5 PROJECT ALTERNATIVES

5.1 Introduction

The consideration of alternatives ***in a project*** is a key requirement of an EIA as it provides a basis for choice for the competent authority and I&APs. The NEMA EIA Regulations of 2006 define alternatives in relation to a proposed activity as "*different means of meeting the general purpose and requirements of the activity, which may include alternatives to the –*

(a) property on which or location where it is proposed to undertake the activity;

(b) type of activity to be undertaken;

(c) design or layout of the activity;

(d) technology to be used in the activity; and

(e) operational aspects of the activity;"

Alternatives are considered as a means of reaching the same need and purpose as the originally proposed project ***design*** in a way that minimises its negative and maximises its positive impacts. Alternatives that are considered must be reasonable and feasible.

This section describes the alternatives that have been considered during the EIA process. These include the following:

- Location of the power station;
- Forms of power generation;
- Nuclear plant types;
- Layout of the nuclear plant;
- Fresh water supply and utilisation of abstracted groundwater;
- Management of brine;
- Intake of sea water;
- Outlet of water and chemical effluent;
- Management of spoil material;
- Access to the proposed sites; and
- The no-development alternative (i.e. 'No-Go').

The alternatives that have been considered are ***briefly listed*** in this Chapter. An assessment of the ***potential impacts of the*** alternatives and recommendations on the preferred alternatives, based on the assessment of impacts undertaken by the specialists, is contained in Chapter 9 of this ***Revised Draft*** EIR.

5.2 Location of the Nuclear Power Station

The consideration of alternative locations for the proposed Nuclear-1 power station was derived from the findings of the Nuclear Site Investigation Programme (NSIP) study undertaken by independent consultants during the 1980s and the findings of the Scoping Phase of this EIA process. Details pertaining to the above-mentioned studies are briefly discussed below. This section also outlines the response of the Department of Environmental Affairs (DEA) to the recommendations made in the Scoping Report. Thereafter, the sites considered as feasible and reasonable alternative locations for the proposed power station are discussed further.

5.2.1 The outcome of the NSIP undertaken during the 1980s

The Scoping Phase of the EIA process ***described and discussed*** the NSIP, commissioned by Eskom and aimed at identifying the most suitable sites for location of nuclear power stations in South Africa. The NSIP included a wide range of specialist studies, such as engineering, social science, geology, ecology and town planning. ***The environmental portion of the work was undertaken by the Environmental Evaluation Unit of the University of Cape Town, Port Elizabeth and Rhodes.***

The primary objective of the NSIP was to identify sites along the coastline of South Africa, suitable for the construction and operation of future nuclear power stations. The NSIP comprised of three phases: Phases 1 and 2 involved desktop studies, which assessed the general suitability of regions located along the coast. Subsequent to this, specific sites within the identified regions were earmarked for further detailed investigations. Phase 3 involved field investigations of those sites, identified during the preceding phases, by various specialists. Field investigations were undertaken in order to determine the suitability and sensitivity of the sites identified and culminated in the identification of five suitable sites, namely:

- Brazil (Northern Cape);
- Schulpfontein (Northern Cape);
- Duynefontein (Western Cape);
- Bantamsklip (Western Cape); and
- Thyspunt (Eastern Cape).

At the commencement of the Scoping Phase of the EIA, GIBB started with these five sites and reviewed the NSIP summary reports as provided by Eskom to confirm the continuing validity of the sites as feasible and reasonable alternatives for the Nuclear-1 EIA and requiring further specialist investigation.. The five sites were taken forward as the starting point in the Scoping processes. The EIA specialists undertook baseline investigations and reviewed all previous work undertaken at and in the vicinity of the sites, including the NSIP studies. At the start of the Scoping Phase all five of the alternative sites were considered reasonable and feasible alternatives for Nuclear-1.

5.2.2 The outcome of the Scoping Phase of the EIA process

The EIA team, comprising the lead consultants and specialists, undertook site visits to each of the five sites in order to obtain an overview of the potential environmental risks and key impacts associated with the proposed Nuclear-1. Risks and key impacts associated with the construction, operational and decommissioning phases were identified and addressed in consultation with I&APs. Potential negative impacts identified during the Scoping Phase included the following:

- Geological and geotechnical suitability;
- Depth of water table and associated dewatering requirements as well as the repercussions in terms of surrounding water users;
- Source of water supply for operations of Nuclear-1;
- Disturbance and disruption of terrestrial ecological processes such as loss of habitat and associated flora and fauna. The disruption of faunal migration patterns between the coast and inland as well as mobile dunes;
- Marine ecology disturbance through requirements for cooling water, the potential for desalination and activities associated with the disposal of brine;
- Health, safety and security of the site as well as limitations on surrounding land use;
- Changes to community structures through the influx of workers and associated infrastructural requirements;
- Change in tourism activities;
- Visual disturbance;
- Loss of heritage and cultural resources;
- Loss of potential agricultural land;
- Wind generated dust;

- Construction of required facilities and infrastructure associated with accessibility to the site, transport as well as the integration of the generated power into the networks;
- Security; and
- Waste handling and management.

The power generated by any technology must be integrated into the existing networks in an efficient and strategic manner. There are two primary aspects pertaining to the integration of power, namely integration into the national grid, and exportation of the excess power to areas outside of the local network. Integration of the power on a local level, to supply the local area network requires a number of transmission lines, either 400 kV or 750 kV, linking into the main load substations or transmission nodes. The export of power requires either the development of new transmission line corridors or the utilisation of existing corridors through the necessary reinforcements.

The investigation undertaken during the Scoping Phase highlighted that the Brazil and Schulpfontein sites would require:

- construction of extensive power corridors; and
- export of the majority of the power to areas of demand, given the limited local demand.

In light of the above and for the reasons outlined below, the Brazil and Schulpfontein sites were deemed unsuitable for Nuclear-1 and were therefore excluded from further assessment during this EIA.

Reasons for the exclusion of Brazil and Schulpfontein were as follows:

- Optimal, strategic and cost effective utilisation of existing infrastructure associated with the Duynefontein, Bantamsklip and Thyspunt sites, with respect to the local integration and exportation of power via existing power corridors;
- Lengthy time delays associated with the authorisation and construction of the new power corridors applicable to the Northern Cape sites, which will prevent Eskom from providing power within the required timeframes;
- Unnecessary environmental impacts associated with the construction of new power corridors given that there is existing infrastructure at the other three potential sites; and
- Cost implications associated with the development of new power corridors at the present time.

Despite Brazil and Schulpfontein's proposed exclusion from the EIA Phase for Nuclear-1, this does not preclude these sites from ***possible*** consideration in the future. The three site alternatives taken forward for further assessment in the EIA Phase of this project are Duynefontein, Bantamsklip and Thyspunt (**Figure 5-1**).

5.2.3 DEA's response to the proposed exclusion of Brazil and Schulpfontein

The then DEAT provided a formal response to the Nuclear-1 Scoping Report and Plan of Study for EIA on 20 November 2008 (**Appendix B2**). DEAT approved the proposed exclusion of the Brazil and Schulpfontein sites for the purposes of the Nuclear-1 EIA and acknowledged that these sites may, however, be subject to future investigations for future nuclear power generation developments. ***The approach of basing the alternative sites on those identified in the NSIP was also approved by the DEA.***

Figure 5-1: Three sites (Duynefontein, Thyspunt and Bantamsklip) deemed suitable for further consideration in the EIA Phase

5.2.4 Sites identified for detailed assessment in the EIA Phase

The following section provides a brief description of the three sites deemed suitable for further consideration in the EIA Phase of the EIA process.

(a) Duynefontein

The site is located adjacent and to the north of the existing Koeberg ***Nuclear Power Station,*** which is situated on the Cape West Coast, approximately ***27*** km north of Cape Town (**Figure 5-2**). The proposed site falls within the existing Eskom-owned property (which includes the site of the existing Koeberg Nuclear Power Station) as well as the Koeberg Nature Reserve. Eskom has for many years engaged in a ***biodiversity management process through*** removing alien vegetation from the Eskom-owned property and introducing game onto the property.

The existing infrastructure on the Eskom-owned property includes the following:

- Koeberg has two 900 MW Pressurised Water Reactors (PWR) units, with a total output of 1 800 MW;
- Associated infrastructure including bulk stores ***and the road network***;
- Transmission lines;
- Nature conservation centre;
- Visitors centre; and
- Weather station.

The Duynefontein site will increase the existing installed capacity in this power pool thus increasing the concentration of power generation in this area for the Western Cape. It is close to the existing main transmission infrastructure and the power will connect directly to the Cape Peninsula loads with excess power evacuated via the main transmission system to the north.

Figure 5-2: View of Duynefontein looking east towards the coast, with the existing Koeberg Nuclear Power Station visible in the left background

(b) Bantamsklip

Bantamsklip is situated along the Southern Cape coast located approximately mid-way between Danger Point and Quoin Point (**Figure 5-3**). The site for the proposed Nuclear-1 forms a part of the total Bantamsklip property. The proposed site is vacant and only utilised for activities such as flower harvesting, as well as fishing and illegal harvesting of abalone.

The Bantamsklip site also increases the power pool generation capacity in the Western Cape, but is located relatively far from the existing transmission infrastructure. Thus significant new transmission lines will be required to first connect it to the main transmission system before the power can be distributed either to the Western Cape loads or to the north.

Figure 5-3: View of the eastern portion of Bantamsklip

(c) Thyspunt

Thyspunt is situated in the Eastern Cape on the coast between the towns of Oyster Bay in the west and St. Francis Bay in the east (**Figure 5-4**). The site for the proposed Nuclear-1 ***power station*** is currently vacant. There are a number of houses on the adjacent properties, but these are far outside the proposed ***Proactive Action Zone (PAZ)*** of 800 m from the ***proposed nuclear power station***. To the north of the sand dunes, which span the northern portion of the site, the dominant land use is ***dairy*** farming.

The Thyspunt site will provide a completely new generation pool for the Eskom transmission system to supply both the Eastern Cape loads as well as export excess power to the rest of the network. Besides the advantages of diversity of generation the Thyspunt site will link up to the new transmission lines under construction to Port Elizabeth, thus maximising the benefits of the new transmission infrastructure, as well as provide a voltage controllable busbar in the Eastern Cape, which is of significant value to the operation of this network and the transmission system as a whole.

