9 ENVIRONMENTAL IMPACT ANALYSIS

9.1 Introduction

This chapter provides a summary of the potential impacts that have been assessed by the various specialists. The aspects and potential impacts assessed were based on a combination of the following:

- Issues identified ***by I&APs*** during the public participation process;
- Issues identified by ***the*** specialists ***appointed for the Nuclear-1 EIA (hereafter referred to as the specialists)*** as a result of background "desktop" research;
- Experience of relevant specialists with projects of a similar nature or in a similar environment;
- ***Consultation between the specialists and other specialists or residents with local knowledge;*** and
- Environmental resources and conditions identified by the specialists during site surveys (i.e. field-based ground-truthing).

Mitigation measures discussed here are at a high level, and not all detailed mitigation measures ***contained in the specialist report reports*** are reflected in this Chapter. However, all relevant mitigation measures identified in specialist reports have been incorporated into the Draft Environmental Management Plan (EMP) in **Appendix F**.

Three main categories of potential impacts are considered:

- Firstly, potential impacts that the environmental conditions may have on the proposed development i.e. aspects related to the suitability of the environment for development (**Section 9.3** to **9.8**). These studies include the following:
    - Geology and geological risk assessment ***(Appendix E3);***
    - Seismic risk assessment ***(Appendix E4);***
    - Geotechnical suitability assessment ***(Appendix E5);***
    - Hydrological assessment ***(Appendix E6);***
    - Geo-hydrological assessment ***(Appendix E7);***
    - Freshwater supply study ***(Appendix E8); and***
    - ***The risk of debris flows, liquefaction and flooding of the R330 Road on the approach to the Thyspunt site (Appendix E30).***
- Secondly, potential impacts of the development on the biophysical environment (**Section 9.*9*** to **9-1*7***). These studies include the following:
    - Air quality and climate assessment ***(Appendix E10);***
    - Dune Geomorphology assessment ***(Appendix E2);***
    - Botanical assessment ***(Appendix E11);***
    - Freshwater ecology (wetland) assessment ***(Appendix E12);***
    - Terrestrial vertebrate fauna assessment ***(Appendix E13);***
    - Terrestrial invertebrate fauna assessment ***(Appendix E14);***
    - Marine biology assessment ***(Appendix E15); and***
    - ***Oceanographic conditions and surf breaks (Appendix E16).***
- Thirdly, potential impacts of the development on the social and economic environment (**Section 9-18** to **9-29**). These studies include the following:
    - Economic impact assessment ***(Appendix E17);***
    - Social impact assessment ***(Appendix E18);***
    - Visual impact assessment ***(Appendix E19);***

- o Heritage impact assessment ***(Appendices E20);***
- o Agricultural impact assessment ***(Appendix E21);***
- o Tourism impact assessment ***(Appendix E22);***
- o Noise impact assessment ***(Appendix E23);***
- o Human health risk assessment ***(Appendix E24);***
- o Transportation assessment ***(Appendix E25);***
- o Emergency response ***(Appendix E26);***
- o Site control and access ***(Appendix E27);*** and
- o Impacts of nuclear waste ***(Appendix E29).***

Apart from the above-mentioned potential impacts, ***technical*** factors relating to the integration of electricity produced at the nuclear power station into ***the*** South African electricity transmission network have also been considered (**Section 9-2*8***).

The Chapter 9 has been structured by impact category (e.g. botanical impacts, impacts on fauna, impacts on invertebrates, etc.). ***Under each impact category, each of the alternative sites is considered..*** Tabular ratings of potential impacts are provided, together with a short discussion about the impact. However, for a full discussion of potential impacts, readers are referred to the relevant technical specialist studies contained in **Appendix E**.

9.2 Assumptions and limitations

The key assumptions and limitations (i.e. uncertainties and gaps in knowledge) relevant to the EIA Phase are discussed below.

9.2.1 Limitations

The following limitations are relevant to the study:

- The initial application was for a single site (one of three alternative sites). During the course of 2009, Eskom announced its intention to apply for a combined authorisation for the construction, operation and decommissioning of a nuclear power station on all three alternative sites, based on the expected changes to EIA legislation. However, at the time of writing, such amendments had not yet been promulgated and the application has therefore reverted to the original application for authorisation of a single site. Such changes in approach may be confusing to members of the public. The changes in approach to the application are explained in **Chapter 1**.
- As a result of the timing of the Applicant's request to continue with the EIA Phase in 2009, the commencement of fieldwork for specialist studies has in some instances been undertaken outside of the ideal season sampling season. In such cases, additional fieldwork in the appropriate season has been commissioned to ensure adequate confidence in the specialist's predictions. ***For example, additional invertebrate studies in the summer season were commissioned, and ongoing groundwater monitoring was conducted throughout 2010 to confirm the linkage between groundwater levels and wetlands at all three sites.*** Ongoing future studies have been and will continue to be commissioned by Eskom in the future to add to the technical knowledge-base.. ***For example, invertebrate and heritage monitoring will continue during and after the completion of the EIA and prior to construction.***
- ***Potential*** costs associated with the design and construction of a structure that would be able to withstand seismic ***hazard*** has not been included in the economic impact assessment (**Appendix E17**). ***However, an indicative cost for such a structure is shown in the Revised Draft EIR.***
- Limitations as documented by technical specialists in **Appendices E2 to E30**, but not listed here ***separately***.

- ***It is assumed that the NNR will accept Eskom's proposal, adopted from the European Utility Requirements (EUR) for new reactor designs, for emergency planning zones (EPZs) of 800 m and 3 km for the Proactive Action Zone (PAZ) and the Urgent Protective Zone (UPZ), respectively. Should this not be the case, a re-assessment of the impacts in relevant specialist studies and in the EIR may need to be undertaken.***
- The proposed ***PAZ*** of 800 m around the proposed power station places limitations on the degree to which the power station footprint can be moved around on the site to adapt to the site's environmental sensitivities. The power station may not be any closer than 800 m from a public road. This ***may*** place restrictions especially at the Bantamsklip site, where ***the*** public road ***(the R43) is very close (but outside) the EPZ of the reactors.***
- It is a requirement of Section 32(2)(e)(iv) of the EIA regulations (Government Notice No. R 385 of 2006) that the EIR must include copies of any representations, objections and comments received from registered Interested and Affected Parties (I&APs). In this instance, all such representations, objections and comments are included verbatim in the Issues and Response Reports (IRRs) appended to this Report. Inclusion of the original written comments as appendices to the report is impractical due to the volume of these documents. Therefore, these documents will be made available for viewing on request, if required.
- ***The seismic hazard report is based on the current state of knowledge without making provision for results of the Senior Seismic Hazard Analysis Committee (SSHAC) investigations for a Site Safety Report as required by the NNR. Conclusions regarding the seismic suitability of the sites are therefore based on the current state of knowledge.***

9.2.2 Assumptions

The following assumptions are relevant to the study:

- At the time of compiling the EIR, Eskom ***and the South African Government*** had not yet decided on a vendor for the supply of nuclear power station equipment. Thus, an "envelope" of data was used. This envelope includes the highest possible values for various aspects for a range of different nuclear technology vendors. It is assumed that the design specifications of the proposed plant by the approved vendor will conform to the "envelope". If any of chosen vendor's power station characteristics fall outside of the specified envelope, it may have to be re-assessed from an environmental point of view (depending on the degree of variance).
- It has been assumed that mitigation measures identified in this EIR, the EMP and in specialist studies will be effectively implemented and continual improvement in environmental outcomes through methodology, technology etc. be implemented.
- It is assumed that should authorisation be granted for the construction, operation and decommissioning of a nuclear power station on any of the alternative sites, Eskom will manage access to the power station site. It is further assumed that Eskom will manage the remainder of the site assessed in this EIA (i.e. outside the ***identified footprint per site***), as well as any additional land purchased or managed by Eskom (e.g. servitudes purchased over adjoining land) for conservation purposes.
- It is assumed that the NNR (being mandated by the NNRA) will respond to Eskom's formal application for a nuclear installation license for the siting, construction, operation, decontamination and decommissioning of the proposed nuclear power station and that the proposed nuclear power station will not be constructed before this license is obtained.
- As advised by the DEA and in terms of the Constitution of the Republic of South Africa (Act No. 108 of 1996) and the NEMA, it is assumed that the DEA is responsible for assessing the potential impacts of the power station on the environment. It is further assumed that in recognition of the dual but distinct responsibility with respect to the assessment of radiation hazards, the DEA, is the lead authority on environmental matters and the NNR is the decision-making authority with respect to radiological issues. It is further assumed that the DEA and the NNR will work in close collaboration

on the assessment of nuclear related matters with respect to Nuclear-1 and that specialist studies relating to radiological issues have been included ***on request from the DEA.***

- Any infrastructure not specified in this EIR and the Application Form (and it revision) fall outside the scope of the application for authorisation.
- Authorisations other than the EIA authorisation (e.g. water use licenses, authorisations for heritage site excavations as well as additional authorisations in terms of amongst others Sections 27, 35, 36 and 38 of the National Heritage Resources Act, 1999 (Act 25 of 1999) and its prescriptions, borrow pit authorisations, licenses for the removal of protected trees, waste permits and other plans, etc.) falls outside the scope of this application. The Applicant will apply for these authorisations through separate processes.
- The EMP is regarded as a dynamic document and will be kept updated by the Applicant as new information becomes available.
- ***Since the Nuclear-1 Draft EIR was provided for public comment, it has been announced that the plans for the Pebble Med Modular Reactor Demonstration Power Plant (PBMR DPP) at Koeberg have been abandoned. Any references to the PBMR and possible cumulative impacts of Koeberg and Nuclear-1 at the Duynefontein site with the proposed PBMR DPP that were found in the Draft EIR have therefore been removed from the Revised Draft EIR.***
- ***Comments of commenting authorities (the Western Cape Department of Environmental Affairs and Development Planning and the Eastern Cape Department of Economic Affairs Environment and Tourism) were not included in the Draft EIR, but have been included in the Revised Draft EIR.***
- ***It is assumed, based on information provided by the Eskom engineering team, that the proposal for piped offshore disposal of spoil (particularly at the Thyspunt site) is technically feasible. Should this not be the case, then a re-assessment of the impacts of spoil disposal proposals would be required.***
- ***It is assumed that the figures provided by Eskom for in the Consistent Dataset are accurate. This assumption applies particularly to the volumes of spoil to be disposed at each of the alternative sites and to the cooling water intake and outlet pipes, since these are critical factors that will determine the nature and significance of impacts on oceanographic conditions and marine organisms.***
- ***In the event of inconsistencies between the Consistent Dataset (Appendix C) and any other data, the Consistent Dataset will be regarded to be accurate.***
- ***The executive summaries of all specialist reports, as well as the executive summary of the EIR, have been translated from English into Xhosa and Afrikaans. In the event of any inconsistencies in meaning between the versions, the English version must be considered as the master copy.***
- ***The content of all reports is accurate on the date of completion of these reports, unless otherwise stated.***
- ***The review of the NSIP undertaken during the Scoping phase of this Scoping and EIA process was based on the NSIP Summary Reports. As stated in this review (an addendum to the Scoping Report), it was not <u>the intention of this review to identify possible shortcomings or opportunities that might occur in the technical reports that have been prepared for Phases 1, 2 or 3 of the NSIP or as a result of changing circumstances in the country since the 1980s.</u> Rather, the purpose was to understand the process by which the then five sites were identified and thus to understand whether the process by which these sites were identified as preferred sites for nuclear development could be regarded as reasonable and feasible for the Nuclear-1 EIA process. As such, the purpose was also to understand what information was available in the NSIP reports and what additional technical information needed to be generated during the EIA process specialist studies. During the Scoping process, it was confirmed that there are no fatal flaws at any of the sites and that the Western Cape and Eastern Cape sites could be regarded as reasonable and feasible for the Nuclear-1 EIA process.***

9.3 Geotechnical suitability of the sites

The geotechnical assessment ***(Appendix E5)*** assesses the suitability of the soil and geological conditions for the construction of structures. The geotechnical assessment was based on a desk study of historical information as well as on extensive data gathered through intrusive field investigations.

9.3.1 Duynefontein

The key findings of the geotechnical investigation at Duynefontein are as follows:

- The site soil profile differs from Thyspunt and Bantamsklip in that it is almost homogeneously 20 m thick everywhere on the site;
- The geotechnical properties of these soils are relatively consistent across the site;
- The groundwater table is elevated on this site and occurs between 4 and 10 m below natural ground level;
- The soils have no cohesion and when saturated, and will require innovative slope stabilisation techniques for any proposed excavations;
- The overburden sands are underlain by Malmesbury rocks consisting of a succession of greywacke, hornfels, mudstone, siltstone and shale, all of varying competence; and
- The greywacke and hornfels are more competent than the mudstone, siltstone and shale, which are all more prone to weathering.

9.3.2 Bantamsklip

The key findings of the geotechnical investigation at Bantamsklip are as follows:

- The site soil profile varies less in thickness than the Thyspunt site as one moves inland, ranging from 0 m thick (at the sea) to almost 20 m thick within the dune area;
- The geotechnical properties of these soils are consistent across the site and significant calcretised zones are encountered;
- The groundwater table is situated just above the bedrock;
- The soils have no cohesion and when saturated, will require innovative slope stabilisation techniques for any proposed excavations, but the presence of calcrete will provide some assistance in this regard;
- The bedrock is dominated by quartzitic sandstones of the Peninsula Formation; and
- These quartzitic sandstones are highly jointed, but competent and present a more competent wave cut platform than at Thyspunt.

9.3.3 Thyspunt

The key findings of the geotechnical investigation at Thyspunt are as follows:

- The site soil profile varies considerably in thickness as one moves inland, ranging from 0 m thick (at the sea) to almost 60 m thick within the dune area;
- The geotechnical properties of these soils are consistent across the site and random calcrete zones are encountered;
- An intergranular aquifer exists at the site, the groundwater table daylights at the sea and there is a variance in depth to the groundwater table in the dune area;

- The soils have no cohesion and when saturated, will require innovative slope stabilisation techniques for any proposed excavations;
- Two dominant geological formations are encountered under the soils, namely the Skurweberg and Goudini Formations;
- The Skurweberg Formation is located nearer the sea and the Goudini Formation more inland;
- The quartzitic sandstone Skurweberg Formation is marginally more competent (harder and more resistant to erosion) than the carbonaceous sandstone Goudini Formation; and
- An historical erosion depression containing cobbles exists in the Goudini Formation and this cobble layer influences groundwater flow direction in a South Easterly direction.

9.3.4 Recommended mitigation measures

Slope stability will be enhanced by dewatering prior to excavation and by maintaining flatter slope angles. In areas where overburden thickness is less (20 m or less), lateral support systems can be optimally designed to maximise slope angles and minimise excavation volumes.

The recommended mitigation measures for the respective sites are:

- ***Duynefontein: explore the feasibility of lateral support systems to retain approximately 20 m of overburden and minimise excavation volumes, all within an effectively dewatered site;***
- ***Thyspunt: place that part of the site to be founded on bedrock near the sea and minimise the excavation volumes and slope stability risks by siting in areas of less overburden thickness. Once again, this must be done within an effectively dewatered site;***
- ***Bantamsklip: place the site near the sea and minimise the excavation volumes and slope stability risks by positioning in areas with less overburden. This must be done within an effectively dewatered site.***

The mitigation measures at all the sites emphasize the importance of placing the power station footprint as close as possible to the sea. However, as indicated later in this report, a 200 m buffer has in all cases been maintained between the high water mark and the power station footprint. This buffer has been specified in order to avoid the impacts on heritage resources, to protect sensitive fauna and flora communities (e.g. coastal springs) and to protect the power station against possible sea level rise due to climate change. This buffer is non-negotiable and has been agreed with all specialists and Eskom.

9.3.5 Site disturbance

The mitigation measures proposed for slope stability integrity are mirrored for site disturbance as the aims are to minimize slope height (excavation depth), thus minimising excavation volumes and disturbed area. At Thyspunt and Bantamsklip, site disturbance will be reduced should the site be located within the thinner overburden areas at the sea.

9.3.6 Effectiveness of mitigation measures

Placing the proposed plant footprint in areas with less overburden will have a marked effect on reducing impacts. This is not possible at the Duynefontein site as overburden material is homogeneously distributed across the site.

9.3.7 Recommended monitoring and evaluation programme

It is imperative that dewatering efficiency is monitored at all times to ensure excavated slope integrity. No other monitoring requirements are necessary.

9.3.8 Conclusion

Potential environmental impacts that could alter the functioning of the natural geotechnical environment are related to:

- Slope instability in rocks and soils during and post construction resulting in safety risks to people and to a lesser extent the environment;
- Geotechnical conditions (and specifically overburden thickness and groundwater profiles) dictating that large site disturbances will occur in excavations (that will need to be battered back to angles in the range of 20º); and
- The disposal of excavated spoil.

The potential impacts related to slope stability imposing safety risks without mitigation measures have low significance and consequences at all of the sites, as slope stability design techniques will be employed to deal with these issues. Standard slope stabilisation techniques in sands will almost certainly mean that excavated slopes will need to be battered back to flat angles (i.e. cut back to acute angles in the range of 20º) to limit the potential for slope failure. This leads to the overriding impact (resulting from flat slope angles) of larger volume excavations being required, leading to larger excavation footprint disturbances and a need for disposal of greater volumes of spoil.

The impacts associated with this (without mitigation) are of low significance at all three alternative sites. With mitigation, which essentially involves locating the excavations near the sea at Bantamsklip and Thyspunt, the significance of associated impacts continue to be low at all sites.

Table 9-1: Geotechnical suitability at all three alternative sites

Impact[1]	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	Significance
1A. Slope failure, leading to safety risks	*Negative*	*Medium*	*Low*	*Low*	*High*	*Low*	*High*	*Low*
1B. Mitigated	*Negative*	*Low*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*
2A. Failure of rock slopes, leading to safety risks	*Negative*	*Low*	*Low*	*Low*	*High*	*Low*	*High*	*Low*
2B. Mitigated	*Negative*	*Low*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*
3A. Excessive site disturbance, resulting in environmental damage	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Low*	*High*	*Low*
3B. Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*

[1] ***Throughout this chapter, "A" indicates an impact without mitigation, and "B" indicates the corresponding impact with mitigation.***

9.4 Seismic suitability of the sites

The seismic specialist study is contained in Appendix E4.

Stress release in the earth's crust causes movement along faults at surface or at depth, resulting in earthquakes with noticeable to severe ground movement especially in unconsolidated media. Seismic shockwaves and aftershocks are transmitted with velocities and amplitudes dependent on the rock media through which they travel. The design of a nuclear facility has to be able to survive a "design basis" seismic event, which is determined by the characteristics of the site. It is possible to engineer a design capable of meeting the seismic criteria (generally accepted internationally to be in the order of 0.3 g Peak Ground Acceleration [PGA] for intra-plate sites similar to South Africa) and therefore the safety requirements. There is no physical upper limit for the seismic design of a nuclear power stations, but increasing the specification to seismic criteria above 0.3 g increases both cost and time required for design of the power station[2].

The assessment of potential environmental impacts related to the seismic risk associated with a nuclear power station is significantly interrelated to other areas of impact assessment, particularly geology and geotechnical factors. Hence, much of the work involved in the characterisation of the seismic hazard at a particular site is involved with the identification of seismic sources, characterisation of their activity, development of attenuation of ground motion between the source and the power station site, and the site response below the Nuclear Island.

The seismic hazard assessment provides an evaluation of ground-motion vibratory hazard as well as of the hazard for deformation at or near the surface, in order to determine the suitability of the three alternative sites as nuclear power sites, based on the work carried out to date. Further studies have been identified and are being performed, in order to permit adequate engineering solutions to geologic and seismic effects at the sites.

9.4.1 Objectives

The objectives of the seismic hazard ***assessment are*** to:

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- ***Describe the baseline conditions that exist in the study area and identify any sensitive areas that would need special consideration;***
- ***Ensure that all issues and concerns and potential environmental impacts relevant to the specific specialist study are addressed and recommend the inclusion of any additional issues required in the Terms of Reference, based on professional expertise and experience. Also consider comments on the previous specialist studies undertaken for the NSIP undertaken during the 1980s - 1990s;***
- ***Provide a brief outline of the approach used in the study, as well as assumptionsssumptions, sources of information and the difficulties with predictive models;***
- ***Indicate the reliability of information used in the assessment, as well as any constraints/limitations applicable to the report (e.g. any areas of insufficient information or uncertainty);***
- ***Identify the potential sources of risk to the affected environment during the construction, operational and decommissioning phases of the proposed project;***

[2] The KNPS aseismic bearings are understood to have added 10% to the civil construction cost of the plant and the extra design and analysis required for such a system could increase the overall project schedule by some 24-36 months (*pers. comm*. Dave Nicholls, Nuclear Engineer Eskom).

- *Identify and list relevant legislative and permit requirements applicable to the potential impacts of the proposed project;*
- *Include an assessment of the "no go" alternative and identified feasible alternatives;*
- *Assess and evaluate potential direct and indirect impacts during construction operational and decommissioning phases of the proposed project;*
- *Identify and assess any cumulative effects arising from the proposed project;*
- *Undertake field surveys, as appropriate to the requirements of the particular specialist study;*
- *Identify areas where impacts could combine or interact with impacts likely to be covered by other specialists, resulting in aggravated or enhanced impacts and assess potential effects;*
- *Apply the precautionary principle in the assessment of impacts, in particular where there is major uncertainty, low levels of confidence in predictions and poor data or information;*
- *Determine the significance of assessed impacts according to a Convention for Assigning Significance Ratings to Impacts;*
- *Recommend practicable mitigation measures to minimise or eliminate negative impacts, enhance potential project benefits or to protect public and individual rights to compensation and indicate how these can be implemented in the final design, construction, operation and decommissioning of the proposed project;*
- *Provide a revised significance rating of assessed impacts after the implementation of mitigation measures;*
- *Identify ways to ensure that recommended mitigation measures would be implemented, as appropriate; and*
- *Recommend an appropriate monitoring and review programme in order to track the effectiveness of proposed mitigation measures.*

9.4.2 Methodology

The National Nuclear Regulator Act, 1999 (No. 47 of 1999) regulates, amongst others, the seismic design criteria and safety assessments with respect to the construction and operating of nuclear power plants in South Africa. The geological and geophysical investigations performed for the placement of a new nuclear power plant are further subject to international regulatory requirements (IAEA, 2002). At present there are no specific South African regulations for seismic and geological issues related to the licensing of nuclear power plant sites, but the NNR requires that current state of the art and best engineering practice be applied in assessments which impact on safety.

The following US NRC (United Stated Nuclear Regulatory Commission) codes have been consulted in determining the current seismic hazard levels for the sites:

- *10 CFR (Code of Federal Regulations) Part 50, Appendix A, "General Design Criteria for Nuclear Power Formerly NUREG-75/087 Plants", General Design Criterion 2 – "Design Bases for Protection Against Natural Phenomena;*
- *10 CFR Part 100, "Reactor Site Criteria"";*
- *10 CFR100, Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Pants""; and*
- *NUREG 0800 – Standard Review Plan (Revision 6 – March 2007). This Standard Review Plan is intended to guide the U.S. Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. "Standard Review Plans are not substitutes for regulatory guides or the U.S. NRC's (NRC) regulations and compliance with them are not required".*

The following regulatory guides provide information, recommendations and guidance and in general describe a basis acceptable for implementing the requirements General Design Criterion 2, Part 100, and Appendix A to Part 100:

- ***Regulatory Guide 1.132, "Site Investigations for Foundations of nuclear power plants";***
- ***Regulatory Guide 4.7, "General Site Suitability Criteria for Nuclear Power Stations".***
- ***Regulatory Guide 1.165 – Identification and characterization of seismic sources and determination of Safe Shutdown Earthquake Ground Motion (SSEGM) (1997): This guide has been developed to provide general guidance on procedures acceptable to the USNRC for (1) conducting geological, geophysical, seismological, and geotechnical investigations, (2) identifying and characterising seismic sources, (3) conducting probabilistic seismic hazard analyses, and (4) determining the Safe Shutdown Earthquake (SSE) for satisfying the requirements of 10 CFR 100.23 (i.e. 10 CFR 100 paragraph 23). The information collections contained in this regulatory guide are covered by the requirements of 10 CFR Part 50.***

Following the quantification of the seismic hazard for the 3 sites, the US NRC and IAEA published updated regulatory guides. These include:

- ***NUREG-1.208 A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion. The purpose of this regulatory guide is to provide guidance on the development of the site-specific ground motion response spectrum. This represents the first part of the assessment of the SSE for a site as a characterization of the regional and local seismic hazard. It provides an alternative to using the requirements of NUREG 1.165; and***
- ***IAEA SSG-9 Seismic Hazards in Site Evaluation for Nuclear Installations. This site-specific guide also provides guidance to the IAEA member states on the evaluation of seismic hazard at nuclear facilities.***

Additionally, the American Standards Institute (ANSI) and the American Nuclear Society (ANS) have recently published standards including detailed technical requirements to follow for geo-scientific investigations and Probabilistic Seismic Hazard Analysis PSHA of nuclear facility sites:

- ***ANSI/ANS-2.27-2008 Criteria for Investigations of Nuclear Facility Sites for Seismic Hazard Assessments. This standard provides detailed requirements and guidelines to follow in the geo-scientific investigations carried out to determine the inputs of a PSHA for nuclear installation sites.***
- ***ANSI/ANS-2.29-2008 Probabilistic Seismic Hazard Analysis. This standard provides detailed requirements and guidelines to follow in the execution of a PSHA for nuclear installation sites.***

Work is currently in progress to ensure compliance to these nuclear regulatory requirements and will be completed for the nuclear licensing process through various submissions to the South African National Nuclear Regulator.

Since the US nuclear regulatory requirements for seismic hazard analysis are much more stringent and prescriptive than the IAEA requirements these were used to define the study areas as described below.

For the purpose of complying with United States Nuclear Regulations, the area that has to be included in investigations for a Nuclear Power Station is bound by concentric regulatory radii of 320, 40 and 8 km around the proposed site. The following acceptance criteria and compliance were applicable to the studies:

- ***Acceptance criteria and compliance of Site Region (320 km radius).);***
- ***Acceptance criteria and compliance of Site Vicinity (40 km radius); and***
- ***Acceptance criteria and compliance of Site Area (8 km radius).***

9.4.3 General discussion on vibratory ground motion

Stress release causes movement along known or new faults at surface or rock stress release at depth (blind faults) resulting in earthquakes with noticeable to severe ground movement especially in unconsolidated media, resulting in seismic shockwaves and aftershocks being transmitted with velocities and amplitudes dependent on the rock media through which they travel. They are natural phenomena, impossible to predict. The impact of this hazard varies between the three alternative sites and is discussed separately for each site.

9.4.4 Duynefontein

The recent geo-scientific surveys served to largely confirm the position of known faults, and delineate some new features within the Site Region area, Site Vicinity area or the Site Area, some of which should now be added to the fault database.

A prime objective of the surveys around Duynefontein was to find evidence of a fault that could have been responsible for the 4 December 1809 event. Several candidates have been identified in the offshore, but the onshore extension of these structures remains uncertain. The multibeam echo-sounder surveys resulted in a more accurate position for the fault scarp known to have been located by Dames and Moore (1976) about 8 km from Duynefontein. A number of additional fault features that should be included in sensitivity analyses for the SHA have been identified. To date none of the identified structures could be demonstrated as being "capable" (i.e. there will be no further movement in the fault).

Based on the current state of knowledge, there are no disqualifiers that preclude a Nuclear Power Station at the Duynefontein site.

It is noted that the Duynefontein site has the highest seismic hazard (0.3 g). Despite this, the site is suitable for the development of a nuclear power station. This is evidenced by the construction of KNPS, where a standard export power plant, having a seismic design basis of 0.2 g, was modified through the introduction of a-seismic bearings below the Nuclear Island. The National Nuclear Regulator at the time further qualified ***the KNPS*** to a seismic design basis of 0.36 g.

9.4.5 Bantamsklip

The existing geo-scientific surveys served largely to confirm the position of several known faults, and delineate some new features within the Site Region area, Site Vicinity area or the Site Area, some of which should now be added to the fault database.

The results of the surveys confirmed most of the positions of the major faults and added a better understanding of the exact position of some, e.g. the Groenkloof Fault. It was concluded from extensive ground follow-up work that the "Blomerus Fault" does not exist, and that this feature represents a Pliocene-age 50 m palaeo-shoreline. Evidence for the north-westward continuation for the Celt Bay Fault was difficult to interpret due to possibly little lithological contrast. The Bantamsklip site is situated approximately 4.5 km away and midway between the Groenkloof and Elim Faults. No evidence could be found that indicates fault activity since the Late Cretaceous, but new information may be discovered if detailed investigations on the relationships between these faults and the Miocene-Quaternary sediments of this area should be undertaken.

The results of the multibeam and side-scan sonar surveys were very efficient in pointing out underwater fractures in the basement and Table Mountain Group rocks on the Bantamsklip promontory. To date, no evidence of prehistoric strong ground motion could be found in this area, which presently displays very subdued seismicity, but this will be confirmed by future on-land palaeoseismic investigations.

The current hazard at this site is a PGA of 0.23g. Based on the data available at this stage of the geo-scientific investigations, there are no disqualifiers for a Nuclear Power Station at the proposed Bantamsklip site.

9.4.6 Thyspunt

Results of the SHA investigations to date indicate that the information available does not preclude Nuclear Power Station at the proposed Thyspunt site. The geological structure of greatest relevance to a SHA is the offshore Plettenberg Bay Fault. Geological information along a number of existing faults has been updated, and several new and inferred faults have been identified, but to date none of them have been demonstrated to be capable.

The current hazard at this site is a PGA of 0.16g. With the current state of knowledge stemming from the work done to date, there are no disqualifiers for the construction of a nuclear power station at the Thyspunt site.

9.4.7 Cumulative impacts

Since the effects of the site-specific geology on the level of ground-motion are explicitly included in the seismic hazard calculations to assess vibratory ground-motion levels used in the definition of the design parameters, no additional consideration of a cumulative impact is required, other than the consideration of secondary hazards such as fault rupture, liquefaction and slope stability which are discussed in Section 9.3 of this EIR.

The distance between the sites is sufficient to ensure that when considering the three sites together, the impact on each site would be specific to that site and would not be combined with or contribute to the impacts on other sites. This is because each development site has unique geologic considerations that would be subject to uniform site development and construction standards. In this way, potential cumulative impacts resulting from geological, seismic, and soil conditions would be reduced to insignificant. In addition, development on the site would be subject to stringent site development and construction standards that are designed to protect public safety (Council for Geoscience 2011).

9.4.8 Mitigation

- ***The geotechnical and structural civil engineers shall apply the appropriate "seismic design criteria" for the design of nuclear safety and seismic classified utilities, and non classified utilities.***
- ***Eskom must regularly update the expected ground motions and seismic design parameters derived from geological, seismotectonic and palaeoseismic information, as well as instrumentally recorded seismicity, including consideration of all aleatory and epistemic uncertainties associated with the data and models considered.***
- ***The ground motion parameters thus determined are to be used as design input for determining the Safe Shutdown Earthquake Ground Motion while the site is operational as well as during the regulatory period after decommissioning.***
- ***Additional geologic investigations aimed at reducing the uncertainties regarding the geological model for the Site Vicinity area. This includes ongoing fault characterization, followed by the compilation of updated source models. This information will then be utilized in regular updates of the PSHA that will follow current internationally accepted practice.***
- ***Continued seismic monitoring. In terms of global seismicity southern Africa is a stable continental region, with natural earthquakes occurring sporadically in time and space (Council for Geoscience 2011). Owing to the relatively short documented seismic history of the southern African sub-continent most of the available information relates to instrumental data acquired since 1971, with earlier information being derived predominantly based on macro seismic observations.***

- ***The US Code of Federal Regulations recommends the installation of micro-seismic monitoring networks at a Nuclear Power Station. Local networks should be deployed during the siting process to rate sites according to their seismic hazard potential. After the siting process, monitoring should continue so as to re-confirm the suitability of the selected site.***
- ***Seismic monitoring should also continue during operation of the Nuclear Power Station, and even after decommissioning when re-use of the site is considered.***
- ***It is recommended that strong-motion accelerographs be installed on rock outcrops at the Bantamsklip and Thyspunt sites.***

9.4.9 Conclusions

At Thyspunt the onshore regional pre-Quaternary-age geology and tectonics are well understood. Several fault sources (or fault systems) were identified as being potentially capable of generating significant seismic events. Some of the key sources are located offshore, which complicates characterization of these structures. Some of these are only inferred from geophysical exploration, while none of these faults have any correlation with seismicity, or any evidence for reactivation. Based on the current state of knowledge there are no seismic disqualifiers for this site.

At Bantamsklip the onshore regional pre-Quaternary-age geology and tectonics are well understood. The airborne, ground, and marine geophysical surveys conducted by the CGS and Fugro within the Site Area (8 km radius) and part of the Site Vicinity area (40 km radius) to a large extent complemented the known onshore and offshore geology at Bantamsklip. The results of the surveys confirmed the positions of the major faults and added a better understanding of the exact position of some, e.g. the Groenkloof fault. From extensive ground follow-up work the "Blomerus Fault" was reinterpreted as a Pliocene-age 50 m palaeo-shoreline.

Many faults have been identified in the region surrounding Bantamsklip, but are located in an area of very subdued seismicity and no evidence of prehistoric strong ground motion exists. Surface deposits render the characterisation of fault capability of the numerous faults located in close proximity to the proposed site location exceedingly difficult. There is consequently significant uncertainty regarding the seismo-tectonic model for Bantamsklip. Nevertheless, based on the current state of knowledge there are no seismicseismic disqualifiers for this site.

At Duynefontein the onshore regional pre-Quaternary-age geology and tectonics are well understood. The airborne, ground, and marine geophysical surveys conducted by the Council for Geoscience and Fugro, within the Site Area (8 km radius) and part of the Site Vicinity area (40 km radius)), to a large extent complementcomplement the known onshore and offshore geology.

A prime objective of the surveys around Duynefontein was to find evidence of a fault that could have been responsible for the 4 December 1809 event. Several candidate structures have been identified in the offshore, but the onshore extension of these remain uncertain. The multibeam surveys resulted in a more accurate position for the fault scarp known to have been located by Dames and Moore (1976) about 8 km from Duynefontein. Based on the current state of knowledge there are no seismic disqualifiers for this site.

The SHA undertaken to date has determined the PGAs on hard rock of 0.16g, 0.23 g and 0.30 g for the Thyspunt, Bantamsklip and Duynefontein sites, respectively.

9.4.10 Recommendations

As in the case of other nuclear power plants around the world, investigations, studies and seismic monitoring will be conducted to ensure regular updates to the seismic hazard. The methodologies used to perform PSHA are continually evolving and the

most up to date, accepted methodology (according to US NRC and IAEA) will be used in each of the PSHA updates for the alternative sites.

At this point in the seismic hazard assessment process, the largest seismic margin ***(the difference between the actual PGA and the PGA value that is safe for a standard nuclear power station)*** exists for the Thyspunt site i.e. the site hazard is 0.16 g and the standard export nuclear power station is designed for 0.3 g. Hence, this site represents the lowest risk in meeting the plant design value. At the other sites the seismic margin is less, and if the SSHAC site-specific design basis PGA were to exceed the vendor design PGA, then mitigating action would be required. This mitigation may be in the form of seismic bearings or a revised design. Mitigation will have a significant impact on Eskom's programme for Nuclear-1 and the costs would be increased considerably. ***However, CGS (2011) concluded that there are no seismic disqualifiers at any of the three alternative sites and that they would, therefore, all be suitable for the construction of a nuclear power station.***

Table 9-2: Summary of Seismic Suitability at all three alternative sites

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Impact of Vibratory Ground Motion on the power station structure	***Negative***	***High***	***Medium***	***High***	***Medium***	***High***	***Low***	***Medium***
1B: Mitigated	***Negative***	***Low***	***Medium***	***Low***	***Low***	***Low***	***Low***	***Low***

9.5 Geological suitability of the sites

The assessment of potential impacts related to geological risk (**Appendix E3**) is not only significantly interrelated to the seismic hazard of the site but also to the water quality in the area.

Geology and soils effects may differ from those of other disciplinary areas of assessment because many proposed projects or actions will not actually cause effects *on* the geology of soils of an area. Effects, rather, are normally associated with geology or soils as opposed to causing any physical or chemical changes in the characteristics of the actual geology or soils.

The proposed project could have a significant environmental impact if it would:

- Expose people or structures to potential substantial adverse effects, involving:
  - Surface rupture;
  - Subsurface stability; and
  - Volcanic activity;
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse.

This section and the Geological Hazard Assessment therefore identifies and evaluates geologic conditions at the project site that could affect, or be affected by implementation of the proposed project and recommends mitigation measures to avoid or lessen potential impacts. A summary of the potential impacts is given in **Table 9.5** below.

Geological hazards have been investigated within consecutive radii of 320, 40 and 8 km around the proposed alternative sites as required by several United States Nuclear Regulatory Commission guidelines (see references in the specialist report).

9.5.1 Duynefontein, Bantamsklip and Thyspunt

The potential impacts on the sites and the significance of the potential impacts for all of the sites under consideration are identical and will thus be treated as one discussion in the sections to follow.

Although vibratory ground motion resulting from tectonic movement along geological faults is related to geological hazards, this aspect is discussed in the section on seismic hazard, and is therefore not repeated here.

