered to be of **VERY LOW** significance. The area would open up to fishing after decommissioning.
- West Coast rock lobster: Vessels could potentially set traps within 500 m of the pipeline, however, not over or in very close proximity to the pipeline. The impact is considered to be of **VERY LOW** (Noordwesbaai, Silwerstroom Strand and Duynefontein) to **LOW** (Grotto Bay and St Helena Bay) significance. The area would open up to fishing after decommissioning.

Onshore pipeline

Onshore pipeline installation could have visual, farming and tourism impacts. However, these impacts are expected to be of very short duration (8 – 10 months), as the pipeline would buried underground and farming can recommence once the pipeline has been laid. These impacts are expected to be **INSIGNIFICANT to LOW** significance with mitigation for all southern and northern pipeline routes alternatives.

The installation of the proposed pipeline through the coastal zone to the onshore facility or termination point could disturb cultural heritage material, including early fish traps, fossils, shell middens and other archaeological material. In the southern study area no archaeological material was noted along any of the pipeline routes. However, shell midden material was found at the Grotto Bay shore-crossing site. Due to the presence of pleistocene fossils within the Koeberg Nature Reserve, it is anticipated that palaeontological material could be encountered along all routes. In the northern study area, there is a historic fish trap (Grade lllA) in the vicinity of the St Helena West shore-crossing. Should the avoidance of the fish trap not be possible, localised demolition of a fish trap may be necessary, which would also require a heritage permit from SAHRA. The potential heritage impact associated all alternatives is considered to be of **LOW** significance with mitigation.

Onshore gas receiving facility

The proposed gas receiving facility at Silwerstroom Strand would be visible by users at the northern part of the Silwerstroom Strand resort. The potential visual impact is assessed to be of **MEDIUM** significance with mitigation. The site alternatives adjacent to Ankerlig have a moderately high visual absorption capacity due to their location adjacent to the Ankerlig Power Stations and location in the Atlantis Industrial Area, which results in an impact of lower significance (**LOW** significance with mitigation).

9.1.3 HUMAN HEALTH

Offshore production facility

No emission standards were exceeded for all offshore operations and all simulated “ground” level concentrations comply with NAAQS. There were also no offsite exceedances of the inhalation screening criteria for non-criteria pollutants (including VOCs, Hydrogen Chloride, Hydrogen Fluoride and Mercury). During operation the potential impact on employees and contractors from criteria and non-criteria pollutants is considered to be of **VERY LOW** significance with mitigation.

Onshore pipeline and facility

During construction atmospheric emissions and air quality impacts would occur as a result of land clearing, excavations grading, bulldozing, compaction, etc. The overall impact related to criteria pollutants (PM2.5 and PM10) is assessed to be of **VERY LOW** significance with mitigation for all pipeline routes and onshore facilities sites. For onshore facility operations, no emission standards were exceeded and all simulated ground level concentrations comply with NAAQS. There were also no offsite exceedances of the inhalation screening criteria for non-criteria pollutants (including VOCs). The impact during operation at the onshore gas receiving facility from criteria and non-criteria pollutants is considered to be of **LOW** significance with and without mitigation and for all proposed onshore facilities sites.

The main risk associated with the proposed onshore pipeline and gas receiving facility relate to a loss of containment of natural gas, with the main hazards being (1) the thermal radiation from jet or flash fires, and (2) overpressure from VCEs. In terms of the maximum individual risk, the risk associated with all pipeline routes is classified as a “trivial risk” in terms of the internationally recognised ALARP triangle. In terms of societal risk, which takes into account population density, the Grotto Bay shore-crossing, passes relatively close to the Grotto Bay residential area is expected to yield a slightly higher societal risk than Silwerstroom Strand and Duynefontein. However, these risks can be reduced with the recommended engineering design. The northern shore-crossings are all considered to have the same societal risks. The impact associated with an unlikely loss of containment is considered to be of **LOW** significance with mitigation for all pipeline route alternatives.

9.1.4 COMPARATIVE ASSESSMENT OF PROJECTS ALTERNATIVES

9.1.4.1 Production facility

All potential impacts associated with the normal operation of either a FPSO or semi-submersible production platform are assessed to be of similar significance. These include:

- Disturbance to seabed;
- Emissions to the atmosphere;
- Discharge of waste to sea;
- Fauna attraction to production facility; and
- 500 m safety zone around the production facility.

There are no additional impacts or differences in impact significance relating to the choice of production facility that may be used for this proposed project.

9.1.4.2 Pipe-laying method

Two offshore pipeline installation methods may be employed, namely S-Lay and J-Lay methods. Although the S-Lay method is the most likely there are no additional impacts or differences in impact significance relating to the choice of installation method.

9.1.4.3 Offshore pipeline alignment

The pipeline would be located roughly parallel to the coast between the 100 m and 250 m contour line. Although the final routing of the pipeline would ultimately be determined by a subsea route and site survey, this S&EIA takes into consideration that the proposed offshore pipeline alignment is indicative and that the final pipeline alignment may be adjusted, as needs be, in order to avoid significant topographic features and sensitive benthic habitats.