Figure 5-4: View of the coastal portion of Thyspunt looking east

5.2.5 Coega as an alternative site

The question has been raised by I&APs in public participation meetings and in written comments during the scoping and EIA phase as to why the Coega Industrial Development Zone (IDZ) has not been considered as a suitable site, as it would seem to be an ideal site for a nuclear power station, owing to the fact that the Coega IDZ is attempting to attract large, electricity-intensive industries such as smelters. It is, furthermore, an already developed site and may therefore not be subject to the same environmental impacts as undeveloped sites such as Bantamsklip and Thyspunt.

The background to the investigation of the Coega IDZ and reasons why the IDZ cannot be considered as a reasonable and feasible alternative for Nuclear-1 are as follows:

- ***Technical reasons:***
  - ***At the time that the NSIP was developed, criteria that were applied for distances from major metropolitan areas (in this case Port Elizabeth) effectively excluded the Coega site from consideration. A 50 km radius from metropolitan areas was excluded from consideration. The Alexandria area was omitted from consideration after Phase 3A and 3B investigations revealed the following:***
  - ***Only a small stretch of coastline approximately 1 km in length near Springmount remained after applying the 50 km demographic requirement from Port Elizabeth and the 200 km requirement from the (then) Ciskei;***
  - ***A power station would have to be founded on at least 20 to 30 metres of unconsolidated sand. Piled foundations would have to be used for which are unacceptable for the seismic design requirements are particularly onerous;***
  - ***According to the Council for Geoscience, which was responsible for the seismic studies for the sites under consideration for Nuclear-1, the presence of the Coega fault, which runs across the southern part of the Algoa basin before extending into Algoa Bay near the Coega harbour, means that the Coega IDZ should be considered carefully before proceeding with geological investigations for nuclear siting and,***
  - ***the confirmation of seismic suitability requires the installation of a network of micro-seismic monitors across the site, and the collection of***

monitoring data over a period of at least five years. Given the urgency of the development of additional generation capacity (as indicated in Chapter 4), waiting another five years for confirmation of Coega's suitability would not enable South Africa to commission the power station in time to meet the need to more electricity as indicated in the Draft Integrated Resource Plan 2010.

- ***Ecological reasons:***
  - ***The region consists of sandy beaches with large wind driven mobile dunes behind the shoreline which comprise the largest mobile dune field in South Africa. The only rocky outcrops are the cliff faces at Cape Padrone and Woody Cape. The shoreline is easily eroded and unsuitable for the siting of a nuclear power station. In addition the engineering problems associated with the natural movement of the dunes would be considerable;***
  - ***The environmental consultants (the University of Cape Town's Environmental Evaluation Unit)) considered the environmental sensitivity of this portion of coastline to be very high. The Alexandria Forest is a unique natural forest occurring only along this stretch of the Eastern Cape coastline and any disturbance to them would be highly undesirable; and.***
  - ***The ecology of the dune fields is also considered to be highly sensitive.***

- ***At the time of the Scoping Phase for Nuclear-1Coega Development Corporation (CDC) indicated that there was insufficient land available for a nuclear power station subsequently in May 2010, the CDC has during the EIA Phase (refer to Appendix D5 containing minutes of CDC meeting of 24 May 2010), indicated that sufficient space is now available for a nuclear power station as several of the Coega IDZ's previous potential tenants have now abandoned their projects.***

5.3 Forms of power generation

5.3.1 Nuclear generation alternatives

The alternative activity type assessment was undertaken during the Scoping Phase and the results thereof are captured in **Chapter 8** of the **Final Scoping Report** (FSR). A brief summary of the findings is provided hereunder, together with additional information of relevance to alternative forms of power generation.

In order for Eskom to achieve its objectives, Eskom requires a reliable source of power generation that will supply a consistent base load that can be efficiently integrated into the existing South African power network. Only certain electricity generation technologies are presently commercially available, although not necessarily financially viable in South Africa, based largely on the availability of resources (fuel) and geographical constraints. The range of viable technologies, which were discussed and compared during the Scoping Phase of the EIA, is listed in **Table 5-1**.

Table 5-1: Summary of electricity generation technologies that are commercially available, but not necessarily financially viable for Eskom

Development Phase	Technology
Proven base load	Conventional coal (pulverised fuel)

Development Phase	Technology
technologies	Light Water Reactor nuclear power stations, which include Pressurised Water Reactors and Boiling Water Reactors
	Fast Breeder Reactors
	Heavy Water Reactors
	Imported hydro-electric energy
	Combined Cycle Gas Turbine (CCGT)
Proven peak load technologies	Open cycle gas turbine (OCGT)
	Pumped storage schemes
	Hydro-electric generation on the Orange River
Proven (*intermittent*)	Wind
Demonstration	Pebble Bed Modular Reactor (PBMR) (Nuclear) – ***project discontinued***
	Underground Coal Gasification (UCG)
	Concentrated Solar Thermal and its storage capability
Research	Tidal energy and ocean currents

5.3.2 Wind generation

A significant number of comments have been received during the period of availability of the Draft EIR that wind-generated power must be considered as an alternative to a nuclear power station, especially in the Eastern Cape around the Thyspunt site, as EIA processes are currently being undertaken for a number of wind energy facilites in the area. A request was made to provide a comparison of the surface area that would be required for wind powered generation of 4 000 MW, the same capacity as the proposed Nuclear-1 power station. In this regard, it must be stressed that the then DEAT's approval of the Final Scoping Report and the Plan of Study for Scoping accepted that power generation alternatives do not need to be investigated in the EIA phase of the project. It has also been made clear in Chapter 1 of this Revised Draft EIR that nuclear power is not being pursued as an alternative to any form of renewable power generation, but that all forms of power generation have an appropriate role in the mix of generation alternatives, the relative contributions of which are to be determined by the Integrated Resource Plan (IRP) 2010. However, a brief discussion on the possible implications of wind power as an alternative is provided for comparison below.

A number of wind energy facilities are currently being considered in South Africa, especially in the coastal regions where the wind regime is suitable. Around the Thyspunt site, three wind farms were the subject of EIA processes in 2010.

The space required for wind farms is dependent on a large number of variables such as wind speed, wind direction, turbine size, terrain (i.e. small hills, valleys), land conditions (i.e. sensitive areas, fauna), surface roughness (it is preferable to avoid trees and bushes, etc.), ground conditions and human settlements. Generally, based on some rules of thumb, a spacing of eight turbine rotor diameters downwind and four turbine diameters across wind can be applied.

If one has a prevailing wind direction where the wind originates from for the majority of the time, wind turbines can be placed four diameters apart (cross wind). However, if the wind direction varies more (as is the case with most coastal areas with pressure driven wind systems), then the turbines need to be placed eight rotor diameters apart down wind and cross wind. Areas with a unidirectional or bi-directional wind are generally thermally driven systems typically found in regions such as at Sutherland or on escarpments.

Turbine rotor diameters vary from 80 m to 120 m. In this instance, a 90 m diameter has been used an as example and capacity of 2 MW per turbine has been assumed. If a spacing between turbines of eight rotor diameters by eight rotor diameters is assumed, then an area of 345 600 ha[1] will be required for 13 333 MW of installed capacity. Due to the fact that wind is not available at all times, a capacity factor[2] of 30 % is assumed and the effective power produced will be 4 000 MW. EPRI (2010) indicates that wind turbines at an unspecified coastal location have a capacity factor of 29.1 to 40.6 %. If a rotor diameter of 80 m is assumed instead of 90 m, the space requirement would be 273 000 ha. The actual space that will be used will inevitably be greater than these estimates due to not all pieces of land being suitable for turbine placement.

For Nuclear-1, it is estimated that the total area required is approximately 200 - 280 ha, depending on the terrain. This footprint includes the reactor and auxiliary buildings, laydown areas required during construction which includes topsoil storage areas.

The actual space that the wind turbines rendered unusable for activities such as farming is less than 1 % of this area. This is the footprint of the turbines (an area of approximately 18 x 18 m per turbine foundation), a clearance area around each turbine (for fires etc.), roads, sub-stations etc. Potential environmental impacts that typically need to be considered for wind turbines include the footprint of the wind turbines themselves, as well as the footprint of access roads for construction and maintenance, noise of the rotating turbines, visual impacts (which are usually substantial due to the height or the turbines and the movement of the blades) and impacts on birds (usually substantial) and impacts on bats. Traffic impacts during construction would also be substantial due to extra heavy vehicles that would need to be used to transport the large masts.

5.3.3 Comparative costs of power generation alternatives

It is not the intention of this EIA process to provide a detailed evaluation of the costs of various alternative forms of electricity generation. However, comparative financial costs of generating base load electricity from coal-fired and nuclear technologies, as well as from various other forms of renewable energy were reviewed in two reports: a joint report (IEA and NEA 2010) by the International Energy Agency (IEA) and the OECD Nuclear Energy Agency (NEA) and the other, a report (EPRI 2010) commissioned for the South African IRP 2010 process.

(a) IEA and NEA comparative costs for electricity generation alternatives

The report by the IEA and NEA provides levelised costs of electricity (LCOE) per MWh for almost 200 generating plants, based on data covering 21 countries (including four major non-OECD countries), and several industrial companies and organisations. The study was carried out with the guidance and support of an ad hoc expert group of officially appointed national experts, industry experts and academics.

The study reaches two important conclusions:

- ***First, in the low discount rate (5%) scenario, more capital-intensive, low-carbon technologies such as nuclear energy are the most competitive solution compared with coal-fired plants without carbon capture and natural gas-fired combined cycle plants for base load generation. Based on the data available for this study, where coal has a low cost (such as in Australia or certain regions of the United States), both coal plants with and without carbon capture [but not transport or storage] are also globally competitive in the low discount rate case (See Figure 1); and***

[1] For comparative purposes, Addo National Park is 164 000 ha (SANParks website) and Baviaanskloof Mega-Reserve is approximately 500 000 ha.