(a) Surface Rupture

- This refers to the identification of any capable faults that may cause surface deformation as a result of tectonic faulting. According to the guidelines provided by the US Nuclear Regulatory Commission and specifically 10 CFR100, capable fault is defined as a fault that exhibit on or more of the following:
  - Movement at or near the ground surface at least once within the past 35 000 years or movement of a recurring nature within the past 500 000 years.
  - Macro-seismicity instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault.
  - A structural relationship to a capable fault according to the above two points such that movement on one could be reasonably expected to be accompanied by movement on the other.

The impact intensity of surface rupture will vary depending on where it occurs, but is in general expected to be low for the natural environment and medium for the nuclear power station.

The intensity of the environmental impact resulting from surface rupture may increase in the event that it causes critical damage to the nuclear power station facility. The significance of the potential impact is low and the likelihood of it occurring improbable and remains low after mitigation.

Although a number of faults occur within the Thyspunt Site Vicinity, no faults with demonstrable neo-tectonic reactivation have been found on this area.

Since the Bantamsklip site is situated in a fractured part of the Cape Fold Belt (called the syntaxis), the basement rock of the Site Vicinity and part of the Site Region are intensely faulted. At present there is no primary evidence to suggest post-Tertiary movement of any faults within a 40 km radius of the Bantamsklip site. There is no evidence of faults in the offshore Bredasdorp Basin having been active after the 93 Ma old 15At1 unconformity.

The Duynefontein <u>regional</u> area of investigation contains some of the most faulted parts of the Cape Fold Belt, with current prominent seismicity in the Ceres– – Tulbagh area. Several inferred faults have been proposed based on geophysical work, but very little detailed work has been done on these and in some cases the nature. The most important of these is the <u>inferred</u> Melkbos Ridge Fault identified from the multibeam imagery of the Duynefontein extended marine area. It is an offshore lineament (previously called the Table Bay Fault), a magnetic low with apparent displacement of a dyke anomaly west of Milnerton. In addition, several geophysical lineaments and other features have been described in the Duynefontein Site Area, but the evidence for considering these as faults is weak.

(b) Subsurface stability

Subsurface stability refers to any potential surface or subsurface subsidence, solution activity, subsidence or uplift. The Thyspunt and Bantamsklip sites are underlain by quartzitic sandstones of the Table Mountain Group, which are stable and highly resistant to weathering.

No evidence of liquefaction-induced structures was observed at Duynefontein, but it is well-known that the 4 December 1809 M>6 events in Cape Town induced extensive liquefaction (primarily in the wetlands around Rietvlei), as far north as Bloubergsvlei, a farm located 11 km south east of the KNPS In addition, the sand of the Duynefontein plume of the Witzand Formation is an important aquifer that serves as a source of potable water for municipal areas within the area served by the City of Cape Town. Water can therefore be expected to accumulate on the interface between Cenozoic-age deposits and the deeply weathered clays of the Malmesbury Group. Also, clay layers within successions such as the Springfontyn Formation could act as aquicludes, preventing effective drainage and inducing conditions in sands that are ideal for liquefaction by seismic shaking.

However, the likelihood of this event occurring is improbable. ***If it*** were to occur the significance would be medium.

(c) Volcanic activity

Any active or recently active volcanoes within the site vicinity of a nuclear power station would constitute a risk to such a facility. However, sedimentary rocks of various ages dominate the surface geology at all three alternative sites. Intrusive rocks are primarily represented by the (Neoproterozoic) Cape Granite Suite at Bantamsklip and Duynefontein as well as Mesozoic dyke swarm between Milnerton and Bloubergstrand (Duynefontein). There is no evidence to suggest any Cenozoic-age ***(i.e. within the last 65 million years)*** volcanic activity at any of the three alternative sites.

Thus, the nature of the lithology suggests that the likelihood of a volcanic event occurring is highly unlikely.

(d) Cumulative impacts

Potential geological impacts related to the proposed development involve hazards associated with site-specific soil conditions, erosion, slope stability, surface rupture and groundshaking during earthquakes. Since hazardous events of this type, as well as seismological activity, occur infrequently in this region and display high return periods, the cumulative, incremental impact resulting from repeated events in the geological, tectonic and seismological environment is expected to be low.

The three localities under review are thus considered suitable locations for nuclear power stations following extensive investigations. ToT date no geological evidence has been found that would halt the development of a nuclear power station at any of these ***alternative*** sites.

(e) Mitigation measures

- Foundations of the structures to be sunk into solid bedrock ***or engineered foundations***. where required;
- Construct vibration/shock absorbers between the turbines and ***support structure, if required***;
- A thorough assessment of the area excavated for nuclear power station footprint to uncover the presence of any undetected capable faults;
- Incorporating the results of the geological investigations to aid in the selection of an appropriate nuclear power station design; and
- The results of the geological and seismological studies should be used as design input for determining the Safe Shutdown Earthquake Ground Motion (SSEGM) during operation as well the regulatory period after its decommissioning.

9.5.2 Conclusion

The proposed nuclear power stations will have very little effect on the geological environment. ***However,*** potential impact of the geological environment on a nuclear power station and associated infrastructure is much bigger and may pose a risk to the proposed development.

Given the long return periods employed in geological studies the geological risk remains relatively constant throughout the different project phases of construction, operation and decommissioning. The three proposed nuclear power station sites are furthermore exposed to very similar geological environments. Changes in the geological environment resulting from the mass movement of rock or soft sediment are considered improbable, especially as all three sites are situated on stable plains far away from potentially unstable slopes of higher gradient.

Various mitigation measures such as the erection of rock fall barriers and sinking of foundations into bedrock, may be considered, but are not considered necessary. With the exception of the impact of the Atlantis Aquifer at the Duynefontein site, the risk of subsurface instability is low. Even in the case of the latter it can be mitigated against by monitoring the level of the said aquifer. Geologically there are no sensitive areas that need to be avoided at the Bantamsklip and Duynefontein sites. At the Thyspunt site the foundation of critical structures should not cross the contact between the Goudini and Skurweberg Formations.

Generally, fault rupture and volcanic activity represents more serious geological hazards to a nuclear power station, as they have the potential to cause the failure of the facility's safety systems. There is however no evidence of any recent volcanic activity within the site region of any of the three proposed alternative sites.

In summary, current information related to the site suggest that there is a low geological risk and no disqualifiers for any of the three proposed sites and surrounding natural environment ***based on current information.***

Table 9-3: Summary of Geological Hazard Impacts at all three alternative sites

Impact	Nature	Intensity	Extent	Duration	Impact on Irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Surface Rupture: Capable faults that may cause surface deformation as result of tectonic faulting	***Negative***	***Medium***	***Medium***	***High***	***Medium***	***Medium***	***Medium***	***Medium***
1B: Mitigated	***Negative***	***Low***	***Medium***	***High***	***Medium***	***Low***	***Low***	***Low***
2A: Subsurface Stability: Potential subsurface subsidence or uplift	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
2B: Mitigated	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
3A: Volcanic Activity: Any recently active volcanoes within site vicinity	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***Low***	***Low - Medium***
3B: Mitigated	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***Low***	***Low - Medium***

9.6 Hydrological suitability of the sites

The hydrological assessment (***Appendix E6***) investigated the suitability of the sites in terms of the hydrological conditions and features streams, rivers and other forms of watercourses. It assesses the potential for the generation of stormwater and the potential impacts that this may have on the sites. A summary of the potential impacts is given in **Tables 9-9 to 9-12** below.

With respect to hydrological impacts, the operational phase (expected to be about 60 years) of the proposed project will be the longest phase of the total project and therefore the probability of having a 1:10 000 year rainfall event is greater than for the construction phase (which is expected to be about shorter than 10 years). The probability of occurrence of a 1:10 000 year event is only 0,0001 in any one year but is 0,00995 during a period of 100 years. Thus, the probability of a 1:10 000 year rainfall event is higher during operation than during construction. The confidence in the impact prediction, is also lower for the operational phase than for the construction phase due to the need to extrapolate rainfall data, which is not available for the 1:10 000 rainfall event. The 1:10 000 year event is specifically selected in the case of Nuclear Installations as required by the International Atomic Energy Agency (IAEA) Safety Standards Series, Safety Requirements.

9.6.1 Duynefontein

The direct potential impacts relating both to the construction and operational phases of the project are directly related to increased run off associated with the hardened surfaces. In turn this also increases the erosion potential in and around the site. Storm water can potentially wash pollutants in and around the site to the neighbouring watercourses and the ocean, should mitigation measures not be put into place.

During the construction phase, it is predicted with a high level of confidence that the potential impact the project will have at this site will be of low***-medium*** significance. The implementation of recommended mitigation measures will further significantly negate the residual adverse impacts.

The potential cumulative impacts are of low significance at a local level, the reason being that this site is isolated and the most significant cumulative impact relates to the commercial and residential activities in the area. Increased run-off from hardened surfaces will impact on surface water bodies and the ocean should mitigation measures not be implemented.

An insignificant potential impact is predicted on a regional level due to no significant water resources in close proximity to the proposed nuclear power station.

9.6.2 Bantamsklip

The direct potential impacts relating both to the construction and operational phases of the project are directly related to increased run off associated with the hardened surfaces. In turn this also increases the erosion potential in and around the site.

As with the the Duynefontein and Thyspunt sites, stormwater can potentially wash pollutants in and around the site to the neighbouring water courses and the marine environment, should mitigation measures not be put in place.

During the construction phase, it is predicted with a high level of confidence that the potential impact of the project will be low. The implementation of recommended mitigation measures will further negate the residual impacts. Confidence in the impact prediction is lower for the operational phase, a result of extrapolated rainfall data which are not available for the 1:10 000 rainfall event, as is required for this type of activity.

The impact is low at a local level, the reason being that this site is isolated and the most significant potential cumulative impact relates to the commercial and residential activities in the area. Increased run off from hardened surfaces will impact on the surface water bodies and the ocean should mitigation measures not be implemented.

A potential impact of low significance is predicted on a regional level due to no significant water resources in close proximity to the proposed nuclear power station.

9.6.3 Thyspunt

The direct potential impacts relating both to the construction and operational phases of the project are directly related to increased run off associated with the hardened surfaces. In turn, this also increases the erosion potential in and around the site.

As with the other two alternative sites, stormwater can potentially wash pollutants in and around the site to the neighbouring watercourses and the marine environment, should mitigation measures not be put into place.

During the construction phase, it is predicted with a high level of confidence that the significance of the potential impact will be low--***medium***. The implementation of recommended mitigation measures will further reduce the adverse impacts.

9.6.4

9.6.5 Mitigation

An internationally accepted approach is the application of ***Best Management Practices*** **(BMPs)** when considering mitigation measures. The BMPs approach is defined as “A Multi-disciplinary approach in applying appropriate technology to preserve the environment and comply with accepted safety standards”. The BMPs can be applied to the following phases of development:

(b) Planning and design phase (Pre-Development)

- Plan the final locality and level of the plant area in order to minimise the impact of the flood hazards;
- Take into account the extreme water levels from the ocean ***due to extreme high water levels and possible Tsunamis, it is recommended that the base*** levels of the ***power station should be at least 10.54, mamsl, 11.02 mamsl, and 14.9 mamsl*** respectively at Duynefontein, Bantamsklip and Thyspunt; and
- Ensure that the plant footprint should, if possible, not be positioned within a water course area.

(b) Construction phase

During the construction phase it will be important to:

- Separate “clean” storm water run-off from “dirty” storm water run-off and minimise the inflow of “clean” storm water run-off into the construction site. The “clean” storm water run-off is defined as surface water emanating from “virgin” undeveloped catchments and “dirty” storm water would emanate from areas with construction activities.
- Ensure that a storm water diversion embankment is constructed around the perimeter of the site to ensure that both catchment run-off and sea water ingress is prevented. This diversion embankment could possibly be constructed to later be incorporated with the final plant level and platform.
- Ensure that a temporary storm water collection sump is installed during foundation excavation activities to allow excess run-off to drain to a defined low area (sump) where any transported sediment could be contained and storm water pumped out. Depending on the nature and content of the sediment this could be pumped to a temporary holding facility and then transported to a waste disposal site. Further details would be obtained

from more detailed water quality studies at a later stage. In terms of Regulation 704 (June 1999) of the National Water Act, 1998 (Act No. 36 of 1998) at least the 1:50 year run-off volume with an 800 mm freeboard would need to be contained. The 1:50 year flood event is significant in the design of the pollution mitigation measures while the 1:10 000 flood event parameter is relevant to nuclear safety.

(b) Operational Phase

At the operational phase it is important to:

- Have designed, sized and implemented all required storm water control and mitigation measures so as to comply with applicable design standards, thereby ensuring the safety of the plant as well as the conservation of the surrounding environment.
- Define any "dirty" storm water run-off from the plant area and prevent this from leaving the plant area. This must be achieved by implementing "dirty" water collection channels at the perimeter of the plant area. To allow for a sufficient hydraulic gradient and flow velocity, the channels should be positioned so as to drain half the site into the south-western corner and the other half into the south-eastern corner. In terms of IAEA Safety Guide No NS-G-3.5, (IAEA, 2003) the drainage system needs to handle up to the 1:50 year storm event.
- The entire plant run-off would need to be contained in dirty water containment ponds. This is currently a conservative approach as not all the plant run-off possibly needs to be classified as "dirty" run-off, thereby reducing the amount of storage required. Further details and refinements would be determined from more detailed water quality control studies.
- In addition to the above, the average monthly operating volume (i.e. that volume accumulating from the plant area due to average monthly rainfall and run-off) would also need to be taken into account. Due to the current uncertainties of the plant size, dirty water areas and imperviousness, a water balance has not yet been carried out. This must be carried out at design phase.
- Implement a surface water monitoring protocol that monitors for the following variables in surface water:
    - Electrical conductivity;
    - pH;
    - Turbidity;
    - ICP metal scan;
    - Volatile Organic Compounds;
    - Nutrients; and
    - Radioactive isotopes.
- Monitor and maintain storm water structures; and
- Maintain a data management system for the storing and analysis of all monitoring data.

9.6.6 Conclusions

For the currently proposed EIA corridor for nuclear plant and auxiliary buildings of the sites there is a potential flood hazard at low points along the coastal frontage of the corridor in the event of an unusually high water level. A flooding hazard due to ponding also exists at each of the alternative sites at the construction phase, due to the open excavations for the plant foundations.

Potential sea level rise due to global warming has little effect on the ***proposed*** nuclear power station and climate change should also have a minor effect on the nuclear power station considering the absence of major watercourse on the sites.

Due to hardening of surfaces at the plant and auxiliary works the storm water run-off volumes and peaks are expected to increase by about 25 to 40 times when compared to the pre-development conditions. All impacts can, however, be reduced with the implementation of mitigation measures.

The major characteristics that differentiate the impacts on the environment at the three sites mainly relate to rainfall, the presence of seasonal wetlands and non-perennial watercourses. Thyspunt has the highest rainfall as well as seasonal wetlands and a non-perennial water course. At Duynefontein the impact on the seasonal wetlands is less since the rainfall is the lowest of the three sites. Rainfall at Bantamsklip is higher than Duynefontein, but there are no directly affected sensitive hydrological features or any ecologically sensitive wetlands. **The direct hydrological impacts at all three sites are of *low to low - medium* significance.**

Table 9-4: Hydrological impacts caused by the proposed nuclear power station at Duynefontein

Impact	*Nature*	*Intensity*	*Extent*	*Duration*	*Impact on irreplaceable resources*	*Consequence*	*Probability*	*SIGNIFICANCE*
1A: Increased run-off peaks due to hardened surface	*Negative*	*Medium*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
1B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
2A: Increased run-off volume due to hardened surface	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
2B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
3A: Disruption during construction: Increased erosion potential	*Negative*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*	*Low - Medium*
3B: Mitigated	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*	*Low*
4A: Disruption during construction: Flooding of works	*Negative*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*	*Low - Medium*
4B: Mitigated	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*	*Low*
5A: Changes in flow paths	*Negative*	*Medium*	*High*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
5B: Mitigated	*Negative*	*Low*	*High*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
6A: Disruption during construction Increased silt deposition due to barren soil	*Negative*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*	*Low - Medium*
6B: Mitigated	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*	*Low*
7A: Pollution of surface waters	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
7B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
8A: Sea level rise	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
8B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*

Table 9-5: Hydrological caused by the proposed nuclear power station impacts at Bantamsklip

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Increased run-off peaks due to hardened surface	Negative	Medium	Medium	High	Low	Medium	Low	Low - Medium
1B: Mitigated	Negative	Low	Low	High	Low	Low	Low	Low
2A: Increased run-off volume due to hardened surface	Negative	Low	Medium	High	Low	Medium	Low	Low - Medium
2B: Mitigated	Negative	Low	Medium	High	Low	Medium	Low	Low - Medium
3A: Disruption during construction: Increased erosion potential	Negative	Medium	Medium	Low	Low	Medium	Low	Low - Medium
3B: Mitigated	Negative	Low	Medium	Low	Low	Low	Low	Low
4A: Disruption during construction: Flooding of works	Negative	Medium	Medium	Low	Low	Medium	Low	Low - Medium
4B: Mitigated	Negative	Low	Medium	Low	Low	Low	Low	Low
5A: Changes in flow paths	Negative	Medium	High	High	Low	Medium	Low	Low - Medium
5B: Mitigated	Negative	Low	High	High	Low	Medium	Low	Low - Medium
6A: Disruption during construction Increased silt deposition due to barren soil	Negative	Medium	Medium	Low	Low	Medium	Low	Low - Medium
6B: Mitigated	Negative	Low	Medium	Low	Low	Low	Low	Low
7A: Pollution of surface waters	Negative	Low	Medium	High	Low	Medium	Low	Low - Medium
7B: Mitigated	Negative	Low	Medium	High	Low	Medium	Low	Low - Medium
8A: Sea level rise	Negative	Low	Medium	High	Low	Medium	Low	Low - Medium
8B: Mitigated	Negative	Low	Medium	High	Low	Medium	Low	Low - Medium

Table 9-6: Hydrological impacts caused by the proposed nuclear power station at Thyspunt

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Increased run-off peaks due to hardened surface	Negative	Low	Medium	High	Low	Medium	Low	Low - Medium
1B: Mitigated	Negative	Low	Medium	High	Low	Medium	Low	Low - Medium
2A: Increased run-off volume due to hardened surface	Negative	Low	Medium	High	Low	Medium	Low	Low - Medium
2B: Mitigated	Negative	Low	Medium	Low	Low	Low	Low	Low
3A: Disruption during construction: Increased erosion potential	Negative	Low	Medium	Low	Low	Low	Low	Low
3B: Mitigated	Negative	Low	Medium	Low	Low	Low	Low	Low
4A: Disruption during construction: Flooding of works	Negative	Low	Medium	Low	Low	Low	Low	Low
4B: Mitigated	Negative	Low	Medium	Low	Low	Low	Low	Low
5A: Changes in flow paths	Negative	Low	High	High	Low	Medium	Low	Low - Medium
5B: Mitigated	Negative	Low	High	High	Low	Medium	Low	Low - Medium
6A: Disruption during construction Increased silt deposition due to barren soil	Negative	Low	Medium	Low	Low	Low	Low	Low
6B: Mitigated	Negative	Low	Medium	Low	Low	Low	Low	Low
7A: Pollution of surface waters	Negative	Low	Medium	High	Low	Medium	Low	Low - Medium
7B: Mitigated	Negative	Low	Medium	High	Low	Medium	Low	Low - Medium
8A: Sea level rise	Negative	Low	Medium	High	Low	Medium	Low	Low - Medium
8B: Mitigated	Negative	Low	Medium	High	Low	Medium	Low	Low - Medium

Table 9-7: Impacts of the hydrological environment on the proposed nuclear power station at all three alternative sites

Impact	*Nature*	*Intensity*	*Extent*	*Duration*	*Impact on irreplaceable resources*	*Consequence*	*Probability*	*Significance*
1A: Rising Sea Level	*Negative*	*High*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
1B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
2A: Highest astronomical tide	*Negative*	*High*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
2B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
3A: Extreme high water level	*Negative*	*High*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
3B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
4A: Frequent high rainfall events	*Negative*	*High*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
4B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*

9.7 Geo-hydrological suitability

The assessment of the suitability of the sites in terms of geo-hydrological conditions is contained in **Appendix E7**.

9.7.1 Background

Extensive and detailed work has been carried out at all three sites as part of this EIR, including a hydrocensus, surface geophysics, drilling, test pumping, packer tests, chemical analysis, numerical flow and transport modelling and monitoring.

Since the release of the Draft EIR in March 2010, an extended groundwater/ wetlands monitoring programme was initiated in February 2010. The purpose of this programme was to improve the confidence in the groundwater models for the alternative sites. This modelling continued for 12 months, and involved the installation of additional boreholes/ piezometers and continuous data loggers. The monitoring database was updated on a monthly basis and further flow modelling was undertaken to process the new data and assess any changes to predicted impacts. This work was carried out jointly with the wetlands specialist. The results of this monitoring programme are referred to in the Wetlands Report (Appendix E12) and Section 9.12 of this Revised Draft EIR.

The three alternative sites are all located in coastal environments. There are, therefore, certain key geohydrological characteristics that are likely to govern groundwater occurrence and behaviour at all three alternative sites. These are:

- ***There is unlikely to be any downstream groundwater use;***
- ***Groundwater at the site will be near / at the end of its flow path;***
- ***There will be a component of groundwater flow towards the water table (i.e. upwards);***
- ***Groundwater levels will be near the ground surface;***
- ***The bedrock may comprise a wave-cut platform;***
- ***The receiving environment / downstream receptor of any contamination will be the shore zone / sea;***
- ***There is likely to be a two aquifer system, with an upper intergranular and a lower fractured rock aquifer;***
- ***These two aquifers are likely to be in hydraulic connection but may be separated by a weathered zone in the bedrock possibly constituting an aquitard;***
- ***Local recharge may only affect the upper aquifer. Deeper aquifers may be recharged further inland, possibly many kilometres the site;***
- ***Groundwater quality may be relatively poor because of a combination of the length of the flow path, time for interaction with aquifer materials and proximity to the sea (sea-water intrusion, wind-blown salts);***
- ***Groundwater flow rates are likely to be relatively slow because of low hydraulic gradients;***
- ***There will be an interface between 'fresh' groundwater from inland and saline groundwater in the shore-zone;***
- ***Groundwater may feed coastal springs or seeps, which may support sensitive ecosystems; and***
- ***Potential leaks of radioactivity will not affect existing groundwater users directly.***

9.7.2 Impacts at Duynefontein, Bantamsklip and Thyspunt

Six potential environmental impacts involving groundwater have been identified at all three alternative sites, namely:

- ***Flooding of excavated areas by groundwater;***
- ***Depletion of local aquifers leading to decreased yield of existing production boreholes;***
- ***Degradation of wetlands / phreatophytes/ seeps/ coastal springs;***
- ***Contamination of groundwater;***
- ***Degradation of infrastructure by corrosion; and***
- ***Contamination of the shore zone by sea water intrusion.***

The discussion of these potential impacts during the construction phase is common to each of the three sites, since the nature and significance of the impacts are generally the same across all three sites.

Flooding by Groundwater (Impact of the environment on the proposed development)

As the natural groundwater levels at the sites are shallow, flooding of excavations will occur once these excavations extend below the water table. Groundwater inflow into excavations will be a safety hazard to construction workers. Without mitigation the intensity (i.e. the management of the impact in relation to the sensitivity of the receiving environment) is assessed to be medium because the natural geohydrological processes (i.e. movement of groundwater) will continue, albeit in a modified way. Localised flow directions may be altered as a result of the change in hydraulic gradient. However, the duration of this potential impact is assessed to be short-term, as once the excavation works have been completed, the environment will mostly recover to equilibrium with groundwater levels and flow directions achieving pre-construction conditions. With mitigation, the intensity is assessed to be low.

Depletion of Local Aquifers (Impact of the proposed development on the environment)

Dewatering the construction areas will result in lowering of the water table, which could deplete the local primary aquifer system. Potential impacts relating to a lowered water table include the threat of decreased yields of existing production boreholes / wellpoints, drying up of wetlands, loss of phreatopytes[3] and subsidence, which could have a detrimental impact on land and buildings. Two wellfields, the Witzand and Aquarius Wellfields, are located in relatively close proximity to the Duynefontein site. However, the latter is only sparsely used and for a non-essential purpose. These well fields could be impacted on, with their sustainable exploitability decreasing due to decreasing borehole yields, although numerical modelling has indicated that this is unlikely, especially with installation of cut-off walls. Without mitigation the intensity is assessed to be low as the natural processes (i.e. depth to groundwater, sustainable borehole yields, etc.) would be negligibly altered. The duration of this potential impact is assessed to be short-term, since the water table will soon attain its pre-construction depth once excavation works are completed.. Mitigation measures could include managed artificial recharge of the primary aquifer with pumped groundwater near to sensitive features and installing cut-off walls around the dewatered excavation areas. With mitigation, the intensity is assessed to be low. The extent of the influence of dewatering on groundwater levels was determined by numerical modelling and shown to be of limited extent. At the Bantamsklip and Thyspunt sites, there are no cumulative impacts relating to depletion of the aquifer systems as there are no other significant developments and / or large-scale groundwater abstraction areas.

It must be noted that the impact of groundwater drawdown on wetlands at Thyspunt has been assessed in detail in the freshwater ecology report (Appendix E12), based on numerical modelling of groundwater monitoring carried out in 2010.

Degradation of Ecologically Sensitive Wetlands / Phreatophytes / Seeps / Springs (Impact of the proposed development on the environment)

[3] Water-loving plants

Although this impact has been assessed in the geohydrological specialist study, a more detailed assessment of the impacts on wetlands has been carried out (Appendix E12). Readers are, therefore, referred to that Appendix, as well as Section 9.12 of this Revised Draft EIR for a discussion on impacts on wetlands.

<u>Contamination (Impact of the proposed development on the environment)</u>

The groundwater resources underlying the sites may potentially be contaminated by the following:

1. ***Saline intrusion: This will have to be considered during the design of a dewatering scheme at any of the sites;***
2. ***Hydrocarbon contamination: Downward migration of leaked and / or spilled fuel, oil and grease into the underlying aquifer system;***
3. ***Hazardous waste contamination: Downward migration of contaminants from on-site waste storage areas;***
4. ***On-site leakage of radioactive effluent;***
5. ***Atmospheric emissions of radioactive contaminants; and***
6. ***Organic and bacterial (microbiological) contamination: Downward migration of contaminants from leakage and / or spillage of sewage on site.***

The intensity of saline intrusion is assessed to be medium as the natural quality of the groundwater, especially in the primary aquifers, may temporarily deteriorate as sea water (which has a significantly greater concentration of salts compared to the groundwater) migrates against the natural hydraulic gradient towards the site. The reversal of the hydraulic gradient from coast to land would be a direct result of the dewatering activities. It is expected that the time frame for which this impact will be experienced is medium-term, as the environment will gradually re-establish equilibrium.

In terms of hydrocarbon, hazardous waste, and organic and bacterial (microbiological) contamination, among others, the intensity is assessed to be low, as the natural quality of groundwater at the sites should not be notably degraded. It is presently not known what types of hazardous wastes may be treated, stored, transported or disposed of, or otherwise managed, at the sites. However, examples are paints and solvents, vehicle wastes (e.g. used motor oil, etc.), mercury-containing wastes (e.g. thermometers, switches, fluorescent lighting, etc.), caustics and cleaning agents and batteries.

It is expected that without mitigation, the quantity of potential non-radioactive contaminants used and / or stored, and spilled and / or leaked at the sites, will be insufficient to extensively contaminate the primary aquifers. With mitigation, the intensity remains low. The impact will be of a short-term nature. For example, the water quality analyses from boreholes drilled at the Duynefontein site showed no indications of degradation of quality due to the operation of the KNPS over the past 30 years.

<u>Corrosion of Infrastructure (Impact of the environment on the proposed development)</u>

Corrosive / aggressive groundwater may impact on foundations and buried services. Corrosion is a complex series of reactions between the water and metal surfaces, the building structure of concrete and cement and materials in which the water is stored or transported. With respect to the corrosion potential of groundwater, the primary concerns include the potential presence of toxic metals, such as lead and copper; deterioration and damage to infrastructure.

In scale forming water, a precipitate or coating of calcium or magnesium carbonate can form on the inside of the piping. This coating can inhibit the corrosion of the pipe, because it acts as a barrier, but it can also cause the pipe to clog. Water with high levels of sodium, chloride, or other ions will increase the conductivity of the water and promote corrosion.

<u>Contamination of the Shore Zone (Impact of the proposed development on the environment)</u>

It has been shown that groundwater naturally flows towards the ocean. For this reason, any contaminated groundwater will discharge to the sea and could potentially be toxic to marine life. Although any contaminants may be concentrated in a small area, flow will be limited to a small area and non-radioactive contaminants will readily dissipate.

There is only one potential impact of groundwater on the shore zone during construction of a nuclear power station, namely the disruption of habitat.

Potential impacts during operation include:

- ***Mortality of organisms;***
- ***Changes in species composition; and***
- ***Accumulation of radioactivity in marine organisms.***

The above may in turn pose risks to the plant. These risks include blockage of water intakes and fouling of the cooling systems by marine organisms.

The impact rating of the potential environmental impacts is summarised as follows for the construction and operational phases:

- ***Flooding by groundwater: Low at all three sites with and without mitigation;***
- ***Depletion of local aquifers: Low at all three sites with and without mitigation;***
- ***Non-radioactive contamination: Low at all three sites with and without mitigation;***
- ***Degradation of infrastructure: Duynefontein overall index slight to serious corrosion and minor scaling. Bantamsklip overall index slight to serious corrosion and minor scaling. Thyspunt overall index non corrosive to corrosive and scaling.***
- ***Contamination with radioactive material: High at all three sites without mitigation and medium with mitigation;***
- ***No go option: Low impact at Bantamsklip and high at Thyspunt and Duynefontein without mitigation, and low at Bantamsklip and medium at Thyspunt and Duynefontein with mitigation.***

The low ratings are largely a function of the sites being situated in coastal zones with groundwater being at/near the end of its flow path and minimal downstream receptors.

9.7.3 Mitigation

Essential mitigation measures at all three sites include the following:

- ***Use of a sea water desalination plant to supply construction and operational fresh water requirements;***
- ***Setting up of a suitably designed groundwater monitoring network to cover water levels and quality in all aquifers/wetlands;***
- ***Use of cut-off barriers around excavations to limit the spread of drawdown during construction;***
- ***Use of managed artificial recharge of groundwater pumped from excavations during dewatering to maintain wetlands/ springs/ seeps and phreatophytes;***
- ***Positioning of the power station on the site within the EIA Corridor such that the impacts identified can be reduced in significance, e.g. avoiding faults/fracture zones and maintaining a 200 m buffer from the high water mark;***
- ***Use of corrosion-resistant foundations, pipes and fittings where infrastructure will be located below the water table;***
- ***Use of nuclear reactor design(s) meeting the National Nuclear Regulator's requirements for normal operational dose emissions and containment of accident emissions; and***

- ***Development of a remediation/mitigation protocol prior to construction so that measures are documented and in place to deal rapidly with any potential on-site contamination incidents or signs that predicted drawdown levels have been exceeded.***

9.7.4 Conclusions

Based on the geohydrological assessment presented in this specialist report, all three sites are environmentally acceptable, in terms of groundwater, for the development of a nuclear power station. Essential mitigation measures at all three sites include the following:

- ***Use of a nuclear sea water desalination plant to supply construction and operational fresh water requirements;***
- ***Setting up of a suitably designed groundwater monitoring network to cover water levels and quality in all aquifers/wetlands;***
- ***Use of cut-off barriers around excavations to limit the spread of groundwater drawdown during construction;***
- ***Use of managed artificial recharge of groundwater pumped from excavations during dewatering to maintain wetlands/ springs/ seeps and phreatophytes;***
- ***Positioning of the power station on the site within the EIA Corridor such that the impacts identified can be reduced in significance, e.g. avoiding faults/fracture zones and maintaining a 200 m buffer from the high water mark;***
- ***Use of corrosion-resistant foundations, pipes and fittings where infrastructure will be located below the water table;***
- ***Use of nuclear reactor design(s) meeting the National Nuclear Regulator's requirements for normal operational dose emissions and containment of accident emissions; and***
- ***Development of a remediation/mitigation protocol prior to construction so that measures are documented and in place to deal rapidly with any potential on-site contamination incidents or signs that predicted drawdown levels have been exceeded.***

9.7.5 Conclusions

Based on the geohydrological assessment presented in this specialist report, all three sites are environmentally acceptable, in terms of groundwater, for the development of a nuclear power station.

The impact rating of the potential environmental impacts is summarised as follows for the construction and operational phases:

Impact	Significance rating	
	Without mitigation	With mitigation
Flooding by groundwater	*Low at all three sites*	*Low at all three sites*
Depletion of local aquifers	*Low at all three sites*	*Low at all three sites*
Degradation of wetlands	*See Section 9.12 and Appendix E12*	
Non-radioactive contamination	*Low at all three sites*	*Low at all three sites*
Radioactive contamination	*High at all three sites*	*Medium at all three sites*
No-go option	*Low at Bantamsklip and high at Thyspunt and Duynefontein*	*Low at Bantamsklip and medium at Thyspunt and Duynefontein*

The low ratings are largely a function of the sites being situated in coastal zones with groundwater being at/near the end of its flow path and minimal downstream receptors.

Overall sensitivity of the sites, based on geohydrological conditions, is rated as follows:

- ***Duynefontein: Low along the coast, increasing in sensitivity inland;***
- ***Bantamsklip: Low; and***
- ***Thyspunt: Low to medium, with the highest level of sensitivity close to the wetlands.***

Table 9-8: Geo-Hydrological impacts at Duynefontein during the construction phase

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Flooding of the excavated areas by groundwater	*Negative*	*Medium*	*Low*	*Low*	*Low*	*Medium*	*High*	*Medium*
1B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
2A: Decreased yields of existing production boreholes	*Negative*	*Medium*	*Low*	*Low*	*Low*	*Medium*	*Low*	*Low - Medium*
2B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
3A: Drying up of coastal springs	Refer to Section 9.12 and Appendix E12 of the EIR.							
3B: Mitigated								
4A: Degradation of wetlands								
4B: Mitigated								
5A: Intrusion of saline water	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*High*	*Medium*
5B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
6A: Hydrocarbon contamination of groundwater	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
6B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
7A: Hazardous waste contamination of groundwater	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*
7B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
8A: Organic and bacteriological contamination of groundwater	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
8B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*

Table 9-9: Geo-Hydrological impacts at Bantamsklip during the construction phase

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Flooding of the excavated areas by groundwater	*Negative*	*Medium*	*Low*	*Low*	*Low*	*Medium*	*High*	*Medium*
1B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
2A: Decreased yields of existing production boreholes	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
2B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
3A: Drying up of coastal springs	Refer to Section 9.12 and Appendix E12 of the EIR.							
3B: Mitigated								
4A: Degradation of wetlands								
4B: Mitigated								
5A: Intrusion of saline water	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*High*	*Medium*
5B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
6A: Hydrocarbon contamination of groundwater	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
6B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
7A: Hazardous waste contamination of groundwater	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*
7B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
8A: Organic and bacteriological contamination of groundwater	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
8B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*

Table 9-10: Geo-Hydrological impacts at Thyspunt during the construction phase

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Flooding of the excavated areas by groundwater	*Negative*	*Medium*	*Low*	*Low*	*Low*	*Medium*	*High*	*Medium*
1B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
2A: Decreased yields of existing production boreholes	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
2B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
3A: Drying up of coastal springs	Refer to Section 9.12 and Appendix E12 of the EIR.							
3B: Mitigated								
4A: Degradation of wetlands								
4B: Mitigated								
5A: Intrusion of saline water	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*High*	*Medium*
5B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
6A: Hydrocarbon contamination of groundwater	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
6B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
7A: Hazardous waste contamination of groundwater	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*
7B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
8A: Organic and bacteriological contamination of groundwater	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
8B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*

Table 9-11: Geo-Hydrological impacts at Duynefontein during the operational phase

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Impact 1: Radioactive and toxic contamination of groundwater	*Negative*	*High*	*Low*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
With mitigation	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
Impact 2: Hydrocarbon contamination of groundwater	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*High*	*Low - Medium*
With mitigation	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
Impact 3: Organic and bacteriological contamination of groundwater	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*High*	*Low - Medium*
With mitigation	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
Impact 4: Decreased yields of existing production boreholes	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
With mitigation	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
Impact 5: Drying up of coastal springs and/or seeps	Refer to Section 9.12 and Appendix E12 of the EIR.							
With mitigation								
Impact 6: Degradation of wetlands								
With mitigation								
Impact 7: Intrusion of saline water	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*High*	*Medium*
With mitigation	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*

Table 9-12: Geo Hydrological impacts at Bantamsklip during the operational phase

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Impact 1: Radioactive and toxic contamination of groundwater	***Negative***	***High***	***Low***	***High***	***Low***	***Medium***	***Low***	***Low - Medium***
With mitigation	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
Impact 2: Hydrocarbon contamination of groundwater	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
With mitigation	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Impact 3: Organic and bacteriological contamination of groundwater	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
With mitigation	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

Table 9-13: Geo-Hydrological impacts at Thyspunt during the operational phase

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Impact 1: Radioactive and toxic contamination of groundwater	*Negative*	*High*	*Low*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
With mitigation	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
Impact 2: Hydrocarbon contamination of groundwater	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*High*	*Low - Medium*
With mitigation	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
Impact 3: Organic and bacteriological contamination of groundwater	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*High*	*Low - Medium*
With mitigation	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
Impact 4: Decreased yields of existing production boreholes	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
With mitigation	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
Impact 5: Drying up of coastal springs and/or seeps	Refer to Section 9.12 and Appendix E12 of the EIR.							
With mitigation								
Impact 6: Degradation of wetlands								
With mitigation								
Impact 7: Intrusion of saline water	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*High*	*Medium*
With mitigation	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*

9.8 Suitability of the sites in terms of freshwater supply

The assessment of the suitability of the alternative sites in terms of the availability of fresh water is contained in **Appendix E8**.