The potential impact on the marine benthic environment and significance thereof is ultimately dependent on whether any vulnerable or sensitive benthic communities occur within the selected pipeline alignment. Similarly, the potential impact on cultural heritage material (e.g. historical shipwrecks) is dependent on whether any historical shipwrecks are located nearby. Thus in order to minimise the significance of these potential impacts, it is recommended that the final pipeline alignment be adjusted , as needs be, in order to avoid any significant topographic features, vulnerable habitats / species or historical shipwrecks.

9.1.4.4 Southern shore-crossing and associated pipeline alignments

A comparative assessment of the southern pipeline routes is presented in Table 9.4 below. Impacts for all these alternatives range from **INSIGNIFICANT** to **LOW – MEDIUM** with mitigation. Thus from an impact significance level perspective, all route alternatives are deemed feasible for implementation.

Table 9.4: Comparative assessment of the southern pipeline route impacts.

Environmental aspect		Southern pipeline routes				
		Grotto Bay	Silwerstroom Strand			Duyne-fontein
			North (Alt 1)	Central (Alt 2)	South (Alt 3)	
Biophysical	Disturbance of seabed	L	L	L	L	L
	Disturbance of coastal zone	INSIG	VL	VL	VL	VL
	Noise, vibrations and blasting	INSIG	VL	VL	VL	VL
	Vegetation	VL	L	L	L	L
	Terrestrial fauna	INSIG - VL	INSIG - VL	INSIG - VL	INSIG - VL	INSIG - VL
	Freshwater	INSIG	L - M	L - M	L - M	INSIG - VL
Socio-economic	Cultural heritage	L	L	L	L	L
	Visual	L	L	L	L	L
	Rock lobster sector	VL	INSIG	INSIG	INSIG	INSIG
	Farming	INSIG	INSIG	INSIG	INSIG	INSIG
	Tourism	VL	VL	VL	VL	INSIG
	Future land use	L	INSIG	INSIG	L	INSIG
Human health	Air quality	VL	VL	VL	VL	VL
	Risk	L	L	L	L	L

Lower significance ⇨ to ⇨ Higher significance			
INSIG	INSIG-VL to VL	L	L-M

There are, however, differences between the alternatives in terms of the length of the pipeline and extent of the impacts at a localised scale. Pipeline route lengths (and extent of indigenous vegetation clearance) from longest to shortest are as follows:

- Grotto Bay: ±26.0 km (47 ha)
- Silwerstroom Strand:
  - Alt 3: 17.3 km (34 ha)
  - Alt 1: 18.6 km (36 ha)
  - Alt 2: 19.4 km (38 ha)
- Duynefontein: ±13.9 km (28 ha)

The Duynefontein alternative, for most criteria, is considered to be the best alternative for the following reasons:

- it is the shortest onshore route and would result in the least disturbance to indigenous vegetation;
- it is located more than 200 m away from any residential areas;
- the coastal portion occurs within a restricted area; and
- the more simple installation method (i.e. trenching and bottom tow) could be used.

However, the key criterion that could be considered as a shortcoming of this alternative is that Eskom has expressed concerns relating to risk, possible pipeline failure and the safe operation of Koeberg Power Station. The proposed pipeline may change the power station's risk profile, which may require an amendment to the Koeberg Nuclear Emergency Plan.

If Eskom does not deem the Duynefontein alternative to be acceptable from a risk perspective, the Silwerstroom Strand pipeline alternatives are considered to be the next best option, although these alternatives would potentially result in a slightly higher freshwater impact. The reasons for Silwerstroom Strand being preferred over Grotto Bay are as follows:

- The pipelines would be shorter than the Grotto Bay alternative, resulting in the disturbance of between 9 ha to 13 ha less of indigenous vegetation;
- The societal risk at Silwerstroom Strand is expected to be a slightly lower, as the resort is not permanently used and at Grotto Bay the pipeline would be located approximately 40 m from an existing residential area at it closest point; and
- The Silwerstroom Strand alternative would require the more simple installation method (i.e. trenching and bottom tow), compared to Grotto Bay which would require the more complex horizontal directional drilling method.

Of the three Silwerstroom Strand alternatives, the northern alignment is preferred as it affects a smaller portion of the resort and avoids areas identified for possible future residential development on Farm Groote Springfontein to the south.

9.1.4.5 Northern shore-crossings and associated pipeline alignments

A comparative assessment of the northern pipeline routes is presented in Table 9.5 below. Impacts for all alternatives, with the exception of the Noordwesbaai West route, range from **INSIGNIFICANT** to **LOW-MEDIUM** with mitigation. Thus from an impact significance level perspective, the St Helena West, St Helena East and Noordwesbaai East route alternatives are all deemed feasible for implementation. The Noordwesbaai West route, which passes through an additional CBA close to the coast, is not considered feasible for implementation.

Table 9.5: Comparative assessment of the northern pipeline route impacts.