[2] ***The percentage of time that the installation can produce its full output***

- ***Secondly, in the high discount rate (10%) case, coal without carbon capture equipment, followed by coal with carbon capture equipment, and gas-fired combined cycle turbines (CCGTs), are the cheapest sources of electricity. In the high discount rate case, coal without CC(S) is always cheaper than coal with CC(S), even in low-cost coal regions, at a carbon price of US$ 30 per ton. The results highlight the paramount importance of discount rates and, to a lesser extent, carbon and fuel prices when comparing different technologies.***

As an overall conclusion, the study suggests that no single electricity generating technology can be expected to be the cheapest in all situations. The preferred generating technology will depend on a number of key parameters and the specific circumstances of each project. The investors' choice of a specific portfolio of power generation technologies will most likely depend on financing costs, fuel and carbon prices, as well as the specific energy policy context (security of supply, CO_2 emissions reductions and market framework).

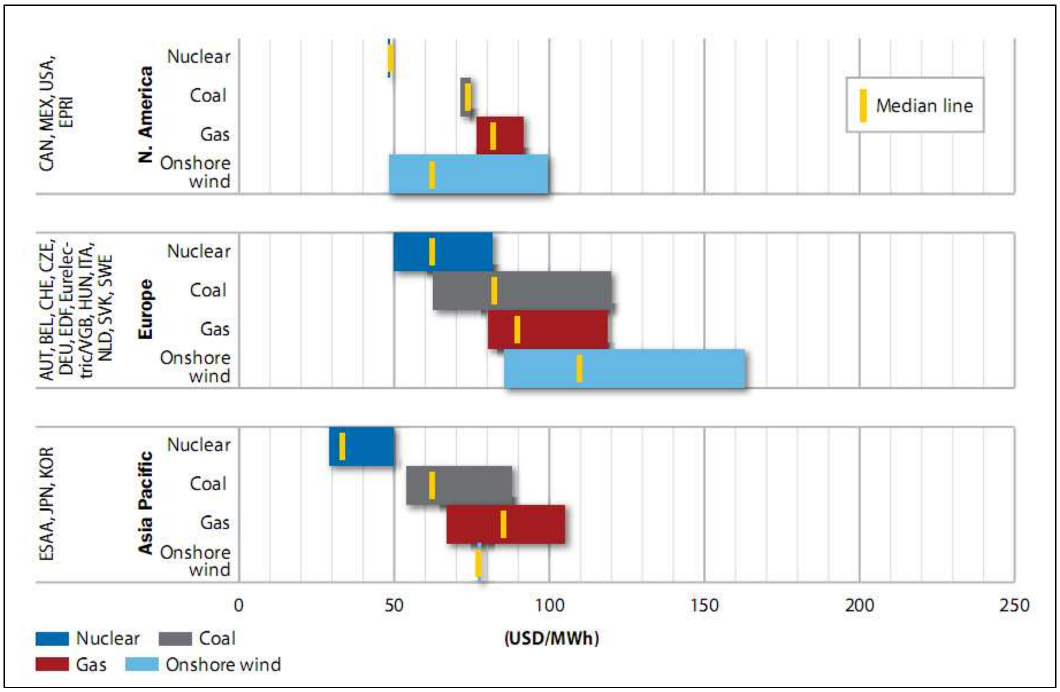

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Figure 5-5: Regional ranges of LCOE for nuclear, coal, gas and onshore wind power plants (at 5% discount rate)

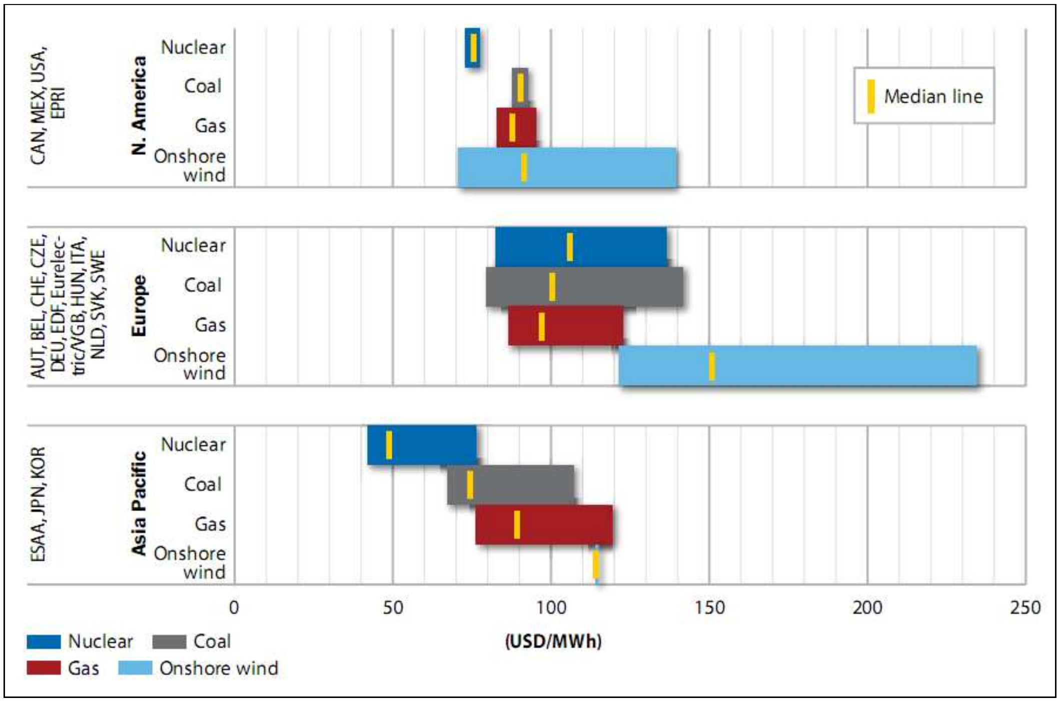

Figure 5-6: Regional ranges of LCOE for nuclear, coal, gas and onshore wind power plants (at 10% discount rate)

It is important to note that the above-mentioned analysis deals only with financial costs of generation alternatives, but does not include externalities such as the environmental costs. Nuclear energy tends to have a high start up cost with a lower operational cost, compared to coal. Secondly, transport costs also need to be considered by taking into account the location of a proposed power station. If generating electricity in the coastal areas, as in the intention with Nuclear-1, transport costs for coal would be high, whereas transport costs for nuclear fuel would be similar, no matter where the power station is located. The costs of losses in the transmission network for a coal-fired station located in Mpumalanga or Limpopo and providing power to the coastal regions would also need to be considered.

(b) EPRI 2010 study of comparative costs for electricity generation alternatives

Further analysis of the comparative costs of generation technologies is provided by a study commissioned for the IRP 2010. The Electric Power Research Institute (EPRI) produced this report (EPRI 2010) for input into South Africa's IRP 2010. This report provides cost and performance data on renewable resource based technologies such as wind, solar thermal, solar photovoltaic, and biomass, fossil fuel based technologies such as pulverized coal, fluidized bed combustion, integrated coal gasification/combined cycle, open cycle (natural) gas turbine, gas turbine/combined cycle and nuclear technologies expressed in Rand terms per unit of power and unit of energy produced (Table 5-2).

Table 5-2: Summary of plant and operational costs for a range of generation technologies (values from EPRI 2010)

Technology type	Capacity	Overnight capital cost / KW[3]	Fixed operational and maintenance cost
Pulverised coal	***3 x 750 MW with FGD[4]***	***R 20 145***	***R 428 / kW-yr***
Integrated Gasification Combined Cycle	***789 MW***	***R 28 550***	***R 395 / kW-yr***
Fluidized Bed (coal)	***3 x 250 MW with FGD***	***R 16 955***	***R 348 / kW-yr***
Nuclear (European Pressurized Reactor)	***1 600 MW***	***R 28 375***	***R1008 / kW-yr[5] (R 125.1 / MWh)***
Nuclear (AP 1000 Reactor)	***1 115 MW***	***R 33 235***	***R1008 / kW-yr (R 125.1 / MWh)***
Open Cycle Gas Turbine (OCGT)	***115.9 MW***	***R 4 545***	***R 57 / kW-yr***
Combined Cycle Gas Turbine (CCGT)	***732.4 MW***	***R 6 280***	***R 75 / kW-yr***
Wind	***100 x 2 MW***	***R 14 445***	***R 266 / kW-yr***
Parabolic trough (solar) with 9 hrs storage	***125 MW***	***R 50 910***	***R 635 / kW-yr***
Central receiver (solar) with 9 hrs storage	***125 MW***	***R 36 225***	***R 603 / kW-yr***
CdTe Photovoltaic	***10 MW***	***R 28 055***	***R 403 / kW-yr***
Amorphous Silicon Photovoltaic	***10 MW***	***R 28 910***	***R 403 / kW-yr***
Concentrating Photovoltaic	***10 MW***	***R 37 225***	***R 403 / kW-yr***
Biomass (municipal solid waste)	***25 MW***	***R 66 900***	***R 2,579 / kW-yr***

5.4 Nuclear plant types

Table 5-3 ***indicates*** the five reactor technologies that Eskom short-listed following the screening phase ***for the proposed project***, which occurred in 2006/7. The table provides a list of the various technologies and the salient features associated with each reactor type.

[3] ***1 kW = 1000 (one thousand) W and 1 mW = 1 000 000 (one million) W. A kilowatt-hour (kWh) is the amount of energy equivalent to a steady power of 1 kW running for 1 hour. One mWh is the amount of energy equivalent to a steady power of 1 mW running for 1 hour.***

[4] Flue gas desulphurisation

[5] ***Based on 92% capacity factor as stipulated in EPRI (2010)***

Table 5-3: Summary of Eskom's short-listed nuclear plant type technologies

REACTOR TYPE	TECHNOLOGY	PLANT TYPE	SALIENT TECHNICAL FEATURES
Light Water Reactors	Pressurised Water Reactor	AP1000	Reactor Thermal Power : 3 400 MWt Electrical Power Output: approximately 1140 MWe Safety systems such as: • Passive core cooling system (PXS) • Passive containment cooling system (PCS) • Control room emergency habitability systems (VES) • Containment isolation Efficiency (overall): 33.53%
		EPR	Reactor Thermal Power: 4 616 MWt Electrical Power Output: approximately 1 650 MWe Safety systems such as: • Three protective barriers • Core Catcher • Safety injection system • In-containment refuelling water storage system (IRWST) Efficiency of 35.75%
		RSA 1000	Reactor Thermal Power : 2 895 MWt Electrical Power Output: 1 020 MWe Safety Aspects: • Several interconnecting systems resulting in various complex failure mechanisms • Proven technology with more likely design base incident optimized as a result of OE. • Operator intervention only necessary after 20 minutes. Overall efficiency: ~33%
	Advanced Boiling Water Reactor	ABWR	Reactor Thermal Power: 3 992 MWt Electrical Power Output: approximately 1 371 MWe Safety systems such as: • Vessel-mounted recirculation pumps • Fine motion control rod drives • Advanced digital and multiplexed instrumentation and control system Efficiency: Unknown with present data Overall efficiency: 34.34%

REACTOR TYPE	TECHNOLOGY	PLANT TYPE	SALIENT TECHNICAL FEATURES
Heavy Water Reactors	**CANDU**	**CANDU-6**	**Reactor Thermal Power: 2100 MWt** **Electrical Power Output: approximately 700 MWe** **Safety features such as:** • **Defence in depth design approach incorporate tri-level passiveness** • **Preventative boundaries (safety systems are separated physically and functionally) and two independent shutdown systems are built in at different levels** **Efficiency: 33.33%**

At the time of writing, Eskom had not yet chosen a preferred vendor for the supply and installation of PWR technology. Thus, Eskom has identified an "envelope" that defines the full range of different technologies, in terms of their footprints and the emissions to air, land and water that they may cause. The envelope represents a "worst case scenario" of potential impacts from a nuclear power station. The envelope was presented in the form of a "consistent dataset" that was provided to all specialists, to serve as the basis for their assessment.