Water requirements for a 4 000 MW nuclear power station will be as follows:

- Normal requirement : 70 ℓ/s
- Construction peak : 104 ℓ/s
- Site establishment : 23 ℓ/s

There are no rivers or perennial streams at any of the three sites and as the nuclear power station will be developed at a coastal site where groundwater is near the end of the flow path. The.only existing groundwater use that could be directly affected is that from coastal springs. Any impacts on these springs, according to the Fresh Water Supply Assessment, will be of a very localised extent. In terms of safety and assurance of supply and given the periodic droughts that affect the areas, the already scarce water supply situation and global warming impacts, establishment of a desalination plant is a very favourable alternative and is in fact Eskom's preferred alternative at all three sites (see **Chapter 5** for the discussion of alternatives).

The potential impacts of the construction and operation of the nuclear power station is summarised in **Table 9-7** to **Table 9-9** below.

9.8.1 Duynefontein

(a) Sea water intrusion

Sea water intrusion could be caused by pumping of supply boreholes (or dewatering/groundwater control measures). This would be a *localised* potential impact of *low* significance. There is currently no on-site use of groundwater ***at Duynefontein.*** Sea water intrusion occurred during dewatering operations for the foundations for KNPS but there are no reports of adverse impacts and this was of a very localised extent.

(b) Installation of beach wells

The installation of beach wells will result in ***an impact of low extent*** in the shore zone of *LowL**-Medium*** significance.

(c) Cumulative impacts

The existing KNPS is supplied with fresh water from municipal sources and potentially from the Aquarius Wellfield (water of poor quality is therefore only being used for game watering). Use of municipal water would put additional strain on local supplies, and supply could not be guaranteed.

9.8.2 Bantamsklip

(a) Sea water intrusion

As with the Duynefontein site, ***seawater intrusion*** could be caused by pumping of supply boreholes (or dewatering/ groundwater control measures). This would be ***an impact of low extent and of low-medium*** significance, ***since there*** is no on-site use of groundwater and no viable aquifers ***on the portion of the site where the power station is proposed.***

(b) Installation of beach wells

The installation of beach wells will result in ***an impact of low extent*** in the shore zone of ***low–medium*** significance and l***ow*** duration.

9.8.3 Thyspunt

(a) Drying up of coastal springs (coastal seeps)

The impact on coastal seeps, although assessed in the freshwater supply report, have been more comprehensively assessed in the wetlands report (Appendix E12) and in section 9.12 of this Revised Draft EIR and are therefore not in this section on freshwater supply.

(b) Sea water intrusion

This potential impact would be ***an impact of low extent and*** of l*ow* significance.

(c) Installation of beach wells

Local potential impact in the shore zone of ***low-medium*** significance and ***low*** duration is expected at the Thyspunt site.

9.8.4

9.8.5 No-go option

In the event that the sites are not developed for nuclear power stations, Eskom may sell the Bantamsklip and Thyspunt properties and non-essential parts of Duynefontein could also be sold. In this scenario the impact is considered to be of low intensity, neutral consequence and low significance for the Bantamsklip site (no aquifers) but of medium intensity, negative consequence and high significance for the Thyspunt and Duynefontein sites, as local groundwater resources could be exploited by private land owners/developers. The main mitigation measure for this scenario would be strict enforcement of conditions applicable to any approved future development of the sites.

9.8.6 Mitigation

Mitigation measures are the same for all three sites and involve the following:

- Use of groundwater during construction.
  - Only use deep (>100 m depth) boreholes on site.
  - Apply sustainable pumping rates derived from credible geo-hydrological testing and analysis.
  - Set target groundwater levels for maximum allowable drawdown.
  - Implement a monitoring programme to provide early warning of any detrimental effects of pumping.
- Long-term groundwater control measures around the nuclear power station during construction
  - Detailed site investigation and numerical simulation to predict effects.
  - Injection of pumped groundwater back into the aquifer to maintain groundwater levels. ***However, these is no guarantee that this will be successful***
  - Coastal location of the nuclear power station.
  - Use of surface water during construction.
  - Tap into a regional scheme rather than a local scheme.
  - Relatively small volumes of water required.
  - Use desalinated water.
  - Installation of beach wells during construction
  - Draw-up an environmental management plan prior to installation.
  - Monitor water levels and quality.
- Disposal of brine during construction.

  - Monitoring by a Marine Ecologist of disposal in the surf zone.
- Use of groundwater during operation.
  - Only use deep (>100 m depth) boreholes.
  - Apply sustainable pumping rates derived from credible geo-hydrological testing and analysis.
  - Continue and expand the monitoring programme to provide early warning of any detrimental effects of pumping.
- Long-term groundwater control measures around the nuclear power station during operation
  - Detailed site investigation and numerical simulation to predict effects.
  - Use of passive systems such as sheet piles/cutoff slurry wall.
  - Coastal location of the nuclear power station.
- Use of surface water during operation.
  - Tap into a regional supply scheme rather than a local scheme.
- Use desalinated water during operation.
  - Source of sea water.
  - Siphon-off from cooling water intake
- Disposal of brine during operation.
  - Disposal by mixing with cooling water discharge
- Atmospheric releases from the nuclear power station (normal plant operation).
  - Coastal location of nuclear power station.
  - Design containment.
  - Monitoring of atmospheric releases.
  - NRR requirement for annual release limits.
- Release of liquid effluent (normal plant operation).
  - Coastal location of the nuclear power station-only some coastal springs could be affected.
  - Containment structures.
  - Monitoring.
- Emergency containment plans.

9.8.7 Conclusion

There is extensive current use of groundwater in the area surrounding the Duynefontein site (Atlantis) but not at Duynefontein itself. The KNPS is connected to the municipal water supply scheme and Nuclear-1 water use would place an additional burden on this source. Desalination of sea water is the most viable alternative for an assured water supply with least environmental impact and it would not be affected by climate change.

The KNPS has been in operation for some 30 years and there are three operational wellfields and a major unconfined aquifer in relatively close proximity to the Power Station. Two of these wellfields form part of the City of Cape Town's domestic water supply network to the Greater Cape Town Area. There is no evidence that emissions from the KNPS have had any measurable effect on these features. Local groundwater close to the reactors shows somewhat elevated tritium levels compared to background levels, but well below being anywhere near levels of concern for health impacts.

There are no viable aquifers on the Bantamsklip site and local and regional surface water sources are fully utilized. The alternative option for surface water supply is import of water from the Riviersonderend-Breede River scheme. However, desalination of sea water is the most viable option for an assured water supply with least environmental impact and would not be affected by climate change.

There is extensive use of groundwater in the surrounding area and coastal springs at Thyspunt. Local and regional surface water resources are under stress and additional draw-off to supply a nuclear power station would exacerbate this situation. The main alternative for surface water supply with least local and regional potential impact is import of water from the Orange River Scheme. However, desalination of sea water is the most viable option for an assured water supply with least potential environmental impact and would not be affected by climate ***change***.

Table 9-14: Summary of Freshwater Supply Impacts at Duynefontein

Impact	Nature	Intensity	Extent	Duration	Consequence	Impact on irreplaceable resources	Probability	SIGNIFICANCE
Construction phase								
1A: Sea water intrusion	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Medium***	***Low***
1B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
2A: Installation of beach wells	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
2B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
3A: Disposal of brine	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
3B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Operational phase								
4A: Sea water intrusion	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Medium***	***Low***
4B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
5A: Disposal of brine	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***High***	***Low – Medium***
5B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

Table 9-15: Summary of Freshwater Supply Impacts at Bantamsklip

Impact	Nature	Intensity	Extent	Duration	Consequence	Impact on irreplaceable resources	Probability	SIGNIFICANCE
<u>Construction phase</u>								
1A: Sea water intrusion	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
1B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
2A: Installation of beach wells	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
2B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
3A: Disposal of brine	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
3B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
<u>Operational phase</u>								
4A: Sea water intrusion	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
4B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
5A: Disposal of brine	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***High***	***Low - Medium***
5B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

Table 9-16: Summary of Freshwater Supply Impacts at Thyspunt

Impact	Nature	Intensity	Extent	Duration	Consequence	Impact on irreplaceable resources	Probability	SIGNIFICANCE
Construction phase								
1A: Drying up of coastal springs/ degradation of wetlands	***Refer to Section 9.12 and Appendix E12 of the EIR.***							
1B: Mitigated								
2A: Sea water intrusion	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
2B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
3A: Installation of beach wells	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
3B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
4A: Disposal of brine	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
4B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Operational phase								
5A: Drying up of coastal springs/ degradation of wetlands	***Refer to Section 9.12 and Appendix E12 of the EIR.***							
5B: Mitigated								
6A: Sea water intrusion	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
6B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
7A: Disposal of brine	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***High***	***Low - Medium***
7B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

9.9 The risk of debris flow, liquefaction and damage to roads at the Thyspunt site

During the period that the Draft EIR was available for comment from March to June 2010, a number of stakeholders with an interest in the Thyspunt site claimed that there could be a significant risk of "debris flows" at the Thyspunt site. These stakeholders included Prof. Fred Ellery of Rhodes University. These claims were based on, amongst others, deposits laid down by the Sand River, the presence of quicksand in previous floods of the Sand River and the November 2007 flood that damaged the R330 at St. Francis. In support of the claims regarding the risk of debris flow, Prof. Ellery provided evidence (in the form of photographs of alluvial deposits), as well as reference to evidence collected by other specialists and academics. The details of this evidence and the findings in response to these claims are documented Appendix E30).

9.9.1 Characteristics of debris flows

The characteristics of debris flows are as follows and a typical debris flow is illustrated in Figure 9-1:

- ***Debris flows initiate on steep slopes, typically 30º or more, with a minimum of 15º. Gravity is the driving force that creates the flows, not entrainment (i.e. picking up and carrying along) of sediment by moving water.***
- ***Debris flows that cause significant destruction are mostly those that are initiated on steeper slopes: 20º and above.***
- ***Debris flows can continue flowing on shallow slopes, at least 1º, until friction dissipates their inertia.***
- ***Water often initiates a debris flow by lubricating the sediment, enabling it to start sliding; extreme rainfall events trigger most debris flows.***
- ***Debris flows stop flowing after a short while and end abruptly: they are "frozen" when they run out of inertia. There are consequently no sedimentary structures like cross-bedding, soft-sediment deformation, etc.***
- ***Biologic material is not necessarily a constituent of debris flows.***

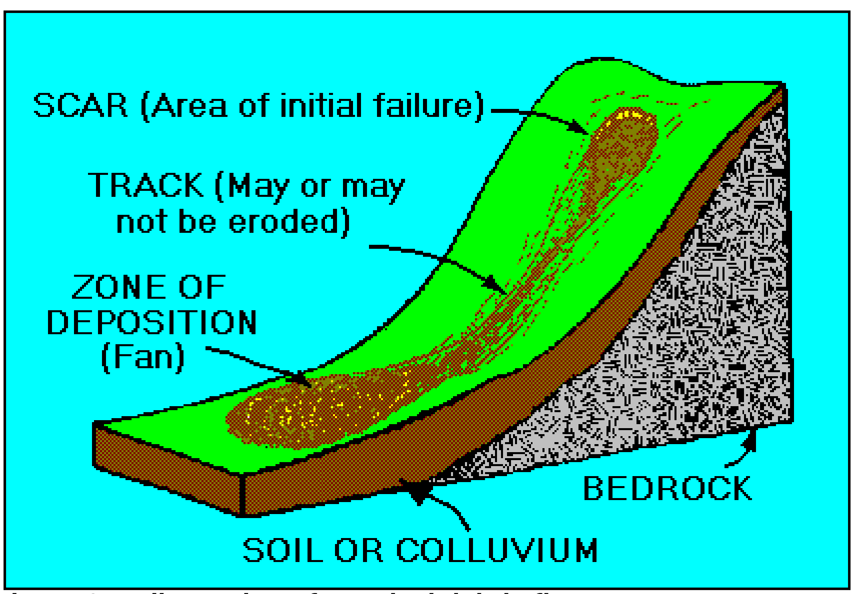

Figure 9-1: Illustration of a typical debris flow

9.9.2 The potential for debris flow at Thyspunt

The dune geomorphology specialist, Dr. Werner Illenberger, came to the following conclusions regarding the potential for debris flow at the Thyspunt site and in the surroundings:

- ***Slopes in the area that are steep enough to initiate debris flows are ridges formed by arms of parabolic dunes and sidewalls of previously mobile dune fields. However, these ridges are composed entirely of sand, and debris flows cannot form in pure sand because water soaks away rapidly into sand.***
- ***The Sand River slopes at 0.67º, which is too shallow to form or sustain debris flows.***
- ***Relevant specialists such as Koos Reddering have studied the photographs of the deposits using image enhancement, and have identified features that could be cross-bedding and soft-sediment deformation, although these are vague, and cannot be positively identified as originating from debris flows. Koos Reddering has mapped the geology of the area in detail and has never seen any debris flow deposits.***
- ***Relevant and knowledgeable specialists including Jenny Burkinshaw, Izak Rust, Pete Illgner and Dr. Illenberger himself have never found evidence of debris flows or debris flow deposits in many field visits to the area, including some visits made shortly after flood events of the Sand River.***

The opinion of the above specialists is that the supposed debris flow deposits provided by Prof. Ellery are river flood deposits of sand, some mud, a few pebbles, and some plant debris, that were entrained and later deposited by the Sand River when in flood. The Sand River carries a high sediment load ("hyper-concentrated flow"), so sedimentary structures are often poorly developed. The sediments were probably deposited by a flood event of the Sand River.

It is concluded that there are no debris flows or debris flow deposits in the Sand River. There are no other environmental conditions in the Cape St. Francis area that are conducive to the formation of debris flows. Thus debris flows do not pose a threat to a potential potential nuclear power station and its associated infrastructure at the Thyspunt site.

9.9.3 The potential for liquefaction of sand

One of the concerns raised by stakeholders at St. Francis was that liquefaction of sand could take place within the mobile dunefields, and amongst vegetated dunes and wetlands that the Eastern Access Route (See Chapter 5 for a description of this route) to the Thyspunt site would traverse, resulting in quicksand that could engulf vehicles, hence making access routes to the possible nuclear power station and its associated infrastructure at the Thyspunt site unsafe.

To this concern, Illenberger (2010) found that quicksands often occur in the mobile dunes of the Oyster Bay dune field: many people have experienced all terrain vehicles being bogged down while driving through the dune field during wet periods. The quicksands are mostly formed when loosely consolidated sand is inundated. A front end loader that was trapped in quicksand during the 2007 floods is an example of this.

It is concluded that vehicles would not be engulfed in quicksands in the Oyster Bay dunefield unless they drive on the bed of the Sand River or around interdune ponds. Vehicles travelling on the R330 are not in any danger of being engulfed in quicksands. The proposed "Eastern Access Route" to the Thyspunt site that would cross vegetated dunes and wetlands would be built to correct engineering specifications including geotechnical surveys with boreholes, etc. It would be designed with suitable foundations to accommodate any poor founding conditions, so that vehicles can safely use the road. The proposed nuclear power station would be founded on solid rock and so quicksands or liquefaction of sand could not have any effect on it.

9.9.4 The potential for flood damage to the R330

A major flood occurred at St. Francis during November 2007. The catchment area and flow path of the flood-water are as shown in Figure 9-2. These floodwaters did not originate from the Sand River (which is situated to the north of where the flooding occurred). A large elongated east-west trending dune ridge separates the Sand River catchment from catchments to the south (Figure 4.1). The catchments to the south are separated by similar but lower dune ridges that are mostly closely spaced. Consequently these catchments are long and narrow.

The table below summarises recent flood events at St. Francis Bay (Ninham Shand, 2008, quoted in Illenberger, 2010). Rainfall was above average, with numerous medium-sized flood events that caused an increase in groundwater level. The November 2007 flood is estimated to be a 1:200 year event that was very localised.

Table 9-17: Rainfall leading up to the November 2007 flood at St. Francis

Date	Total amount	Peak
August 2006	248 mm	165 mm over 3 days
March 2007	176 mm	175 mm over 3 days
May 2007	179 mm	161 mm over 3 days
August 2007	142 mm	56 mm over 3 days
23 November 2007	184 mm over 1 day	120 mm in 4 hours – over very small area

The recent removal of alien vegetation in the catchment of the November 2007 also caused an increase in groundwater level. Groundwater level was thus very high during the last quarter of 2007, so infiltration was reduced and runoff increased proportionally. There was a fire in the catchment in early November 2007 which would have further reduced infiltration rates and increased runoff. All these factors compounded to cause an unusually high amount of runoff. The factors are largely natural.

The catchment for the November 2007 floodwater is formed by the narrow Eastern Valley Bottom wetland that is confined by the aforementioned low east-west trending dune ridges. The floodwater then flowed across the Links Golf Course (Figure 4.2). Runoff from the Links Golf Course augmented the flow, but apparently not to a great extent (Ninham Shand, 2008 as quoted in Illenberger, 2010). The flow path used to follow a natural course across the R330, as shown in Figure 4.1, before St. Francis Bay Village was built. Although storm water pipes had been built under the R330 at this point, the development of St. Francis Bay Village blocked this natural course. Hence the floodwater turned and ran down the R330 and then turned again to cross the R330 to run into the St. Francis Bay Golf Course (Figures 4.1 & 4.4). Some of the floodwater ponded here and soaked away slowly, and some flowed down the length of the Golf Course to eventually discharge into the sea. During this event significant damage was done to the R330 where the floodwater crossed the road.

According to a number of sources, as documented in Illenberger (2010), the most extensive damage to the R330 occurred during a flood in November 1996, when the wing walls on either side of the culvert were damaged and there was some erosion of the tarred surface by water flowing over the road. The road was still wide enough to accommodate two directions of traffic flow. The sand that is transported by the Sand River passes through the culvert under the road during normal flow and flood events. The R330 has been damaged by some of the numerous floods of the Sand River since the road was rebuilt to its current standard in 1989/1990, but damage was minor in that vehicular access was never interrupted.

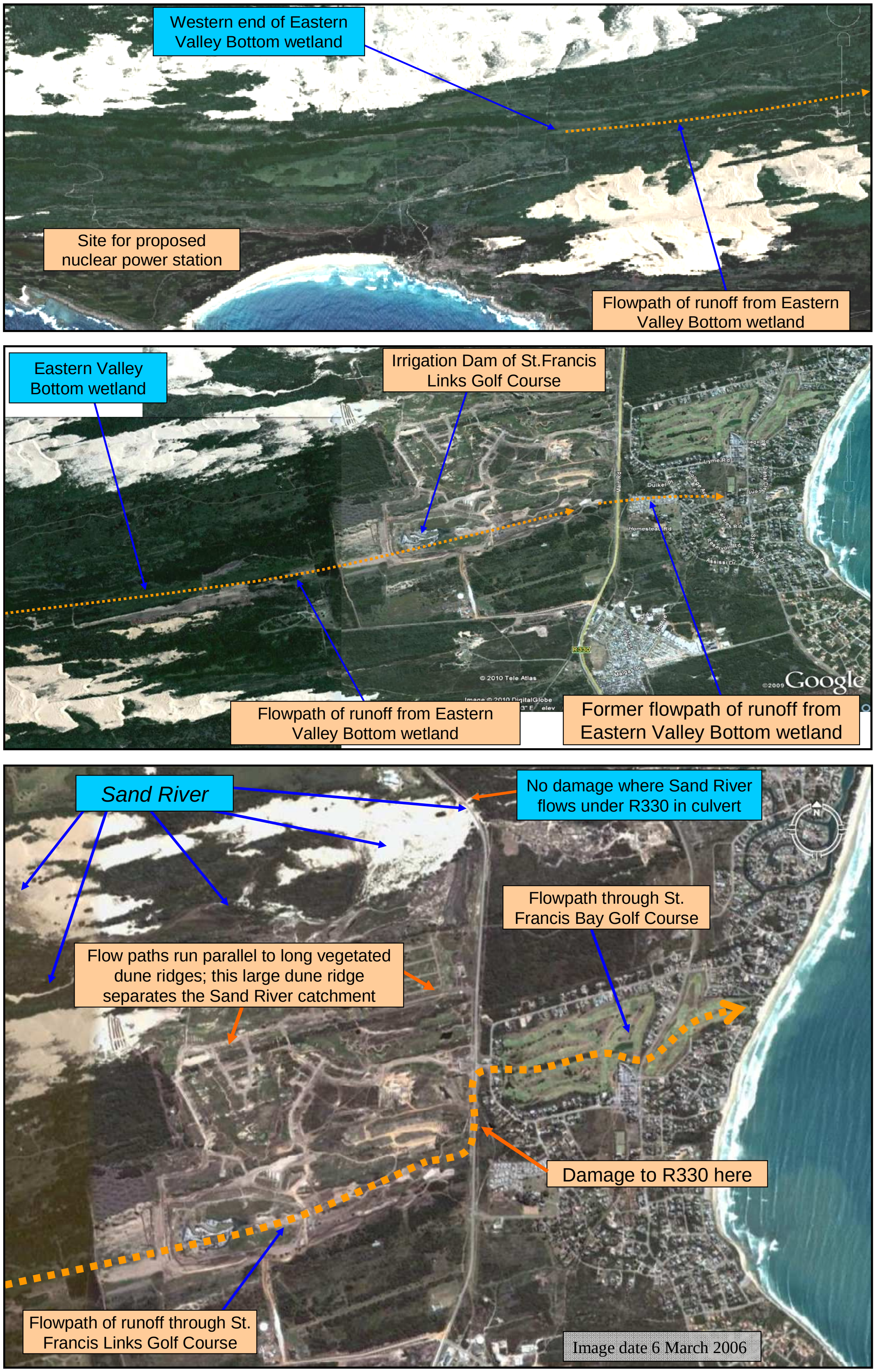

Figure 9-2: Flow path of floodwater that damaged the R330 in November 2007. (The map is in three parts, top to bottom is from west to east)

Based on the above-mentioned findings it is recommended that:

- ***The wing walls on either side of the culvert be repaired;***
- ***Road engineers should check what flood recurrence interval the culvert can handle, and improvements should be made if necessary;***
- ***The culvert should be checked regularly to see that it is not blocked by sand; and***
- ***The culvert should be checked during floods and any debris that is caught across it should be removed.***

9.9.5 Conclusions

It is concluded, based on Illenberger (2010), that:

- ***There is no significant risk of debris flow damage to the nuclear power station or to the access roads to the site, primarily since the slopes of the area are not conducive to (steep enough for) debris flows. According to a number of specialists who have been consulted, there is no evidence of debris flows having occurred in the Thyspunt environment.***
- ***There is a potential for liquefaction of sand within the mobile dunes of the Oyster Bay dune field. The quicksands are mostly formed when loosely consolidated sand is inundated by water. Provided that these areas are avoided (as is proposed, since the power station footprint is located well south of the mobile dune fields), there is minimal risk to the power station and the access roads. There is no evidence of liquefaction along the alignments of the proposed Eastern or Western Access Roads to the Thyspunt site.***
- ***The November 2007 flood event that caused washing away of sections of the R330 at St. Francis was caused by an estimated 1:200 year flood event, preceded by a number of high rainfall events during the preceding months and a downpour of 120 mm in four hours occurring within a very localised area. Other causal factors include the long and narrow nature of the catchment (situated to the south of the Sand River) and a fire in the catchment during early November 2007. The fire reduced infiltration and increased runoff.***
- ***The culverts underneath the R330 have been sufficient to handle most flooding events in recent history, although there is occasional overtopping of the road. The wing walls of the culverts were damaged during a flood in November 2006, and it is recommended that they should be repaired.***

9.10 Impacts on flora and ecosystem functioning

The botanical assessment is contained in Appendix E11.

9.10.1 Duynefontein

(a) Loss of habitat and species

At Duynefontein Eskom has managed its property as a reserve and will continue to be managed in this manner. Most of the proposed EIA corridor and HV yard is located in Cape Flats Dune Strandveld. This vegetation type has a rarity ranking of Endangered (i.e. high rarity). The primary dunes (Cape Seashore vegetation - Least Threatened and low rarity) might also be impacted, depending on what coastal setback is created. Such loss will be locally, regionally and nationally significant and permanent. The footprint would be located in habitat of high rarity. Such loss would be permanent and local, regional and national

All phases are located in areas which have low species rarity. Red Data species losses would be localised and permanent

The **powerlines and access roads** from the proposed nuclear facility would cross the transitional transverse dunes/parabolic dunes (Cape Flats Dune Strandveld) as well as Atlantis Sand Fynbos. Both are Endangered or have high rarity. This would lead to possible local, regional and national losses of this system

Habitat rarity for the transitional transverse dune vegetation is medium whilst that of the acid sandy acid flats is very high. Losses at a local, regional and national level would thus be significant. Species rarity in the transitional vegetation is low, but very high on the sandy acid flats.

(b) Loss of dunes and dune ecosystem function

According to the botanical specialist, construction of a nuclear facility would potentially lead to the loss of most of a large transverse dune system endemic to the lower Cape West Coast. The Duynefontein system is regarded is remarkable for its size (nearly 1 000 ha) and location at the coast. This system is poorly represented in the region, although there is a similar large transverse dunefield to the north-east at Witzand and a similar, but larger, more intact system north of Yzerfontein (protected within the West Coast National Park). ***However, field observations together with the dune geomorphologist confirm that there is fairly substantial inland sand movement from the south-west, suggesting there has either been somewhat of a “correction” in the dune system, or that the south-western source of sand has been present for some length of time, which implies that the impacts on this system may not be as serious as initially anticipated.***

This finding of the botanical specialist contrasts with the findings of the dune geomorphology specialist. According to the dune geomorphology specialist (Illenberger *pers. comm.* 2010), although the dune system at Duynefontein has value, it has been extensively disturbed in the past. .The KNPS was built within the southern portion of this system, and the dune system is therefore far from pristine. In order to minimise the impact of wind blown sand on Koeberg and its associated infrastructure, the area around Koeberg was artificially stabilised through the establishment of vegetation.. The KNPS significantly compromises the supply of sand to the northern portion of the dunefield, although sand supply to the northern portion of the dune field has not been completely interrupted. Illenberger’s opinion is that, from a geomorphological point of view, the impact of the proposed Nuclear-1 on the dune systems would be insignificant, provided that the footprint of the power station is kept to the periphery of the dune system.

(c) Loss of ecosystem function in sand plain fynbos

This system would be affected by and large by the construction of power lines to the south and east of the nuclear facility, as well as access roads. This would lead to the partial loss of ecosystem function, particularly where the pylon bases are located and roads are constructed.

(d) Impacts of sea level rise

The maximum predicted water surface elevation above mean sea level (amsl), taking climate change into account, is 11.2 m, 1.1 m above the present maximum. A 1:100 year sea level floodline based upon the year 2075, allowing for 60 years' operation after possible completion in 2021 has been assumed. It has been noted that the coastline is sandy and that beach erosion is likely to be high, both along the coast as well as if the coastline is breached. In the latter scenario, flooding could occur behind the dunes immediately on the coast.

Primary and transverse dunes would be the most affected, with likely impacts on the functioning of the latter. However, part of the coastline is a raised beach located upon older Pleistocene calcretes and limestones and this is likely to reduce the potential impact of sea level rise to some extent.

(e) Cumulative impacts

Impacts likely to be incurred in the long term and over the operational phase of the facility are chiefly those which would lead to loss of natural habitat fragment and in any way compromise ecosystem functioning. These include loss of the mobile and endemic transverse dunes and associated habitats. If more than one facility is constructed, then losses of transverse dunes habitat as well as impacts on the Sand Plain Fynbos would increase.

(f) Continued conservation of the site

The continued management of the Koeberg Nature Reserve, which entails the whole of the site outside the present nuclear power station, is considered a positive impact. Current multiple-use of the reserve is extensive and conservation management would continue with the new nuclear power station.

Potential impacts likely to be incurred in the long term and over the operational phase of the facility are chiefly those which would lead to loss of natural habitat fragment and in any way compromise ecosystem functioning. These include loss of the mobile and endemic transverse dunes and associated habitats. If more than one facility is constructed, then losses of transverse dunes habitat as well as potential impacts on the sand plain fynbos would increase.

(g) Mitigation

- Any construction of structures associated with the facility should be consolidated where possible, to minimise fragmentation and thus reduce the compromising ecosystem functioning;
- Where possible, power lines should be routed away from sensitive habitats and systems. These include the mobile transverse dunes and the transition between the transverse and parabolic dunes, and the acid sand plain fynbos, to the south-east of the planned facility. Number of pylons should be kept to a minimum (i.e. longer power line spans used) and power line supports where possible located in previously disturbed areas;
- For each phase of construction within natural veld, a search and rescue operation is required which will identify all plants which are either extremely rare (i.e. Endangered or Critically Endangered) or which can be used in site rehabilitation.
- A rehabilitation plan which should ensure that all areas disturbed in the development of the proposed facility are satisfactorily rehabilitated with locally occurring indigenous

species. This must include the collection of appropriate plant material prior to construction's commencing, the storage of such material and/or the growing on of suitable material. Plants would need to be at least two to three years old for use in rehabilitation and thus sampling should commence during the construction period, at least three years before commissioning of the nuclear power station.

- At least two years before commencement of construction an on-site nursery with manager needs to be set up at Duynefontein. A list of appropriate species needs to be drawn up and both seed and cuttings collected, planted out and suitably hardened off.
- Topsoil (0 – 300 mm depth) must be removed from any area being disturbed temporarily or permanently, and stockpiled. Piles should be no more than 1.5 to 2 m high to avoid decrease in aeration, but also too rapid decomposition of organic matter, the latter essential for providing a good start for new plants.
- Stockpiles should be placed in previously disturbed areas and should definitely not be located on natural vegetation. This would lead to the death of the latter.
- Planting of nursery-grown and translocated species should be undertaken at a density set by the rehabilitation specialist, but generally at no less than 1 m apart. Time of planting should be just prior to the commencement of the rainy season in the Western Cape (April/ May) so that plants are provided with good moisture conditions prior to the onset of the summer season some six months later
- A 200 m wide coastal corridor must be maintained between the nuclear power station and the high water mark.

9.10.2 Bantamsklip

(a) Loss of habitat and species

The extent of the proposed EIA corridor and HV Yard comprises some 322 and 207 ha respectively, with the nuclear power station likely to be in the order of 230 ha. Virtually the entire EIA corridor and HV Yard is located on the Least Threatened (i.e. low rarity*)* vegetation type, namely Overberg Dune Strandveld. All phases are located in habitat that either has no Red Data species, or has low to medium rarity. An area of high rarity (coastal limestones) may be affected in the south-east of the footprint, depending on the placement of the nuclear power station within the EIA corridor.

(b) Loss of ecosystem function

Construction of the nuclear power station could lead to the loss of partially stable transverse and stable deflated parabolic dunes. Both these dune systems are, however, well-represented along this coastline. The transverse dunes at Bantamsklip are severely impacted by invasive *Acacia cyclops* rooikrans, and these have artificially stabilised much of this naturally mobile system. However, construction on the eastern end of the western transverse dune system could lead to management challenges in the longer-term, as natural dune movement would still be eastwards. Depending on the placement of the nuclear power station within the EIA corridor, the functioning of the rare coastal limestones on the northern portion of coastline may be also be affected.

(c) Impacts of sea level rise

The maximum predicted water surface elevation above mean sea level (amsl), taking climate change into account, is 10.8 m, 1.4 m above the present maximum. A 1:100 year sea level floodline has been determined for Bantamsklip. It has been noted that the coastline is sandy and that beach erosion is likely to be high, both along the coast as well as if the coastline is breached. In the latter scenario, flooding could occur behind the dunes immediately on the coast. Primary and transverse dunes would be the most affected, with likely impacts on the functioning of both.

(d) Cumulative impacts

Impacts likely to be incurred in the long term and over the operational phase of the facility will include those that fragment and otherwise compromise ecosystem functioning. This applies in particular to the transverse dune systems and coastal limestones. If an additional nuclear power station is constructed (as part of Nuclear-2 and Nuclear-3), then additional losses of the western and eastern transverse dune systems are likely to occur.

(e) Conservation of the site

Whilst the dune systems are fairly well-conserved along the coastline between Hermanus and Cape Agulhas, the inland systems have demonstrated higher rarity and greater conservation importance. The inland systems are on the whole poorly conserved. Any additions to those vegetation types with <10 % protected would make significant contributions to conservation in the region. If a nuclear facility is built at Bantamsklip it would bring some 2 300 ha (the balance of the site after construction of the nuclear power station) of protected natural vegetation to the western Agulhas Plain. To ensure that the benefits of conservation continue to be felt after decommissioning, Eskom would need to retain ownership of the land in perpetuity, or the land would need to be handed over to a conservation body such as CapeNature or South African National Parks Board.

(f) Mitigation

- The coastal limestone should be avoided and if possible, although not essential, the transverse dunes should be avoided.
- Any construction of structures associated with the facility should be consolidated where possible, to minimise fragmentation and thus reduce the compromising ecosystem functioning.
- Internal power lines should not cross the rare and sensitive natural vegetation in the north of the site. Rather they should be routed away from such habitats and where possible placed along the outside of the area.
- Search and rescue operations, rehabilitation plans, a nursery and topsoil management must be the same as for Duynefontein
- A 200 m wide ecological corridor as a minimum width for serving as a conduit for pollinating and fruit-translocating fauna and an enabling area for essential ecological processes, such as dune mobility, pollination, and preservation of major communities.

9.10.3 Thyspunt

(a) Loss of habitat and species

The proposed EIA corridor will impact on the Least Threatened vegetation type (i.e. low rarity), namely Algoa Dune Strandveld, with a smaller area of Southern Cape Dune Fynbos (also Least Threatened) also affected. A small part of the Langefontein Wetland in the eastern extremity of the EIA corridor could also be impacted – such losses would be highly significant and permanent. With the exception of the Langefontein wetlands (very high rarity), the corridor is located mainly in habitat of very low and low rarity. The entire EIA corridor are located in habitat which either has no Red Data species or has low rarity.

The proposed power line alignment would cross stable parabolic and unstable (mobile) transverse dunes between the EIA corridor and the HV Yard. The communities affected here are Least Threatened (i.e. low rarity). The community of highest rarity and highest sensitivity that would be affected is the band of transverse dunes that runs through the centre of the ***Eskom-owned property*** from east to west.

Potential impacts of the proposed eastern access road (from Cape St. Francis) will have a low impact. Impact of the western access road (between the eastern boundary of Oyster Bay and along the coast to the nuclear power station) would have a high potential impact on the northern transverse dunes and mobilising parabolic dunes in this area. The vegetation types affected are all Least Threatened and the alignment could be designed to pass through habitats of low rarity, in particular avoiding any tall thicket and coastal forest which occurs here in patches. However, the dilemma with this alignment is in how the endemic Oyster Bay Cape St. Francis headland bypass dune is viewed. The ***initially proposed (but now rejected)*** northern access road (running roughly south from HV Yard) would ***have*** cut through the mobile northern transverse dune system as well as stable and partially stage parabolic dunes. It would then cross the sandstone wetlands north of the transverse dunes and follow a route over degraded sandstone fynbos within and outside of the "panhandle". Most of the route ***would have crossed*** Southern Cape Dune Fynbos or Algoa Dune Strandveld, which are both Least Threatened (Low rarity). The stabilised dunes along the route are of Low rarity with the mobile transverse dunes being of High rarity, coupled with high sensitivity. The sandstones (Tsitsikamma Sandstone Fynbos are by and large severely degraded, but are nevertheless of low rarity as well. Species rarity, both unweighted and weighted, is very low. The band of wetlands within the transverse dunes as well as just north of the transverse dune system are rated as having High rarity, and are also endemic.

(c) Loss of ecosystem function

Construction of the power station in its proposed present locality would lead to the loss of fairly extensive tracts of partially stable parabolic and stable deflated parabolic dunes. These dunes are well-represented on the Thyspunt site as well as elsewhere along the Eastern Cape coastline. Loss of ecosystem function within these communities is probably low as large, connected tracts of this system would still remain intact post-construction, In addition, there are indications, based upon historical aerial photographs, that the area has been increasingly stabilised in recent times, with a general reduction in extent of mobile sand.

The greatest concern would be the potential loss of wetland function for both the Langefontein and the coastal wetlands (to the south of the site). These two systems are extremely rare and endemic and are essentially irreplaceable. ***In spite of the above-mentioned concern, the geohydrological monitoring and subsequent modelling has confirmed that the impacts on Langefontein can be mitigated.***

Construction of power lines along the proposed alignment would have a negligible effect on dune ecosystem functioning, as long as pylons avoid the mobile part of the transverse dunes. Construction of the eastern access road would have negligible impact on ecosystem function. The western access road could have significant impacts on the functioning of the dune system. The northern access road ***(now rejected) was*** regarded as highly undesirable as it ***would have crossed*** a mobile dune system, which is likely to be heavily compromised by permanent structures built across the flow of sand (eastwards). In addition wetland function could be impacted due to the complex nature of these habitats, which are interwoven with the transverse dunes, and which act as special habitat along the northern boundary of these dunes.