Environmental aspect		Northern pipeline routes			
		St Helena West	St Helena East	Noordwesbaai	
				West	East
Biophysical	Disturbance of seabed	L	L	L	L
	Disturbance of coastal zone	VL	VL	VL	VL
	Noise, vibrations and blasting	L	L	L	L
	Vegetation	VL	L	M	VL
	Terrestrial fauna	INSIG - VL	INSIG - VL	INSIG - VL	INSIG - VL
	Freshwater	VL	INSIG	VL	VL
Socio-economic	Cultural heritage	L	L	L	L
	Visual	L	L	L	L
	Rock lobster	INSIG	INSIG	VL	VL
	Farming	VL	VL	VL	VL
	Tourism	INSIG	INSIG	INSIG - VL	INSIG - VL
	Future land use	L-M	L-M	L-M	L-M
Human health	Air quality	VL	VL	VL	VL
	Risk	L	L	L	L

Lower significance ⇨		to	⇨ Higher significance	
INSIG	INSIG-VL to VL	L	L-M	M

The key difference between the St Helena West, St Helena East and Noordwesbaai East alternatives relates to the extent of clearance of indigenous vegetation. The estimates loss of indigenous vegetation for these alternatives is as follows:

- Noordwesbaai East: 11 ha
- St Helena East: 4 ha
- St Helena West: 3 ha

The St Helena alternatives are preferred over the Noordwesbaai East alternative for the following reasons:

- They would result in significantly less clearance of indigenous vegetation;
- There is no or limited access to the coast, resulting in few possible visitors / tourists in close proximity to the pipeline;
- Existing farming practices and a possible future wind farm could continue after pipeline installation; and
- There would be no impact on future residential development.

Of the two St Helena alternatives, the eastern alignment is preferred as it avoids the early fish trap located in the vicinity of St Helena West.

9.1.4.6 Onshore gas receiving facility

The alternative facility sites located adjacent to Ankerlig are in general deemed to be less sensitive than the sites adjacent to the Silwerstroom Strand Water Treatment Plant, specifically with regard to vegetation, freshwater and visual impacts (see Table 9.6). The Ankerlig sites are located within an existing industrial area and the vegetation has already been heavily impacted by disturbance and the invasion by alien invasive species. The Ankerlig sites also have a greater visual absorption capacity, due to their location adjacent to an existing power station, resulting in a lower visual impact. The Silwerstroom Strand sites are also located in a relatively sensitive area in terms of ground and surface water interaction.

The finding of this assessment is that the Ankerlig sites are the preferred sites. The implication of this, however, is that the onshore pipeline would operate at a higher pressure for the majority of its length. The risk assessment has, however, classified the risk associated with all pipeline routes, operating at the higher pressure, as a “trivial risk” and concluded that there are no fatal flaws that could prevent the project proceeding.

Table 9.6: Comparative assessment of the onshore facility site impacts.

Environmental aspect		Onshore facility			
		Ankerlig		Silwerstroom Strand	
		1a	1b	2a	2b
Biophysical	Vegetation	M	M	H	H
	Terrestrial fauna	INSIG - VL	INSIG - VL	INSIG - VL	INSIG - VL
	Freshwater	L	VL	L - M	L - M
Socio-economic	Cultural heritage	L	L	L	L
	Visual	L	L	M	M
	Future land use	INSIG	INSIG	L	L
Human health	Air quality	L	L	L	L
	Risk	L	L	L	L

Lower significance ⇨		to ⇨		Higher significance	
INSIG	INSIG-VL to VL	L	L-M	M	H

9.1.4.7 No-go alternative

As the original NEMA and MPRDA approvals are still in place, the no-go alternative could on one hand relate to the implementation of the original project proposal, i.e. two subsea production pipelines to an onshore gas processing facility on the Northern Cape coast. The impacts associated with this alternative were assessed as part of the original S&EIA undertaken by Forest.

Alternatively, the no-go alternative could be the option of not proceeding with the proposed gas field development project in any form. In this case, the residual impacts (i.e. impacts after implementation of mitigation measures) of the proposed activities would not occur. The implications of not going ahead with the proposed project are as follows:
- South Africa would lose the opportunity to establish the extent of indigenous oil / gas reserves on the West Coast;
- South Africa would lose the opportunity to maximise the use of its own indigenous oil and gas reserves, and create an oil and gas industry on the West Coast;
- There would be lost economic opportunities related to sunken costs (i.e. costs already incurred by Sunbird) of exploration in the licence area;
- Ankerlig would continue to operate using diesel, which is an expensive and inefficient operation. Thus there would be a lost opportunity to lower energy costs;
- There would also be a lost opportunity to improve energy security and diversify the country's energy mix; and
- South Africa would continue to rely on coal to meet almost 90% of its energy needs. Thus there would be a lost opportunity to generate a "cleaner" energy, which could have significance benefits for the regional and South Africa as a whole.

9.1.5 RECOMMENDATION / OPINION OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

The key principles of sustainability, including ecological integrity, economic efficiency, and equity and social justice, are integrated below as part of the supporting rationale for recommending an opinion on whether the proposed project should be approved.

- Ecological integrity

  The disturbance of benthic communities that would result from the offshore project components is considered negligible in relation to the available area of similar habitat on and off the edge of the continental shelf in the Atlantic Offshore Bioregion, which is classified as Least Threatened. In addition, the impact is localised and short-term with recovery expected within two to five years, (assuming as recommended the avoidance of rock outcrops / reefs). The impact associated with pipeline installation should be weighed up against the potential biophysical benefits that may result from the presence of the pipeline on the seabed, which could be colonised by vulnerable / sensitive benthic species.