The envelope data are as indicated in **Appendix C**. Only the key features of the envelope are indicated in **Table 5-4**.

Table 5-4: Key features of the Nuclear-1 envelope

	Unit	Envelope
Auxiliary Steam Boiler		
Auxiliary Steam Boiler (x3)	t/h	32
Diesel Storage Tanks (x2)	m³	230
Chlorination		
CRF (Main Cooling Water)		
Normal Operation-Continuous	mg/kg	2.00
Shock (3x/day for 15 min)	mg/kg	4.00
Continuous consumption rate	kg	13 565
Shock consumption rate	kg	848
Total consumption rate	kg	14 413
Civil Works		
(Existing landscape)		
Maximum height above MSL	m	14
Minimum height above MSL	m	6
Sand removal for Construction (**subject to change as it is dependent on the site, terrace elevation and vendor technology)**	m³	15 000 000
Finished Terrace above MSL	m	10
Desalination Plant		
Will the sea water ***used in the desalination plant*** be taken up through the cooling water ***system***?		Not initially. Will later be incorporated when the intake ***system*** is complete.

	Unit	Envelope
What input volume of water will be needed and how does it compare to the uptake of cooling water	m³/day	9 000 maximum = 0.14% of intake
Output of ***desalination*** plant (***during*** earth works)	m³/day	3 x 3 000
Output of ***desalination*** plant (***during*** construction)	m³/day	1 x 600
Output of ***desalination*** plant (***during*** operation)	m³/day	2 x 2 000
Brine		
Input	ppm	35 000
Output	ppm	59 000
Diesel Generators		
(Per nuclear unit)		
Emergency Diesel Generators		
Number of generators	each	4
Output Capacity	MW	8
Diesel storage arrangement		Run at rated power for 72 hours
Testing hours per week	hr	2.00
Diesel storage tanks	kl	1 000
Dose Rates		
Radiation Worker		
Normal Operation		
(For Power Station)		
100m	nSv/h	0.30
300m	pSv/h	27.00
1000m	pSv/h	0.20
Incident Conditions		
100m	nSv/h	2.50
300m	nSv/h	0.20
1000m	pSv/h	1.60
Public Radiation		
(For Power Station)		
Normal Operation	mSv	0.10
Incident and Accident	mSv	10.00
Electrical and thermal characteristics		
(per unit) – *maximum based on EPR design*		
Gross Electrical Output	MWe	1 784
Net Electrical Output	MWe	1 650
House Load	MWe	134
Thermal Output	MWth	4 616
Efficiency	%	35.75%
Availability	%	
18 months	%	91.5%
First 2 years	%	91.5%
Power factor at generation terminals		0.90
Employees on Site		
Please note that this will be the maximum number of employees per group. The peak will not be at the same time for all groups		

	Unit	Envelope
Eskom project staff		140
Consultants		40
Vendor staff		2 172
Vendor construction workers		5 000
Eskom operation staff		1 385
Housing		
General Facilities		
Land requirement	ha	44.2
Vendor Staff		
Land requirement	ha	89.5
Total vendor construction staff	ea	2 172
Eskom Project Personnel		
Land requirement	ha	12
Total Eskom project staff	ea	140
Consultants	ea	40
Vendor Construction Workers		
Land requirement		65.7
Workers on site	ea	5 000
% Local	%	25
Workers require housing	ea	3 750
Intake / Outfall Structure		
Intake		
Distance off shore	m	1000 to 2000
Number of Tunnels (for power station)	ea	1 or 2
Diameter of tunnels	m	5 to 10
Water velocity at intake	m/s	approx 1,0
Water velocity in tunnel	m/s	approx 3,0
Depth of tunnels	m	Approximately 30
Tunnel Spoil		Placed in Rock Retaining Walls and/or ***used as armourstone or gravel in HV yard, if suitable.*** Any additional ***spoil*** will be transported to a suitable approved location off site
Outfall		
Outfall type		Can be off ***shore via pipelines,*** via tunnels or outflow like Koeberg.
Tunnel alternative		
Number of tunnels	ea	***6 to 10***
Diameter of tunnels	m	approximately

	Unit	Envelope
		3
Distance off shore	m	approximately 500
Depth Of Tunnels	m	approximately 5
Water velocity at the outfall	m/s	approx 5,0
Gas turbines (only at Thyspunt)		
General specifications		
Gross Output Power (2off)	MW	25.30
Gross Efficiency	%	34.00
Fuel mass flow	kg/s	1.74
Noise		
Average sound attenuation @ 1m from the package and 1,5m above ground	dB(A)	85
After additional sound damping	dB(A)	80
Stack		
Gas		Ventilation
Location of release point;	ft	Next to reactor
Height of release above ground;	m	96.00
Vent tip diameter;	m	3.00
Gas exit volume	m³/min	
Exit gas velocity (normal)	m/s	5.80
Exit gas velocity (outage)	m/s	6.35
Exit gas temperature (winter)	℃	Ambient
Exit gas temperature (summer)	℃	Ambient
Gas Turbine Exhaust Gas		
Exhaust gas mass flow	kg/s	85
Exhaust gas temperature	℃	538
Gas Composition		
N_2	%Vol	74.80
O_2	%Vol	13.90
CO_2	%Vol	4.20
H_2O	%Vol	6.20
Ar	%Vol	0.90
SO_2	%Vol	0.00
Nuclear fuel		
Enrichment of fuel (by weight)	%	4.95
Rods / assembly	each	265
Assemblies / load	each	241
Fuel active height	m	4.20
Fuel assembly pitch	m	0.215
Mass of fuel rod	kg	2.80
Mass of assembly	kg	780
Total assembly mass in reactor	ton	187.98
Duration of fuel in reactor	months	18
Spent fuel over lifecycle (Approx)	ton	1 880
(Approx)	m³	468
Nuclear waste		
Low level waste / year	Steel	470

	Unit	Envelope
	drums	
Mass of steel drums (approx)	kg	50-100
Intermediate level waste / year	Concrete	160
Mass of concrete drums (approx)	ton	6.3
Number of trucks to transport the low and intermediate level waste / year	each	The existing Eskom lorry / trailer at Koeberg can take 80 steel drums at a time plus 3 concrete drums. We transport at our own and Necsa's convenience to ensure it is optimised for both parties. As there is a lot of storage space, when and how often we transport is not an issue. We stay away from school holidays and rainy season as part of the road is not tarred.
Primary energy		
Eskom coal usage	ton/MWh	0.56
Reactor pressure vessel		
Design pressure	bar	167
Design temperature	°C	351
Reactor power	MWth	4616
Coolant Pressure	MPa	15.50
Hot leg temperature	°C	330.00
Cold leg temperature	°C	295.20
Seismic design		
Peak Ground Acceleration (PGA)		
Horizontal		***0.30***
Vertical		0.19
Sewer		
People during construction	ea	8 000
Water consumption / person / day	l	120
Sewer plant to treat 70% (rounded)	m³/day	750
Waste water treatment plant		
Potentially active waste (SEK/KER): 6 tanks	m³	750
Potentially active waste TER: 2 tanks	m³	750

The EIA investigations have been based on this “envelope” of nuclear power station characteristics, and any nuclear power station design that conforms to this envelope will, by implication, be acceptable at the recommended site. ***Should the design of the chosen vendor be different to the envelope of criteria, then that aspect of the design may have to be re-assessed.***

5.5 Layout of the nuclear plant

Preliminary site ‘envelope’ layouts of the power station footprint were developed by Eskom for each site. These layouts were provided to the EIA Team and were subsequently refined to address some of the issues and concerns that the specialist raised during the specialist integration workshop held on the 25 August 2008, at a second integration meeting with a smaller group of specialists held on the 26 September 2008 (both during the Scoping Phase of the EIA process), as well as a specialist integration workshop held on 24 and 25 November 2009, during the EIA Phase.

One of the main changes that were made to the layout was the shifting of the proposed power station from 100 m from the ocean to at least 200 m from the high water mark. This shift was to allow for the maintenance of ecological corridors, whilst also limiting the impact on sensitive dunes and heritage features, across all sites. The setback from the high water mark will also assist in preventing impacts on the station due to a sea level rise associated with climate change. The proposed layouts have allowed for three slightly different positions for the proposed power station and associated infrastructure[6]. Each layout indicates a position for Nuclear-1 with subsequent expansions. The position for Nuclear-1 could be in either of the proposed areas for expansion provided. The specialists assessed the entire possible footprint area (EIA corridor) and provided recommendations on mitigation measures, areas of high sensitivity and no-go areas.

Figure 5-7 to **Figure 5-9** provide an indication of the proposed layout of the nuclear plant at the three alternative sites. The “EIA Corridor” on these plans indicates the area within which a power station can be placed. Adjacent to the corridor is an area indicated for the possible placement of the High Voltage (HV) yard. Three possible positions for the HV yard are indicated. In the case of the Bantamsklip alternative site, an area of the EIA corridor is indicated as being subject to land purchase. This land does not currently belong to Eskom, but it could be purchased in future. This area has been included in the assessments of all specialists.