(c) Impacts of sea level rise

The maximum predicted water surface elevation above mean sea level (amsl), taking climate change into account, is 7.4 m, 1.3 m above the present maximum. The coastline is sandy and that beach erosion is likely to be high, both along the coast as well as if the coastline is breached. In the latter scenario, flooding could occur behind the dunes immediately on the coast, especially at Thysbaai itself.

(d) Cumulative impacts

Impacts likely to be incurred in the long term and over the operational phase of the facility will include those which fragment and in any way compromise ecosystem functioning. Key areas of concern are the coastal wetlands and Langefontein, which could be severely compromised in the long term if appropriate mitigation measures are not introduced. The western access road would permanently compromise the western end of the northern transverse dune, whilst construction of a road and, to a certain extent, power lines across the middle of the same transverse dunes could also create long term impacts if mitigation is inadequate. Construction of further nuclear power station phases could also cause further permanent losses of wetland habitat and functioning.

(e) Conservation of the site

The Oyster Bay-Cape St. Francis headland bypass dune (HBD) and its associated wetlands are seen as a key priority for conservation. However, this system is under-conserved with only five reserves in the intact part of the HBD. None of these (Eskom's Thyspunt Natural Heritage Site, the Rebelsrus Private Nature Reserve, Derek Cook Thula Moya, (500 ha) Links Nature Reserve (100 ha) or Sand River Sanctuary Private Nature Reserve) has any statutory status. The HBD is being threatened by urban and related development such as the St. Francis Golf Course and Links. Already 19 % of the HBD has been developed, mainly through residential expansion or golf courses. ***If a nuclear power station were to be built at Thyspunt it would bring some 1 400 ha of four major dune types to a conservation area for the HBD against a relatively small area of 200 – 280 ha for a nuclear power station. If Eskom follows the example of Duynefontein (Koeberg Nature Reserve), a similar reserve could be created here.*** This would be a mayor benefit to the conservation of this area and unique dune system. To ensure that the benefits of conservation continue to be felt after decommissioning, Eskom would need to retain ownership of the land in perpetuity. A preferred option for security of the land would be to hand it over to a conservation body such as Eastern Cape Nature Conservation, Cape Nature or South African National Parks Board.

(f) Mitigation

- The sensitive coastal environment, including any mobile or semi-mobile dunes, should be avoided. In particular both the coastal wetlands and the Langefontein wetlands should be avoided and a suitable buffer of minimum 100 m wide created.
- Where rare habitat, such as the coastal wetlands, stands to be lost or compromised, for example by draw down of groundwater, every effort should be made to adjust development footprints so that such habitat is avoided or loss is minimised.
- The northern access road must be avoided.
- Any construction of structures associated with the facility should be consolidated where possible, to minimise fragmentation and thus reduce the compromising ecosystem functioning. Power lines have less of fragmentation impact than roads more flexible in implementation.
- Internal power lines should not cross the rare and sensitive natural vegetation in the north of the site. Rather they should be routed away from such habitats and where possible placed along the outside of the area.
- Search and rescue operations, rehabilitation plans, a nursery and topsoil management must be the same as for Duynefontein
- A 200 m wide ecological corridor as a minimum width for serving as a conduit for pollinating and fruit-translocating fauna and an enabling area for essential ecological processes, such as dune mobility, pollination, and preservation of major communities.

9.10.4 Conclusion

The location of the HV Yard at Thyspunt in degraded sandstone fynbos is considered acceptable, providing the footprint is realigned to occupy previously farmed land.

Of the three sites, Bantamsklip will experience the least impact on botanical communities and species, as the ecosystems on this site are fairly common along this section of coastline, provided the nuclear power station is situated on the eastern half of the EIA corridor, away from the limestone fynbos.

Of Thyspunt and Duynefontein, Thyspunt has by far the greatest diversity of vegetation communities, including extensive and highly sensitive wetlands, particularly the Langefontein wetland complex in the eastern portion of the site. The headland bypass dune system is also sensitive to disturbance and acknowledged as a unique coastal feature, although is has been greatly impacted by the development of Oyster Bay to the west and St. Francis to the east. Of the three proposed access roads, the eastern access road will cause the most significant impacts, followed by the western and northern access roads ***(the latter has been rejected as an alternative).***

The EIA corridor at Duynefontein is characterised by a mobile dune system, which has been extensively impacted historically by the KNPS. The system is regarded as sensitive botanically. **However, according to the dune geomorphology specialist, the system is not highly valuable due to its impacted nature.** There is a well-protected very similar system further north along the Western Cape coast at Yzerfontein in the West Coast National Park. Therefore, in spite of the botanical specialist's concerns about the impacts on the dune system at Duynefontein, this is not regarded as a significant impact.

Of the three alternative sites, Thyspunt will experience the highest level of potential impact (i.e. is least preferred), followed by Duynefontein (intermediate preferred) and Bantamsklip (most preferred).

Of the three alternative sites, Bantamsklip and Thyspunt will potentially benefit the most from the establishment of a protected area (provided it is handed over to conservation authorities after decommissioning), as neither of these sites currently has formal protected status. Thus the Thyspunt and Bantamsklip sites may also get the greatest possible benefit from the establishment of a power station, provided that it is placed and constructed in such a way that the most sensitive ecosystems are not affected. The No-Go alternative in the case of these alternative sites may be even more environmentally degrading than the development of a power station, since the sites would then in all probability be sold and may be subject to residential or other forms of development that could result in impacts of greater significance than the development of a power station. Due to the large safety zones of a nuclear power station (at least 800 m radius from the nuclear power station), a sizable portion of the site would effectively be conserved. There is no such guarantee of a portion of the site being conserved in the event of other forms of development.

Table 9-18: Impacts on flora at Duynefontein: nuclear power station and spoil

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Loss of habitat (present location)								
1A: Loss of unvegetated and partially vegetated dune vegetation	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
1B: Mitigated (footprint outside of transverse dune)	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
Loss of ecosystem function								
2A: Loss of endemic transverse dune	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
2B: Mitigated (footprint outside of transverse dune)	***Negative***	***Low***	***Low***	***High***	***High***	***Medium***	***High***	***Medium***
Loss of Red Data species								
3A: Loss of locally occurring Red Data species	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
3B: Mitigated (translocate or grow affected species)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Medium***	***Low***
Climate change (rise in sea level)								
4A: Loss of coastal habitat	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
4B: Mitigated (coastal corridor and nuclear power station setback from the coast)	***Negative***	***Low***	***Low***	***Low***	***Medium***	***Low***	***Low***	***Low***
Cumulative impacts								
5A: Loss of species, habitat and ecosystem	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***

functioning								
5B: Mitigated (locate footprint outside transverse dune)	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*

Table 9-19: Impacts on flora at Duynefontein: powerlines and access roads

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
6A: Loss of dune habitat	*Negative*	*High*	*Low*	*High*	*High*	*High*	*High*	*High*
6B: Mitigated (align powerlines to avoid sensitive dune habitat)	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
7A: Loss of Red Data species	*Negative*	*High*	*Low*	*High*	*High*	*High*	*High*	*High*
7B: Mitigated (locate bases of powerlines to avoid Red Data species)	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*

Table 9-20: Impacts on flora at Bantamsklip

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Loss of habitat - coastal sand fynbos								
1A: Loss of coastal fynbos	***Negative***	***Medium***	***Low***	***High***	***High***	***Medium***	***High***	***Medium***
1B: Mitigated (move footprint)	***Negative***	***Low***	***Low***	***Medium***	***Low***	***Low***	***Low***	***Low***
Loss of habitat - coastal limestone fynbos								
2A: Loss of limestone fynbos	***Negative***	***High***	***Low***	***Medium***	***High***	***High***	***High***	***High***
2B: Mitigated (move footprint)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Loss of transverse dunes								
3A: Loss of semi-mobile transverse dunes	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***High***	***Medium***
3B: Mitigated (move footprint)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Loss of ecosystem function								
4A: Loss of transverse dune function	***Negative***	***High***	***Low***	***High***	***Medium***	***Medium***	***High***	***Medium***
4B: Mitigated (move footprint)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Loss of Red Data species								
5A: Loss of locally occurring RD species	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
5B: Mitigated (move footprint; translocate or grow affected species)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Climate change (rise in sea level)								

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
6A: Loss of coastal habitat/ possible impacts on the nuclear power station	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
6B: Mitigated (coastal corridor and setback from coast)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Cumulative impacts								
7A: loss of species, habitat and ecosystem functioning	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
7B: Mitigated (locate footprint away from transverse dunes and coastal limestones)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

Table 9-21: Impacts on flora at Thyspunt: nuclear power station and spoil

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Loss of coastal habitat								
1A: Loss of dune fynbos and thicket	***Negative***	*High*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
1B: Mitigated (move footprint)	***Negative***	*Medium*	*Low*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
Loss of coastal dunes		-	-	-	-	-	-	-
2A: Loss of semi-mobile parabolic dunes, rocky shore, coastal limestones)	***Negative***	*High*	*Low*	*High*	*High*	*High*	*High*	*High*
2B: Mitigated (locate footprint away from these habitats)	***Negative***	*Medium*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
Loss of ecosystem function		-	-	-	-	-	-	-
3A: Loss of coastal dune and adjacent wetland function	***Negative***	*High*	*Low*	*High*	*High*	*High*	*High*	*High*
3B: Mitigated (locate footprint away from affected areas)	***Negative***	*Medium*	*Low*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
Loss of Red Data species		-	-	-	-	-	-	-
4A: Loss of locally occurring Red Data species	***Negative***	*Medium*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
4B: Mitigated (translocate or grow affected species)	***Negative***	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
Climate change		-	-	-	-	-	-	-
5A: Loss of coastal habitat/ possible impacts on nuclear power station	***Negative***	*High*	*High*	*High*	*High*	*High*	*High*	*High*

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
5B: Mitigated (coastal corridor and nuclear power station setback from coast)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Cumulative impacts		-	-	-	-	-	-	-
6A: Loss of species, habitat and ecosystem functioning	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
6B: Mitigated (locate footprint away from wetlands)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

Table 9-22: Impacts on flora at Thyspunt: Powerlines

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Loss of coastal habitat								
7A: Loss of dune habitat	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***High***	***Medium***
7B: Mitigated (align powerlines to avoid rare and sensitive habitat)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Loss of Red Data species								
8A: Loss of locally occurring RD species	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***High***	***Medium***
8B: Mitigated (locate bases of powerlines to avoid RD species; translocate or grow RD species)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Cumulative impacts								

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
9A: Loss of species, habitat and ecosystem functioning	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***High***	***Medium***
9B: Mitigated (locate bases of powerlines to avoid crossing sensitive transverse dunes and wetlands)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

Table 9-23: Impacts on flora at Thyspunt: High Voltage Yard

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Loss of habitat								
10A: Loss of low quality sandstone fynbos	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***High***	***Medium***
10B: Mitigated (relocate HV Yard to disturbed habitat)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Loss of ecosystem function								
11A: Loss of sandstone habitat function	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***High***	***Medium***
11B: Mitigated (relocate footprint of HV Yard to disturbed habitat)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Loss of Red Data species								
12A: Loss of locally occurring RD species	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***High***	***Medium***

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
12B: Mitigated (relocate footprint of Yard to avoid RD species; translocate or grow RD species)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Cumulative impacts								
13A: Possible loss of species, habitat and ecosystem functioning	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***High***	***Medium***
13B: Mitigated (locate footprint away from good quality sandstone fynbos)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

Table 9-24: Impacts on flora at Thyspunt: Eastern Access Road

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Loss of dunes								
14A: Loss of dune fynbos & thicket	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***High***	***Medium***
14B: Mitigated (no mitigation for habitat loss, but avoid good quality and rare sites)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Loss of wetlands		-	-	-	-	-	-	-
15A: Loss of wetlands to east of the Langefontein	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
15B: Mitigated (realign to avoid wetlands; bridge over wetland just east of the Langefontein)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Loss of ecosystem function		-	-	-	-	-	-	-

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
16A: Possible loss of wetland function	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
16B: Mitigated (realign away from sensitive wetlands)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Loss of Red Data species		**-**	**-**	**-**	**-**	**-**	**-**	**-**
16A: Loss of locally occurring RD species	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***High***	***Medium***
16B: Mitigated (realign road to avoid RD species, and/or translocate or grow in nursery)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Cumulative impacts		**-**	**-**	**-**	**-**	**-**	**-**	**-**
17A: Loss of species, habitat and ecosystem functioning	***Negative***	***High***	***Low***	***High***	***Medium***	***Medium***	***High***	***Medium***
17B: Mitigated (locate road away from mobile dunes and wetlands)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

Table 9-25: Impacts on flora at Thyspunt: Western Access Road

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Loss of dunes								
18A: Loss of dune fynbos & thicket	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
18B: Mitigated (no mitigation for habitat loss, but avoid good quality and rare sites)	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***Low***	***Low - Medium***
Loss of wetlands		**-**	**-**	**-**	**-**	**-**	**-**	**-**

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
19A: Loss of wetlands near Oyster Bay	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
19B: Mitigated (realign to avoid wetlands)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
<u>Loss of ecosystem function</u>		**-**	**-**	**-**	**-**	**-**	**-**	**-**
20A: Loss of part of western transverse dune system & possibly some wetland function	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
20B: Mitigated (realign away from sensitive dunes & wetlands)	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***Medium***	***Medium***
<u>Loss of Red Data species</u>		**-**	**-**	**-**	**-**	**-**	**-**	**-**
21A: Loss of locally occurring RD species	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***High***	***Medium***
21B: Mitigated (realign road to avoid RD species, and/or translocate or grow on in nursery)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
<u>Cumulative impacts</u>		**-**	**-**	**-**	**-**	**-**	**-**	**-**
22A: Loss of species, habitat and ecosystem functioning	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
22B: Mitigated (difficult to mitigate totally, but where possible locate road away from mobile dunes and wetlands)	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***Medium***	***Medium***

9.11 Impacts on dune geomorphology

This section discussed the impacts of the proposed power station, access roads and other associated infrastructure such as power lines and spoil dumps on the dynamics of the vegetated and unvegetated (mobile) dunes. The specialist report dealing with issues of Dune Geomorphology is contained in Appendix E2.

9.11.1 Duynefontein

(a) Impacts related to groundwater and surface water as far as they affect dunes

There are no significant impacts related to the interaction between groundwater and dune dynamics at Duynefontein site.

.

(b) Dynamics of mobile dunes (with specific reference to the viability of constructing infrastructure, transmission lines and access roads)

Mobile dunes upwind of infrastructure, transmission power lines and access roads will be blown onto ***transmission line pylons and access roads.*** This will have a high level of impact on the infrastructure. Mobile dunes downwind of infrastructure and access roads will be starved of sand supply. Mobile dunes will cease to exist when the ground level drops to the interdune level, and the area will become naturally vegetated. This environmental impact will be low, as natural processes will be mimicked, albeit at an accelerated rate.

(c) Dynamics and stability of the artificially vegetated (fixed) dunes and naturally vegetated Late Holocene parabolic dunes (with relation to the construction of infrastructure, transmission lines and access roads)

Major disturbance or damage to the vegetation on the artificially vegetated dunes will re-mobilise the dunes. Similarly the Late Holocene dunes will be re-mobilised by disturbance of plant cover.

(d) Impact of climate change

A retreat of the coastline in response to higher sea level may shift or create new sandy beaches that supply wind-blown sand to dunes. Mobile dunes and dunefields may thus be created in areas that are currently vegetated. This would require monitoring and suitable management in the distant future. Wind speed is expected to increase by 10 %, and storminess is expected to increase. Because wind-blown sand transport rate is roughly proportional to the cube of wind speed, sand transport rate and correspondingly dune movement rates of mobile dunes would increase by about 30 %. This will not have any potential environmental impact.

Rainfall decrease and temperature increase will have no effect on mobile dunes. Plants on vegetated dunes will be stressed by rainfall decrease and temperature increase, so blowouts will form more easily.

(e) Mitigation

The mobile dunes can be stabilised with drift fences, brushwood and with pioneer indigenous dune vegetation prior to planting to prevent mobile sand from covering infrastructure.

9.11.2 Bantamsklip

(a) Impacts related to groundwater and surface water as far as they affect dunes

Groundwater and surface water have no potential impact on the mobile or artificially vegetated dunes.

(b) Dune dynamics and stability of the artificially vegetated mobile dunes and Late Pleistocene vegetated dunes

Any disturbance or damage to vegetation of the artificially vegetated mobile dunes can be rehabilitated by re-planting the dune sand with suitable pioneer species of indigenous vegetation to re-stabilise the dune sand and using brushwood and drift fences where necessary. The Late Pleistocene parabolic dunes have a moderately developed soil with nutrient-rich fines so soil exposed during construction and in soil stockpiles will be liable to wind erosion that winnows these fines out of the soil.

(c) Impacts due to climate change

A retreat of the coastline in response to higher sea level may shift or create new sandy beaches that supply wind-blown sand to dunes. Mobile dunes and dunefields may thus be created in areas that are currently vegetated. This would require monitoring and suitable management in the distant future.

Wind speed is expected to increase by 10 %, and storminess is expected to increase. Because wind-blown sand transport rate is roughly proportional to the cube of wind speed, sand transport rate and correspondingly dune movement rates of mobile dunes (that currently are only found off the site, towards Pearly Beach) would increase by about 30 %. This will not have any environmental impact.

Rainfall decrease and temperature increase will have no effect on mobile dunes. Plants on vegetated dunes will be stressed by rainfall decrease and temperature increase, so blowouts will form more easily.

(d) Mitigation

- The mobile dunes can be stabilised with drift fences, brushwood and with pioneer indigenous dune vegetation prior to planting to prevent mobile sand from covering infrastructure.
- Minimise area being cleared for construction at any one time, wet down these areas. Wet down soil stockpiles, cover stockpiles with brushwood.
- Rehabilitation of vegetated Late Pleistocene dunes to their natural state will be difficult, as climax vegetation will have to be re-introduced once the pioneer vegetation is established.
- A suitably qualified environmental officer must supervise the rehabilitation of vegetation on the Late Pleistocene parabolic dunes.

9.11.3 Thyspunt

(a) Impacts of the proposed Northern Access Road on the Oyster Bay dunefield

When this option was first mooted, it was for a route along the eastern side of the “panhandle”, where dunes are lower (maximum height about 10 metres). The route currently under consideration runs along the western side of the “panhandle”, where transverse dunes are about 30 m high, as dune height increases westward. There is a maximum dune height that this option could handle, in the order of 10 m. This option is thus not viable for the route along the western side of the “panhandle”. In addition, large cut and fill will be required as two large vegetated dune ridges would have to be crossed. Thus large unvegetated surfaced would be created that could result in sand being deposited blown about. The viable route in this instance is thus the route via the eastern side of the "panhandle" (see **Section d** below as well as **Figure 9.1**)

(b) Impacts of the disposal of topsoil

Three alternatives exist for the disposal of topsoil, namely:

- Disposal in the mobile dune field;
- Disposal in the vegetated dune field;
- Disposal at sea; and
- Disposal in the "panhandle" north of the Oyster Bay dune field.

The potential impact of marine spoil disposal is not dealt with in this section, as it is dealt with in the Marine Impact Assessment and the Oceanographic Assessment (respectively Appendices E15 and E16). The discussion below is related only to the potential impacts of land-based disposal on dunes.

For disposal in the mobile dune field, spoil would be removed to the mobile dunefield where it is dumped in areas of mobile dunes where no vegetation is growing. The spoil would be left to the elements of nature. The overall impact of this is very high, as the nature and dynamics of dunes that would eventually form would be different from the existing dunes, interdune wetlands would be destroyed, and any material finer than about 60 microns would be carried away as dust, with a high impact on down-wind areas where the dust will eventually settle. This option is fatally flawed, as all the impacts are unacceptably high, and cannot be mitigated.

If spoil would be disposed within the vegetated dunefield, the stockpile would have a surface area of about 350 000 m², roughly 5 % of the total surface area of the vegetated dunefield on the Eskom property. The stockpile will be 25 m high, higher than many of the dune ridges. The dunes and the vegetation on the vegetated dunefield will be destroyed, and the very distinctive natural of dune ridge topography will be completely altered. Airflow will be modified significantly, leading to localised speed-up of winds that may result in blowouts and re-mobilizing of dunes.

If spoil would be disposed in the "panhandle", spoil would have to be moved from the excavation over the sand dune. For this option, the spoil will need to be transported across the vegetated and mobile dunefields by means of a temporary conveyor belt with supports at a close spacing and an associated construction road; or via a temporary haul road. If a conveyor belt were to be used, there would be insignificant damage to mobile dunes, but it will probably be best to route the conveyor to avoid mobile dunes because of the difficulty of construction and high operational maintenance in mobile dunes. As the structures would be temporary, drift-fences installed by hand can be used to temporarily stop wind-blown movement of dunes in places where it is difficult to avoid mobile dunes. In the vegetated dunefield supports for the conveyor belt will need to be closely spaced and the temporary construction road will entail crossing the vegetated dune ridges with a road that would need cut and fill to create a road with a smooth gradient. Terraforce or similar blocks would have to be used to stabilise the sides of the cut and fill, as stabilising by vegetating the slopes will be difficult and slow. There will be little effect on the stability of the dunes, apart from the risk of slumping during the construction phase.

(c) Impacts due to climate change

A retreat of the coastline in response to higher sea level may shift or create new sandy beaches that supply wind-blown sand to dunes. Mobile dunes and dunefields may thus be created in areas that are currently vegetated. This would require monitoring and suitable management in the distant future.

Wind speed is expected to increase by 10 %, and storminess is expected to increase. Because wind-blown sand transport rate is roughly proportional to the cube of wind speed, sand transport rate and correspondingly dune movement rates of mobile dunes would increase by about 30 %. This will not have any potential environmental impact.

Winds at Thyspunt will have a larger proportion of easterly winds, so the seasonal reversal of mobile dune movement will be higher, and overall sand transport rate and correspondingly dune movement rates will decrease. As the proportion has not been quantified, the amount of decrease cannot be estimated.

Temperature increase will have no effect on mobile dunes. Plants on vegetated dunes will be stressed by temperature increase, so blowouts will form more easily.

(d) Mitigation

- The northern access road must be relocated eastward to where maximum dune height is below 10 metres.
- Avoid wetland areas wherever possible.
- Because of issues such as wetland fragmentation, culverts must be so closely spaced that they virtually form a bridge over wetlands that have to be crossed, to allow groundwater flow and wetland functioning.
- The road reserve and width disturbed during construction must be kept as narrow as possible, not more than 20 m.
- Monitoring and repair of possible uncontrolled blowouts or water erosion that may occur as a result of windy or rainy periods during rehabilitation and recovery phases must be undertaken.
- Special rehabilitation techniques may have to be developed to ensure that the wetlands, surface water and groundwater dynamics recover fully.
- Terraforce or similar blocks must be used to stabilise the sides of the cut and fill in dunes, as rehabilitation by vegetating the slopes will be difficult and slow. There will thus be little effect on the stability of the dunes, apart from the risk of slumping during the construction phase.
- A suitably qualified ECO must be appointed to supervise the construction phase and rehabilitation of the construction road.

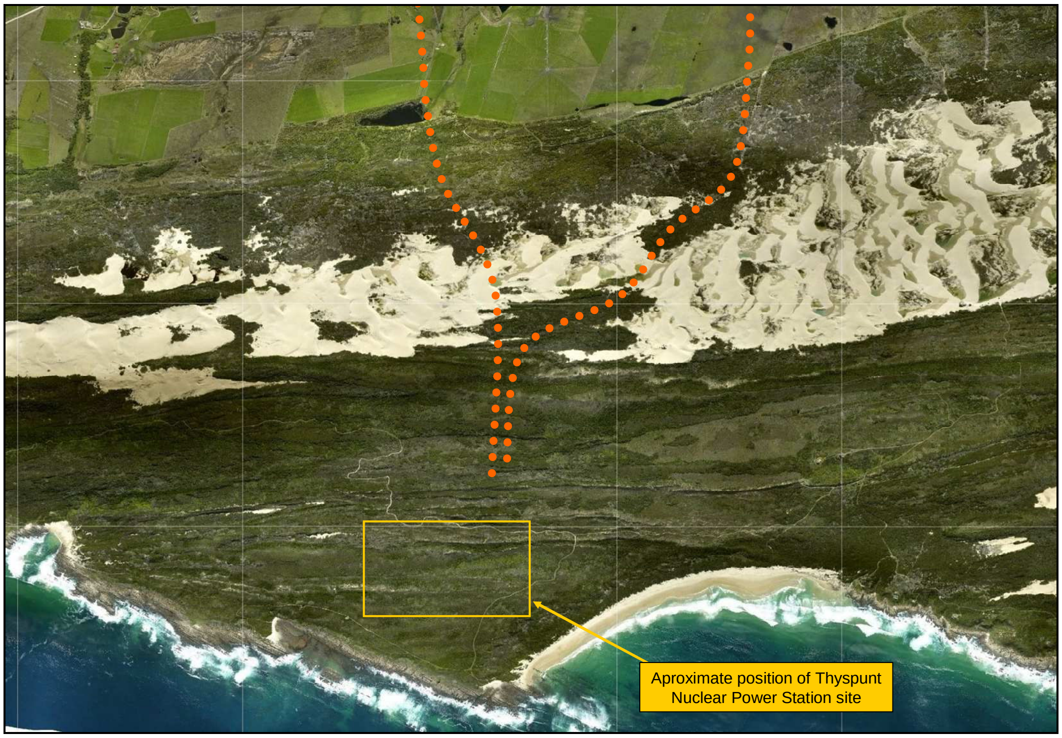

Figure 9-3: Proposed position of the northern access road and the recommended (more eastern) position

9.11.4 Conclusion

Groundwater does not "daylight" ***in the dunes*** at Duynefontein or Bantamsklip. Thus, there are no impacts related to the interaction between groundwater and dune dynamics at these sites.

Access roads and transmission lines can be built across the mobile dunes at Duynefontein and Bantamsklip, with operational impacts ranging from medium to low significance. Access roads and transmission lines at Duynefontein can be built across the artificially vegetated dunefield and the naturally vegetated parabolic dune fields with low significance operational impacts. Access roads and transmission lines can be built across the artificially vegetated dune fields and older naturally vegetated parabolic dunes at Duynefontein with low significance operational impacts after careful rehabilitation. In both cases, mobile dunes in the vicinity of infrastructure would need to be artificially stabilised.

At Duynefontein, topsoil and spoil stockpiles located on the mobile dunes will have medium significance operational impacts. Topsoil and spoils stockpiles located on the artificially vegetated dune fields or the naturally vegetated parabolic dunefield will have low significance operational impacts. At Bantamsklip, topsoil and spoils stockpiles located on the artificially vegetated dune fields or on the older naturally vegetated parabolic dunes will have low significance operational impacts.

The interaction between dunes systems and wetlands is more complex at Thyspunt, since groundwater "daylights" in many inter-dune areas within the Oyster Bay dunefield to form wetlands. The dune dynamics interacts with wetland, groundwater and surface water. Thus, any disturbance of the Oyster Bay dunefield may cause significant secondary impacts on wetlands. Furthermore, as a result of the location of the proposed construction of transmission lines ***and possible*** haul roads ***(e.g. the proposed Northern Access Route – now abandoned) between*** the nuclear power station in the south and the HV ***Yard*** in the north, the impacts on dune geomorphology at Thyspunt will be more extensive than at the other two sites.

The construction of the Northern Access Road at Thyspunt ***(now rejected as an alternative)*** would ***have caused*** a significant impact on the Oyster Bay dune field. The proposed alignment ***of this route*** traversed the western portion of the Oyster Bay dunefield where the dunes are highest, resulting in large cuttings. An alternative alignment through the eastern portion of the dunefield is therefore recommended, ***should this route have been selected. However, as indicated in Chapter 9, this route has been rejected).***

Transmission lines are proposed to cross the Oyster Bay dunefield from the nuclear power station in the south to the HV yard in the "panhandle" in the north. The operational impacts of towers spaced at 300 - 400 m intervals[4] would range from medium in the case of access roads being used for construction, to low in the case of helicopters being used for construction. Using towers spaced at 800 m intervals (a very expensive option that would also result in unacceptably high visual impacts ***due to the increased height of the pylons***) would result in no activities or structures being located within the mobile dunes and thus the impact would be ***reduced***.

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[4] Thus a single pylon would be placed in the middle of the dunefield for each transmission line, with adjacent towers outside the dune field. There may be up to 4 transmission lines between the power station and the HV Yard.

Table 9-26: Summary of dune geomorphology impacts at Duynefontein

Impact	Nature	Intensity	Extent	Duration	Consequence	Impact on irreplaceable resources	Probability	SIGNIFICANCE
Dune dynamics of the mobile dunes - constructing infrastructure, transmission lines and access roads								
1A: Mobile dunes upwind of infrastructure	***Negative***	***High***	***Low***	***High***	***Low***	***Medium***	***Low***	***Medium***
1B: Mitigated (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	***None***							
2A: Mobile dunes downwind of infrastructure	***Negative***	***Medium***	***Low***	***High***	***Low***	***Medium***	***Low***	***Low - Medium***
2B: Mitigated (none possible)	***None***							
Stability of the artificially vegetated dunes - constructing infrastructure, transmission lines and access roads								
3A: Constructing infrastructure and access roads	***Negative***	***High***	***Low***	***High***	***Low***	***Medium***	***High***	***Medium***
3B: Mitigated (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	***None***							
Stability of the naturally vegetated late Holocene parabolic dunes - constructing infrastructure, transmission lines and access roads								
4A: Constructing infrastructure and access roads	***Negative***	***High***	***Low***	***High***	***Low***	***Medium***	***High***	***Medium***
4B: Mitigated (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	***None***							
Topsoil stockpile on mobile dunes								
5A: Mobile dunes blowing onto stockpile	***Negative***	***High***	***Low***	***Low***	***Low***	***Medium***	***High***	***Medium***
5B: Mitigated (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	***None***							

Impact	Nature	Intensity	Extent	Duration	Consequence	Impact on irreplaceable resources	Probability	SIGNIFICANCE
Topsoil stockpile on artificially vegetated dunes								
6A: Impact on the artificially vegetated dunes	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
6B: Mitigated (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	***None***							
Topsoil stockpile on the naturally vegetated Late Holocene dunes								
7A: Impact on Holocene parabolic dunes	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
7B: Mitigated (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	***None***							
Spoils stockpile on the mobile dunes								
8A: Mobile dunes blowing onto stockpile	***Negative***	***High***	***Low***	***Low***	***Low***	***Medium***	***High***	***Low - Medium***
8B: Mitigated (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	***None***							
Spoils stockpile on the artificially vegetated dunes								
9A: Impact on the artificially vegetated dunes	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
9B: Mitigated (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	***None***							
Spoils stockpile on the naturally vegetated Late Holocene dunes								
10A: Impact on Holocene parabolic dunes	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***High***	***Low - Medium***
10B: Mitigated (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	***None***							

Table 9-27: Summary of dune geomorphology impacts at Bantamsklip

Impact	Nature	Intensity	Extent	Duration	Consequence	Impact on irreplaceable resources	Probability	SIGNIFICANCE
Stability of the artificially vegetated dunes - constructing infrastructure, transmission lines and access roads								
1A: Constructing infrastructure and access roads	***Negative***	***High***	***Low***	***High***	***Low***	***Medium***	***High***	***Medium***
1B: Mitigated (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	***None***							
Stability of the naturally vegetated late Pleistocene parabolic dunes - constructing infrastructure, transmission lines and access roads								
2A: Exposure of soil to wind erosion	***Negative***	***Medium***	***Low***	***High***	***Low***	***Medium***	***High***	***Medium***
2B: Mitigated (reduce wind erosion)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
3A: Damage of vegetation	***Negative***	***Medium***	***Low***	***Low***	***Low***	***Medium***	***High***	***Medium***
3B: Mitigated (careful rehabilitation)	***None***							
Topsoil stockpile on artificially vegetated dunes								
4A: Impact on artificially vegetated dunes	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
4B: Mitigated (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	***None***							
Topsoil stockpile on the naturally vegetated late Pleistocene parabolic dunes								
5A: Exposure of soil to wind erosion	***Negative***	***Medium***	***Low***	***Low***	***Low***	***Medium***	***High***	***Medium***
5B: Mitigated (reduce wind erosion)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
6A: Damage of vegetation	***Negative***	***Medium***	***Low***	***Low***	***Low***	***Medium***	***High***	***Medium***
6B: Mitigated (careful rehabilitation)	***None***							
Topsoil stockpile on artificially vegetated dunes								

Impact	Nature	Intensity	Extent	Duration	Consequence	Impact on irreplaceable resources	Probability	SIGNIFICANCE
7A: Impact on the artificially vegetated dunes	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
7B: Mitigated (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	***None***							
Spoils stockpile on the naturally vegetated late Pleistocene parabolic dunes								
8A: Exposure of soil to wind erosion	***Negative***	***Medium***	***Low***	***Low***	***Low***	***Medium***	***High***	***Medium***
8B: Mitigated (reduce wind erosion)	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
9A: Damage of vegetation	***Negative***	***Medium***	***Low***	***Low***	***Low***	***Medium***	***High***	***Medium***
9B: Mitigated (careful rehabilitation)	***None***							

Table 9-28: Summary of dune geomorphology impacts at Thyspunt

Impact	Nature	Intensity	Extent	Duration	Consequence	Impact on irreplaceable resources	Probability	SIGNIFICANCE
Northern Access Road and conveyor belt or temporary haul road across mobile dunes and interdune wetlands of the Oyster Bay Mobile Dune Field	***As indicated in Chapter 5 of the EIR, the Northern Access Road and the proposed conveyor belt system for transport of spoil from the power station and the HV Yard have been removed from consideration based on the consensus recommendation of the EIA specialists.***							
1A: Destruction and alteration of dune topography and interruption of natural sand movement (power station construction phase)								
2A: Impact on dune, groundwater - wetland dynamics (operational phase)								
2B: Mitigated (move the road eastward and avoid wetlands)								
3A: Formation of blowouts								
3B: Mitigated (stabilise and rehabilitate								
Removal of conveyor belt or temporary haul road across mobile dunes and interdune wetlands of the Oyster Bay Mobile Dune Field (end of construction phase)								
4A: Destruction and alteration of dune topography and interruption of natural sand movement (construction and operation)								
4B: Mitigated (Careful rehabilitation with ECO)								
Northern Access Road: smooth access road across mobile dunes and interdune wetlands of the Oyster Bay mobile dune field - construction phase								
5A:Constructing infrastructure and access roads								
5B: Mitigated (avoid wetlands, where possible, keep road narrow)								

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Impact	Nature	Intensity	Extent	Duration	Consequence	Impact on irreplaceable resources	Probability	SIGNIFICANCE
5B: Mitigated (space culverts closely so that wetland functioning not impaired)	***As indicated in Chapter 5 of the EIR, the Northern Access Road and the proposed conveyor belt system for transport of spoil from the power station and the HV Yard have been removed from consideration based on the consensus recommendation of the EIA specialists.***							
5B: Mitigated (repair of blowouts and water erosion)								
5B: Mitigated (ECO and special rehabilitation techniques)								
Northern Access Road: smooth access road across mobile dunes and interdune wetlands of the Oyster Bay mobile dune field - operational phase								
6A: Impact on dune - groundwater - wetland dynamics								
6B: Mitigated (none)								
Northern Access Road: aerodynamic bridge across mobile dunes and interdune wetlands of the Oyster Bay mobile dune field - construction phase								
7A: Impact on dune - groundwater - wetland dynamics								
8A: Temporary construction road								
8B: Mitigated (ECO and special rehabilitation techniques)								
Northern Access Road: aerodynamic bridge across mobile dunes and interdune wetlands of the Oyster Bay mobile dune field - construction phase								
9A: Impact on dune - groundwater - wetland dynamics								
9A: Temporary construction road								
9B: Mitigated (ECO and special rehabilitation techniques)								
Northern Access Road: aerodynamic bridge across mobile dunes and interdune wetlands of the Oyster Bay mobile dune field - operational phase								

Impact	Nature	Intensity	Extent	Duration	Consequence	Impact on irreplaceable resources	Probability	SIGNIFICANCE
10A: Impact on dune - groundwater - wetland dynamics	***As indicated in Chapter 5 of the EIR, the Northern Access Road and the proposed conveyor belt system for transport of spoil from the power station and the HV Yard have been removed from consideration based on the consensus recommendation of the EIA specialists.***							
10B: Mitigated (continue careful rehabilitation of dune-groundwater – wetland)								
Eastern and Western Access Roads across vegetated dunefield - construction phase								
11A: Formation of blowouts	***Negative***	***Medium***	***Low***	***Low***	***Low***	***Medium***	***High***	***Medium***
11B: Mitigated (stabilise, rehabilitate)	***Negative***	***Low***	***Low***	***Medium***	***Low***	***Low***	***High***	***Low – Medium***
Eastern and Western Access Roads across vegetated dunefield - operational phase								
12A: Usage of access roads	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***High***	***Low - Medium***
12B: Mitigated (none)	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***High***	***Low - Medium***
Transmission lines with 300-400m span across mobile dunes and interdune wetlands of the Oyster Bay mobile dune field - construction phase								
13A: Constructing infrastructure and access roads	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
13Bi: Mitigated (Careful positioning of towers with ECO)	***Negative***	***Medium***	***Low***	***High***	***Low***	***Medium***	***High***	***Medium***
13Bii: Mitigated (Use helicopters for construction)	***Negative***	***Low***	***Low***	***Low***	***High***	***Medium***	***High***	***Low - Medium***
Transmission lines with 300-400m span across mobile dunes and interdune wetlands of the Oyster Bay mobile dune field - operational phase								
14A: Infrastructure and access roads	***Negative***	***Low***	***Low***	***High***	***High***	***Medium***	***High***	***Medium***
14B: Mitigated (Use light vehicles for maintenance)	***None***							
Transmission lines with 300-400m span across vegetated dune field - construction phase								

Impact	Nature	Intensity	Extent	Duration	Consequence	Impact on irreplaceable resources	Probability	SIGNIFICANCE
15A: Constructing infrastructure and access roads	*Negative*	*High*	*Low*	*Low*	*High*	*High*	*High*	*High*
15Bi: Mitigated (Locate towers on broad ridges and wide interridge valleys)	*Negative*	*Medium*	*Low*	*Low*	*Medium*	*Medium*	*High*	*Medium*
15Bii: Mitigated (Use helicopters for construction)	*Negative*	*Low*	*Low*	*Low*	*Medium*	*Low*	*High*	*Low – Medium*
Transmission lines with 300-400m span across vegetated dune fields - operational phase								
16A: Infrastructure and access roads	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Low*	*High*	*Medium*
16B: Mitigated (Use light vehicles for maintenance)	*Negative*	*Low*	*Low*	*High*	*Medium*	*Low*	*High*	*Low - Medium*
Topsoil and spoils stockpiles on mobile dunes of the Oyster Bay dune field & Temporary conveyor belt or temporary haul road to carry topsoil and spoil across mobile dunes and interdune wetlands of the Oyster Bay mobile dunefield	*As indicated in Chapter 5 of the EIR, the Northern Access Road and the proposed conveyor belt system for transport of spoil from the power station and the HV Yard have been removed from consideration based on the consensus recommendation of the EIA specialists.*							
17A: Impact on mobile dune field								
Topsoil and spoils stockpile on naturally vegetated dune field								
18A: Destruction of dune vegetation & topography	*Negative*	*High*	*Low*	*Medium*	*Medium*	*Medium*	*High*	*Medium*
18B: Mitigated (Re-create original topography)	*Negative*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*	*High*	*Medium*

Table 9-29: Impacts on dune geomorphology at all sites

Impact	Nature	Intensity	Extent	Duration	Consequence	Impact on irreplaceable resources	Probability	SIGNIFICANCE
Potential impacts of climate change								
1A: Creation of new active mobile dunefields due to sea-level rise	***Negative***	***High***	***Low***	***High***	***Low***	***Medium***	***Medium***	***Medium***
1B: Mitigated (none)	***Negative***	***High***	***Low***	***High***	***Low***	***Medium***	***Medium***	***Medium***
2A: Blowout increase due to rainfall decrease and temperature increase	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
2B: Mitigated (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***High***	***Low - Medium***

9.12 Impacts on wetlands

The specialist report dealing with the impacts on wetlands is contained in Appendix E12.