  Although the southern pipeline routes would result in the clearance of Endangered and Critically Endangered vegetation, which have been largely mapped as CBAs, it is not possible to avoid these sensitive areas between the coast and Ankerlig. Since the pipeline would be buried, it would allow the majority of the pipeline servitude to be rehabilitated after installation. Successful rehabilitation is deemed to be achievable based on the success of the revegetation along the existing Chevron pipeline. The northern pipeline routes have been aligned to cross mainly farmland and largely avoid indigenous vegetation.

The conversion of Ankerlig from diesel to gas would reduce carbon emissions. Currently South Africa relies on coal to meet almost 90% of its energy needs. The generation of “clean” energy could have significance benefits for the regional and South Africa as a whole.

In summary, the proposed project would result in the loss of some ecological integrity in the study area, which with successful rehabilitation in case of the onshore pipeline would ensure that this loss is minimal. At the same time the proposed project would have a positive contribution to air quality.

- Economic efficiency

  Due to the size of the project there is no reason to believe that the proposed project would have any significant positive or negative macro-economic consequences for the economy. It is also not known whether the project would generate a net inflow of foreign funds, as it is not known if funds would be sourced locally or internationally. On a regional level the proposed project is in line with the planning frameworks for the region and the development of the gas industry in the Western Cape. It would also improve energy security and would diversify the country’s energy mix, with added benefit to Eskom in the form of lower energy costs.

  Since the onshore pipeline would be buried visual, current land use (e.g. farming) and tourism impacts would be limited. Future development would, however, need to take cognisance the pipeline location and may require an appropriate physical separation depending on the nature of any other proposed activities.

  During operation, the offshore production pipeline would only affect those sectors that have gear that comes into contact with the seafloor (namely demersal trawl, demersal long-line and West Coast rock lobster). After decommissioning, however, it is only the demersal trawl sector, which generally operates offshore of the proposed offshore pipeline route, that would be affected as the other two sectors would be able to fish over the abandoned pipeline.

  The proposed development would stimulate direct and indirect employment opportunities over its duration, as well as result in skills and SMMEs being developed in the study area. Although the proposed project would be a relatively small employer, any job opportunities would undoubtedly have a positive impact in the project area.

  The proposed project is considered to be economically efficient, as it fits in with the development plan for the region and the development of a gas industry, improves energy security and diversifies the country’s energy mix. The proposed project would also result in the Ankerlig Power Station operating on indigenous gas rather than diesel (refined from imported crude oil), which would be more cost effective. The proposed project could also provide opportunities for other industries to use the gas for operational activities, especially in the Saldanha area.

- Equity and social justice

  The proposed project would not unfairly discriminate, directly or indirectly, against any one party nor result in an unequal distribution of negative impacts.

It is the opinion of CCA that in terms of the sustainability criteria described above there is no reason why the proposed project should not receive a favourable decision with implementation of the proposed mitigation measures.

9.2 RECOMMENDATIONS

9.2.1 RECOMMENDATIONS TO MITIGATE BIOPHYSICAL IMPACTS

9.2.1.1 Production pipeline

(a) Pipeline alignment

- A pre-installation site survey (using a ROV or similar device) should be undertaken along the entire pipeline route in order to confirm the presence or absence of any significant topographic features (e.g. rocky outcrops) and potential vulnerable deep water habitats (e.g. deep water reefs, vulnerable sponge fields and sea pen populations). The final pipeline alignment should, as far as practically possible, be adjusted to avoid any identified sensitive benthic habitats (see Figure 4.9, 4.10 and 4.14);
- As far as is reasonably possible, the final pipeline alignment (including associated construction area) and onshore facility should be located at least 30 m outside of the delineated edge of any significant freshwater features. Where the pipeline route crosses streams or drainage lines, it should be aligned perpendicular to the watercourse in order to minimise the area of disturbance; and
- Any measures required to protect the pipeline below the ground should, as far as possible, be designed so as not to impede any subsurface flow that may exist.

(b) Pipeline installation

- As far as practically possible and where the geology allows it, the horizontal directional drilling method should be the preferred installation option. Although this method may only be suitable at Grotto Bay, it is recommended that a detailed geotechnical site investigation be undertaken to determine the possibility of using horizontal directional drilling at either St Helena Bay or Silwerstroom Strand where there is a rocky intertidal zone or potentially shallow bedrock beneath the sand;
- Blasting recommendations:
  - The blasting programme should be scheduled so as to avoid cetacean migration periods or winter breeding concentrations (beginning of June to end of November). In addition, the summer breeding season of shore birds (primarily oystercatchers, gulls and terns) should also, where possible, be avoided.
  - The number of blasts should be restricted to the absolute minimum required and to smaller, quick succession blasts directed into the rock using a time-delay detonation;
  - All blasting activities should be conducted in accordance with recognised standards and safety requirements;
  - Pre-blast surveys should be undertaken to ensure the impact zone is clear of marine mammals and diving seabirds (large flocks) and only once the impact zone and an associated buffer zone (i.e. within a 2-km radius of blasting point) have been declared free of marine mammals and diving seabirds should blasting commence. It is also recommended that:
    - Observer teams are stationed some distances to the north and south of the blasting point (possibly just outside the impact zones) to monitor coastal dolphin movements immediately prior to any blasting. Observers are to be positioned at suitable vantage points (at some altitude) along the coast; and
    - Observers on land should record and report all sensitive fauna, their positions, occurrence of calves and direction of movement to the Operations Manager.
  - PAM should be considered to detect the presence of small cetaceans in the impact area prior to blasting. Such acoustic monitoring would support that undertaken visually from the land, and has the advantage monitoring during periods of poor visibility; and
  - As a blasting event may attract seals and scavenging birds to stunned or dead fish, the blasting programme should be scheduled to allow seals to leave the area before the next blasts commences; and
- Excavations should be backfilled, as soon as practically possible, in order to avoid keeping long sections of trench open for extended periods.