In the case of all alternatives sites, the EIA corridor is large enough to accommodate additional units based on the specifications in the “consistent dataset”. A single power station consisting of 2 to 3 units may be placed anywhere within the EIA corridor.

It is important to note that there are constraints with respect to the Emergency Planning Zones (EPZs) that determine how far a power station position can be moved on the sites. In the case of all three alternative sites, there will be an ***PAZ (refer to Section 3.20.2 for an explanation of the EPZ zones)*** with a radius of at least 800 m from the power station. Thus the power station can be moved no closer than 800 m from the closest road, as no ***unrestricted*** public access is allowed within the ***PAZ.***

[6] It must be noted that the final position of the nuclear power station will be determined following the appointment of the final vendor and the detailed investigations on the inter-site geological conditions. The positions proposed by the specialists and EAP are to be used as a guideline..

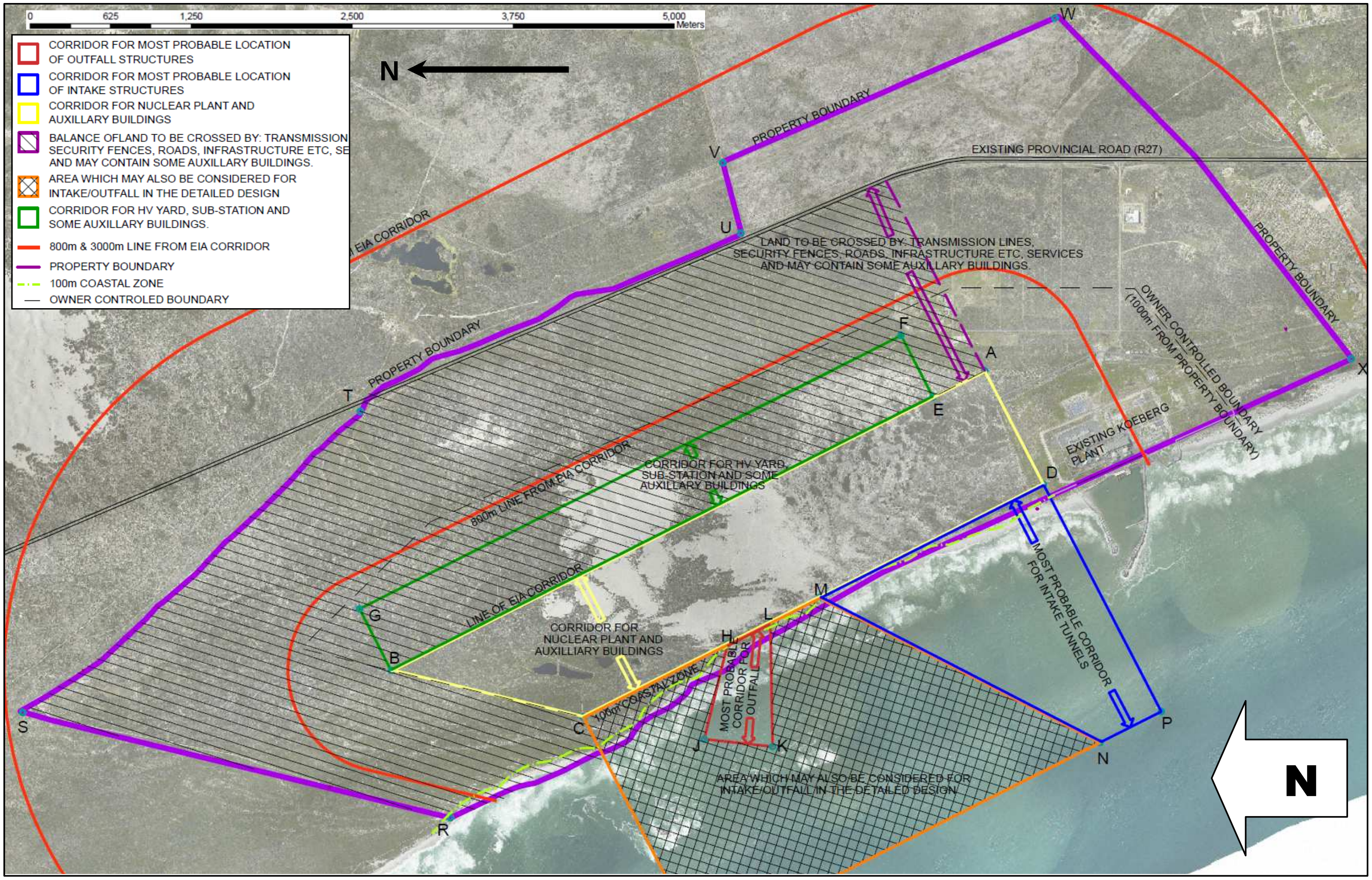

Figure 5-7: Nuclear-1 EIA corridor at Duynefontein (not to scale)

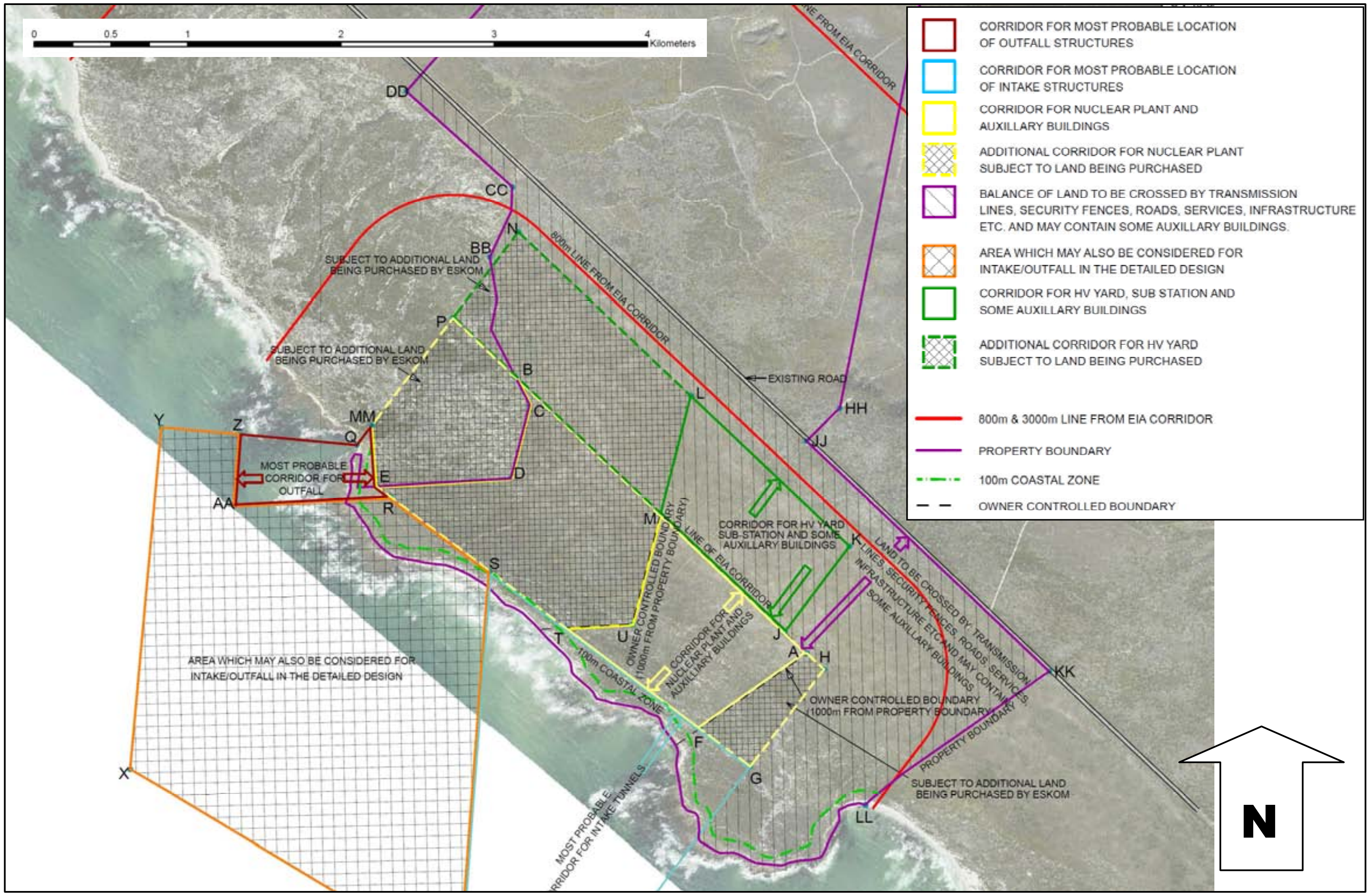

Figure 5-8: Nuclear-1 EIA corridor at Bantamsklip (not to scale)