The report on which this summary is based has taken cognisance of the outcomes of a year of intensive groundwater and surface water monitoring and analysis, which have resulted in higher levels of confidence being accorded to predictions of the impacts of proposed activities associated with the development of a nuclear power station, on wetlands at each of the three alternative sites. Some of the conclusions of this report have thus changed substantially from those contained in previous versions of the wetland report.

Furthermore, the wetland report referred extensively to the claimed debris flows at Thyspunt. Since a study has been completed specifically to confirm whether debris flows could occur (and has found no evidence for this), references to debris flow have been removed from Appendix E12.

9.12.1 Duynefontein

The assessment[5] of potential impacts associated with the development of a nuclear power station at Duynefontein indicates that the proposed development is unlikely to result in any unmitigable impacts to wetland systems that would have high negative significance. Moreover, the recommended mitigation measures are not considered onerous, and revolve largely around best practice measures and excluding specified wetland areas from development.

While development of the proposed nuclear power station at the Duynefontein site would not be associated with any potential impacts of high negative significance, assuming implementation of mitigation measures, it must be noted that it does not present positive opportunities for conservation either, unlike the other two sites. Conservation of natural ecosystems has already been achieved through the past formation and management of the Koeberg Nature Reserve, the integrity of which is threatened by, rather than secured by, the proposed nuclear power station development.

9.12.2 Bantamsklip

Development of the proposed nuclear power station at Bantamsklip would not be associated with any potential impacts to wetland systems that are considered unmitigable or that would, once mitigated, result in a negative potential impact of higher than “low” significance level (**Table 6.2**). This is because the nuclear power station-associated activities would be concentrated in the area to the south of the R43. The potential impacts that have been assessed revolve around indirect potential impacts to the ecologically important Groot Hagelkraal wetlands, primarily associated with increased traffic through the area (e.g. affecting the use of the wetlands as a corridor between high lying areas, the estuary and the sea). Other potential impacts that have been identified include those associated with increased development in the presently small resort settlement of Pearly Beach, and the increase in sewage treatment and water demands, with their potential knock-on effects for wetland systems. Low confidence is attached to this assessment, given the low certainty that the impact could occur.

[5] For a detailed description of all identified potential impacts on wetlands on not only the Duynefontein site but also the Bantamsklip and Thyspunt sites, refer to the specialist report attached in **Appendix E12** and **Tables 9-20 to 9-22** below.

Mild concern raised by the geo-hydrological assessment regarding the extent of draw-down effects on the wetlands of the Groot Hagelkraal and Koks Rivers have been addressed through recommendations for accurate groundwater modelling, based on final proposed nuclear power station platforms and design, and the potential need (to be informed by the above) for implementation of a membrane or other device that will severely limit draw-down extent.

The recommended mitigation measures for the development at this site are not considered complex. Moreover, the possibilities to bring about positive impacts to wetland ecosystems through implementation of recommended mitigation activities have been assessed as of high positive significance, and thus of bearing in the decision making process for this site. It should be noted however that the actual achievement of these positive outcomes relies on a concerted effort to secure the Groot Hagelkraal wetlands, including their extensive hillslope seeps and adjacent terrestrial areas, and to put in place measures that will assure their management and conservation in the long term. The proposed nuclear power station site is believed to be one of the most feasible vehicles for setting in place such management, based on the observed conservation management at the Duynefontein site, and visible present efforts at both the Thyspunt and Bantamsklip sites in terms of the control of alien vegetation.

9.12.3 Thyspunt

The length and detail of the assessment tables for the proposed nuclear power station development at Thyspunt highlight the complexity of issues to be considered in terms of potential impacts to wetland systems. It is suspected that there is a high degree of interaction between the dune systems and the wetlands. The dune systems act as filters for water and feed the wetland systems. Most of the potential impacts assessed are associated with a high level of negative significance in their unmitigated form. ***The uncertainty regarding the interactions between groundwater and wetlands has been largely addressed by a year's worth of groundwater modelling (starting in February 2010) and subsequent numerical modelling, starting in February 2010.***

The most significant sources of potential impact to wetland systems are associated with interferences in surface / groundwater interactions in the vicinity of the site. These could have serious implications for wetland function, resulting in permanent loss of important and presently virtually unimpacted coastal seep wetland ecosystems. Mitigation measures that seek to reduce these potential impacts increase the risk of draw-down related impacts to the adjacent Langefonteinvlei wetlands.

However, the groundwater monitoring and modelling process found that the potential impacts on the Langefonteinvlei can be mitigated, based on the fact that Langefonteinvlei is perched above the groundwater table in its southern and western extents. Hence, draw-down impacts would need to extend to the northern and eastern portions of Langefonteinvlei before they had an effect on wetland hydrology. Mitigation of groundwater drawdown through the implementation of a hydrological cut-off wall during dewatering would effectively mitigate the impacts on Langefonteinvlei.

Impacts (outright loss and degradation) to a section of near-pristine coastal seep wetland are not however considered effectively mitigable, and this impact remains of high negative significance.

Even with implementation of all of the recommended mitigation measures, the net cumulative impact on wetland systems is still considered of negative and of high significance, as a result of the residual impact to currently largely unimpacted wetlands, and the definite and unmitigable degradation of a limited area of currently unimpacted coastal seep wetlands.

Offset mitigation of the wetland impacts is possible, and would involve conservation of areas that include both the Eastern Valley Bottom wetlands and the Oyster Bay dunefield itself, as far as the impacted area at the upstream boundary of The Links golf

estate. This mitigation would in theory result in a net positive impact to wetland systems. Such an assessment assumes that securing of all erven along the proposed Eastern Access Roads takes place before these are developed, thus securing a large expanse of wetland and dune system that would otherwise be permanently impacted (but not destroyed) by development. Such offset mitigation does not negate the loss of coastal seep wetlands, but the opportunity for large-scale active management and conservation of wetland ecosystems as a whole is considered to offset the loss of some of these important wetlands, while retaining the Langefonteinvlei and duneslack wetlands in an unimpacted condition. This is based on the proviso <u>that the extent of wetland loss, and the degree of degradation of remaining coastal seeps, can be effectively mitigated by shifting the nuclear power station footprint east (without impacting on the Langefonteinvlei or other wetlands)</u>***. In the event that full mitigation as well as offset measures were implemented, the net impact to wetlands on the Thyspunt site is likely to be positive, and a preferable scenario to the "no development" alternative.***

With this being said, however, it is fully acknowledged that ideally, none of the wetlands within and associated with the Oyster Bay dunefield should form part of any development offset. In the event that a no development alternative was available that provided adequate funding opportunities for alien control, and did not include piecemeal fragmentation of the area into multiple small developments, then a no-go alternative would clearly be preferred (from an ecological perspective), to any development of a nuclear power facility at this site.

The assessment process also indicated ecologically preferred alternatives for a range of activities that would be associated with the proposed nuclear power station. The outcomes of the assessments are as follows:

- Preferred sewage treatment alternative: on-site treatment and recycling of effluent; and
- Preferred fresh water supply option: desalination, supplemented by treated effluent, ***with short term construction phase abstraction of groundwater only, subject to a range of conditions.***

Other activities, such as the proposed routing of transmission lines across the mobile dunefields and wetland areas to the north, coupled with possible transport of sand across the dunefield, will result at best in a general degradation of what is at present a relatively undisturbed, one-in-a-kind habitat, and at worst, threaten the function and structure of the dune system which is a critical support system for the wetlands.

The assessment of different alignments for the access road, as shown in **Table 6.3** brings into play another set of complicating issues. The assessment process indicates that the proposed eastern access, with substantial mitigation measures focusing on avoidance of critical impacts, would be the preferred access option. If two access routes are required, specifically for construction, then the proposed western access route is greatly preferred to the northern route. ***The Northern Access Route, as indicated before in this EIR, has been eliminated based on a consensus decision by the EIA team.***

The eastern route carries with it a means to mitigate against the high cumulative significance of the proposed development. On the basis of full and effective implementation of all recommended mitigation measures, including recommendations regarding access routes to the site, the active conservation management in the long term (beyond the life time of the nuclear power station site) of the Eskom site, and the recommendation for application to be made for the Oyster Bay mobile dunefield and its associated dune and wetland systems to be managed as a Ramsar wetland area, and on the assumption that Eskom will purchase all properties through which the proposed access road passes, and include this land in the conservation area, then the cumulative impact of the development ***on wetland systems*** would be assessed to be positive. This implies that the inclusion of the full extent of remnant valley bottom wetland between Langefonteinvlei and The Links golf course near Cape St. Francis, and the inclusion of a substantial portion of the Oyster Bay dunefield system in this effective reserve, outweighs the definite impact of loss of and degradation to a section of presently unimpacted coastal seep wetlands, which are of high conservation importance.

The above assessment is dependent on confirmation that the current geo-hydrological model regarding drawdown impacts is relevant to the actual size and location of the nuclear power station; the feasibility of the eastern portion of the site for the nuclear power station site and, critically, on the urgent implementation of the proposed surface / groundwater monitoring programme, which aims to address the present uncertainty regarding wetland / groundwater interactions.

9.12.4 Mitigation

(a) Duynefontein

Avoidance mitigation of potential impacts to wetlands is considered feasible at this site. Mitigation measures focus on effective management of dust, stormwater and road construction processes, and the location of the nuclear power station and its infrastructure in the least sensitive areas of the development envelopes. Within the EIA and HV Yard corridors, retention of the mobile dunes as a viable system is recommended, to ensure maintenance of wetland functions within and to the north of the dunes. Wetlands on the Duynefontein site that lie outside of the EIA and HV Yard corridors have, along with their terrestrial margins and interlinking corridors, been identified as “no development” areas.

(b) Bantamsklip

Essential mitigation measures for this site would require:

- Management of the site to the north of the R43 as a conservation area, with provision for the long-term conservation of the site (after the life span of the nuclear power station);
- Enlarging of the culverts at the Groot Hagelkraal crossing under the R43; and
- Adhering to certain development restrictions at Pearly Beach.

The potential cumulative impact of a nuclear power station at this site, with mitigation, would be a positive impact of high significance, based on the opportunity entailed in the development for securing the long-term conservation of the wetland systems to the north of the R43.

(c) Thyspunt

Mitigation measures at this site centre around both impact avoidance and increasing the confidence with which assessment of the implications of key potential impacts can be made, specifically with regard to the siting of the proposed nuclear power station. Essential mitigation measures comprise the following:

- Recognition of various “no go” development areas and ecological setbacks;
- Management of the whole site, apart from the nuclear power station footprint within the EIA corridor and the HV yard, as a formal conservation area;
- Purchase of all ***properties*** potentially crossed by the proposed eastern access road to the east of the Thyspunt site as far as the western boundary of The Links, and the management of the dunefields and wetlands thus acquired as a dedicated conservation area;
- inclusion of technology in the dewatering design to allow controlled dewatering, such that neither the present condition nor the resilience of upstream wetlands is affected by groundwater draw-down;
- inclusion in the dewatering design of mechanisms that will allow the redistribution and spread of diverted / dewatered groundwater back into the aquifer, such that it can feed

the coastal seeps downstream, taking cognisance of projected increases in sea level that are likely to result in salinisation of groundwater levels just above present sea level.

- ***The proposed drawdown mitigation design should meet the following design criteria as a minimum:***
    - ***i. The extent of drawdown should not extend beneath the Langefonteinvlei (that is, there should be no change in groundwater levels at any point of the Langefonteinvlei, as a result of groundwater draw-down). This measure is conservative, as data indicate that only the northern and eastern portions of the Langefonteinvlei are directly linked to the groundwater table;***
    - ***ii. There should be no change in natural fluctuations of water table height in the transverse dune system (this impact is considered unlikely);***
    - ***iii. The cutoff wall should extend around all sides of the drawdown area, to limit the extent of impacts to coastal seep wetlands;***
    - ***iv. If necessary, more than one cutoff wall (or other similarly functioning system) should be utilised, to control the extent of dewatering required across the power station site as a whole (e.g. dewatering of construction areas where groundwater may be exposed by site levelling, even though construction to bedrock as in the case of the Nuclear Island is not required;***
    - ***v. The short-term drawdown effects and dune instability that would occur during installation of the proposed cutoff wall/ membrane / other appropriate device would need to be such that they too did not result in any drawdown of the Langefonteinvlei and its associated wetlands or the duneslack wetlands in the mobile dune; and***
    - ***vi. The specifications outlined for mitigation against dewatering-related loss of coastal seep wetlands should be met in the design.***
- ***The detailed design of the proposed drawdown mitigation measure should be fine-tuned on the basis of the results of longer term surface and groundwater monitoring being carried out at Thyspunt.***

Other mitigation measures at this site entail the following:

- The northern access road should not be used, and the western access road should be re-aligned northwards so as to avoid a number of coastal seeps;
- Access roads should allow for bridging of wetlands that are unavoidably crossed by the routes; and
- Transmission lines should not include any maintenance / access roads across the mobile dunes, and provision should be made for by quad bike only.

9.12.5 Conclusions

(a) Duynefontein

The development envelopes for both the EIA and the HV yard corridors at Duynefontein lie well away from the most sensitive wetlands on the site – that is, the duneslack depressional wetlands in the south western portion of the site. The main potential impacts associated with development of a single phase nuclear power station at Duynefontein relate to degradation of or disturbance to the artificial wetlands in the north west of the site, the transient duneslack wetlands of the mobile dune and an isolated seasonal wetland potentially in the vicinity of a proposed access road. Groundwater modelling associates a low level of draw-down risk to both these and other wetlands on the site, as a result of dewatering.

Without the implementation of mitigation measures, the potential impacts of development of a nuclear power station at Duynefontein are regarded of medium negative significance.

(b) Bantamsklip

The envelopes for the proposed EIA and HV yard corridors at Bantamsklip lie to the south of the R43 road through the site and thus will not directly affect the critically important Groot Hagelkraal River and its associated hillslope seeps and valley bottom wetland tributaries. This means that impacts to wetland systems resulting from the proposed project would be largely avoided. The following are the main areas of concern:

- Increased traffic on the R43, leading to fragmentation of wetland corridors;
- Potential wetland degradation depending on the siting of nuclear power station administration buildings. These will however be sited South of the road therefore have no impact;
- Potential side-effects of increased development in the Pearly Beach area; and
- The geo-hydrological study also indicated that the radius of draw-down associated with dewatering of this site could extend close to the Groot Hagelkraal and Koks River systems but was however unlikely to affect either of them.

Without the implementation of any mitigation measures, the potential cumulative impacts of development of an nuclear power station at Bantamsklip was assessed as being of at least medium negative significance.

(c) Thyspunt

Potential impacts at Thyspunt would be associated with the greatest number, intensity and complexity of impacts to important wetland systems. The main impacts include:

- Permanent loss and degradation of coastal seep wetlands as a result of dewatering / groundwater diversion, concentration of groundwater flows and proposed new roads;
- Risks of impacts to the Langefonteinvlei and its associated hillslope seep to the south, as a result of possible draw-down effects ***(it has been confirmed by groundwater monitoring that this can be mitigated through appropriate cut-off walls);***
- Fragmentation, infilling and physical disturbance to duneslack wetlands in the Oyster Bay mobile dune system as well as to wetlands immediately north of the Oyster Bay dunefield, as a result of impacts associated with the proposed passage of transmission lines and associated roads; and
- Potential infilling and fragmentation of important valley bottom wetlands to allow the construction of access routes to the site, as well as laying of sewage and water pipelines.

The above impacts are likely to result in profound degradation of a system that presently exists as a relatively unimpacted mosaic of terrestrial and wetland habitats, with high levels of interconnectivity and high overall biodiversity value, to which the wetland systems make a significant contribution. The potential cumulative impacts of the proposed development of a single nuclear power station at the Thyspunt site without implementation of mitigation measures has been assessed ***to be of*** high negative significance. ***The additional groundwater monitoring and numerical modelling has*** increased the certainty of mitigation ***for the Langefonteinvlei.*** The onus is on ***Eskom*** to ensure that mitigation measures are put in place to meet the requirements ***to protect*** the wetlands ***and extend the conserved area of wetlands, thereby creating a potential net positive impact for wetlands.***

Table 9-30: Summary of impact on wetlands at Duynefontein

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Construction Phase								
1A: Loss or degradation of wetlands resulting from dewatering	***Negative***	***Medium***	***Low***	***Medium***	***Low***	***Medium***	***Low***	***Low - Medium***
1B: Mitigated	***Negative***	***Low***	***Low***	***Medium***	***Low***	***Low***	***Low***	***Low***
2A: Loss or degradation of wetlands resulting from seawater contamination, following dewatering	***Negative***	***High***	***Low***	***Medium***	***Medium***	***Medium***	***Low***	***Low - Medium***
2B: Mitigated (no mitigation required)	***Negative***	***High***	***Low***	***Medium***	***Medium***	***Medium***	***Low***	***Low - Medium***
3A: Degradation of wetlands as a result of construction of internal access roads	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
3B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Operational Phase								
4A: Degradation and fragmentation of wetlands as a result of construction of internal roads	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
4B: Mitigated	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
5A: Cumulative impacts	***Negative***	***Low***	***Low***	***High***	***Medium***	***Medium***	***Low***	***Low - Medium***
5B: Mitigated	***Negative***	***Low***	***Low***	***High***	***Medium***	***Medium***	***Low***	***Low - Medium***

Table 9-31: Summary of impacts on wetlands at Bantamsklip

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Construction phase								
1A: Loss or degradation of wetlands as a result of dewatering	***Negative***	***Medium***	***Low***	***Medium***	***Medium***	***Medium***	***Low***	***Low - Medium***
1B: Mitigated	***Negative***	***Low***	***Low***	***Medium***	***Low***	***Low***	***Low***	***Low***
2A: Degradation of wetlands as a result of physical disturbance to wetlands north of the R43 during construction	***Negative***	***Medium***	***Low***	***Medium***	***Medium***	***Medium***	***Low***	***Low - Medium***
2B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
Operational phase								
3A: Degradation of wetlands associated with the Groot Hagelkraal system through alien encroachment	***Negative***	***Medium***	***Medium***	***Medium***	***Medium***	***Medium***	***Medium***	***Medium***
3B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
4A: Increased fragmentation of wetlands up- and downstream of the Groot Hagelkraal system as a result of increased road use along the R43	***Negative***	***Low***	***Medium***	***Medium***	***Low***	***Low***	***Medium***	***Low***
4B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
5A: Impacts to wetland systems associated with indirect impacts of the proposed NPS development	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

Table 9-32: Summary of impacts on wetlands at Thyspunt

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Construction phase								
1A: Loss or degradation of the Langefonteinvlei and/or duneslack wetlands as a result of dewatering	*Negative*	*High*	*Low*	*Medium*	*High*	*High*	*Low*	*Medium*
1B: With mitigation	*Negative*	*Medium*	*Low*	*Medium*	*High*	*Medium*	*Low*	*Low - Medium*
2A: Loss or degradation of coastal seep wetlands as a result of interference with surface or groundwater flows, including dewatering activities	*Negative*	*High*	*Low*	*High*	*High*	*High*	*High*	*High*
2B: With mitigation	*Negative*	*High*	*low*	*high*	*Medium*	*Medium*	*Medium*	*Medium*
3A: Degradation of coastal seep wetlands as a result of receipt of concentrated volumes of potentially sediment-rich water from dewatered areas	*Negative*	*Medium*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*Medium*
3B: With mitigation	*Negative*	*Low*	*Low*	*Medium*	*High*	*Medium*	*Low*	*Low - Medium*
4A: Degradation of the Langefonteinvlei (western sector) and other non-coastal hillslope seep wetlands as a result of the proximal location of stockpiles of spoil or topsoil	*Negative*	*Low*	*Low*	*Medium*	*High*	*Medium*	*Low*	*Low - Medium*
4B: With mitigation	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*
5A: Degradation of coastal seep wetlands as a result of catchment hardening and runoff from laydown areas	*Negative*	*Low*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*Medium*
5B: With mitigation	*Negative*	*Low*	*Low*	*Medium*	*High*	*Medium*	*Low*	*Low - Medium*
6A: Degradation / drainage / infilling of hillslope seeps and valley bottom wetlands north of the high dune fields	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
6B: With mitigation	*Negative*	*Low*	*Low*	*High*	*Medium*	*Medium*	*Low*	*Low*
Operational phase								
7A: Loss or degradation of coastal seep wetlands as a result of interference with surface or groundwater flows	*Negative*	*High*	*Low*	*High*	*High*	*High*	*High*	*High*

7B: With mitigation	***Negative***	***Medium***	***Low***	***High***	***High***	***Medium***	***High***	***Medium***
8A: Degradation of remnant coastal seepage wetlands as a result of receipt of stormwater runoff	***Negative***	***Low***	***Low***	***High***	***High***	***Medium***	***Low***	***Low - Medium***
8B: With mitigation	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
9A: Degradation of hillslope seeps and valley bottom wetlands north of the high dune fields	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***High***	***Low - Medium***
9B: With mitigation	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
10A: Degradation of dune slack wetlands as a result of increased vehicle passage across the dunes	***Negative***	***Medium***	***Low***	***High***	***High***	***Medium***	***Medium***	***Medium***
10B: With mitigation	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
11A: Conservation of remaining dune slack, coastal seep and valley bottom wetlands on the site	***Positive***	***Medium***	***Low***	***High***	***High***	***Medium***	***Medium***	***Medium***
12A: Treatment of sewage on site: water quality impacts to wetlands	***Negative***	***Medium***	***Low***	***High***	***Medium***	***Medium***	***High***	***Medium***
12B: With mitigation	***Negative***	***Low***	***Low***	***High***	***Medium***	***Medium***	***Low***	***Low – Medium***
Impacts associated with fresh water supply								
13A: Degradation of wetlands along pipeline routes or as a result of abstraction	***From a fresh water supply perspective it has been concluded that desalination is the only feasible water supply option for all sites. Pipelines and groundwater abstraction would therefore not occur during operation.***							
13B: Mitigated								
14A: Wetland disturbance, fragmentation and disruption of through-flows as a result of access roads and transmission towers in or across wetlands (with respect to transmission lines between the power station and the HV Yard)	***Negative***	***Medium***	***Low***	***High***	***High***	***Medium***	***High***	***Medium***
14B: With mitigation (i.e. mitigated use of dual circuit transmission system)	***Negative***	***Medium***	***Low***	***High***	***High***	***Medium***	***Low***	***Low – Medium***
15A: Conveyance of sand to the panhandle using a temporary conveyor belt: degradation of duneslack wetlands, as well as depressions and valley bottoms north of the mobile dune field	***As indicated in Chapter 5 of the EIR, the Northern Access Road and the proposed conveyor belt system for transport of spoil from the power station and the HV Yard have been removed from consideration based on the consensus recommendation of the EIA specialists.***							

15B: With mitigation								
16A: All access routes: Construction phase: wetland degradation as a result of disturbance, water quality changes, compaction	***Negative***	***Medium***	***Medium***	***Medium***	***Medium***	***Medium***	***High***	***Medium***
16B: With mitigation	***Negative***	***Low***	***Medium***	***Low***	***Medium***	***Low***	***Medium***	***Low***
17A: All routes: Operational phase: wetland fragmentation; disruption of faunal and hydrological corridors; degradation of wetlands as a result of water quality impacts and erosion; infilling and constriction of wetlands at bridge crossings	***Negative***	***Medium***	***Medium***	***High***	***Medium***	***Medium***	***High***	***Medium***
17B: With mitigation	***Negative***	***Low***	***Medium***	***High***	***Medium***	***Medium***	***Low***	***Low - Medium***
18A: Eastern route: disturbance of the eastern valley bottom wetland at crossing point; localised impacts to flow	***Negative***	***Medium***	***Medium***	***High***	***Medium***	***Medium***	***High***	***Medium***
18B: With mitigation	***Negative***	***Low***	***Medium***	***High***	***Medium***	***Medium***	***Low***	***Low - Medium***
19A: Western Route: infilling of coastal and hillslope seep wetlands and disruption of through-flows	***Negative***	***Medium***	***Medium***	***High***	***Medium***	***Medium***	***High***	***Medium***
19B: With mitigation	***Negative***	***Low***	***Medium***	***High***	***Medium***	***Medium***	***Low***	***Low – Medium***
20A: Northern Route: infilling of a number of duneslack depressions; fragmentation of the dune system; potential disruption of through-flows	***As indicated in Chapter 5 of the EIR, the Northern Access Road and the proposed conveyor belt system for transport of spoil from the power station and the HV Yard have been removed from consideration based on the consensus recommendation of the EIA specialists.***							
20B: With mitigation								
Cumulative impacts								
21A: Cumulative impact: Unmitigated impact of development	***Negative***	***High***	***Medium***	***High***	***High***	***High***	***High***	***High***
21B: Cumulative impacts associated with development, without incorporation of offset mitigation, but with all other mitigation in place	***Negative***	***Medium***	***Medium***	***High***	***High***	***Medium***	***High***	***Medium***

9.13 Impacts on terrestrial vertebrate fauna

Impacts of terrestrial vertebrate fauna (including birds), is dealt with in Appendix E13.

The impacts of the proposed nuclear power station development, Nuclear-1, are identified separately for each of the three alternative sites, namely Duynefontein, Bantamsklip and Thyspunt (below). Note that most of the predicted impacts are common to all three sites, although the severity and significance of those impacts may differ between sites.

9.13.1 Duynefontein

(a) Destruction of natural habitats and populations

Wherever buildings and infrastructure are constructed, natural habitats will be destroyed. In addition, lay-down areas for machinery, materials and soil will be heavily impacted, albeit not permanently. Many of the animals associated with affected habitats will be killed at the time of site clearance. Some of those animals that are able to escape will establish themselves in similar habitats nearby, but their long-term prospects for survival will be poor because those habitats will most likely already be at carrying capacity for the relevant species. These potential impacts will be locally intense and mainly of a permanent nature. Lay-down areas can be rehabilitated over time. Mitigation should take the form of avoidance of the most sensitive areas.

(b) Reduction in populations of Threatened species

Species which have Threatened or Near Threatened status (see fauna specialist report **Appendix E13**) may experience a reduction of their national or global populations and an exacerbation of their poor conservation status. Species relevant to Duynefontein are: Gronovi's Dwarf Burrowing Skink *Scelotes gronovii* (Near Threatened), Southern Adder *Bitis armata* (Vulnerable), Blouberg Dwarf Burrowing Skink *Scelotes montispectus* (Near Threatened), Whitetailed Mouse *Mystromys albicaudatus* (Endangered), Honey Badger *Mellivora capensis* (Near Threatened), African Black Oystercatcher *Haematopus moquini* (Near Threatened) and Black Harrier *Circus maurus* (Near Threatened). Other relevant bird species will be less directly impacted. The fact that habitats occupied by these species will be permanently destroyed means that the negative impacts on the species are likely also to be permanent.

(c) Fragmentation of natural habitats and patterns of animal movement

The construction of buildings and infrastructure, including fencing, will break up blocks of continuous or intergrading habitats into relatively isolated fragments. The impact of such fragmentation will vary from species to species, depending on the degree of mobility of the species and its tolerance of sub-optimal habitat types. Many species, with limited mobility and low tolerance of habitats other than their preferred habitat, will become isolated within fragments and thereby become more vulnerable to local extinction. This potential impact is likely to be permanent, but with the greatest impact on species with restricted movements, such as fossorial reptiles, and the least impact on birds. Ecological corridors are key to mitigate fragmentation.

(d) Road mortality

Local populations of animals will be negatively impacted by mortality on the roads. Areas close to roads are likely to become population “sinks” in which the rate of increase from reproduction and immigration is less than the rate of decrease owing to deaths on the road. For some species, especially nocturnal species, such impacts may be intense, especially if the road separates two different habitats which are both essential to the species, e.g. dryland and wetland habitats, or inland and coastal habitats.

(e) Mortality associated with overhead-transmission lines and substations

Overhead cables are obstacles to birds in flight and collisions can occur, especially under conditions of poor visibility. Such conditions frequently prevail on the west coast when fog rolls in from the sea. The danger applies particularly to larger birds, which are less manoeuvrable in flight. If transmission lines cross regularly used flight paths, the potential impact of the power lines on local or even regional populations can be severe. Large birds that perch on pylons can also be at risk of electrocution. Substations (e.g., the proposed HV yard) present what appear to be good nesting sites for some birds, but such nesting attempts are inherently dangerous. The interaction of birds and electrical installations is not only potentially deleterious to birds, but can also result in costly breaks in transmission. Eskom has extensive experience and technological expertise in mitigating problems of this kind. Note that the transmission lines are the subject of a separate EIA and these issues will presumably be highlighted in that process.

(f) Disturbance of sensitive breeding populations

Noise, visual disturbance, and especially an increased presence of human beings, all have the potential to disturb wild animals and possibly disrupt their normal behaviour patterns. This becomes particularly problematic when breeding of rare and sensitive species is disrupted. Impacts tend to be more intense during the construction phase when human activity is more intense and less routine. Extraordinary disturbances, such as blasting, are also associated with the construction phase. Depending on the nature and timing of disturbances, their impacts can vary from local and moderate to regional and intense. Species likely to be affected are, especially, seabirds roosting and breeding in the relatively protected environment in and around Koeberg harbour, including Swift Terns *Sterna bergii*, African Black Oystercatchers *Haematopus moquini* (Near Threatened), Cape Cormorants *Phalacrocorax capensis*, Crowned Cormorants *P. neglectus* (Vulnerable), and Bank Cormorants *P. coronatus* (Near Threatened). Nuclear-1 will not be using or affecting Koeberg harbour directly, but construction activities in the vicinity have the potential to cause damaging disturbance.

(g) Dust pollution beyond the building site

During the construction phase, dust generated by construction activities, especially trucks on dirt roads, will drift onto neighbouring vegetation and cause degradation of habitats with negative effects on the animals using those habitats. This potential impact is temporary and localised.

(h) Pollution of soil and water beyond the building site

The use of heavy machinery and vehicles will inevitably lead to fuel and chemical spills with some chemical pollution of soil and groundwater, especially during the construction phase when the use of machinery is more intense. The danger is that polluted water can move, either on the surface or underground, to areas beyond the building site and, in particular, may reach wetlands. Pollution of soil can also be damaging if such pollution occurs in areas that are intended for later rehabilitation to a natural state. Depending on the severity of the pollution, the resultant degradation of habitats can extend into the medium and long term, especially if polluting events continue during the operational phase. Pollution arising from the disposal of sewage is especially relevant in this regard. Some types of pollution can also be cumulative (e.g. heavy-metal pollution and organic eutrophication).

(i) Light pollution beyond the building site

Outdoor lighting, especially of the short-wavelength type (white and blue), attracts night-flying insects from considerable distances, and this leads to unacceptably high levels of mortality among these insects, many of which are critically important to normal ecosystem functioning. In addition, an abundance of insects under lights tends to attract predators such as owls, bats and toads, thus disrupting the normal behaviour patterns of these species. Long-term use of external lighting has a cumulative negative potential impact on ecosystems.

(j) Alteration of surface and groundwater levels and flows; knock-on effects on local wetlands

The hard surfaces of buildings and roads cause increased run-off, which is often contaminated with pollutants. Such potential impacts may be minor and negligible, or may be major with important ecological consequences for wetland-dependent fauna. The opinion of relevant specialists at the November 2009 specialist integration meeting was that such impacts will be insignificant at Duynefontein.

(k) Poaching of local wildlife

The area around the Duynefontein site comprises the Koeberg Private Nature Reserve, which is home to many antelope, game birds and other wildlife that is likely to tempt people who would like to hunt for sport or for the pot. With large numbers of workers temporarily on site during the construction phase, the negative potential impact of poaching could be locally intense. However, with the conservation personnel of Koeberg Private Nature Reserve already deployed on site, this impact will presumably be kept under reasonable control.

(l) Problem-animal scenarios

Of concern are animals that have the potential to become problematic, especially during the operational phase when some animals become accustomed to the presence and activities of humans. The Chacma Baboon *Papio ursinus* is often a good example, but this species does not occur at Duynefontein. However, even small and relatively harmless species, such as Small Grey Mongoose *Galerella pulverulenta*, Small-spotted Genet *Genetta genetta*, Cape Porcupine *Hystrix africaeaustralis,* and various rodents can become problem animals if they are tempted to exploit resources provided by humans. People, in their eagerness to interact with wildlife, will often try to feed mammals and birds. The feeding of birds, although traditional, can cause certain species to become a nuisance, and leftover food attracts other species, such as rodents. If rodent populations build up in an area as a result of artificially elevated food supplies, predators of rodents (including venomous snakes such as the Puff Adder *Bitis arietans* and Cape Cobra *Naja nivea*) will also be attracted. The development site is close enough to residential areas for domestic animals to also pose a potential problem. Stray animals have the potential to become feral and prey on wild fauna.

(m) Cumulative impacts

Several of the potential impacts listed above will potentially continue during the operational phase of the nuclear power station (e.g. road mortality, light pollution, disturbance of sensitive populations, etc.) and will thereby exert a cumulative impact over time. Given the fact that there is already one nuclear power station at Duynefontein, the addition of another nuclear power station just to the north of Koeberg will clearly lead to cumulative impacts. Virtually all of the impacts listed above will be cumulative relative to similar impacts brought about by Koeberg. One of the most serious potential cumulative impacts is the increasing isolation of coastal and inland habitats from each other. Many of the more mobile species, especially among mammals and birds, rely on a diversity of habitats to sustain them at different times and under varying conditions. For this reason it is ecologically important that animals be able to move freely and unhindered between coastal and inland habitat types. An increasingly long string of buildings and fences at the coast make such movements difficult or impossible and thereby have a cumulative negative impact on local populations. Another potentially serious cumulative impact is the disruption of dune systems. The mobile sands of the sand plume to the north of the site create a mosaic of habitat types with ecologically valuable edges. If the continuous addition of mobile sand from the south is further disrupted – it has already been partially disrupted by Koeberg – the existing dunes are likely to stabilize and become permanently vegetated, causing a cumulative negative impact on the diversity of the local ecology.