9.2.1.2 Production facility

(a) Production facility location

- A ROV (or similar device) should be used to survey the seafloor prior to platform installation in order to confirm the presence or absence of any significant topographic features, vulnerable habitats and / or species within the anchor spread area. The position of the facility should, as far as practically possible, be adjusted to avoid any identified sensitive benthic habitats and species.

(b) Lighting

- Light shielding should be implemented;
- Non-essential lighting should be minimised on all platforms to reduce nocturnal attraction. However, such measure should not undermine work safety aspects or concerns; and
- A monitoring programme of faunal attraction should be implemented where all seabird mortalities are logged.

(c) Normal discharges to sea

- Develop a waste management plan using waste hierarchy;
- Ensure compliance with MARPOL 73/78 standards;
- Deck drainage should be routed to a separate drainage system (oily water catchment system) for treatment to ensure compliance with MARPOL (15 ppm);
- All process areas should be bunded to ensure drainage water flows into the closed drainage system;
- Drip trays should be used to collect run-off from equipment that is not contained within a bunded area and the contents routed to the closed drainage system;
- Low-toxicity biodegradable detergents should be used in the cleaning of all deck spillages;
- All hydraulic systems should be adequately maintained and hydraulic hoses should be frequently inspected; and
- Spill management training and awareness should be provided to crew members of the need for thorough cleaning-up of any spillages immediately after they occur in order to minimise the volume of contaminants washing off decks.

(d) Accidental release of oil

- A project-specific oil spill contingency plan must be prepared and be in place at all times during operation. The oil spill contingency plan should include or address, but not be limited to, the following:
  - > Alert procedure;
  - > Initial / immediate actions;
  - > Oil Spill Response Options / Strategies;
  - > Roles and responsibilities (including Emergency Directory);
  - > Response Actions;
  - > Response termination procedure;
  - > Oil Spill Modelling Report;
  - > Oil Spill Risk Assessment (environmental sensitivities and priorities for protection);
  - > Oil Spill Response Equipment Inventory;
  - > Response technical guidelines and limitations;
  - > Response equipment and maintenance / Inspection plan;
  - > Facilities (including specification) and products (including MSDS manual); and
  - > Drills and training.
- A Shipboard Oil Pollution Emergency Plan (SOPEP) must be prepared for all support vessels and be in place at all times during operation;
- Training and exercise programmes must be established to ensure that the response activity can be effectively executed; and

- Onboard spill equipment and spill containment materials must be in place, maintained and positioned in clearly identified locations.

9.2.1.3 General construction-related recommendations

Construction activities would be managed through the effective implementation of an Environmental Management Programme (EMP) (see Appendix 5 of the main report). The EMP sets environmental targets for Sunbird and its Contractors and reasonable standards against which their performance can be measured during each of the project life cycle phases (design, construction, operation and decommissioning).

The mitigation measures provided below were specifically raised by specialists and these have been included in the project-specific EMP.

(a) Permits

- A Coastal Water Discharge Permit or a General Discharge Authorisation must be obtained from DEA (Coastal Pollution Management) prior to discharging the hydrotest water;
- A vehicle access permit must be obtained from DEA (Branch Oceans and Coasts) prior driving in the coastal zone; and
- A permit must be obtained from prior to clearing or disturbing indigenous vegetation.

(b) Construction timing

- Construction in or adjacent to freshwater features should take place during a period of low flow (summer).

(c) Environmental Awareness

- A comprehensive Environmental Awareness Programme must be conducted amongst construction personnel.

(d) Site demarcation and clearing

- The ‘working zone’ should be kept to a minimum and no arbitrary movement of vehicles through the coastal zone, undisturbed vegetation and wetlands should be permitted. Once the pipeline alignment is finalised and the associated construction site is determined, the area located outside of the site should be clearly demarcated and regarded as a ‘no-go’ area;
- Construction vehicles should be restricted to clearly demarcated access routes and construction areas within the coastal zone. These areas should be defined in consultation with a marine / coastal ecologist;
- A ‘Search and Rescue’ operation (mainly for geophytes) should be undertaken in the CBAs along the Noordwesbaai alternative (see Figure 5.13);
- Topsoil management:
    - Topsoil (top 300 – 400 mm) should be removed from areas to be disturbed along the entire pipeline servitude, including temporary activities such as storage and stockpiling, and stockpiled separately from the subsoil for rehabilitation purposes to ensure there is no contamination;
    - Stockpiles should be demarcated to minimise the risk of disturbance and contamination;
    - Stockpiles should not be compacted;
    - Stockpiles should be monitored regularly to identify any alien invasive plants, which should be removed when they germinate to prevent contamination of the seed bank;
    - Stockpiling should be for as short a period as possible. Thus topsoil should be replaced as the excavation and pipeline installation work progresses; and
    - Topsoil should be replaced after the subsoil has been replaced and compacted.