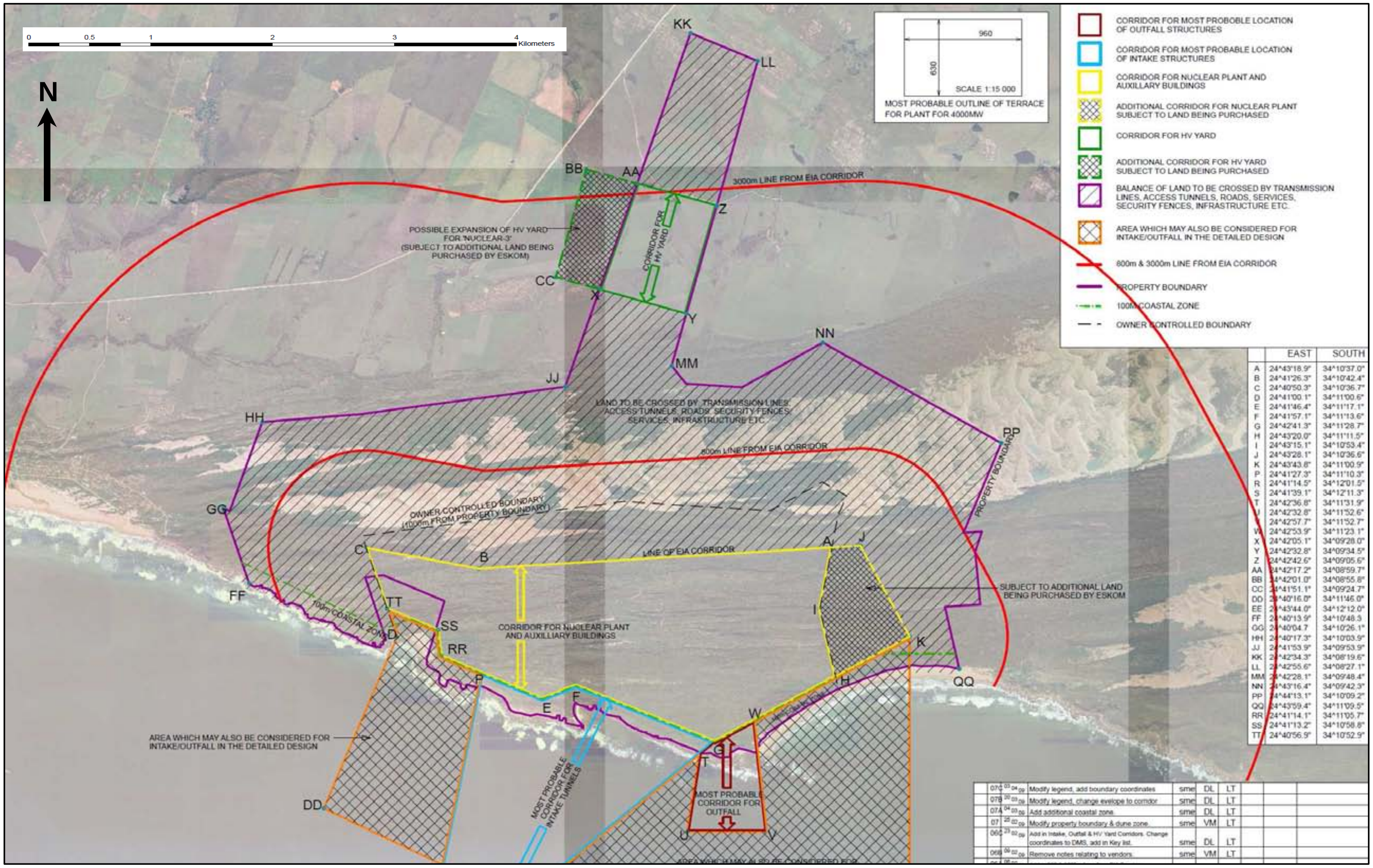

Figure 5-9: **Nuclear-1 EIA corridor at Thyspunt** (not to scale)

5.6 Modes of transport for the construction phase (Bantamsklip only)

Road transport was the only mode of transport considered for delivering construction materials, including heavy and extra-heavy loads, to the proposed alternative sites for Nuclear-1. However, ocean-based transport of materials was also considered for the Bantamsklip site due to the inability of current road transport system (particularly bridges) between Cape Town and Bantamsklip to cope with heavy and extra heavy loads. Barging was therefore considered as an alternative early on the design process for the Bantamsklip alternative site. This would require the construction of suitable landing facilities on the beach at the Bantamsklip site.

The two transport alternatives for the construction (only in the case of Bantamsklip) are therefore:

- Road transport; and
- Barging.

5.7 Utilisation of abstracted groundwater

As part of the excavations required to ***construct foundations for*** the power station, it may be necessary to lower the water table around the excavation by means of dewatering ***(i.e. pumping out groundwater)***. The extent of dewatering is determined by the elevation of the ground water below the natural ground level. This varies amongst the three alternative sites.

The fate of the abstracted groundwater will be determined by the total volume of water abstracted over the duration of the construction period. Three alternative uses for the abstracted groundwater were considered and are discussed in this section, namely:

- Transfer to the municipal water system;
- Storage and utilisation; and
- Discharge to sea.

5.8 Fresh Water Supply

The groundwater abstracted as a result of dewatering during the construction phase, will occur over a relatively short period of time and would therefore not sustain the water requirements for the duration of the operational phase of the power station. ***Furthermore, groundwater is used for domestic supply by neighbouring landowners and to avoid impacts on these users, the extraction of groundwater must be kept as limited as possible.*** Based on the limitations and projections of the water resources in the three water management areas, it was necessary for Eskom to consider alternative water sources applicable to each of the three sites. The following alternatives have been explored for the three alternative sites (not all alternatives are relevant to each of the sites).

- Use of underground water;
- Municipal water supply;
- Desalination; and
- Obtaining water from local rivers and/ or water transfer schemes.

5.9 Management of brine

The desalinisation process results in the creation of brine (concentrated salt) as a waste product, which must be utilised and/or discarded. This section considers two potential alternatives for utilising/discarding the brine emanating from the desalinisation plant during the ***construction and*** operational phases of the nuclear power station.

The following alternatives ***are possible***:

- ***Disposal of brine at a disposal site;***
- Disposal of brine directly into the surf zone of the sea during construction; and
- Co-disposal of brine and cooling water into the sea during operation.

5.10 Intake of Sea Water

The basis for locating a nuclear power station at the coast is access to large volumes of water required to cool and condense the steam that drives the turbines. Alternative methods to obtain the water are:

- Utilising the existing intake structures at Koeberg ***Nuclear Power Station (in the case of the Duynefontein site)***; and
- Installation of intake tunnels and inlet structures.

5.11 Outlet of water and chemical effluent

Two alternatives have been considered for the outlet of the water that is used to cool and condense the steam that drives the turbines. These are:

- A near shore outfall; and
- Offshore outfall tunnel***/ pipelines.***

5.12 Management of spoil material

The development of the nuclear plant (Nuclear Island and turbine hall), the intake basin and associated tunnels will entail extensive excavations. The extent of the excavations will be determined by the depth of the soil profile overlying the bedrock and will therefore vary amongst the sites. The quantities of spoil that will be excavated are vast and thus, alternatives for disposal and/or utilisation warrant further consideration. This section discusses seven alternatives for the discard/utilisation of the spoil. It should be noted that a combination of alternatives may be required in order to completely discard the full volume of the spoil material.

The following alternatives have been considered:

- ***Disposal at*** sea;
- ***Disposal*** on land;
- Development of rock retaining walls;
- Development of terraces;
- Building of dunes;
- Levelling of the HV yard (only applicable at Thyspunt); and
- Commercial uses of the spoil.

Under the option of disposal at sea, different alternatives in terms of the rate of pumping of the spoil and the distance of disposal from shore, have been investigated in the oceanographic modelling report (Appendix E16), based on the oceanographic conditions at each of the sites. The rates of pumping and the distances of offshore disposal are detailed in Table 5.3 to Table 5.5. Pipelines will need to be installed in order to transport the spoil offshore.

Table 5-5: Offshore spoil disposal options at Duynefontein

Alternative	Depth	Distance from shore	Sediment volume	Discharge rate
Alternative 1	***Shallow (21 m)***	***2 km***	***6.48 million m^3***	***3.93 m^3/s***
Alternative 2	***Shallow (21 m)***	***2 km***	***6.48 million m^3***	***2.06 m^3/s***
Alternative 3	***Shallow (21 m)***	***2 km***	***3.24 million m^3***	***2.06 m^3/s***
Alternative 4	***Deep (48 m)***	***6.5 km***	***6.48 million m^3***	***3.93 m^3/s***
Alternative 5	***Deep (48 m)***	***6.5 km***	***6.48 million m^3***	***2.06 m^3/s***
Alternative 6	Deep (48 m)	6.5 km	3.24 million m^3	2.06 m^3/s

Table 5-6: Offshore spoil disposal options at Bantamsklip

Alternative	Depth	Distance from shore	Sediment volume	Discharge rate
Alternative 1	***Shallow (21 m)***	***1.8 km***	***10.07 million m^3***	***3.93 m^3/s***
Alternative 2	***Shallow (21 m)***	***1.8 km***	***10.07 million m^3***	***2.06 m^3/s***
Alternative 3	***Shallow (21 m)***	***1.8 km***	***5.04 million m^3***	***2.06 m^3/s***
Alternative 4	***Deep (52 m)***	***6 km***	***10.07 million m^3***	***3.93 m^3/s***
Alternative 5	***Deep (52 m)***	***6 km***	***10.07 million m^3***	***2.06 m^3/s***
Alternative 6	***Deep (52 m)***	***6 km***	***5.04 million m^3***	***2.06 m^3/s***

Table 5-7: Offshore spoil disposal options at Thyspunt

Alternative	Depth	Distance from shore	Sediment volume	Discharge rate
Alternative 1	***Shallow (57 m)***	***1.8 km***	***6.37 million m^3***	***3.93 m^3/s***
Alternative 2	***Shallow (57 m)***	***1.8 km***	***6.37 million m^3***	***2.06 m^3/s***
Alternative 3	***Shallow (57 m)***	***1.8 km***	***3.19 million m^3***	***2.06 m^3/s***
Alternative 4	***Deep (84 m)***	***6 km***	***6.37 million m^3***	***3.93 m^3/s***
Alternative 5	***Deep (84 m)***	***6 km***	***6.37 million m^3***	***2.06 m^3/s***
Alternative 6	***Deep (84 m)***	***6 km***	***3.19 million m^3***	***2.06 m^3/s***

5.13 Access Routes to the Proposed Sites

5.13.1 Duynefontein

The Duynefontein site can be accessed via the following three currently unsignalised access routes, namely:

(a) R27 / Main Access Road

This access route operates as a main access point to the Duynefontein site. The road will require an upgrade and the transportation study recommended that this intersection is signalised by 2016.

(b) R27 / Emergency Access Road

This access route operates as an emergency access point only. The road will also require an upgrade. According to the transportation study, this access point was recommended for construction vehicle access in order to isolate the Nuclear 1's construction vehicle impact on the normal traffic operations of the Koeberg Nuclear Power Station.

(c) Narcissus Avenue / Ou Skip Road

This operates as a secondary access to the Koeberg Nuclear Power Station and is not recommended as a primary access route.

5.13.2 Bantamsklip

At present, there is no formalised access to the site, off the R43. It is recommended that access to the site occurs via a new access road that must be constructed as a T-junction intersection directly off the R43. There are no other feasible access alternatives at Bantamsklip.