(o) Improvement of the conservation status of undeveloped land

Given that the site of the proposed new nuclear power station, and the land surrounding it, are currently managed by Eskom as an extension of the Koeberg Nature Reserve, it is clear that there will be no improvement of conservation status of Eskom-owned lands. On the contrary, the area under conservation management will shrink substantially. Nevertheless, conservation status can also be enhanced through elevation of the legal status of the reserve, and through improved conservation management, and there is potential to achieve these at Duynefontein.

9.13.2 Bantamsklip

(a) Destruction of natural habitats and populations

The nature of this potential impact will be similar to that at Duynefontein and is therefore not repeated here.

(b) Reduction in populations of Threatened species

Species which have Threatened or Near Threatened status (see **Appendix E13**) may experience a reduction of their national or global populations and an exacerbation of their poor conservation status. Species relevant to the coastal portion of Bantamsklip are: Southern Adder *Bitis armata* (Vulnerable), Fynbos Golden Mole *Amblysomus corriae* (Near Threatened), Whitetailed Mouse *Mystromys albicaudatus* (Endangered), Honey Badger *Mellivora capensis* (Near Threatened), African Black Oystercatcher *Haematopus moquini* (Near Threatened), Black Harrier *Circus maurus* (Near Threatened), and Denham's Bustard *Neotis denhami* (Vulnerable). The fact that habitats occupied by these species will be permanently destroyed means that the potential negative impacts on the species are likely also to be permanent. Other relevant bird species, i.e. various Threatened seabirds, would be less directly impacted, if at all because potential impacts on marine habitats would be minor. Roosting seabirds at the coast can be adequately protected by a wide coastal corridor, as recommended. The concerns, expressed by some I&APs about possible impacts on seabirds breeding on Dyer Island, are misplaced. The only manner in which these birds could be affected is if the nuclear power station somehow affected their food supply, namely the abundance of shoaling fish such as sardines, pilchards and anchovies. There is no danger of such a negative impact (Tamara Robinson, marine ecology specialist, *pers. comm*.).

(c) Fragmentation of natural habitats and patterns of animal movement

The nature of this potential impact will be similar to that at Duynefontein and is therefore not repeated here.

(d) Road mortality

The nature of this potential impact will be similar to that at Duynefontein and is therefore not repeated here.

(e) Mortality associated with overhead-transmission lines and substations

Overhead cables are obstacles to birds in flight and collisions can occur, especially under conditions of poor visibility, for example, when there is fog or mist. The danger applies particularly to larger birds which are less manoeuvrable in flight. If transmission lines cross regularly used flight paths, the impact of the lines on local or even regional populations can be severe. Large birds that perch on pylons can also be at risk of electrocution. Substations (e.g., the proposed HV yard) present what appear to be good nesting sites for some birds, but such nesting attempts are inherently dangerous. The interaction of birds and electrical installations is not only potentially deleterious to birds, but can also result in costly breaks in transmission. Happily, Eskom has extensive experience and technological expertise in mitigating problems of this kind. Threatened birds likely to be particularly affected at Bantamsklip are Blue Crane (Vulnerable), Denham's Bustard (Vulnerable), and Secretarybird (Near Threatened). Note that the transmission lines are the subject of a separate EIA and these issues will presumably be highlighted in that process.

(f) Disturbance of sensitive breeding populations

Noise, visual disturbance, and especially an increased presence of human beings, all have the potential to disturb wild animals and possibly disrupt their normal behaviour patterns. This becomes particularly problematic when breeding of rare and sensitive species is disrupted. Impacts tend to be more intense during the construction phase when human activity is more intense and less routine. Extraordinary disturbances, such as blasting, are also associated with the construction phase. Depending on the nature and timing of disturbances, their impacts can vary from local and moderate to regional and intense. Species likely to be affected at Bantamsklip include, among others, Cape Cormorant (Near Threatened), Bank Cormorant (Endangered), Crowned Cormorant (Near Threatened), African Black Oystercatcher (Near Threatened), Damara Tern *Sterna balaenarum* (Endangered), Black Harrier (Near Threatened), Denham's Bustard (Vulnerable) and Blue Crane (Vulnerable).

(g) Dust pollution beyond the building site

The nature of this potential impact will be similar to that at Duynefontein and is therefore not repeated here.

(h) Pollution of soil and water beyond the building site

The nature of this potential impact will be similar to Duynefontein. However, the apparent absence of wetlands on or near to the proposed Bantamsklip footprint suggests that this impact is of relatively minor importance at this site.

(i) Light pollution beyond the building site

The nature of this potential impact will be similar to that at Duynefontein and is therefore not repeated here.

(j) Alteration of surface and groundwater levels and flows; knock-on effects on local wetlands

The nature of this potential impact will be similar to that at Duynefontein and is therefore not repeated here.

(k) Poaching of local wildlife

The area around the proposed Bantamsklip footprint is relatively wild and natural and home to antelope, game birds and other wildlife that is likely to tempt people who would like to hunt for sport or for the pot. With large numbers of workers temporarily on site during the construction phase, the negative impact of poaching could be locally intense. This negative scenario is exacerbated by the fact that abalone poachers are already active in the area. Numbers of antelope on site were noticeably low, which suggests that poaching of terrestrial fauna may already be happening in the area, adding to the need for strict control.

(l) Problem-animal scenarios

Of concern are animals that have the potential to become problematic. Chief among these is the Chacma Baboon *Papio ursinus*. As human habitation steadily encroaches on their territories, these primates become bolder in exploiting the opportunities presented. At such times, wild animals can become a threatening and hazardous presence. Other potentially problematic and dangerous species include Leopard *Panthera pardus* and Bushbuck *Tragelaphus scriptus*. Even small and relatively harmless species, such as Small Grey Mongoose *Galerella pulverulenta*, Small-spotted Genet *Genetta genetta*, Cape Porcupine *Hystrix africaeaustralis,* Rock Hyrax *Procavia capensis* and various rodents can become problem animals if they are tempted to exploit resources provided by humans. People, in their eagerness to interact with wildlife, will often try to feed mammals and birds. The feeding of birds, although traditional, can cause certain species to become a nuisance, and leftover food attracts other species, such as rodents. If rodent populations build up in an area as a result of artificially elevated food supplies, predators of rodents (including venomous snakes such as the Puff Adder *Bitis arietans* and Cape Cobra *Naja nivea*) will also be attracted. The development site is close enough to residential areas for domestic animals to also pose a potential problem. Stray animals have the potential to become feral and prey on wild fauna.

(m) Cumulative impacts

The nature of this potential impact will be similar to that at Duynefontein and is therefore not repeated here.

(n) Improvement of the conservation status of undeveloped land

Most of the development corridor, and the land surrounding it, are currently owned by Eskom but have no particular conservation status. If Eskom retains ownership of the land and manages the natural, undisturbed parts as a private nature reserve, as is presently the case with Koeberg Private Nature Reserve, it is clear that there will be a significant improvement in the conservation status of the undeveloped parts of the Bantamsklip site. This would be of special significance to the populations of Threatened frogs on the Hagelkraal farm, and other Threatened species. In addition, conservation status could be enhanced through improved conservation management, for example, removal of invasive alien vegetation. Such conservation actions would contribute to national conservation targets and could represent significant offsets for the loss of habitats and individuals at the development footprint.

9.13.3 Thyspunt

(a) Destruction of natural habitats and populations

The nature of this potential impact will be similar to that at Duynefontein and is therefore not repeated here.

(b) Reduction in populations of Threatened species

Species which have Threatened or Near Threatened status (see fauna report) may experience a reduction of their national or global populations and an exacerbation of their poor conservation status. Species relevant to Thyspunt are: FitzSimons' Long-tailed Seps (Vulnerable) and Tasman's Girdled Lizard (Vulnerable), Elandsberg Dwarf Chameleon (Endangered), Fynbos Golden Mole (Near Threatened), Honey Badger (Near Threatened), Blue Duiker (Vulnerable), African Black Oystercatcher (Near Threatened), African Marsh Harrier (Vulnerable), Black Harrier (Near Threatened), White-bellied Korhaan (Vulnerable), Denham's Bustard (Vulnerable), Knysna Woodpecker (Near Threatened) and Knysna Warbler (Vulnerable). Other relevant bird species will be less directly impacted. The fact that habitats occupied by these species may be permanently destroyed means that the negative impacts on the species are likely also to be permanent.

(c) Fragmentation of natural habitats and patterns of animal movement

The nature of these impacts will be similar to that at Duynefontein and are therefore not repeated here in totality. At Thyspunt, however, the impacts of roads are expected to be more intense than at Duynefontein and Bantamsklip. Although there are three alternatives, two major new roads are planned onto the site. The significance of the impacts on the Thyspunt site differ as the lengths of the roads are greater in comparison to the other sites and because the roads cross environmentally more sensitive terrain including the Langefontein Wetland Complex located on the eastern portion of the site and the duned fields located on the northern portion of the site.

(d) Road mortality

The nature of this potential impact will be similar to that at Duynefontein and is therefore not repeated here.

(e) Mortality associated with overhead-transmission lines and substations

Overhead cables are obstacles to birds in flight and collisions can occur, especially under conditions of poor visibility, for example, when there is fog or mist. The danger applies particularly to larger birds which are less manoeuvrable in flight. If transmission lines cross regularly used flight paths, the impact of the lines on local or even regional populations can be severe. Large birds that perch on pylons can also be at risk of electrocution. Substations (e.g., the proposed HV yard) present what appear to be good nesting sites for some birds, but such nesting attempts are inherently dangerous. The interaction of birds and electrical installations is not only potentially deleterious to birds, but can also result in costly breaks in transmission. Happily, Eskom has extensive experience and technological expertise in mitigating problems of this kind. Threatened birds likely to be particularly affected at Thyspunt are Blue Crane (Vulnerable), Denham's Bustard (Vulnerable), White-bellied Korhaan (Vulnerable) and Secretarybird (Near Threatened). Note that the transmission lines are the subject of a separate EIA and these issues will presumably be highlighted in that process.

(f) Disturbance of sensitive breeding populations

Noise, visual disturbance, and especially an increased presence of human beings, all have the potential to disturb wild animals and possibly disrupt their normal behaviour patterns. This becomes particularly problematic when breeding of rare and sensitive species is disrupted. Impacts tend to be more intense during the construction phase when human activity is more intense and less routine. Extraordinary disturbances, such as blasting, are also associated with the construction phase. Depending on the nature and timing of disturbances, their impacts can vary from local and moderate to regional and intense. Threatened species likely to be affected include, among others, Blue Duiker (Vulnerable), African Black Oystercatcher (Near Threatened), African Marsh Harrier (Vulnerable), Black Harrier (Near Threatened), Black-winged Lapwing (Near Threatened), Denham's Bustard (Vulnerable), White-bellied Korhaan (Vulnerable), Blue Crane (Vulnerable); Knysna Woodpecker (Near Threatened) and Knysna Warbler (Vulnerable).

(g) Dust pollution beyond the building site

The nature of this potential impact will be similar to that at Duynefontein and is therefore not repeated here.

(h) Pollution of soil and water beyond the building site

The nature of this potential impact will be similar to that at Duynefontein and is therefore not repeated here in totality. The presence of a large number of wetlands on or near to the proposed Thyspunt footprint suggests that this impact is of major importance at this site.

(i) Light pollution beyond the building site

The nature of this impact will be similar to that at Duynefontein and is therefore not repeated here.

(j) Alteration of surface and groundwater levels and flows; knock-on effects on local wetlands

The fact that the nuclear island itself must be constructed on bedrock (Integration Meeting, pers. comm.) means that, of necessity, there will be local disruption of groundwater flow, and this is likely to lead to altered water supply and/or drainage at local wetlands[6]. The hard surfaces of buildings and roads cause increased run-off which is often contaminated with pollutants. Such potential impacts may be minor and negligible, or may be major with important ecological consequences for wetland-dependent fauna. This specialist is not able to judge, in advance, the severity of such potential impacts, but the opinion of relevant specialists (Integration Meeting; pers. comm.) is that such impacts will be potentially highly significant at the Thyspunt site.

(k) Poaching of local wildlife

The area around the proposed Thyspunt footprint is relatively wild and natural and home to antelope, bushpigs, game birds and other wildlife that are likely to tempt people who would like to hunt for sport or for the pot. With large numbers of workers temporarily on site during the construction phase, the potential negative impact of poaching could be locally intense.

(l) Problem-animal scenarios

Of concern are animals that have the potential to become problematic. Chief among these are Chacma Baboon *Papio ursinus* and Vervet Monkey *Cercopithecus pygerythrus*. As human habitation steadily encroaches on their territories, these primates become bolder in exploiting the opportunities presented. At such times, wild animals can become a threatening and hazardous presence. Other potentially problematic and dangerous species include Leopard *Panthera pardus,* Bushpig *Potamochoerus larvatus* and Bushbuck *Tragelaphus scriptus*. Even small and relatively harmless species, such as Small Grey Mongoose *Galerella pulverulenta*, Small-spotted Genet *Genetta genetta*, Cape Porcupine *Hystrix africaeaustralis,* Rock Hyrax *Procavia capensis* and various rodents can become problem animals if they are tempted to exploit resources provided by humans. People, in their eagerness to interact with wildlife, will often try to feed mammals and birds. The feeding of birds, although traditional, can cause certain species to become a nuisance, and leftover food attracts other species, such as rodents. If rodent populations build up in an area as a result of artificially elevated food supplies, predators of rodents (including venomous snakes such as the Puff Adder *Bitis arietans* and Cape Cobra *Naja nivea*).will also be attracted, The development site is close enough to residential areas for domestic animals to also pose a potential problem. Stray animals can become feral and prey on wild fauna.

(m) Cumulative impacts

The nature of this potential impact will be similar to that at Duynefontein and is therefore not repeated here.

(n) Improvement of the conservation status of undeveloped land

The site of the new nuclear power station, and the land surrounding it, are currently owned by Eskom but have no particular conservation status. If Eskom retains ownership of the land and manages the natural, undisturbed parts as a private nature reserve, as is presently the case at Koeberg Private Nature Reserve, there will be a significant improvement in the conservation status of the Thyspunt site. This would be of special significance to populations of various Threatened species. In addition, conservation status could be enhanced through improved conservation management, for example, removal of invasive alien vegetation. Such conservation actions would contribute to national conservation targets and could represent significant offsets for the loss of habitats and individuals at the development footprint.

[6] ***To be read in context of the updated groundwater monitoring study and wetlands studies, which found that impacts on Langefonteinvlei can be mitigated.***

9.13.4 Impact on decommissioning

Given the extensive and intensive nature of the decommissioning process, it is reasonable to assume that the range of impacts identified for construction and operation will also be relevant to the decommissioning process. These are:

- Destruction of natural habitats and populations;
- Reduction in populations of Threatened species;
- Fragmentation of natural habitats and patterns of animal movement;
- Road mortality;
- Mortality associated with overhead-transmission lines and substations;
- Disturbance of sensitive breeding populations;
- Dust pollution beyond the building site;
- Pollution of soil and water beyond the building site;
- Light pollution beyond the building site;
- Alteration of surface and groundwater levels and flows; knock-on effects;
- Poaching of local wildlife; and
- Problem-animal scenarios.

9.13.5 Mitigation

Mitigation ***measures are generally similar or the same at all site, with some exceptions as indicated below.***

<u>Mitigation of destruction of natural habitats and populations:</u>

- Restrict development to a recommended footprint;
- Restrict the footprint of the development to the smallest area possible;
- Dispose of spoil at sea;
- Create laydown areas in previously disturbed areas;
- Use natural topographical features as boundaries;
- Clear the site in a logical sequence;
- Mark off the affected area;
- Rehabilitate affected areas, where possible; and
- Compensate for loss of habitats. (See below).

<u>Mitigation of reduction in populations of Threatened species:</u>

- All of the mitigation measures listed above;
- Facilitate search-and-rescue operations before and during site clearance; and
- Facilitate collection of scientific material and information before and during site clearance.

<u>Mitigation of fragmentation of natural habitats and patterns of animal movement:</u>

- Most of the mitigations listed above;
- Make provision for ecological corridors;
- Construct under- and overpasses across roads;
- Keep roads as far away from wetlands as possible;
- Use recommended types of security fencing;
- Wherever possible, place pipelines and cables underground, and rehabilitate;
- Reduce the number of roads and tracks and place them carefully; and
- Make roads off limits for fixed periods every day.

<u>Mitigation of road mortality:</u>

- Reduce the number of roads and tracks and place them carefully;
- Keep roads as far away from wetlands as possible;
- Construct under- and overpasses across roads;
- Restrict speed on roads;
- Place warning signage in appropriate places; and
- Use appropriate curb designs.

Mitigation of mortality associated with overhead-transmission lines and substations:
- Fit standard devices on all new routes (e.g., "flappers" or reflectors or "balls"); and
- Monitor routes and installations.

Mitigation of disturbance of sensitive breeding populations:
- Determine location and extent of sensitive bird and other areas;
- Quarantine sensitive bird and other areas;
- Restrict the timing of blasting;
- Create wide buffer zones;
- Restrict air traffic;
- Restrict water traffic;
- Enforce all restrictions; and
- Institute a programme of monitoring.

Mitigation of dust pollution beyond the building site:
- Apply standard mitigation measures, e.g., damping down with freshwater, use of cloth or brush barrier fences, covering dumps with plastic sheeting, etc; and
- Do not use seawater.

Mitigation of pollution of soil and water beyond the building site:
- Apply standard mitigation measures;
- Remove all polluted soil and water from site;
- Dispose of brine from desalination into the sea; and
- Dispose of sewage in a sustainable manner.

Mitigation of light pollution beyond the building site:
- Reduce exterior lighting;
- Use only long-wavelength lights;
- Use directional fittings; and
- Screen interior lighting.

Mitigation of alteration of surface and groundwater levels and flows, and knock-on effects on local wetlands:
- Avoid sites where major damage to wetlands is inevitable;
- Do not use wetlands or groundwater as sources of freshwater;
- Engineer solutions to the flow of groundwater;
- Carry out additional studies at Thyspunt[7] ***and determine whether adequate mitigation of the disruption of groundwater flow is possible; and***
- ***Engineer solutions to the flow of surface runoff.***

Mitigation of poaching of local wildlife:
- Educate workers;
- Patrol the area;
- Control materials;
- Control firearms;
- Control after-hours access; and
- Control access to non-construction areas.

Mitigation of problem-animal scenarios:
- Do not allow feeding of wild animals;
- Keep attractive resources out of reach;
- Exercise rigorous control of edible refuse;
- Eliminate feral cats and dogs; and

[7] ***As recommended by the wetlands assessment. This monitoring started in January 2010 and was completed by December 2010. The results of the monitoring programme are reflected in Appendix E12 and Section 9.12 of this EIR.***

- Do not allow pets on site.

Mitigation of accumulation of radioisotopes in the environment and in bodies of wild animals:

- No mitigations, beyond those required by human health and safety regulations, are recommended.

Mitigation of cumulative impacts:
The recommended mitigations that will contribute most are:

- choice of a suitable development footprint;
- rehabilitation of degraded areas, post construction;
- use of a suitable design for boundary fences;
- use of suitable exterior lighting;
- avoidance and mitigation of impacts on groundwater;
- enforcement of restrictions on disturbance and poaching of wildlife;
- monitoring of sensitive populations to aid environmental management; and
- monitoring of radioisotope pollution to aid environmental management.

Mitigation/offset of impacts through improved conservation of undeveloped land:

At Duynefontein:

- ***Enlarge the reserve through the acquisition of neighbouring farms;***
- ***Elevation of the legal status of KPNR to a statutory nature reserve[8];***
- ***Replacement of unsuitable mesh fences with palisade fences;***
- ***Increased spending on the removal of invasive alien plants;***
- ***Installation of two or three underpasses and/or overpasses across the R27, and major on-site access roads, to facilitate animal movements (if allowed by the appropriate roads authority) – if approved by the relevant roads authority;***
- ***Commissioning of detailed surveys of inadequately surveyed animal groups, viz., reptiles and small mammals, to inform management; and***
- ***Commissioning of a programme to monitor the populations of sensitive species, to inform management.***

At Bantamsklip, this form of compensation for negative impacts can be brought about by declaring the undeveloped portions of Eskom-owned land as a nature reserve and by managing that reserve effectively for conservation purposes. A model is provided by Koeberg Nature Reserve. Further offsets are possible by elevating the legal status of the reserve to a statutory protected area, and by devoting resources to improved management. Such improvements could include:

- ***Increasing the effective size of the reserve through the addition of neighbouring farms, either through purchase or formal co-operative agreements with other landowners;***
- ***Replacement of unsuitable mesh fences with palisade fences;***
- ***Increased spending on the removal of invasive alien plants;***
- ***Installation of two or three underpasses and/or overpasses across the R43, and major access roads on site, to facilitate animal movements;***
- ***Commissioning of detailed surveys of inadequately surveyed animal groups, viz., reptiles and small mammals, to inform management; and***
- ***Commissioning of a programme to monitor the populations of sensitive species to inform management.***

At Thyspunt, this form of compensation for negative impacts can be brought about by declaring the undeveloped portions of Eskom-owned land as a nature

[8] ***Koeberg Nature Reserve is in fact already gazetted.***

reserve and by managing that reserve effectively for conservation purposes. A model is provided by Koeberg Nature Reserve. Further offsets are possible by elevating the legal status of the reserve to a statutory protected area, and by devoting resources to improved management. Such improvements could include:

- ***Increasing the size of the reserve with the addition of neighbouring farms;***
- ***Replacement of unsuitable mesh fences with palisade fences;***
- ***Increased spending on the removal of invasive alien plants;***
- ***Installation of underpasses and/or overpasses across the new, tarred access roads to facilitate animal movements;***
- ***Commissioning of detailed surveys of poorly surveyed animal groups, viz., reptiles and small mammals, to inform management; and***
- ***Commissioning of a programme to monitor the populations of sensitive species, to inform management.***

Recommended monitoring and evaluation programme:
An appropriate monitoring and auditing programme should be put in place to track the efficacy of the mitigation measures. Most of this monitoring must be built into the auditing procedures of the EMPs for the construction, operational and decommissioning phases, but input during the design phase is also important for the demarcation of sensitive areas. The programme should include monitoring directed specifically at sensitive faunal populations.

The monitoring programmes as indicated in* Table 9-33 *are recommended:

Table 9-33: Recommended monitoring and mitigation programmes

No.	***Recommended monitoring programme***	***Duration of monitoring***	***Reporting frequency***	***Management objectives***
1	***Condition of wetlands close to footprint***	***Construction phase plus three years***	***Quarterly***	***Maintenance of pre-development wetland ecology***
2	***Size and breeding success of local breeding colonies of seabirds***	***Commence prior to construction phase and continue during operational phase; ongoing***	***Annual***	***No reduction in colony size and average breeding success rate***
3	***Mortality associated with transmission lines and substations***	***Commence after construction and continue until problems solved***	***Monthly***	***Reduction of frequency of bird mortality to low levels***
4	***Mortality associated with roads***	***Commence at beginning of construction phase and continue until problems solved***	***Monthly***	***Reduction of frequency of roadkills to low levels.***
5	***Population strength of selected sensitive species, e.g., Blouberg Dwarf Burrowing Skink***	***Commence prior to construction and continue during operational phase; ongoing***	***Annual***	***Stabilization or improvement of populations, post-construction***
7	***Regular audits of the EMP for construction phase***	***Construction phase***	***Quarterly***	***Compliance with all provisions***
8	***Regular audits of the EMP for operational phase***	***Operational phase***	***Three- yearly***	***Compliance with all provisions of the EMP***

No.	Recommended monitoring programme	Duration of monitoring	Reporting frequency	Management objectives

Notes regarding the recommended monitoring programmes:

- ***The "reporting frequency" is the frequency at which survey results must be written up and presented to the Environmental Control Officer (ECO).***
- ***The frequency of actual field surveys is not specified here. Survey protocols must be designed by the relevant specialists who are appointed to do the monitoring.***
- ***The breeding colonies in monitoring programme #2 are those at KNPS harbour. Note that monitoring must begin prior to the construction phase so that a baseline for monitoring can be established.***
- ***Monitoring programmes 3 and 4 should be the responsibility of the on-site ECO.***
- ***The sensitive species in monitoring programme #5 are those identified in 3.1.2 (above). Note that monitoring of these species must begin before site clearance so that a baseline for monitoring can be established.***
- ***Audits of the EMPs (#6 and #7) should be carried out by independent consultants.***

9.13.6 Conclusions

(a) Duynefontein

Development of Nuclear-1 at Duynefontein would have significant negative impacts, mainly because of the direct impacts on faunal habitats within the footprint areas. Duynefontein would benefit from the no-development option because the land is already managed as part of a private nature reserve. Opportunities for on-site conservation offsets are limited.

(b) Bantamsklip

At ***Bantamsklip***, the amount of land that is not of high faunal sensitivity between the coast and R43 available for development is more than sufficient to allow for the nuclear power station. The portion of the property inland of the R43 is highly sensitive and should not be developed at all. ***Highly significant potential conservation offsets are possible at Bantamsklip if undeveloped land is declared a nature reserve and is effectively managed as such. This would depend especially on the protection and management of the inland portion, as well as an adequate coastal corridor. The no-development option at Bantamsklip is not positive because it can be assumed that it will lead to a change of land ownership and probable residential and/or resort development at the coast, and a possible increase in intensity of agricultural exploitation on the inland portion.***

(c) Thyspunt

Development of Nuclear-1 at Thyspunt would have significant negative impacts, mainly because of:

- ***direct impacts on faunal habitats within the footprint areas;***
- ***development of three major new access roads; and***
- ***need for a development corridor across a large field of mobile dunes, making this site highly problematic with respect to fauna and faunal habitats.***

On the other hand, highly significant potential offsets are possible at Thyspunt if undeveloped land is declared a nature reserve and is effectively managed as such. Such offsets could be significantly strengthened by acquisition of additional land. The no-development option at Thyspunt is not positive because it can be assumed that it will lead to a change of land ownership and probable residential and/or resort

development at the coast, and a probable increase in intensity of agricultural exploitation on the inland portion.

From the perspective of faunal conservation, the following overall conclusion is that Nuclear-1 could be developed at either Duynefontein or Bantamsklip, without further faunal EIA investigations. If development is pursued at Thyspunt, further monitoring of faunal communities and mapping of vegetation habitats would be required.

Table 9-34: Summary of impacts on terrestrial vertebrate fauna at Duynefontein

Impact	Nature	Intensity	Extent	Duration	Impact on Irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A. Destruction of natural habitats and populations, resulting from site clearance, buildings, laydown areas and infrastructure	*Negative*	*High*	*Low*	*High*	*High*	*High*	*High*	*High*
1B: Mitigated	*Negative*	*Medium*	*Low*	*High*	*High*	*Medium*	*High*	*Medium*
2A. Reduction in populations of Threatened species, resulting from habitat destruction and direct mortality	*Negative*	*Low*	*Low*	*High*	*High*	*Medium*	*High*	*Medium*
2B: Mitigated	*Negative*	*Low*	*Low*	*High*	*High*	*Medium*	*High*	*Medium*
3A: Fragmentation of natural habitats and patterns of animal movement, resulting from buildings, infrastructure and fences	*Negative*	*Medium*	*Medium*	*High*	*High*	*Medium*	*High*	*Medium*
3B: Mitigated	*Negative*	*Low*	*Low*	*High*	*High*	*Medium*	*High*	*Medium*
4A: Road mortality (roadkills), resulting from traffic on roads through natural habitats	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
4B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Low*	*High*	*Low - Medium*
5A: Mortality associated with overhead-transmission lines and substations, resulting from collisions and electrocutions	*Negative*	*Medium*	*Low*	*High*	*Low*	*Medium*	*Medium*	*Medium*
5B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Medium*	*Low*
6A: Disturbance of sensitive breeding populations, resulting from construction activities and direct human disturbance	*Negative*	*High*	*Low*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
6B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*Low*
7A: Dust pollution beyond the building site, resulting from drifting, airborne dust from construction site and roads	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*High*	*Medium*
7B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*High*	*Low - Medium*

Impact	Nature	Intensity	Extent	Duration	Impact on Irreplaceable resources	Consequence	Probability	SIGNIFICANCE
8A: Pollution of soil and water beyond the building site, resulting from spills of chemicals, fuel and sewage	*Negative*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
8B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*Low*
9A: Light pollution beyond the building site, resulting from excessive outdoor lighting, and poor choice of lights and fittings	*Negative*	*High*	*Low*	*High*	*High*	*High*	*High*	*High*
9B: Mitigated	*Negative*	*Low*	*Low*	*High*	*High*	*Medium*	*High*	*Medium*
10A: Alteration of surface and groundwater levels and flows, and knock-on effects on local wetlands, resulting from underground foundation structures and construction methods	*Negative*	*Medium*	*Low*	*High*	*High*	*Medium*	*Low*	*Low - Medium*
10B: Mitigated	*Negative*	*Low*	*Low*	*High*	*High*	*Medium*	*Low*	*Low - Medium*
11A. Poaching of local wildlife during construction phase, resulting from hunting and trapping by workers and employees, for sport and for the pot	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
11B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Low*	*Medium*	*Low*
12A: Problem-animal scenarios, resulting mainly from human interaction with animals	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*Low*	*Low - Medium*
12B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Low*	*Low*	*Low*
13A: Accumulation of radioisotopes in the environment and in the bodies of wild animals, during operational phase, resulting from routine gaseous emissions from the reactors	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
13B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
14A: Cumulative impacts, resulting from addition of impacts to existing impacts, and the operation of impacts over time	*Negative*	*High*	*Medium*	*High*	*High*	*High*	*High*	*High*
14B: Mitigated	*Negative*	*Medium*	*Medium*	*High*	*High*	*Medium*	*High*	*Medium*

Impact	Nature	Intensity	Extent	Duration	Impact on Irreplaceable resources	Consequence	Probability	SIGNIFICANCE
15A. Improved conservation of undeveloped land, resulting from improved legal status and/or management	***Positive***	***Low***	***Medium***	***High***	***High***	***Medium***	***High***	***Medium***
15B: Optimised	***Positive***	***Medium***	***Medium***	***High***	***High***	***Medium***	***High***	***Medium***

Table 9-35: Summary of impacts on terrestrial vertebrate fauna at Bantamsklip

Impact	Nature	Intensity	Extent	Duration	Impact on Irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Destruction of natural habitats and populations, resulting from site clearance, buildings, laydown areas and infrastructure	*Negative*	*High*	*Low*	*High*	*High*	*High*	*High*	*High*
1B: Mitigated	*Negative*	*Medium*	*Low*	*High*	*High*	*Medium*	*High*	*Medium*
2A. Reduction in populations of Threatened species, resulting from habitat destruction and direct mortality	*Negative*	*Medium*	*Low*	*High*	*High*	*Medium*	*High*	*Medium*
2B: Mitigated	*Negative*	*Low*	*Low*	*High*	*High*	*Medium*	*High*	*Medium*
3A: Fragmentation of natural habitats and patterns of animal movement, resulting from buildings, infrastructure and fences	*Negative*	*Medium*	*Medium*	*High*	*High*	*Medium*	*High*	*Medium*
3B: Mitigated	*Negative*	*Low*	*Low*	*High*	*High*	*Medium*	*High*	*Medium*
4A. Road mortality (roadkills), resulting from traffic on roads through natural habitats	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
4B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Low*	*Medium*	*Low*
5A. Mortality associated with overhead-transmission lines and substations, resulting from collisions and electrocutions	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
5B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Low*	*Medium*	*Low*
6A: Disturbance of sensitive breeding populations, resulting from construction activities and direct human disturbance	*Negative*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
6B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*Low*
7A: Dust pollution beyond the building site, resulting from drifting, airborne dust from construction site and roads	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*High*	*Medium*

Impact	Nature	Intensity	Extent	Duration	Impact on Irreplaceable resources	Consequence	Probability	SIGNIFICANCE
7B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*High*	*Low - Medium*
8A: Pollution of soil and water beyond the building site, resulting from spills of chemicals, fuel and sewage	*Negative*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
8B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*Low*
9A: Light pollution beyond the building site, resulting from excessive outdoor lighting, and poor choice of lights and fittings	*Negative*	*High*	*Low*	*High*	*High*	*High*	*High*	*High*
9B: Mitigated	*Negative*	*Low*	*Low*	*High*	*High*	*Medium*	*High*	*Medium*
10A: Alteration of surface and groundwater levels and flows, and knock-on effects on local wetlands, resulting from underground foundation structures and construction methods	*Negative*	*Low*	*Low*	*High*	*High*	*Medium*	*Low*	*Low - Medium*
10B: Mitigated	*Negative*	*Low*	*Low*	*High*	*High*	*Medium*	*Low*	*Low - Medium*
11A. Poaching of local wildlife during construction phase, resulting from hunting and trapping by workers and employees, for sport and for the pot	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
11B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Low*	*Medium*	*Low*
12A: Problem-animal scenarios, resulting mainly from human interaction with animals	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*Low*	*Low - Medium*
12B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Low*	*Low*	*Low*
13A: Accumulation of radioisotopes in the environment and in the bodies of wild animals, during operational phase, resulting from routine gaseous emissions from the reactors	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
13B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*

Impact	Nature	Intensity	Extent	Duration	Impact on Irreplaceable resources	Consequence	Probability	SIGNIFICANCE
14A: Cumulative impacts, resulting from addition of impacts to existing impacts, and the operation of impacts over time	***Negative***	***High***	***Medium***	***High***	***High***	***High***	***High***	***High***
14B: Mitigated	***Negative***	***Medium***	***Medium***	***High***	***High***	***Medium***	***High***	***Medium***
15A: Improved conservation of undeveloped land, resulting from improved legal status and/or management	***Positive***	***Low***	***Medium***	***High***	***High***	***Medium***	***High***	***Medium***
15B: Optimised	***Positive***	***High***	***Medium***	***High***	***High***	***High***	***High***	***High***

Table 9-36: Summary of impacts on terrestrial vertebrate fauna at Thyspunt

Impact	Nature	Intensity	Extent	Duration	Impact on Irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Destruction of natural habitats and populations, resulting from site clearance, buildings, laydown areas and infrastructure	*Negative*	*High*	*Low*	*High*	*High*	*High*	*High*	*High*
1B: Mitigated	*Negative*	*Medium*	*Low*	*High*	*High*	*Medium*	*High*	*Medium*
2A: Reduction in populations of Threatened species, resulting from habitat destruction and direct mortality	*Negative*	*Medium*	*Low*	*High*	*High*	*Medium*	*High*	*Medium*
2B: Mitigated	*Negative*	*Low*	*Low*	*High*	*High*	*Medium*	*High*	*Medium*
3B: Fragmentation of natural habitats and patterns of animal movement, resulting from buildings, infrastructure and fences	*Negative*	*High*	*Medium*	*Low*	*High*	*High*	*High*	*High*
3B: Mitigated	*Negative*	*Medium*	*Low*	*Low*	*High*	*Medium*	*High*	*Medium*
4A: Road mortality (roadkills), resulting from traffic on roads through natural habitats	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
4B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Low*	*High*	*Low - Medium*
5A: Mortality associated with overhead-transmission lines and substations, resulting from collisions and electrocutions	*Negative*	*Medium*	*High*	*High*	*Medium*	*High*	*Medium*	*Medium – High*
5B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Low*	*Medium*	*Low*
6A: Disturbance of sensitive breeding populations, resulting from construction activities and direct human disturbance	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
6B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Medium*	*Low*
7A: Dust pollution beyond the building site, resulting from drifting, airborne dust from construction site and roads	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
7B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Medium*	*Low*

Impact	Nature	Intensity	Extent	Duration	Impact on Irreplaceable resources	Consequence	Probability	SIGNIFICANCE
8A: Pollution of soil and water beyond the building site, resulting from spills of chemicals, fuel and sewage	***Negative***	***Medium***	***Low***	***Medium***	***Medium***	***Medium***	***Medium***	***Medium***
8B: Mitigated	***Negative***	***Low***	***Low***	***Medium***	***Medium***	***Low***	***Medium***	***Low***
9A: Light pollution beyond the building site, resulting from excessive outdoor lighting, and poor choice of lights and fittings	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
9B: Mitigated	***Negative***	***Low***	***Low***	***High***	***High***	***Medium***	***High***	***Medium***
10A: Alteration of surface and groundwater levels and flows, and knock-on effects on local wetlands, resulting from underground foundation structures and construction methods	***Negative***	***High***	***Low***	***High***	***High***	***High***	***High***	***High***
10B: Mitigated	***Negative***	***Medium***	***Low***	***High***	***High***	***Medium***	***High***	***Medium***
11A: Poaching of local wildlife during construction phase, resulting from hunting and trapping by workers and employees, for sport and for the pot	***Negative***	***High***	***Low***	***High***	***Medium***	***Medium***	***Medium***	***Medium***
11B: Mitigated	***Negative***	***Low***	***Low***	***High***	***Medium***	***Low***	***Medium***	***Low***
12A: Problem-animal scenarios, resulting mainly from human interaction with animals	***Negative***	***High***	***Low***	***High***	***Medium***	***Medium***	***Low***	***Low - Medium***
12B: Mitigated	***Negative***	***Low***	***Low***	***High***	***Medium***	***Low***	***Low***	***Low***
13A: Accumulation of radioisotopes in the environment and in the bodies of wild animals, during operational phase, resulting from routine gaseous emissions from the reactors	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
13B: Mitigated	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
14A: Cumulative impacts, resulting from addition of impacts to existing impacts, and the operation of impacts over time	***Negative***	***High***	***Medium***	***High***	***High***	***High***	***Medium***	***Medium – High***
14B: Mitigated	***Negative***	***Medium***	***Medium***	***High***	***High***	***Medium***	***Medium***	***Medium***

Impact	Nature	Intensity	Extent	Duration	Impact on Irreplaceable resources	Consequence	Probability	SIGNIFICANCE
15A: Improved conservation of undeveloped land, resulting from improved legal status and/or management	***Positive***	***Low***	***Low***	***High***	***High***	***Medium***	***High***	***Medium***
15B: Optimised	***Positive***	***High***	***Medium***	***High***	***High***	***High***	***High***	***High***

9.14 Impacts on invertebrate fauna

Impacts on invertebrate are dealt with in the specialist report in Appendix E14.