- Every effort should be made to save and relocate any amphibian, reptile, bird or mammal that cannot flee of its own accord, encountered during site preparation. In addition, excavations should be inspected for trapped animals every morning. Any animal encountered that cannot safely exit by its own accord should be removed to a suitable area immediately outside the construction footprint in a similar faunal habitat.

(e) Material and handling and maintenance

- All materials near watercourses must be properly stored and contained;
- Where reasonably practical, maintenance activities shall only be undertaken in a demarcated maintenance area above the high water mark;
- All vehicles and equipment should be kept in good working order and serviced regularly to ensure no there are no oils, diesel, fuel or hydraulic fluid leaks; and
- The Contractor shall ensure that there is always a supply of absorbent material (spill kit) readily available to absorb / breakdown spills. The quantity of such materials shall be able to handle the total volume of the hydrocarbon / hazardous substance stored on site.

(f) Toilets

- Ablution facilities must be located at least 30 m away from the river systems and wetland areas.

(g Concrete batching

- No concrete should be mixed in the intertidal zone or directly on the ground.

(h) Waste management

- Good house-keeping should form an integral part of the construction operations;
- Discharges from pipe-lay vessel should comply with MARPOL 73/78 standards;
- Contaminated runoff from construction areas should, where possible, be prevented from directly entering rivers / streams. Measures may include the use of sandbags, leaving a “natural berm” between a river and the excavation for as long as possible, cut-off trenches, straw bales or geofabric siltation barriers;
- No waste should be burnt or buried on site;
- Spilled concrete should be cleaned up on a regular basis;
- All rubble associated with construction activities should be removed after construction; and
- All artificial constructions or beach modifications (e.g. cofferdam, jetty or groin) must be removed after pipeline installation.

(i) Rehabilitation

- Any substantial sediment accumulations and stockpiles should be reshaped back as close to the original profile as possible;
- Laydown areas should be scarified to a depth of 100 mm to break up any compacted soil prior to topsoil replacement. This may, however, not be necessary in very sandy areas or where hard calcrete is found at the surface; and
- Seed, collected from adjacent areas in the same vegetation type, may be used during rehabilitation. However, no ‘foreign-sourced’ seed should be introduced, e.g. during hydroseeding.

9.2.2 RECOMMENDATIONS TO MITIGATE SOCIO-ECONOMIC IMPACTS

9.2.2.1 Production pipeline alignment

- A detailed geotechnical site investigation should be undertaken. If any shipwreck material or unexplained seabed anomalies are discovered during this detailed survey, the final position of the pipeline should be adjusted to avoid such features;
- Final design should, where possible, take the following into consideration:
  - > Natural rock gullies and low points of dunes should be preferred for pipeline alignment;
  - > Damage to exposed rock outcrops and blasting should be minimised;
  - > Stream and wetland areas should be avoided; and
  - > Access and haul roads should follow existing roads and firebreaks as far as possible.
- Sunbird should engage with adjacent offshore right holders to discuss the final pipeline alignment in order to reduce the risk of interference with anticipated future prospecting / exploration or mining / production operations. Sunbird should also engage with Mainstream Renewable Power to discuss the final alignment of the St Helena West and East alternatives in order to reduce the risk of interference with their proposed renewable energy project on Farm Nooitgedacht (specifically the location of wind turbines); and
- The offshore portion of the pipeline must be surveyed and accurately recorded on the South African Navy Hydrographic charts.

9.2.2.2 Onshore gas receiving facility design

- Final design of the gas receiving facility should, where possible, take the following into consideration:
  - > Silwerstroom Strand alternatives:
    - Stream and wetland areas near the waste treatment facility should be avoided;
    - A planted earth berm (approximately 6 m) should be constructed to screen the facility from the resort, based on an approved landscape plan;
    - Earthy colours should be used to blend the structures with the natural surroundings; and
    - Outdoor lighting should be minimised. Low-level lighting and fit reflectors should preferably be used to avoid light spillage.
  - > Ankerlig alternatives:
    - Development should be set back from main routes to allow for planted buffer strip;
    - A planted earth berm (approximately 3 m) should be constructed along Dassenberg Road and Charel Uys Drive;
    - Appropriate colours should be used to blend structures with the existing power station; and
    - Reflectors should be fitted to avoid light spillage.
- Parking should be located under shade structures or shade trees;
- Wire mesh fencing with a dark green or black finish should be used. Palisade-type fencing with timber or metal pales, or repetitive brick piers, should be avoided; and
- External signage should be confined to the entrance gate and signs intruding on the skyline should be avoided. Signage should be grouped and limited in size (<2 m^2).