5.13.3 Thyspunt

Currently, the site can be accessed from Oyster Bay via a gravel track or from the R330 in the vicinity of Sea Vista. Two alternative access roads are provided to the site. The Eastern Access Road will be required for heavy vehicle traffic and is essential due to the relatively flat gradient along its alignment ***and the road geometry, which allows ultra heavy vehicles to use the road.*** The Northern and Western Access Routes are alternative alignments for light vehicle traffic ***comprising motor vehicles and buses. The proposed access roads that were considered as alternatives in this EIA are indicated in Figure 5-10.***

(a) Eastern Access Road from St. Francis Bay

This access road from the east turns off the R330 in the vicinity of Sea Vista and proceeds between two dune ***ridges*** to the site. The route selection of this road minimises the impact of the road on the wetlands, while respecting a 100 m exclusion zone to the dunes. This road will be designed for the purpose of all access to the site for both construction vehicles and power station personnel. As such, this road will also be designed to carry the super load vehicles to be used for the transportation of the heavy load plant items ***such as transformers.*** The R330 is currently tarred and the road and bridges are of a good standard.

As indicated in Chapter 9, the impacts of this route on wetlands, botanical resources, faunal habitats and invertebrate habitats are potentially of high significance. The specialists have indicated that the impacts will be acceptable, provided that Eskom purchases additional land as an offset to secure the conservation of wetlands ***(currently in a poor condition***) that currently occur ***immediately to the east of Eskom's*** property. A detailed assessment of this route will have to be undertaken by these appropriately qualified and experienced specialists prior to construction, in order to optimise the alignment of the road.

(b) Western access road

This access road originates near Oyster Bay from the west and turns off the 1730 gravel road in the vicinity of Oyster Bay. The route selection of this road is aimed at minimising the impact of the road on the dunes, as it runs close to the coastline, ***whilst respecting a 200 m*** exclusion zone to the high water mark ***required by the biophysical specialists.***

(c) Northern "panhandle" access route

The northern access route turns off the Oyster Bay – Humansdorp road (a dirt road) and enters the "panhandle" section of the site, and then runs down the western boundary of the panhandle. It then crosses the mobile dune system south of the panhandle before swinging east and then south again, before entering the EIA corridor.

The 1730 gravel road between Humansdorp and Oyster Bay is likely to be tarred prior to construction if Nuclear-1 is constructed at Thyspunt, irrespective of whether the northern or western access routes are used and irrespective of whether the power station is due to be built at Thysount. Tarring of this route was, at the time of preparing this report, being planned by the Eastern Cape Department of Public Works.

(d) Evolution of the Thyspunt access roads

In the initial planning stages, Eskom provided what it regarded as feasible engineering solutions for access roads. Several alternatives to the eastern, northern and western access routes were considered. A site visit, which included a team of biophysical specialists, was undertaken in early 2009 in order to optimise these access roads from an environmental point of view and to determine whether any of these access roads could result in environmental fatal flaws.

Figures 5-11 to 5-13 indicate the alternatives to the northern, eastern and western access routes that were considered.

<u>Northern Access Road</u>

Two alternatives to the Northern Access Road were considered. This includes a western option (N1) and an eastern option (N2). N1 was preferred as it crosses a narrower stretch of the Oyster Bay Mobile Dunefield, and would result in lesser impacts on the wetlands than occur in the dune slacks.

Eastern Access Road

There were three optional alignments from the eastern access road: E1 (southerly), E2 (middle) and E3 (northerly). E1 follows approximately the same alignment as that of the existing access road to the "Rebelsrus Nature Reserve" and would have resulted in extreme disruption to these properties. E2 would have bisected a portion of coastal forest and was rejected for this reason. E3 was settled on, in collaboration with all the specialists involved in the site visit, because it avoids the coastal forest and it far removed from the Rebelsrus landowners. A sub-option (E3A) was also considered. This would have joined E3 but would have joined with the R330 to the north of the St. Francis Links Gold Estate. This option was rejected due to its proximity to the eastern portion of the Oyster Bay Mobile Dunefield, and the complexities of acquiring land in this area.

Western Access Road

Four options for the Western Access Road were considered, namely W1, W2, W3 and W4. W1 to W3 all originate to the west of Umzamuwethu (between Umzamuwethu and Oyster Bay), whilst W4 orignisted from the Humansdorp-Oyster Bay road to the east of Umzamuwethu. W4 was rejected by the biophysical specialists on the basis of it's potential impact on the western portion of the Oyster Bay Mobile Dunefield and associated sensitive ecosystems, its crossing of a drainage line and its length. Of W1, W2 and W3, W1 was preferred by the specialists, as it was considered to have an overall lower potential impact on the biophysical and socio-economic environment than the Northern Access Road.

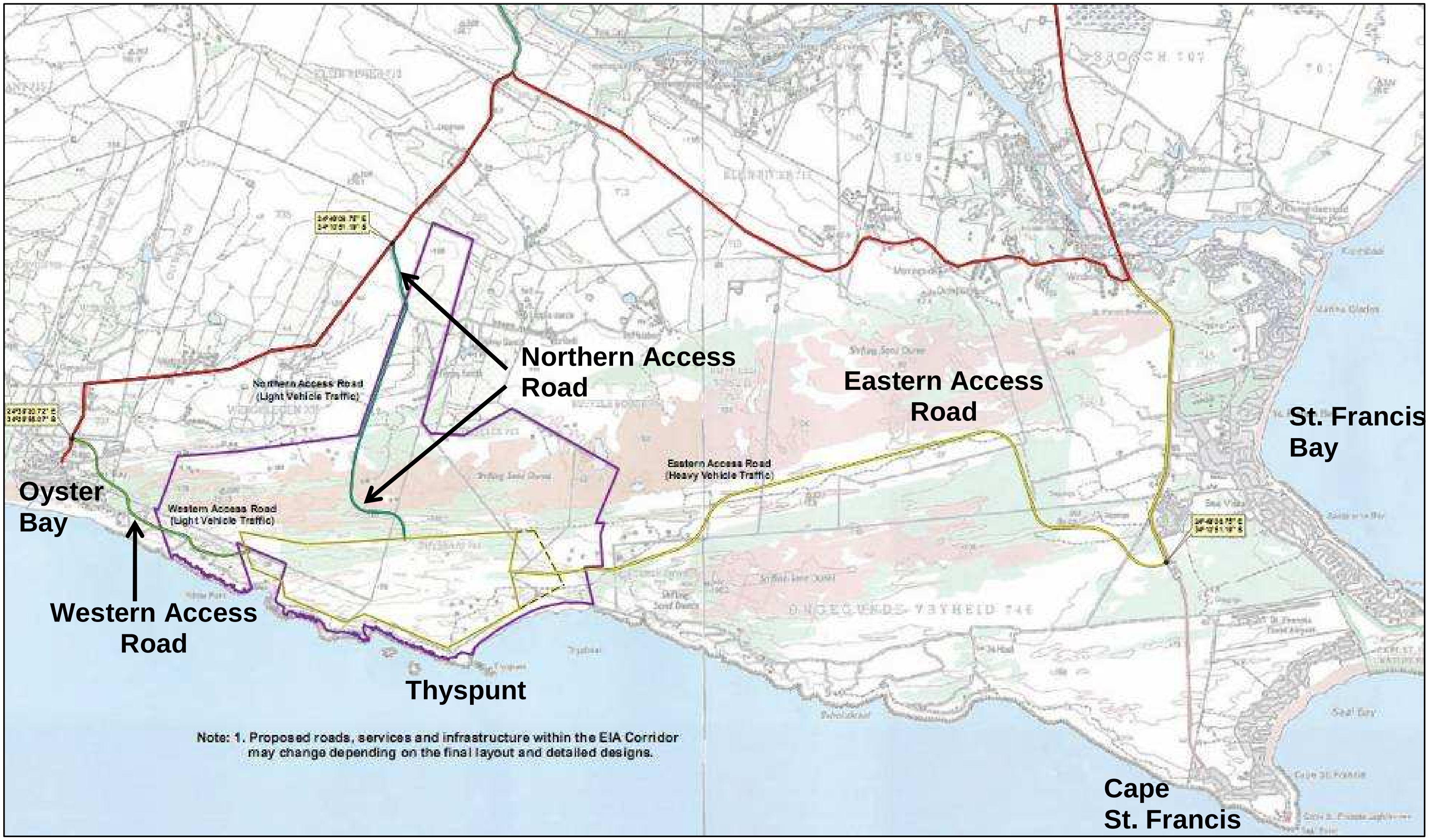

Figure 5-10: Alternative access routes to Thyspunt (Not to scale)

Figure 5-11: Alternative northern access routes to Thyspunt (Not to scale)

Figure 5-12: Alternative eastern access routes to Thyspunt (Not to scale)