The potential impacts of the proposed nuclear power station on the terrestrial invertebrate communities are described for the three sites below; most of the impacts are very similar for all three alternative sites, therefore a separate list for each site is not provided, but site-specific differences in significance or type are emphasised where applicable.

9.14.1 Construction impacts

(a) Direct habitat destruction

The construction of the nuclear power station will result in significant loss of natural habitats. Rehabilitation of some areas is possible, but despite this there is likely to be at least some long-term damage. ***Temporary and uncontrolled dumping*** of construction rubble and waste material may also cause long-term habitat degradation.

(b) Indirect habitat alteration / degradation by changes in groundwater regime

While most obviously impacting on wetland ecosystems, the terrestrial / wetland interface is an important ecosystem component for many species, thus we would like to emphasise the significance of impacts resulting from changes to the groundwater regime; these are covered in more detail in the Wetland Ecosystems specialist report (Day 2009). This potential impact is most likely to be of significance to invertebrate populations at Thyspunt, followed by Duynefontein, while at Bantamsklip there is relatively little likelihood of it being significant

(c) Habitat fragmentation

The construction of buildings, fences and roads will inevitably result in natural movement patterns being disrupted and to a varying degree, depending on how different species react to these barriers, will result in the fragmentation of natural populations. Such potential impacts would be long-term or permanent, most likely the latter, depending on the procedure followed during eventual decommissioning.

(d) Reduction in populations of rare / threatened / protected species

This potential impact would be localised and mainly limited to the direct construction area, access roads and materials / soil lay-down areas during the construction period (but see also under light pollution for more extensive and long-term potential impacts). Populations of non-flying invertebrates on the construction site will largely be destroyed, although some may escape into the surrounding areas. Their chance of survival here may be low due to difficulties in establishing in an area that may already be at or near carrying capacity. Adult stages of species that are able to fly may be able to escape, but their immature stages, which are often confined to the vegetation or are underground, will also be destroyed. The potential impact will be permanent in the transformed areas, but may be partially reversible in rehabilitated portions of the project area.

While several previously undescribed invertebrate species were collected during the very brief initial survey of the Duynefontein, Bantamsklip and Thyspunt sites, and many more undescribed species would be expected to be found if more detailed surveys were carried out, the significance of impacts on these species is difficult to estimate as nothing is currently known about their potential distribution beyond the site boundaries. At least some of the species probably have much wider distributions, but given the coastal location of the three sites, it is possible that some may be specific to coastal habitats and hence have limited distributions. Given the high development pressures on South Africa's coastline, species restricted to the coastal zone may be significantly threatened.

(e) Soil and water pollution

Construction work of the magnitude contemplated for the proposed nuclear power station will always carry a substantial risk of soil and water pollution, with large construction vehicles contributing substantially due to oil and fuel spillages. Building waste, batching plants, sewage and domestic waste are also potential contributors to this problem. If not promptly dealt with, spillages or accumulation of waste matter can contaminate the soil and surface or ground water, leading to potential medium/long-term impacts on invertebrates in the soil as well as aquatic species. Soil stockpiles may run off into streams and wetlands resulting in excessive sedimentation.

(f) Dust pollution

Excavation and movement of soil, as well as movement of heavy vehicles on dirt roads, has the potential to cause substantial dust pollution in the area surrounding the construction site and access roads. Accumulation of dust on plants can reduce their productivity, with knock-on effects on invertebrate herbivores and their predators as well as directly interfering with invertebrate species by *e.g.* physically impeding their movement on plants.

(g) Light pollution

After habitat destruction, light pollution is probably the single most significant potential impact of a development of this nature, but, in the operational phase at least, it is also one of the most easily manageable. The impacts of artificial lighting on insect populations can be very significant, resulting in the deaths of many thousands of individuals every night, and causing a very substantial drain effect ("population sink") on surrounding populations. Other impacts may include interference with normal foraging and mating behaviours, resulting in less immediate but equally significant reductions in natural population levels. The consequent knock-on effects, given the vital role that invertebrates play in ecosystem functioning, may affect virtually every component of the surrounding ecosystem.

Direct impacts of artificial lights such as high pressure mercury vapour streetlamps may extend up to 600 m or more from the source, and the drain effect resulting from continual depletion of the populations within this zone will probably cause a significant decline in population density of affected species up to at least several times this distance. High level unshielded lighting at the nuclear power station could thus extend the area of direct impact from the c. 80 ha of the construction footprint to over 360 ha, with lower intensity indirect impacts potentially being significant over an area of more than 3 000 ha (i.e. beyond the property boundary). These impacts would be continuous throughout the life of the project, and in our opinion, no justification can be made for allowing such easily controllable impacts to occur.

Due to the changing "landscape" within the development footprint as well as the need for strong lighting if construction continues at night, light pollution is often particularly difficult to control during the construction phase, and this is where the greatest potential impacts are to be expected.

(h) Increased risk of fire

The presence of a large number of construction workers on site over a protracted period will result in a greatly increased risk of uncontrolled fires arising from cooking fires, improperly disposed cigarettes etc. This risk may be somewhat higher at ***Duynefontein*** and Bantamsklip due to the more strongly seasonal rainfall at these sites.

(i) Spread of invasive alien invertebrate species

Along with light pollution, this is probably one of the most significant potential impacts from a terrestrial invertebrate perspective, and also may have very significant knock-on effects that could impact of virtually every aspect of the surrounding ecosystem.

Two destructive invertebrate species which have already invaded the Western Cape and are considered the most likely to be of significance to this project are the Argentine ant, *Linepithema humile*, and the alien land snail, *Thisbe pisana*. An additional tramp ant species (*Hypoponera eduardi*) was confirmed only at Duynefontein during the course of this study, supporting the view that construction of the proposed nuclear power station would be likely to increase the risk of establishment of such species.

Invasive invertebrate species are commonly transported to new areas in construction materials and their establishment and spread is often enhanced by disturbance of natural ecosystems. The large volumes of materials that would be required to be transported to the site for construction of a nuclear power station carry a very high risk that invasive species will be carried to the site in this way. The large areas that will be disturbed, as well as the long duration of construction-related disturbance, will provide ideal conditions and ample opportunity for establishment and spread of invasive species on site.

The impact of an invasive species such as the Argentine ant can be very severe, as it displaces many of the indigenous ant species and competes very strongly for resources such as nectar, thus potentially impacting on honeybee populations as well as any other insect species that utilise nectar as a food source. Ant reproductives (“flying ants”) are an important food source for many organisms, particularly for birds, and since Argentine ant reproductives do not fly, this resource can be severely reduced if indigenous ant species are displaced by Argentine ants. Other impacts of this species include reduced pollination and seed set of indigenous plants, and interference with normal seed dispersal, which in the fynbos is carried out to a large extent by indigenous ant species. It is thus very important to prevent invasion by such species in sensitive habitats.

The construction phase almost certainly carries by far the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that colonies of species such as Argentine ants or individuals of exotic snails may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

(j) Road mortality

Large numbers of invertebrates will be killed either by being crushed under the tyres of vehicles in the case of crawling species, or by colliding with the vehicle itself in the case of flying species. While extremely difficult to quantify, a study in Austria has estimated that approximately 116 insects were killed by the front of a car for every 1 km travelled. This apparently did not take into account individuals crushed under the wheels.

It is thus difficult to predict the extent of such mortality, or to suggest whether the impact would be greater during the construction/decommissioning phases (with larger numbers of heavy, but perhaps slower-moving, vehicles) than during the operational phase (with few large but many small and probably faster-moving vehicles), but for all phases it is obvious that mortality would be increased by higher vehicle speeds and numbers.

9.14.2 Operational impacts

(a) Habitat fragmentation

All barriers remaining after construction will continue to impact at least for the life of the project and possibly permanently, depending on the decommissioning process followed.

(b) Soil and water pollution

Sewage and domestic waste would be the main contributors to potential pollution problems during the operational phase, but this can very easily be managed effectively to avoid impacts.

(c) Light pollution

Any external lighting used will continue to have a potential impact throughout the life of the project.

(d) Increased risk of fire

The increased risk of fire would be expected to be smaller during the operational phase, but may still be significant due to the possibility of e.g. cigarette butts being thrown from vehicles transporting personnel to the site, or by accidental fires caused by visitors to the conservation area.

(e) Spread of invasive alien invertebrate species

Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a lower-level risk of importation of alien species throughout the life of the project.

9.14.3 Decommissioning impacts

(a) Direct habitat destruction

Direct habitat destruction would be mainly limited to the construction phase, but could also occur during decommissioning, depending on what procedure is followed. However, the decommissioning process will be carried out so far in the future (*c*. approximately 60 years) that technology and methods are likely to have altered radically from what is currently available; in the absence of plans now (even for the KNPS, we do not know precisely what is to be done and much of the current decommissioning plan relates to development and design of aspects of the plan), we cannot at this stage properly assess the potential impacts and a full EIA process will be required closer to the time of decommissioning.

Decommissioning by immediate decontamination and dismantlement, as currently planned for the KNPS, would have impacts similar to construction in that areas of habitat beyond the immediate footprint of the reactor site would be severely degraded when used for stockpiling of rubble and other waste. However, if effective rehabilitation of these areas as well as the previously developed area is achieved, these potential impacts could be substantially mitigated and a net positive impact could result.

Decommissioning by entombment would have the advantage of not significantly adding to the environmental degradation of the site (small areas might be affected e.g. by the need for concrete preparation), but this needs to be weighed against the lack of improvement in the environmental status of the reactor site itself, as this would not be returned to a natural state.

(b) Indirect habitat alteration / degradation by changes in groundwater regime

This cannot be properly assessed at this stage. If the above-mentioned decommissioning alternative option is followed, further changes (either improvement or further degradation) in the groundwater regime could result, while for the entombment alternative, no change from the operational phase would be expected.

(c) Habitat fragmentation

If decommissioning follows the decontamination and dismantlement process, increased habitat fragmentation may occur during decommissioning, but following rehabilitation all barriers should be removed, resulting in a positive impact. If entombment is used for decommissioning, all barriers remaining during the operational phase would be expected to endure permanently.

(d) Soil and water pollution

The potential impacts during this phase cannot be properly assessed at this stage. If the decontamination and dismantlement option is followed, soil and water pollution impacts could be similar to those experienced during construction, while for the entombment option, no further soil and water pollution would be expected.

(e) Dust pollution

The potential impacts cannot be properly assessed at this stage. If the decontamination and dismantlement option is followed, dust pollution potential impacts could be similar to those experienced during construction, while for the entombment option, minimal dust pollution would be expected.

(f) Light pollution

Potential impacts of this phase will depend on the process followed and so this cannot be fully assessed at present. If the decommissioning option is followed, light pollution impacts could be similar to those experienced during construction, while for the entombment option, minimal light pollution in addition to that experienced during the operational phase would be expected.

Bantamsklip and Thyspunt are probably the most sensitive to this potential impact as their isolation means that at present there is very little impact of artificial lighting, while Duynefontein has probably already been significantly impact and thus cumulative effects would be greatest at Duynefontein. However, the potential impact at all sites is sufficiently severe that the assessment criteria used do not allow a fine enough distinction for these differences in sensitivity to be apparent in the relative significance ratings of the three sites.

(g) Increased risk of fire

Increased fire risk is possibly also important during the decommissioning phase, but the potential impact will be dependant on the means of decommissioning, which is so far in the future (approximately 60 years) that technology and methods may have altered radically from what is currently available, and thus no assessment can be made at present.

(h) Spread of invasive alien invertebrate species

Depending on the process followed, the decommissioning phase may carry risks of alien importation similar in level to those resulting from construction, so monitoring and control at this stage might be equally important as at any other stage; this cannot however be evaluated at this stage.

Bantamsklip is probably the most sensitive to this potential impact as its isolation renders it least likely to already have been invaded; in this respect it is followed by Thyspunt, and then Duynefontein, which may prove to have already been affected. However, the potential impact at all sites is sufficiently severe that the assessment criteria used do not allow a fine enough distinction for this to be apparent in the relative significance ratings of the three sites.

9.14.4 Cumulative impacts

All of the potential impacts identified above would be exacerbated by the construction of additional nuclear power stations at any one of the sites considered. In addition, existing (including KNPS) developments at and near the Duynefontein site would further increase the cumulative effect of many impacts. The implications of these on the invertebrate populations are briefly described below.

If Nuclear-2 and Nuclear-3 projects also go ahead at any one of the sites, potential impacts of the combined construction (and decommissioning) phases of the projects would be similarly increased, and, depending on the degree of temporal overlap between projects, construction (and possibly decommissioning) impacts may occur over such a time period that they would need to be considered as long-term impacts (16 - 30 years), which would have a substantial effect on the consequence ratings of some construction-related impacts (*e.g.* dust pollution).

Cumulative impacts would be greatest at Duynefontein due to the presence of the KNPS, but may be most significant at Thyspunt due to the difficulties of avoiding impacts on wetlands; Bantamsklip would probably experience the lowest cumulative impact due to the relatively uniform mosaic of habitats.

9.14.5 Impacts of climate change

Probable impacts of climate change on invertebrate populations at the proposed Nuclear-1 sites may be divided into three main categories:

- **Reduction in available habitat due to sea level rise resulting from increased global temperatures.** Given the fairly small predicted sea level rise over the next century, this impact is unlikely to be very large over the lifespan of the proposed nuclear power station. It is likely however to be exacerbated by more frequent and severe storms and stronger average wind speed which would increase the amount of habitat lost by wave-mediated erosion, with the 100-year flood line predicted to extend as much as 100 m further inland by 2075 along parts of the shorelines of the proposed nuclear power station sites. This impact would be more severe if the nuclear power station was situated too close to the shoreline as this could interfere with natural movement of habitat boundaries as the mean sea level rises.
- **Indirect effects via change in distribution of vegetation types due to** a) localised microclimatic changes due to altered shoreline caused by sea level rise and b) broader climatic changes (at all three sites involving increased temperature, decreased rainfall, changes in mean wind speed and direction), influencing habitat suitability for and hence distribution of various host or food plant species.
- **Direct effects of** a) localised microclimatic changes due to altered shoreline caused by sea level rise and b) broader climatic changes (at all three sites involving increased temperature, decreased rainfall, changes in mean wind speed and direction), influencing habitat suitability for and hence distribution of various invertebrate species.

Precise impacts (especially for the latter two types of potential impacts) are very difficult to predict given uncertainty about the degree of climatic change that is likely during the lifetime of the nuclear power stations, as well as very limited knowledge of habitat and climatic requirements of the majority of invertebrate species. The only communities for which some predictions may be possible are those which are associated with particular plant communities for which predicted influences of climate change are better-understood.

Note that in assessing the significance of climate change, while this is clearly an influence of global extent, only the on-site impacts are here considered, so it is treated as local in extent.

9.14.6 Positive contribution to conservation by protection of owner-controlled property and prevention of further development within an exclusion zone

The positive impact of continued stewardship by Eskom of the sites on which construction of the nuclear power station is proposed must be emphasised. On all alternative sites a substantial, and in parts extremely effective, effort has been made to control and eradicate alien invasive plant species, with the result that (particularly at Bantamsklip) the Eskom-controlled areas appear in far better condition than their surroundings. Formal proclamation and management of the Bantamsklip or Thyspunt sites as conservation areas would be expected to further enhance these positive impacts, with controlled access hopefully leading to reduced poaching of marine resources and wildflowers. Continued and enhanced conservation-oriented management of these sites by Eskom must be seen as a significant positive impact of the proposed project.

However, it must also be borne in mind that:

- The potential positive impact may be significantly reduced during the construction and possibly decommissioning phases by increased unauthorised use of resources by the workforce;
- The area benefiting from the potential positive impact will be substantially reduced if Nuclear -1, -2 and -3 go ahead on one site; and
- ***The area available for*** conservation at the Duynefontein site will be reduced if any of Nuclear-1, -2, -3 ***power stations*** proceeds at this location.

The potential positive impact could be substantially enhanced if a large exclusion zone around nuclear developments is gazetted, but only if prevention of development is not allowed to result in neglect and further degradation of the surrounding properties. The best approach to prevent such degradation would probably be for all land within the exclusion zone to fall under the stewardship of Eskom so that it could be managed in a coordinated manner along with the Eskom-owned lands on which the nuclear power station is situated.

9.14.7 Conclusion

From an invertebrate conservation perspective the most important potential negative impacts identified at all three alternative sites are the:

- Direct destruction of habitats and local populations of important invertebrates, including new and potentially new species, within the development footprint;
- Wider impact of artificial lighting on invertebrate populations in the surrounding ecosystems; and
- Potential for alien invasive species to become established as a result of site disturbance and importation of materials and equipment.

None of the butterflies likely to occur in the Cape Flats Dune Fynbos area around Duynefontein are endangered or endemic. The non-vegetated and partially vegetated portions of the site were ranked as of Very Low and Low sensitivity respectively. The parts of the site where development is planned have moderate – low butterfly conservation value. In combination with the low predicted butterfly diversity, Duynefontein has the lowest sensitivity of all three alternative sites. The portion of the EIA corridor immediately adjacent to the KNPS is already sufficiently altered from its natural state that development here could be considered.

Bantamsklip is ranked lower than Duynefontein in terms of overall species richness, but considered the high potential for rare, endemic and relictual species at Bantamsklip, its sensitivity ranking can be raised above Duynefontein. There are several other reasons, including the discovery of a probably new mygalomorph spider species and a potentially new specialised ant species, to consider Bantamsklip as highly sensitive. The Agulhas Limestone Fynbos area at Bantamsklip, including patches and elements found within the Overberg Dune Strandveld area, is likely to host at least one regional endemic butterfly and there is also a remote possibility that the Redlisted *Chrysoritis dicksoni* could occur in the area. The local abundance of a probably new trapdoor spider species and a potentially new ant species, combined with the likely presence of a number of rare and relictual taxa, indicate that construction impacts at Bantamsklip could be substantial.

Thyspunt has in all probability the highest butterfly diversity and conservation value of the three sites studied. From the point of view of other invertebrate groups no further evidence was found to suggest that the site was of high significance, but the combination of high butterfly and ant diversity and the Onchyophoran species indicate that Thyspunt has significant conservation value. Thyspunt is identified as higher sensitivity than Duynefontein, and only marginally lower than Bantamsklip. The description of the sites (in order of increasing sensitivity and suitability) is Duynefontein (most suitable), Thyspunt and Bantamsklip (least suitable).

From the viewpoint of potential positive impacts of the nuclear power station, the suitability of the sites is different. Duynefontein already enjoys substantial benefits under the management of Eskom, which means that of all the sites it would experience the least improvement in its status if the nuclear power station was sited there. Bantamsklip and Thyspunt on the other hand would benefit substantially from formalisation of their protected status. It is probable that construction of the nuclear power station at either Bantamsklip or Thyspunt would have a potential net positive impact on invertebrate communities.

Table 9-37: Summary of impacts on invertebrate fauna at Duynefontein

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A. Direct habitat destruction	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
1B: Mitigated	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
2A: Indirect habitat alteration by groundwater disturbance	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
2B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Low*
3A: Habitat fragmentation	*Negative*	*Medium*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*
3B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*
4A: Reduction in populations of rare/protected species	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
4B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Low*
5A: Soil and water pollution	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
5B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Low-Medium*
6A: Dust pollution	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
6B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low-Medium*
7A. Light pollution - construction phase	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
Partly mitigated	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
Fully mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Low-Medium*
7B: Light pollution - operational phase	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
Partly mitigated	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
Fully mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Low-Medium*
8. Increased radiation levels	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Low-Medium*
Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Low-Medium*
9 Road mortality	*Negative*	*Medium*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*
Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*
10 Increased risk of fire	*Negative*	*High*	*Medium*	*Medium*	*Medium*		*High*	*High*

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
11. Spread of alien invasive invertebrate species	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
Mitigated	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
12 Land invasion by employment seekers	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
Mitigated	*Negative*	*Low*	*Medium*	*Low*	*Medium*	*Low*	*Low*	*Low*
13. Cumulative impacts	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
Mitigated	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
14. Climate change	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
Mitigated	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
15. Positive contribution to conservation	*Positive*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
Optimised	*Positive*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*

Table 9-38: Summary of impacts on invertebrate fauna at Bantamsklip

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A. Direct habitat destruction	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
1B: Mitigated	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
2A: Indirect habitat alteration by groundwater disturbance	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
2B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Low*
3A: Habitat fragmentation	*Negative*	*Medium*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
3B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
4A: Reduction in populations of rare/protected species	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
4B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Low*
5A: Soil and water pollution	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*High*	*Medium*
5B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Medium*	*Low*	*High*	*Low-Medium*
6A: Dust pollution	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*High*	*Medium*
6B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*High*	*Low-Medium*
7A. Light pollution - construction phase	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
Partly mitigated	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
Fully mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Medium*	*High*	*Low-Medium*
7B: Light pollution - operational phase	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
Partly mitigated	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
Fully mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Medium*	*High*	*Low-Medium*
8. Increased radiation levels	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low-Medium*
Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low-Medium*
9 Road mortality	*Negative*	*Medium*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
10 Increased risk of fire	*Negative*	*High*	*Medium*	*Medium*	*Medium*	*High*	*High*	*High*

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
11. Spread of alien invasive invertebrate species	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
Mitigated	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
12 Land invasion by employment seekers	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
Mitigated	*Negative*	*Low*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Low*
13. Cumulative impacts	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
Mitigated	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
14. Climate change	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
Mitigated	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
15. Positive contribution to conservation	*Positive*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
Optimised	*Positive*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*

Table 9-39: Summary of impacts on invertebrate fauna at Thyspunt

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A. Direct habitat destruction	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
1B: Mitigated	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
2A: Indirect habitat alteration by groundwater disturbance	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
2B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Low*	*Medium*	*Low*
3A: Habitat fragmentation	*Negative*	*Medium*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
3B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
4A: Reduction in populations of rare/protected species	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
4B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Low*	*Medium*	*Low*
5A: Soil and water pollution	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*High*	*Medium*
5B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Medium*	*Low*	*High*	*Low-Medium*
6A: Dust pollution	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*High*	*Medium*
6B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*High*	*Low-Medium*
7A. Light pollution - construction phase	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
Partly mitigated	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
Fully mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Low*	*High*	*Low-Medium*
7B: Light pollution - operational phase	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
Partly mitigated	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
Fully mitigated	*Negative*	*Low*	*Low*	*High*	*Medium*	*Low*	*High*	*Low-Medium*
8. Increased radiation levels	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low-Medium*
Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Low*	*Low-Medium*
9 Road mortality	*Negative*	*Medium*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
10 Increased risk of fire	*Negative*	*High*	*Medium*	*Medium*	*Medium*	*High*	*High*	*High*

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
11. Spread of alien invasive invertebrate species	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
Mitigated	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
12 Land invasion by employment seekers	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
Mitigated	*Negative*	*Low*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Low*
13. Cumulative impacts	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
Mitigated	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
14. Climate change	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
Mitigated	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
15. Positive contribution to conservation	*Positive*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
Optimised	*Positive*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*

9.15 Impacts on air quality

Impacts on air quality are dealt with in the specialist report in Appendix E10.

Owing to the uniformity of the nuclear power station power generation process at all sites, the nature of the emissions will be very similar for all sites. A short summary of the nature of the emissions is given below before the significance of the potential impacts at each of the sites is discussed individually.

9.15.1 Construction impacts

The air quality impacts of the proposed nuclear power station are expected to occur with construction, operation, and decommissioning phases. Only non-radioactive emissions would occur during the construction period. Air emissions during construction include airborne particulates (including inhalable particulate matter – PM10) and gaseous emissions. Airborne particulates are considered to result in significantly higher potential impact than the gaseous pollutants. Wheel entrainment on the construction site and on unpaved roads would be responsible for the majority of total airborne particulate emissions, and would contribute about 83 % of the total particulate emissions at Duynefontein, 90 % at Bantamsklip and 89 % at Thyspunt. Excavation will be the next largest source of particulate emissions, contributing about 13 % at Duynefontein and 7 % each at Bantamsklip and Thyspunt.

9.15.2 Operational impacts

(a) Non-radioactive emissions

Potential sources of non-radioactive air emissions during operation will include:

- Particulates, sulphur dioxide, oxides of nitrogen and carbon monoxide in the exhaust gases from engines of the backup electricity generators.
- Formaldehyde and carbon monoxide emitted by the insulation when installations go back into operation after servicing; and
- Ammonia discharged as the temperature rises in the steam generators during start-up.

Based on the United States Environmental Protection Agency's "AERMOD" dispersion model, the impacts of these pollutants was modelled over a 40 x 40 km area and with a resolution of 200 m. The emissions of formaldehyde and ammonia were found to be very infrequent and relatively low, and are not expected to exceed any guidelines. The highest hourly average formaldehyde concentrations predicted at Duynefontein, Bantamsklip and Thyspunt are 0.12 µg/m³, 0.30 µg/m³ and 0.19 µg/m³, respectively. This is very low when compared to the 1-hour exposure guideline of 94 µg/m³ (derived by the California Office of Environmental Health Hazard Assessment) for assessment of acute exposure of members of the public to formaldehyde.

The highest hourly average ammonia concentrations predicted at Duynefontein, Bantamsklip and Thyspunt are 14.3 µg/m³, 35.0 µg/m³ and 21.8 µg/m³, respectively. It is much lower than the US EPA's inhalation Reference Concentration of 100 µg/m³.

The predicted short-term ammonia and formaldehyde concentrations are also below the odour recognition concentrations of 200 µg/m³ (10% odour recognition level) and 70 µg/m³ (odour perception), respectively.

The predicted ground level concentrations of pollutants resulting from the operation of the two 25 MWe backup generators are low compared with the relevant air concentration guidelines. The highest hourly average predicted ground level nitrogen dioxide concentrations resulting from the operation of the two 25 MWe backup generators are shown in **Figure 9-4, Figure 9-5** and **Figure 9-6** for the Duynefontein, Bantamsklip and Thyspunt sites, respectively. The spatial distributions for the other pollutants (SO_2, CO and PM10) are similar and therefore not shown here.

(b) Radioactive emissions

Small amounts of radionuclides are released during normal operation of the nuclear power station. Most of these emissions are captured by High Efficiency Particulate Air (HEPA) filters. HEPA filters, by definition, remove at least 99.97% of airborne particles 0.3 µm in diameter. The radionuclide emissions that still manage to find their way to the atmosphere include tritium, carbon-14, iodine isotopes, noble gases and a small amount of other fission/activation products (mainly cobalt and caesium). Noble gases typically include krypton, xenon and argon. These emissions are continuously monitored and reported to the NNR for compliance proposes.

For calculation of the emissions of these gases from the Nuclear-1, a worst case (conservative) scenario was assumed. The main source of gaseous radioactive emissions during normal operation is the gaseous component arising within the primary circuit. Gases from this system are not emitted continuously, and the gaseous radioactive waste system is used intermittently. ***Therefore,*** most of the time during normal operation of the nuclear power station, the gaseous radioactive waste system is ***not required to be active.***

Similar to construction impacts, modelling was carried out for a 40 x 40 km area. For radionuclide emissions, the model was designed to estimate the maximum annual dose received during the period of the practice.

The model-wide maximum predictions for the three sites are summarised in **Table 9-27**

Table 9-40: Maximum inhalation and external effective dose predicted in the 40 km by 40 km study area for a 4000 MWe nuclear power station

Site	Effective Dose (µSv/annum)
Duynefontein	4.07
Bantamsklip	4.60
Thyspunt	11.31

The legal limit[9] for the annual effective dose limit for members of the public is 1 000 µSv, with an additional provision of an annual dose constraint of 250 µSv. The highest predicted inhalation and external effective dose of 11.3 µSv is therefore about 4.5 % of the dose constraint and about 1 % of the annual effective dose limit. Should additional units be added to eventually generate 10 000 MWe per site, the maximum external effective dose would be less than 30 µSv.

9.15.3 Impacts during decommissioning

Based on Eskom's decommissioning plan, limited release of radionuclides may occur during decommissioning. The decommissioning process is well controlled and designed to ensure that potentially radioactive materials are isolated and appropriately disposed. The exposure to radiation would be kept to a minimum and below the required dose stipulated by the NNR through continued measurement. Since these dose limits are based on safe exposure levels, it is expected that the radiation exposure during commissioning would be low.

Backup diesel will continue to be used during decommissioning and their impact will be the same as during the operational phase. The most significant potential impacts during construction would result from the demolition of buildings. The anticipated activities include

[9] Specified in Government Notice No. R 388 of 2009

blasting, coring, drilling, crushing, surface removal and trucking of rubble off-site for disposal as construction debris. The activities during this phase would generate airborne dust and unless proper management and emission control is applied could potentially generate fugitive dust impacts.

9.15.4 Duynefontein

(a) Impacts during the construction phase

Figure 9-7 and **Figure 9-8** summarise the maximum predicted inhalable particulate air concentration and deposition rate for the construction phase at Duynefontein. These predictions exclude any mitigation measures. The most significant potential impact is predicted to occur along the unpaved access road. The distance at which it is predicted that the 180 µg/m³ standard will be exceeded is about 1.4 km. The 75 µg/m³ limit is predicted to be exceeded up to 600 m from the road.

Fallout of larger particles normally occurs near the generating source, as shown in **Figure 9-9.** The fallout rate permissible for residential and light commercial land use is 600 mg/m² per day. The distance to this value is about 126 m. The distance to the SLIGHT fallout rate of 250 mg/m² per day is about 223 m.

(b) Impacts during the operational phase

The highest hourly average formaldehyde concentrations predicted at Duynefontein is 0.12 µg/m³, which is very low compared to the 1-hour exposure guideline of 94 µg/m³. The highest hourly average ammonia concentrations predicted at Duynefontein, is 14.3 µg/m³, which is significantly lower than the US EPA's inhalation Reference Concentration (RfC) of 100 µg/m³.

The highest hourly average predicted ground level nitrogen dioxide concentrations resulting from the operation of the two 25 MWe backup generators at Duynefontein is shown in **Figure 9-4** and are low compared with the relevant air concentration guidelines.

Figure 9-15 shows the maximum cumulative inhalation does at Duynefontein. The maximum effective dose of 4.07 µSv/annum is therefore about 1.6 % of the dose constraint and 0.4 % of the maximum annual average dose limit.

9.15.5 Bantamsklip

(a) Impacts during the construction phase

The predicted particulate unmitigated potential impact during the construction phase at Bantamsklip is given in **Figure 9-9** and **Figure 9-10** for the maximum air concentration and deposition rate, respectively. The distance at which it is predicted that the 180 µg/m³ standard will be exceeded is about 1.4 km (north of the site). Similarly, the 75 µg/m³ limit is predicted to be exceeded up to 3.0 km from the site.

As shown in **Figure 9-7**, the fallout is quite significant; with the rate permissible for residential and light commercial (600 mg/m² per day) predicted to be exceeded up to a distance of about 0.7 km. The distance to the SLIGHT fallout rate of 250 mg/m² per day is about 1.4 km.

(b) Impacts during the operational phase

The highest hourly average formaldehyde concentrations predicted at Bantamsklip is 0.30 µg/m³, which is very low when compared to the 1-hour exposure guideline of 94 µg/m³. The highest hourly average ammonia concentrations predicted at Bantamsklip and is 35.0 µg/m³, which is lower than the US EPA's inhalation Reference Concentration (RfC) of 100 µg/m³.

The highest hourly average predicted ground level nitrogen dioxide concentrations resulting from the operation of the two 25 MWe backup generators for Bantamsklip are shown in **Figure 9-6** and are low compared with the relevant air concentration guidelines.

Figure 9-16 shows the maximum cumulative inhalation doses at Bantamsklip. The maximum effective dose of 4.6 µSv/annum is therefore about 1.84 % of the dose constraint and 0.46 % of the maximum annual average dose limit.

9.15.6 Thyspunt

(a) Impacts during the construction phase

Three different access road options were considered for Thyspunt. With Option A the road enters the site from the north through the "panhandle". The road passes through Oyster Bay from the west in Option B. Option C is for the access to be from the eastern side of the site.

The predicted unmitigated PM10 concentrations for these three road options are given in **Figure 9-12** (Option A), **Figure 9-13** (Option B) and **Figure 9-14** (Option C). These figures include the envelope of the two possible construction locations, located on the eastern and western parts of the corridor. The simulations for the individual sites did not show any preference.

As with Duynefontein, the most significant impact is predicted to occur along the unpaved access road. The distance at which it is predicted that the 180 µg/m³ standard will be exceeded is about 1 km. The 75 µg/m³ limit is predicted to be exceeded up to 2.1 km from the road.

The fallout is quite significant; with the rate permissible for residential and light commercial (600 mg/m² per day) predicted to be exceeded up to a distance of about 0.6 km. The distance to the SLIGHT fallout rate of 250 mg/m² per day is about 1.1 km.

(b) Impacts during the operational phase

The highest hourly average formaldehyde concentrations predicted at Thyspunt is 0.19 µg/m³, which is very low when compared to the 1-hour exposure guideline of 94 µg/m³. The highest hourly average ammonia concentration predicted at Thyspunt is 21.8 µg/m³, respectively, which is lower than the US EPA's inhalation Reference Concentration (RfC) of 100 µg/m³.

The highest hourly average predicted ground level nitrogen dioxide concentrations resulting from the operation of the two 25 MWe backup generators for Thyspunt are low compared with the relevant air concentration guidelines.

Figure 9-17 shows the maximum cumulative inhalation dose at Thyspunt. The maximum effective dose of 11.31 µSv/annum is therefore about 4.5% of the dose constraint and about 1% of the annual effective dose limit.

9.15.7 Mitigation

- An emission minimisation plan is regarded as essential in the situation where construction activities are conducted very close to residential and other sensitive receptors.
- Since the most significant source (between 80% and 90%) of fugitive dust emissions was shown to be wheel entrainment on unpaved roads, it is recommended to have the initial focus on the reduction of emissions from road surfaces. This can be achieved through regular watering of unpaved surfaces, applying chemical dust suppressants, or most preferably, tarring of roads.
- In areas were tarring is not a practical option the management plan should have, as a minimum, watering schedules of unpaved roads and other activities that could be mitigated with water sprays.

- In addition to road surface treatment, it is recommended to utilise the construction mitigation management checklist given in Appendix D of the air quality report, or a suitably modified version thereof.
- An air quality monitoring programme as provided in Section 5.2.1 of the air quality report must be initiated a year prior to construction. This would provide an adequate baseline air concentration trend which would incorporate all seasons. This programme must include both non-radionuclide and radionuclide compounds.
- No additional mitigation measures are required for routine operational emissions of radionuclides. However, once the final reactor technology has been decided, Eskom need to confirm that the emissions from the selected technology confirm to the envelope used in this assessment and that such emissions can be maintained throughout the nuclear power station's lifecycle. This includes a thorough assessment of the reliability and maintenance of the high efficiency particulate air (HEPA) filters which would be used to control radiological air emissions from the nuclear power station.
- Similarly, the successful technology supplier must illustrate how incidental and accidental releases would conform to the NNR's requirements and how these would be kept As Low As Reasonably Achievable (ALARA).
- A site-specific decommissioning plan must be developed according to the most recent requirements stipulated by the NNR.
- It must be ensured that the emissions from the backup power generators perform according to the vendor specifications. Regular stack sampling must be conducted during operation. The first three isokinetic sampling campaigns should also include sulphur dioxide analysis.
- Air dispersion modelling must be repeated using the source terms for normal and upset emissions of the successful vendor and onsite meteorological data prior to construction of the nuclear power station. The simulations must be repeated for both non-nuclear and radionuclide air emissions. Furthermore, the methodology for calculating the dose must be done according to the latest international standards and NNR requirements.

9.15.8 Conclusion

The most significant potential air quality impacts would be felt during construction, due to fugitive dust emissions from general construction activities (clearance, excavation, scraping, road surfaces, etc.) and emissions emanating from vehicles and equipment. Construction phase impacts will have a HIGH *significance* if no or limited mitigation measures are applied. This impact can be reduced to LOW *significance* if unpaved roads are surfaced (i.e. tarred) and with implementation of an air quality management plan.

The operational phase impacts of non-radiological pollutants are predicted to be very low when compared to human health risk criteria. Furthermore, based on the predicted impacts of both non-radioactive and radionuclide air pollution, the assessment concludes that the operational impacts at all the sites would fall safely within legal limits and guidelines limits, and that the impacts at none of the are serious enough to discard them from consideration. During normal operation, trace quantities of radiological materials will be released to the environment. The predicted effective dose from these pathways indicates low *consequence*. However, since the emission is considered to be *definite*, the *significance* of the impact is rated medium. This rating applies to all three sites.