9.2.2.3 Social recommendations

(a) Employment and skills development

- Sunbird should promote jobs that are to be made available locally in advance in order to allow educational facilities and development agencies to develop or facilitate the development of more highly skilled and technical training;

- Initiatives such as the Atlantis Industrial Initiative should be utilised to understand the skills profiles of local communities and to match them with possible employment;
- A proactive and comprehensive skills development programme should be implemented during the pre-construction phase of the proposed project and should focus on developing direct and indirect skills and capacity in the local communities, so as to ensure that a high level of local content in resources, goods and services procurement is achieved over an extended period of time;
- Sunbird should work closely with industry organisations (e.g. SAOGA) to identify relevant business development and educational institutions with which to work;
- Sunbird should promote skills development, local content and beneficiation in their project policies; and
- Skills development should focus on developing skills in previously disadvantaged groups.

(b) Income and related economic dependency

- Sunbird should aim for as high a level of local content as possible during all project phases; and
- Sunbird should develop a parallel economies programme in the development of its skills development programme, which considers alternate or replacement economic activities after gas field closure.

(c) Gender balance

- Sunbird should proceed with a gender equity programme. The previous operator established a gender-based equity target of 10% and it is recommended that Sunbird target a similar level; and
- Sunbird should work closely with industry organisations (e.g. Women in Oil and Energy South Africa) to achieve their gender equity target.

(d) In-migration

- The number of jobs available should be effectively communicated to all potential job seekers and procurement policies and procedures should be implemented in order to manage in-migration and to ensure that local cultures are not marginalised; and
- Sunbird should use reputable labour brokers.

9.2.2.4 Economic-related recommendations

- Landowners should be compensated for any lost crops, exclusion, etc. as required by law;
- Agricultural land should be rehabilitated in consultation with the landowner; and
- Damaged facilities should be reconstructed / repaired.

9.2.2.5 General construction-related recommendations

As noted in Section 9.2.1.3, construction activities would be managed through the effective implementation of an EMP (see Appendix 5). The mitigation measures provided below were specifically raised by specialists and these have been included in the project-specific EMP.

(a) Permits

- If it is not technically feasible to avoid cultural heritage sites / material (including historical shipwrecks, early fish traps, shell middens, etc.), a heritage permit must be obtained from SAHRA (for offshore sites / material) or HWC (for onshore sites / material) in order to disturb such sites / material.

(b) Notification and communication with key stakeholders

- Sunbird should engage timeously with all affected onshore landowners to discuss the scheduling of proposed pipeline installation in order to reduce the interference with farming activities (e.g. sowing, harvesting, etc.). Where possible, pipeline installation should be scheduled at a time that least interferes with farming practices;

- Prior to offshore pipeline installation the following key stakeholders should be consulted and informed of the installation programme (including navigational co-ordinates of production facility and pipeline, timing and duration of proposed activities) and the likely implications thereof (specifically the 500 m safety / exclusion zone around the pipe-lay vessel, production platform and subsea pipeline):
  - Fishing industry / associations: South African Tuna Long-line Association, South African Deep-sea Trawling Industry Association, South African Tuna Association, Fresh Tuna Exporters Association, South African Commercial Linefish Association, West Coast and Peninsula Commercial Skiboat Association, and South African West Coast Rock Lobster Association; and
  - Other key stakeholders: DAFF, DEA, PASA, Transnet National Ports Authority (ports of Cape Town and Saldanha Bay), SAMSA, South African Navy Hydrographic office and adjacent prospecting / exploration right holders.

  These stakeholders should again be notified when installation activities are complete and the pipe-laying vessel is off location;
- Sunbird must request, in writing, the South African Navy Hydrographic office to release Radio Navigation Warnings and Notices to Mariners throughout the pipeline installation period. The Notice to Mariners should give notice of (1) the co-ordinates of the pipeline alignment, (2) an indication of the proposed installation timeframes, and (3) an indication of the 500 m safety zone around the pipe-ley vessel. These Notices to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible;
- Any fishing vessels located at a radar range of 12 nm from the pipe-laying vessel should be called via radio and informed of the navigational safety requirements; and
- Any dispute arising with adjacent prospecting / exploration or mining / production right holders should be referred to the Department of Mineral Resources and / or PASA for resolution.

(c) Construction timing

- Construction in or adjacent to freshwater features should take place during a period of low flow (summer); and
- Construction during the peak holiday/tourism season (Dec-Jan) should be avoided, especially at Grotto Bay, Silwerstroomstrand and Noordwesbaai.

(d) Heritage sites / material

- While continuous monitoring of pipeline excavation for palaeontological and archaeological material is not considered necessary for the entire pipeline route, it is recommended that the first 500 m from the coast be monitored by an archaeologist, where after spot checks should be carried out once every two weeks; and
- Should any human remains be disturbed, exposed or uncovered during excavation, these must immediately be reported the South African Police Service and, if suspected that the remains are older than 60 years, HWC.

9.2.3 RECOMMENDATIONS TO MITIGATE HUMAN HEALTH IMPACTS

9.2.3.1 Air quality

(a) General construction-related recommendations

- Vegetation clearing should, where possible, take place in a phased manner in order to retain vegetation cover for as long as possible;
- A dust control programme (e.g. water sprays) should be implemented to maintain a safe working environment, minimise nuisance for surrounding residential areas / dwellings and protect damage to

natural vegetation, crops, etc. Exposed areas and material stockpiles should be adequately protected against the wind (e.g. wetting exposed soil / gravel areas during windy conditions, covering of material stockpiles, etc.);

- Hauling distances should be minimised; and
- Subsoil and topsoil should be stockpiled for as short a period as possible. Thus subsoil and topsoil should be replaced as the excavation and pipeline installation work progresses forward.