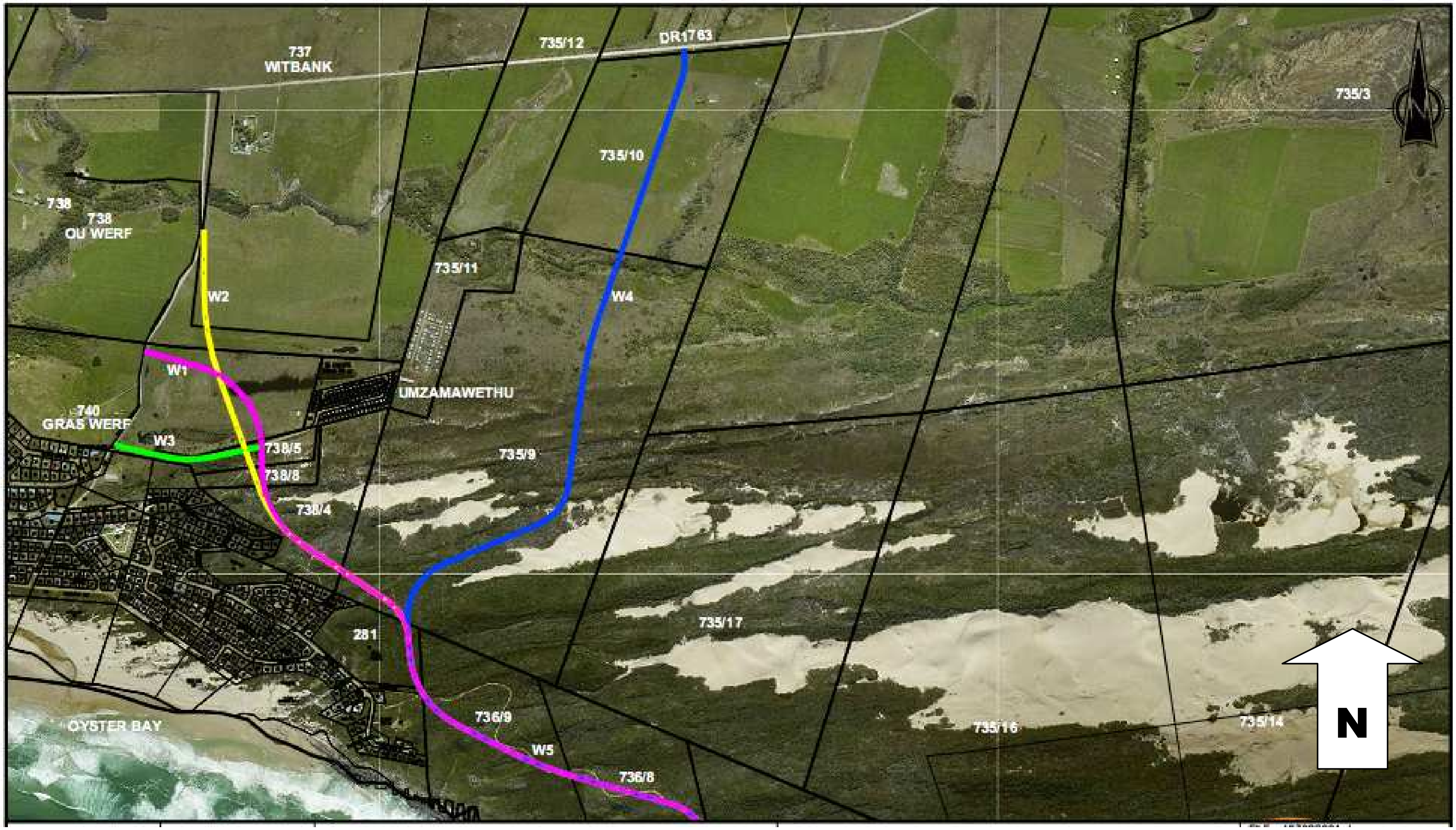

Figure 5-13: Alternative western access routes to Thyspunt (Not to scale)

5.14 Accommodation

The magnitude of the proposed project and the number of personnel required during the construction and operation phases necessitate the consideration of various alternatives for their accommodation. This provides an overview of the general concepts and site specific alternatives presented by Eskom. It must be noted, as stated before, that the construction of accommodation outside the EIA corridor does not form part of this EIA., The discussion on accommodation alternatives therefore provides a general description of the alternatives that Eskom will have to consider (to enable a complete picture of the project scope), but does not assess the ***physical*** environmental impacts of these alternatives. ***The social impact assessment evaluates the social aspects.***

The preferred alternative must consider the long-term utilisation and sustainability in order to maximise the utilisation and enhance the benefits associated therewith. It should also be noted that the capacity of the proposed power station may over time be increased within the existing environmental and Transmissions constraints[7]. This may entail the addition of new nuclear units. Thus, the selected site could be subjected to additional construction phases during the life of Nuclear-1 and it would therefore be cost-effective to utilise the same accommodation facilities for future construction activities.

The following factors should be considered when assessing the accommodation alternatives for the construction phase associated with the proposed development:

- Utilisation as facilities for full time contractors and outage contractors;
- Utilisation as accommodation during outages;
- Utilisation as normal residential accommodation by the community; and
- Limitations of the exclusion zone imposed by the operation of Nuclear-1.

It is Eskom's intention to include the development ***of personnel housing*** into the overall community integration strategy for the Eskom residential developments. The diagram below gives a visual perspective of the accommodation activities.

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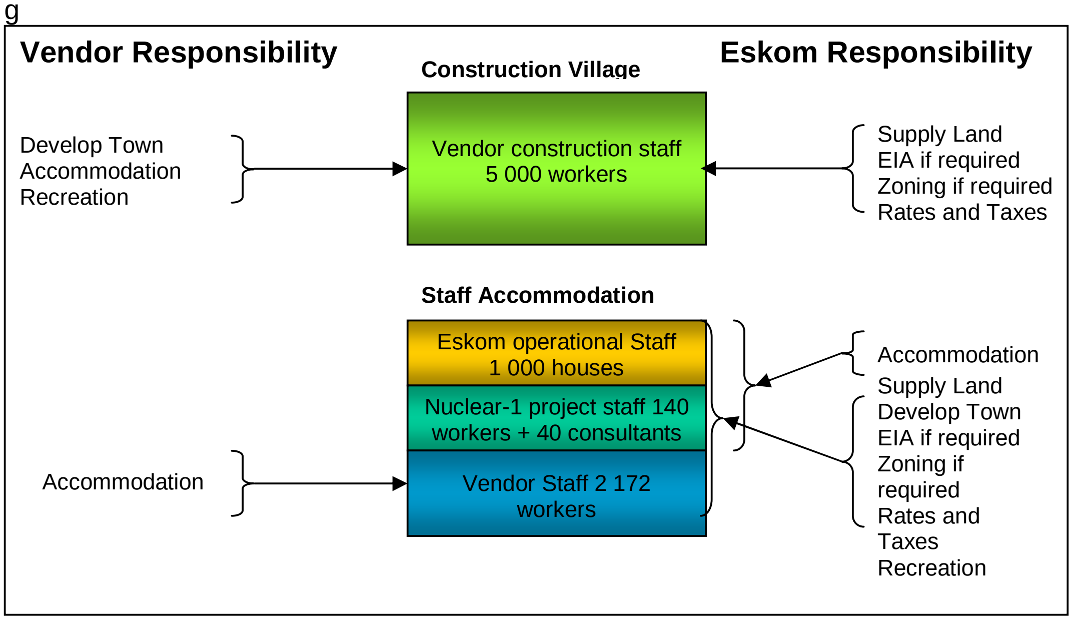

Figure 5-14: Eskom and vendor responsibilities for staff housing

[7] Such expansion would require new EIA processes.

5.14.1 Site Variations

There are substantial differences in the local municipal / private infrastructure in the vicinity of the three sites. The Bantamsklip alternative site has very little infrastructure compared to the other two sites and it is therefore the intention of Eskom to execute the infrastructure development at this site in a different manner.

Eskom will develop villages for Eskom project and operational staff as well as accommodation for the vendor staff at the Bantamsklip site. Possible commercial development alternatives of these villages are described below.

Eskom will not develop staff villages at the Duynefontein and Thyspunt alternative sites. It will be expected from the staff to either purchase or rent existing accommodation in the neighbouring towns of choice. Eskom might discuss the requirements with developers to cater for any new demand. Eskom will build a construction village at suitable sites in towns near to sites.

5.14.2 Construction phase accommodation

The following section provides the alternatives available to Eskom in terms of the accommodation required for all construction workers (during the construction phase).

(a) Establishment of a staff village

Eskom will source land in a town close to the site for the establishment of a ***staff*** village. The EIA on this land as well as the zoning will preferably be completed by the time that Eskom acquires it, but it may also be ***undertaken*** by Eskom, ***if required***. Nuclear-1 will own the facility and the premises must be vacated by the vendor within 3 months after completion of sections of the contract. The accommodation will then be used for maintenance and outage contractors as well as the possible sale of some units to the open market.

Eskom will also consult with the local authorities before building will commence to establish needs and standards.

The following alternatives are being considered by Eskom:

- Appointment of a contractor to build the accommodation ;
- Inclusion of accommodation in the main contractor scope of supply; and
- Entering into a partnership with a developer and the local municipality to supply the construction village (or part thereof) that could be used / converted to low / medium cost housing after the construction phase has been concluded.

(b) Vendor and Eskom project staff village at Bantamsklip during the construction phase

Eskom will source land in a town close to the site for the establishment of a staff village. If required, the EIA on this land as well as the zoning would need to be completed by Eskom. Eskom would own the accommodation and each individual house must be vacated by the vendor within 3 months after completion contract of the employee.

Eskom can then make part of the accommodation available to operational staff or sell it in the open market as the units become available. Some of the vendor staff will only be on site for a very short time (6 months maximum) and guest house facilities will be procured from the open market. Any shortcoming in the supply of this type of accommodation will be built by Eskom. After completion of the project, all remaining properties will be transferred to the Nuclear Sites Team for further administration.

The following alternatives are considered by Eskom:

- Appointment of a contractor to build the accommodation;
- Inclusion of accommodation in the main contractor scope of supply; and
- Entering into a private partnership with a developer to supply a certain number of housing units for Eskom to rent over a long period. The developer can then sell the accommodation if Eskom does not require it any more.

(c) Vendor and Eskom project staff village at Duynefontein and Thyspunt during the construction phase

It will be expected from the Eskom and vendor staff to either purchase or rent existing accommodation in the neighbouring towns of choice. Eskom will not develop staff villages at the Duynefontein and Thyspunt sites. Eskom might discuss the requirements with developers to cater for any new demand.

5.14.2 Operational phase accommodation

The following section provides the alternatives available to Eskom in terms of the accommodation required for permanent (Eskom operations) personnel only.

(a) Eskom staff village at Bantamsklip during the operational phase

Eskom will source land in a town close to the site for the establishment of a staff village. The EIA on this land as well as the zoning will preferably be completed by the time that Eskom acquires it, or the EIA may be commissioned by Eskom.

The following alternatives are considered by Eskom:

- Appointment of a contractor to build the accommodation;
- Selling stands to employees to build own houses;
- Renting or selling finished houses to employees;
- Making construction staff accommodation available to operational staff; and
- Entering into a private partnership with a developer to supply a certain number of housing units for employees to rent or buy.

(b) Eskom staff village at Duynefontein and Thyspunt during the operational phase

It will be expected from the Eskom staff to either purchase or rent existing accommodation in the neighbouring towns of choice. Eskom will not develop staff villages at the Duynefontein and Thyspunt alternative sites. Eskom may discuss the requirements with property developers to cater for any new demand.

5.15 No-Go (No development) alternative

In the context of this project, the No-Go alternative implies that the power station will not be constructed on any of the three alternative sites. The current biophysical, social and economic environments would not be altered by the development of the proposed project.