(b) Air quality monitoring

- A relatively short monitoring campaign (three months) should be undertaken using passive diffusive sampling methods to establish the trend in NO_2 and SO_2 air concentrations during operation. The proposed sampler locations are shown in Figures 8.3 (Ankerlig sites) and 8.4 (Silwerstroom Strand sites).

9.2.3.2 Risk

(a) Design

All designs should be in full compliance (but not necessarily limited) with the Occupational Health and Safety Act, 1993 (No. 85 of 1993) and its regulations, the National Buildings Regulations and the Buildings Standards Act, 1977 (No. 107 of 1977) as well as local bylaws. The following design considerations are recommended:

- The minimum pipeline depth should be 1.2 m (i.e. soil cover over the top of the pipeline), unless rock prevents this depth. Under these circumstances, the American Society of Mechanical Engineers (ASME) 31.8 code should be followed;
- Pipeline alternatives:
  - > The location of the pipeline adjacent to the Chevron servitude should have a minimum separation distance of 0.75 m from the servitude boundary;
  - > The portion of the Grotto Bay pipeline route adjacent to the Grotto Bay residential area should have a design factor of at least 0.5 or lower (which would require thicker pipe walls) to ensure that the proposed pipeline would be suitable for Class 2 (design factor = 0.5) or Class 3 (design factor = 0.4), as defined by the ASME 31 code; and
  - > Similarly, in anticipation of possible future development at or adjacent to Silwerstroom Strand, it is recommended to implement a design factor of at least 0.5 or lower.
- Surface Markers:
  - > Conspicuous concrete surface markers (or similar) should be erected along the onshore pipeline. These markers should be within visible distance of one another or when there is a change in direction;
  - > The marker should state at least the following on a background of sharply contrasting colours:
    - The word "Warning", "Caution" or "Danger" followed by the words "Natural Gas Pipeline". All letters should be at least 30 mm high with an approximate stroke of 10 mm;
    - The name of the operator and a telephone number (including area code) where the operator can be reached at all times; and
    - All information on markers should be in English and a local language of preference.
- Since the proposed pipeline would be considered a Major Hazard Installation (MHI), it is recommended that the risk assessment be reviewed and reassessed where necessary, with “as-built” engineering information. In preparation thereof, the following provisions are made:
  - > A recognised process hazard analysis (HAZOP, FMEA, etc.) should be completed for the proposed option prior to construction;
  - > A safety document detailing safety and design features reducing the impacts from fires, explosions and flammable atmospheres should be prepared. The built facility can then be audited against the safety document to ensure compliance;

  - The risk assessment should be verified after completion of the final designs and layout, but prior to construction; and
  - Emergency response documentation should be finalised with input from local authorities.

(b) Operation

- Early detection and leak detection:
  - A regular visual survey of the pipeline servitude should be implemented, so as to be aware of all activities taking place in the vicinity of this servitude. This would provide an early warning of risky activities (e.g. unauthorised excavations in servitude) and preventative risk management actions can be implemented timeously;
  - An effective leak detection programme should be developed to ensure that leaks are identified; and
  - The following cathodic protection monitoring procedures are recommended:
    - Monthly checks should be undertaken on the condition and performance of the transformer rectifier units supplying cathodic protection to the pipeline;
    - Every six months, 24-hour continuous electro-potential recordings should be taken at appropriate intervals along the line to ascertain the adequacy of the cathodic protection;
    - Checks on the corrosion rate using corrosion coupons and corrosometer probes at the terminal end of the line should performed on an annual basis; and
    - If and where there are indications that the cathodic protection is inadequate, continuous over line surveys should be carried out to detect any breaks in the coating and to have a closer inspection of the levels of cathodic protection over the suspect parts of the pipeline. Direct Current (DC) Voltage Gradient and Close Interval Potential survey techniques should be used.
- Operating procedures:
  - Operating procedures should emphasise the need to eliminate gas from the pipelines after commissioning, maintenance or launcher opening. Failure to degas the lines prior to commissioning would increase the risk of gasket leak or line failure;
  - Predictive maintenance should be scheduled for the maintenance of emergency shutoff and isolation valves;
  - A formal planned maintenance programme, including pig launchers/receivers, should be adhered to;
  - Operating procedures should highlight the risks associated with pigs becoming stuck, due to incorrect line-up/incompletely opened valves. It is recommended that a pig register be implemented; and
  - Pig position indicators should be maintained in an operating condition.
- Emergency Planning:
  - The local Disaster Management Plans must be updated with the Emergency Response Plan specifically developed for the pipeline;
  - Regular exercise of the Emergency Response Plan should be implemented; and
  - The Emergency Response Plan must contain the most recent information on responsible persons and contact details.

(c) Authority awareness

- The contents of the risk assessment should be communicated with the relevant authorities to ensure awareness of, and control over, future developments near the pipeline servitude. There should be appropriate physical separation between future development and the pipeline in order to reduce the probabilities and the consequences of incidents; and
- A programme of regular (e.g. annual) communication with the local authorities should be considered to ensure an ongoing awareness of pipeline servitude risks.

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