The predicted potential impacts are very similar at all three alternative sites and there is no preferable site as far as the impacts on air quality is concerned.

DUYNEFONTEIN - GENERATORS
HIGHEST HOURLY NO2 GROUND LEVEL CONCENTRATIONS (µg/m³)

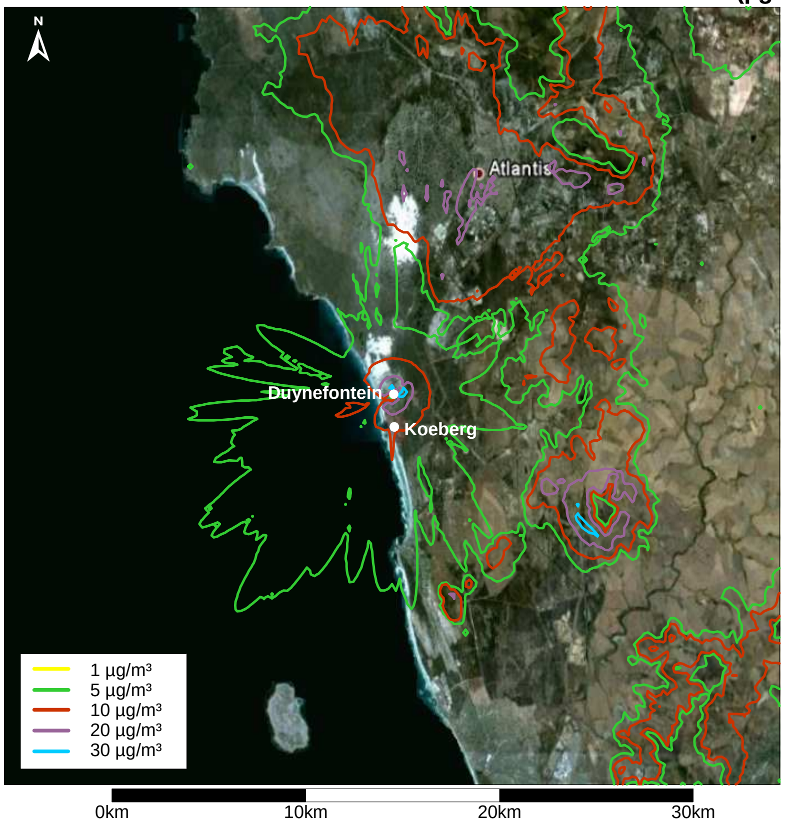


Figure 9-4: Predicted maximum hourly average nitrogen dioxide concentration from backup generators at Duynefontein

BANTAMSKLIP - GENERATORS
HIGHEST HOURLY NO2 GROUND LEVEL CONCENTRATIONS (µg/m³)

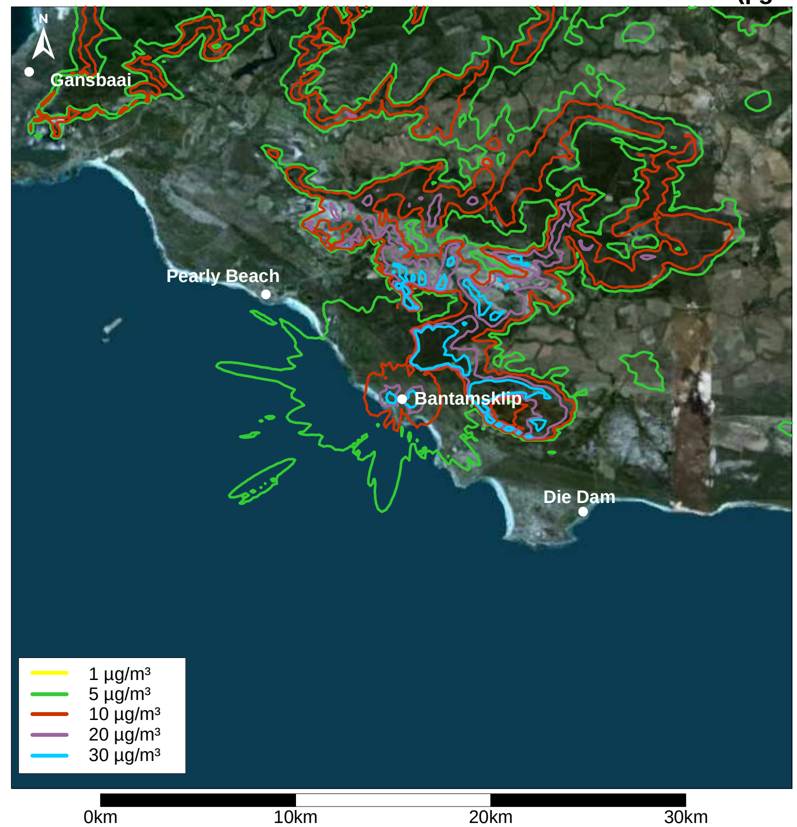


Figure 9-5: Predicted maximum hourly average nitrogen dioxide concentration from backup generators at Bantamsklip

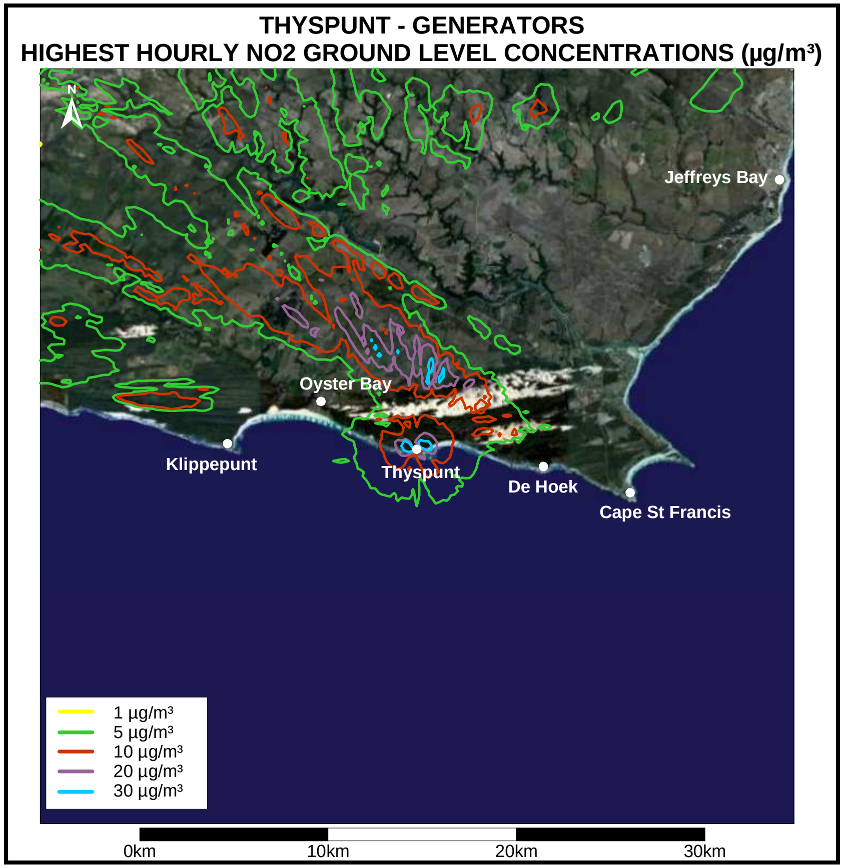


Figure 9-6: Predicted maximum hourly average nitrogen dioxide concentration from backup generators at Thyspunt

Figure 9-7: Predicted maximum daily average inhalable particle (PM10) concentration levels (µg/m³) during construction at Duynefontein (Unmitigated)

Figure 9-8: Predicted maximum daily average particle fallout rates (mg/m²/day) during construction at Duynefontein (Unmitigated)

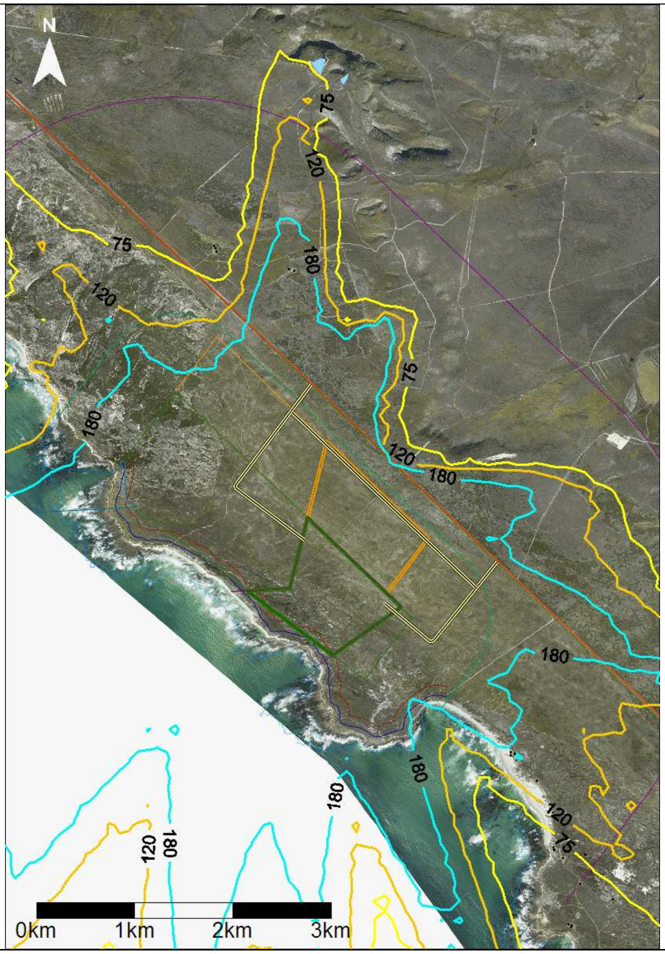


Figure 9-9: Predicted maximum daily PM10 concentration levels (µg/m³) during construction at Bantamsklip (Unmitigated)

Figure 9-10: Predicted maximum daily average particle fallout rates (mg/m²/day) during construction at Bantamsklip (Unmitigated)

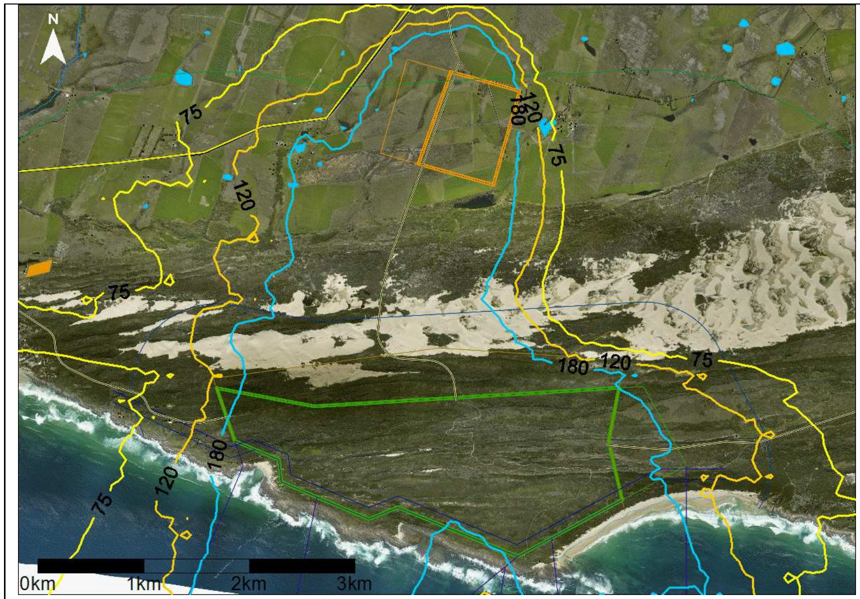


Figure 9-11: Predicted maximum daily average PM10 concentration levels (µg/m³) during construction at Thyspunt with Road Option A and the envelope of the nuclear power station on the east or west of the corridor (Unmitigated)

Figure 9-12: Predicted maximum daily average particle fallout rates (mg/m²/day) during construction at Thyspunt with Road Option A and the envelope of the nuclear power station on the east or west of the corridor (Unmitigated)

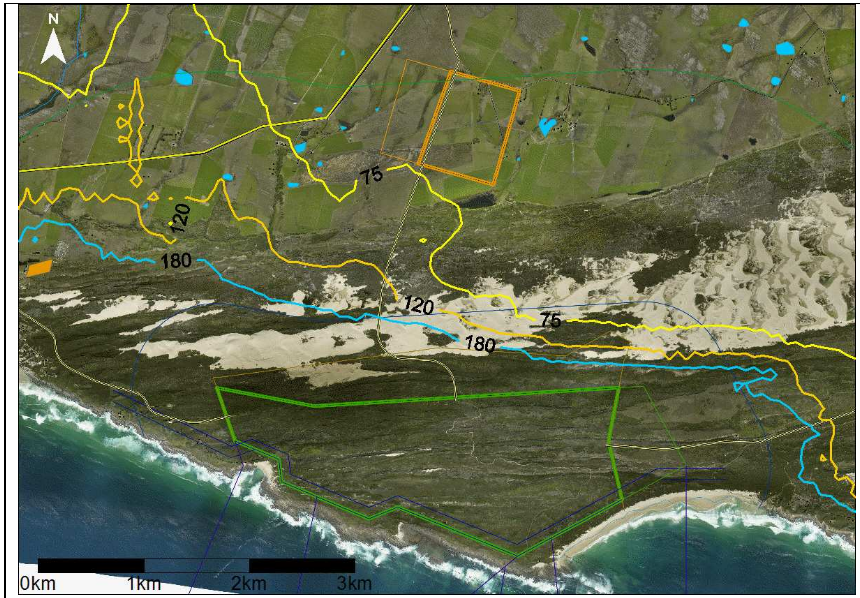
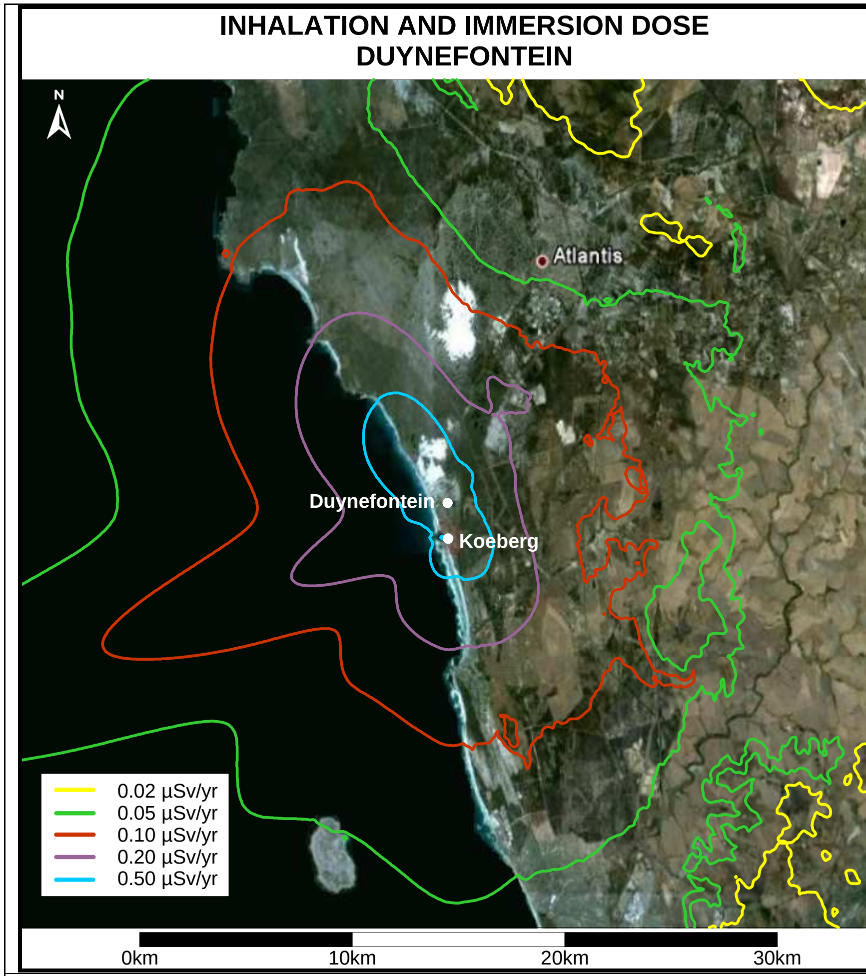


Figure 9-13: Predicted maximum daily average PM10 concentration levels (µg/m³) during construction at Thyspunt with Road Option B and the envelope of the nuclear power station on the east or west of the corridor (Unmitigated)

Figure 9-14: Predicted maximum daily average PM10 concentration levels during construction at Thyspunt with Road Option C and the envelope of the nuclear power station on the east or west of the corridor (Unmitigated)



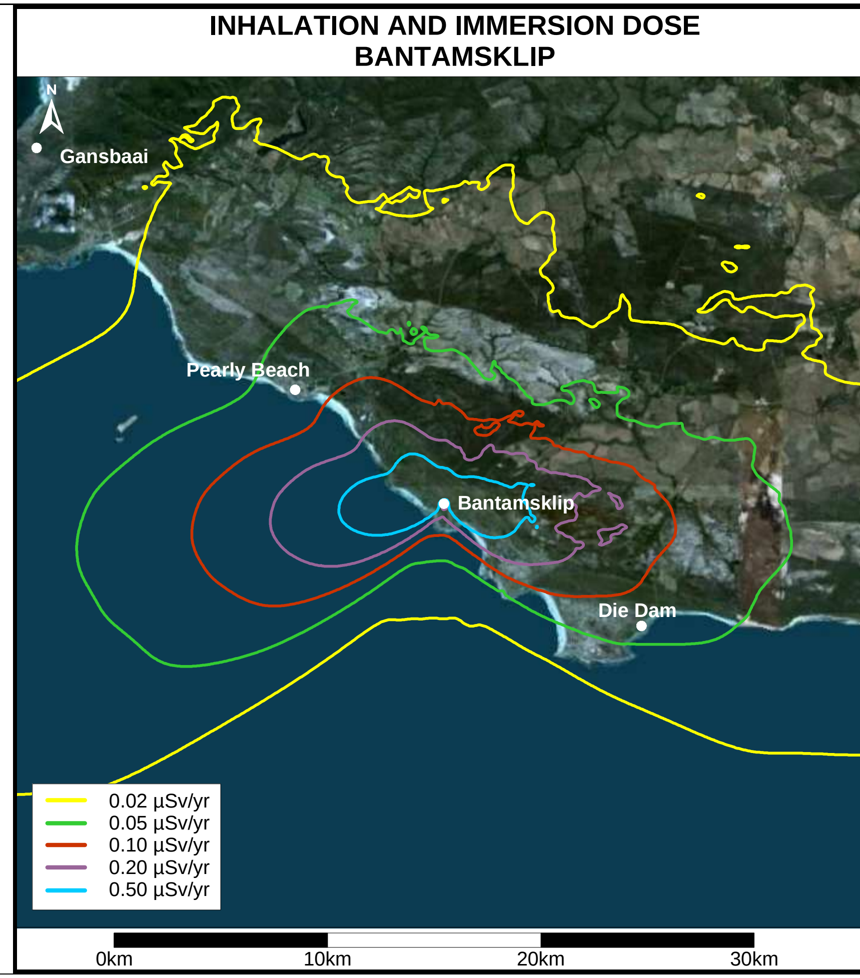


Figure 9-15: Predicted maximum cumulative annual inhalation and external radiation dose (µSv) for Duynefontein using 30 year equilibrium for deposition

Figure 9-16: Predicted maximum cumulative annual inhalation and external radiation dose (µSv) for Bantamsklip using 30 year equilibrium for deposition

INHALATION AND IMMERSION DOSE
THYSPUNT

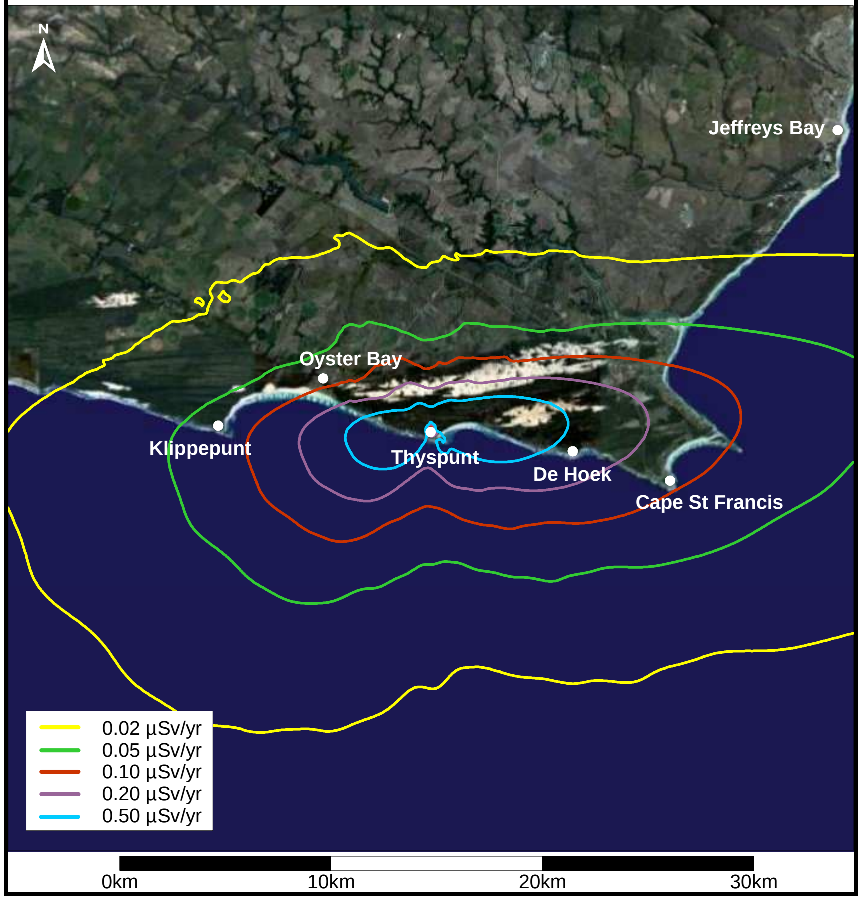


Figure 9-17: Predicted maximum cumulative annual inhalation and external radiation dose (µSv) for Thyspunt using 30 year equilibrium for deposition

Table 9-41: Summary of air quality impacts at Duynefontein

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Construction - Gaseous emissions	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
1B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
2A: Construction - PM10 emissions	*Negative*	*High*	*Medium*	*Medium*	*Low*	*Medium*	*High*	*Medium*
2B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
3A: Construction - Fallout	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*High*	*Low - Medium*
3B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
4A: Operational - Non-radionuclide emissions	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*
4B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*
5A: Operational - Radionuclide emissions	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
5B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
6A: Cumulative impacts	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
6B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*

Table 9-42: Summary of air quality impacts at Bantamsklip

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Construction - Gaseous emissions	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
1A: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
2A: Construction - PM10 emissions	*Negative*	*High*	*Medium*	*Medium*	*Low*	*Medium*	*High*	*Medium*
2B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
3A: Construction - Fallout	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*High*	*Medium*
3B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
4A: Operational - Non-radionuclide emissions	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*
4B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*
5A: Operational - Radionuclide emissions	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
5B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
6A: Cumulative impacts	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
6B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*

Table 9-43: Summary of air quality impacts at Thyspunt

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Construction - Gaseous emissions	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
1B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
2A: Construction - PM10 emissions	*Negative*	*High*	*Medium*	*Medium*	*Low*	*Medium*	*High*	*Medium*
2B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
3A: Construction - Fallout	*Negative*	*High*	*Medium*	*Medium*	*Low*	*Medium*	*High*	*Medium*
3B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
4A: Operational - Non-radionuclide emissions	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*
4B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*
5A: Operational - Radionuclide emissions	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
5B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
6A: Cumulative impacts	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
6B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*

9.16 Impacts on oceanographic conditions and surf breaks

Impacts on oceanographic conditions and the potential impacts on surf conditions to the disposal of spoil in the ocean are contained in Appendix E16. An addendum to Appendix E16 (which was not included in the first Draft EIR released in March 2010) deals with the potential impact of the marine disposal of spoil on surf breaks in the St. Francis and Jeffreys Bay areas.

Although the major infrastructure for the nuclear power station will be built at least 10 m above sea level, associated infrastructure such as the intake and outflow channels for cooling water, as well as the possible disposal of spoil and sediment in the sea, may have an impact of physical oceanographic conditions. The oceanographic study involved modelling of the sea temperature and sediment movement patterns to predict the impacts. In turn, the changes to oceanographic conditions have influenced the prediction of impact on marine ecosystems.

9.16.1 Duynefontein

(a) Short term disruption of sediment transport during construction

The possible construction of the cofferdams at the Duynefontein site will influence sediment transport along the coast in the short term over the construction phase of the development.

Although the sediment transport varies along the beach due to the presence of rip cells, the net transport along the beach is low. The coffer dams are therefore expected to have a limited effect on the sediment transport and coastal erosion. Once construction has been completed the cofferdams will be removed. The overall significance of the impact is therefore considered to be low.

(b) Erosion due to brine discharge during construction

The discharge of brine from the Desalinisation Plant will result in the creation of an erosion channel across the beach. The extent of the channel is expected to be localised and will only impact the beach in the short term. Once construction is complete it is anticipated that the beach profile will quickly return to normal. The impact is therefore considered to have a low significance. Alternative methods of discharge have however been identified which will significantly reduce the erosion impact of the brine.

(c) Long term disruption of sediment transport – operational phase

The inlet pipes will be placed beneath the sea floor and will therefore not impact sediment transport along the coast, whilst the discharge point of the outlet pipes may form a minor barrier to sediment movement. Studies on the existing intake basin at Koeberg (a much larger structure) indicated minor coastal erosion in the first three years after construction but over the last ten years no erosion has taken place. The significance of the impact is therefore considered to be very low.

(d) Thermal plume dispersion – operational phase

The discharge of heated water and other co-discharges such as chlorine and nuclides has the potential to negatively impact upon the local marine ecology. This section will only consider physical factors such as the size, distribution and location of the mixing zone in quantifying potential impacts.

At the Duynefontein site it has been necessary to include the existing Koeberg intake and outfall within the base case model. This allows for an assessment of the potential cumulative impacts and also the potential for temperature increases at the Koeberg intake.

The intake and outfall configuration tested for the Duynefontein plant comprises two submarine intake tunnels extending to a depth of 20 m approximately 2.2 km offshore and two southerly outfall tunnels extending to a depth of 30 m approximately 3.5 km offshore.

Intake structures will be positioned at the end of each intake tunnel with the intake openings positioned 3 to 5 m above the sea bed to prevent the drawing in of large quantities of sediment. To reduce fish entrainment the intake openings should be designed to draw in water horizontally with a velocity of less than 0.3 m/s. The diffuser layout for the outfall was selected to achieve an initial dilution of at least 10 and to ensure that the plume surfaces under all current and ambient stratification conditions.

The modelling predicts no significant (> 1℃) increase in mean or maximum seawater temperature at the seabed as illustrated in **Figure 4-1** and **4-2 of the specialist report**, respectively. The discharge forms a discreet mixing zone at the surface with a 1-2 ℃ mean temperature increase contour extending a maximum of approximately 1.0 km from the outfall. The maximum increase in seawater temperature at the surface is shown by the 7 ℃ contour in the immediate vicinity of the outfall in **Figure 4-2 of the specialist report**.

Due to the buoyancy of the plume and the upward dispersion affected by the diffuser the plume will not impact to any great extent upon sensitive ecological receptors within the benthic environment.

Elevated water temperatures can deplete the dissolved oxygen in the water leading to unfavourable ecological conditions; however the ecological receptors within the water column, where the mixing zone is predicted to occur, are largely mobile and will avoid areas with unfavourable conditions. The significance of the impact of the thermal plume upon the marine environment is therefore considered to be low.

(e) Extreme Water Levels – Operational Phase

The key potential impacts associated with extreme water levels are flooding of the nuclear facility or reduced water levels resulting in interruption of the cooling water supply. The theoretical extreme water levels are a function of a combination of (worst-case) hydrographic conditions.

The extreme high and low water levels are seen to occur during a meteo-tsunami event (i.e. extreme meteorological conditions in combination with maximum probable tsunami run-up and run-down values). Taking into account the effects of climate change upon sea level rise, the maximum water level under these conditions is predicted to be 10.54 m above MSL (at the upper 95 % confidence limit). Due to the site being constructed at 10 m above MSL there is the potential for the flooding. Flooding of the nuclear site is a potential major potential negative impact although the probability of such an occurrence is statistically very low. The potential impact of extreme water levels is therefore considered to be a negative potential impact of medium significance in lieu of appropriate mitigation. The cooling water intakes will be situated at -20 m MSL therefore there will be no potential for drying associated with the extreme low water level during a meteo-tsunami event (calculated to be -7.10 m MSL).

9.16.2 Bantamsklip

(a) Short term disruption of sediment transport during construction

The potential impacts upon short term sediment transport at the Bantamsklip can be considered to be the same as at the Duynefontein site (low significance).

(b) Erosion due to brine discharge during construction

The potential impact of the brine discharge at Bantamsklip can be considered to be the same as at the Duynefontein site (low significance).

(c) Disposal of spoil during construction

Dyer Island, situated approximately 15 km to the east of the nuclear installation corridor is a popular tourist destination with a number of operators offering shark cage diving adjacent to the island. An increase in suspended sediment in the vicinity of the island will reduce visibility and has the potential to impact on the tourism in the area.

Although many factors determine whether or not a sediment plume will be visible, available information suggests that the plume may be visible at suspended sediment concentrations as low as 10 mg/l. Since the maximum concentrations predicted by the model at Dyer Island generally exceed 10 mg/l, this suggests that the plume will occasionally be visible at Dyer Island during the sediment disposal operation.

(d) Long term disruption of sediment transport – operational phase

The potential impacts upon long term sediment transport at the Bantamsklip can be considered to be the same as at the Duynefontein site (low significance).

(e) Thermal plume dispersion – operational phase

The intake and outfall configuration tested for the Bantamsklip site comprises two submarine tunnel intakes extending approximately 3.5 km offshore (45 m depth) and two offshore tunnel outfalls extending approximately 2.5 km offshore (25 m depth). Other aspects of the intake and outfall design are the same as described above for Duynefontein.

A small mixing zone near the seafloor surrounds one of the tunnel outfalls indicating that a minor impact upon the benthic environment is to be expected in this area however the depth of the outfall, buoyancy of the plume and action of the diffusers insures that this impact is minimised as the plume is encouraged to move towards the surface.

The maximum increase in temperature near the seafloor is shown by the 3 – 4 ℃ contour which extends in a narrow band towards the shore. The 1 – 2 ℃ and 2 – 3 ℃ maximum temperature contours near the seafloor extends for a large area and impinges upon a significant extent of coastline.

The mean temperature increase in seawater temperature near the surface resulting from both outfalls is an area approximately 700 m in diameter 1 – 2 ℃ higher than ambient. The maximum temperature near the surface is shown by a very small 5 – 6 ℃ contour indicating that a high level of initial dilution is achieved at this site. However, as with the near seabed contour, the maximum temperature increase mixing zone appears to be forced towards the shallower nearshore waters where the impacts upon marine ecology are potentially greater.

Although the mixing zone has a relatively small extent the fact that it impinges upon the shallow near shore waters and shoreline results in a potential for low negative significance.

For a specific assessment of the potential impacts upon the ecological receptors present please refer to the EIA Marine Ecology Study.

(f) Extreme Water Levels – Operational Phase

The extreme high and low water levels predicted for the Bantamsklip site are seen to occur during a meteo-tsunami event (i.e. extreme meteorological conditions in combination with maximum probable tsunami run-up and run-down values). Taking into account the effects of climate change upon sea level rise, the maximum water level under these conditions is predicted to be 11.03 m MSL (at the upper 95 % confidence limit). Due to the site being constructed at 10 m MSL there is the potential for the flooding, although the probability of such an occurrence is statistically low.

The maximum meteorological extreme high water levels are 7.46 m over a 1:100 year return period. The cooling water intakes will be situated at -45 m MSL. Therefore, there will be no potential for drying associated with the extreme low water level during a meteo-tsunami event. Due potentially severe consequences but extremely low probability of a meteo-tsunami event occurring that may result in flooding of the proposed facility, the potential impact at the Bantamsklip site associated with the predicted extreme high water levels has been assigned a medium negative significance.

9.16.3 Thyspunt

(a) Short term disruption of sediment transport during construction

The potential impacts upon long term sediment transport at the Thyspunt site can be considered to be the same as at the Duynefontein site (low significance).

(b) Erosion due to brine discharge during construction

The potential impact of the brine discharge at Thyspunt can be considered to be the same as at the Duynefontein site (low significance).

(c) Long term disruption of sediment transport –operational phase

The potential impacts upon long term sediment transport at the Thyspunt site can be considered to be the same as at the Duynefontein site (low significance).

(d) Extreme Water Levels – operational phase

The extreme high and low water levels predicted for the Thyspunt site are seen to occur during a meteo-tsunami event. Taking into account the effects of climate change upon sea level rise, the maximum water level under these conditions is predicted to be 14.77 m above MSL (at the upper 95% confidence limit). Due to the site being constructed at 10 m above MSL there is significant potential for the flooding.

The maximum meteorological extreme high water levels are 11.56 m (at the upper 95% confidence limit) over a 1:100 year return period.

The cooling water intakes will be situated at -45 m MSL therefore there will be no potential for drying associated with the extreme low water level during a meteo-tsunami event. Due to the potential for flooding during both a meteo-tsunami event and meteorological extreme high water levels the probability of such an occurrence at the Thyspunt site is relatively greater than the two other sites. The significance of the impact is therefore considered to be high.

(e) Thermal plume dispersion – operational phase

The intake is a submarine tunnel extending to a depth of -29 m CD approximately 1000 m offshore. Either a single tunnel with an internal diameter of approximately 9 m, or two tunnels with diameters of approximately 6.4 m will be used. The outfall comprises six 3 m diameter pipes buried below the seabed in a 27.5 m wide trench and discharging approximately 250 m offshore in a water depth of approximately -5 m CD.

The mean increase in seawater temperature is seen to decrease rapidly from almost 8℃ above ambient immediately adjacent to the outfall to less than 2 ℃ within a discreet mixing zone only a few hundred metres in diameter indicating that good initial mixing is achieved despite the shallow depth. However, the 1 – 2 ℃ co ntour is seen to extend a significant distance and hug the coastline to the east of the outfall.

The mean increase in seawater temperature plume near the surface behaves similarly although is larger in its extent illustrating the buoyancy of the plume.

The maximum temperature increases with the proposed outfall layout are sub-optimal in terms of protecting the marine environment. Both the near seabed and near surface contour plots illustrate that the plume has a tendency to hug the shoreline and shallow nearshore area where the potential for impacts upon benthic ecology are greatest. Significant temperature increases (>2 ℃) are predicted to extend over a large area of coastline. It should however be noted that the maximum temperature increases may only be experienced for a short time over the typical 14 day tidal cycle.

The shallowness of the proposed outfall in this instance results in a relatively greater impact upon the benthic environment. The significance of the impact of the outfall upon the marine environment is considered to be of medium negative significance.

(f) Impacts on surf breaks at Thyspunt

The impact of the proposed marine disposal of spoil from the Thyspunt site has been raised an important potential source of impact on the tourism industry, owing especially to the popularity of the annual Billabong Pro surfing competition at Jeffreys Bay north of St. Francis Bay. This is one of the primary tourism draw cards for tourism to Kouga region. Jeffrey's Bay is widely recognised as South Africa's premier surfing spot with the world's longest right-hand wave break. According to the Tourism Impact Assessment (Appendix E22), the annual value of visitor spending during the Billabong Pro to Jeffreys Bay is in the order of R 25 million.

Furthermore, surf breaks in the area have been affected by previous developments along this coastline. For instance, the construction of housing and stabilisation of the dune field for the establishment of St. Francis have resulted in the disruption of sand movement into St. Francis Bay and the subsequent erosion of the beach in the bay, altering some previously well known surf breaks, most notably "Bruce's Beauties". Factors that affect the way a wave breaks and subsequently the suitability of a wave for surfing include the topography of the sea floor, swell direction, swell height and period and the tide.

It is against this background that the potential impacts on surf conditions at Jeffreys Bay and around Cape St. Francis have been assessed. The location of these surf breaks is indicated in Figure 9-18.

Figure 9-18: Surf breaks in the St. Francis / Jeffreys Bay region

Numerical modelling prepared by PRDW (2009) was used to simulate how the discharged sediment will be distributed on the seabed and how this sediment would move over time due to wave and current action. For the Thyspunt site two different disposal sites (one relatively deep and relatively shallow site), two different sediment volumes and two sediment discharge rates were modelled.

The results of the modelling at the Thyspunt site indicate that halving the sediment discharge rate significantly reduces the suspended sediment concentrations. Halving the sediment discharge rate does not, however, reduce the sediment thickness, since the transport of the coarser sediment away from the disposal mound occurs on a much longer time scale than the disposal operation. Moving the sediment disposal to deeper water reduces the transport of the coarser sediment away from the disposal site (due the reduced orbital velocities of the waves). For all alternatives assessed a significant proportion of the disposed sediment remains on the disposal site after 10 years.

The results for both a shallow and deep disposal site are indicated in Figure 9-19 and Figure 9-20 respectively.

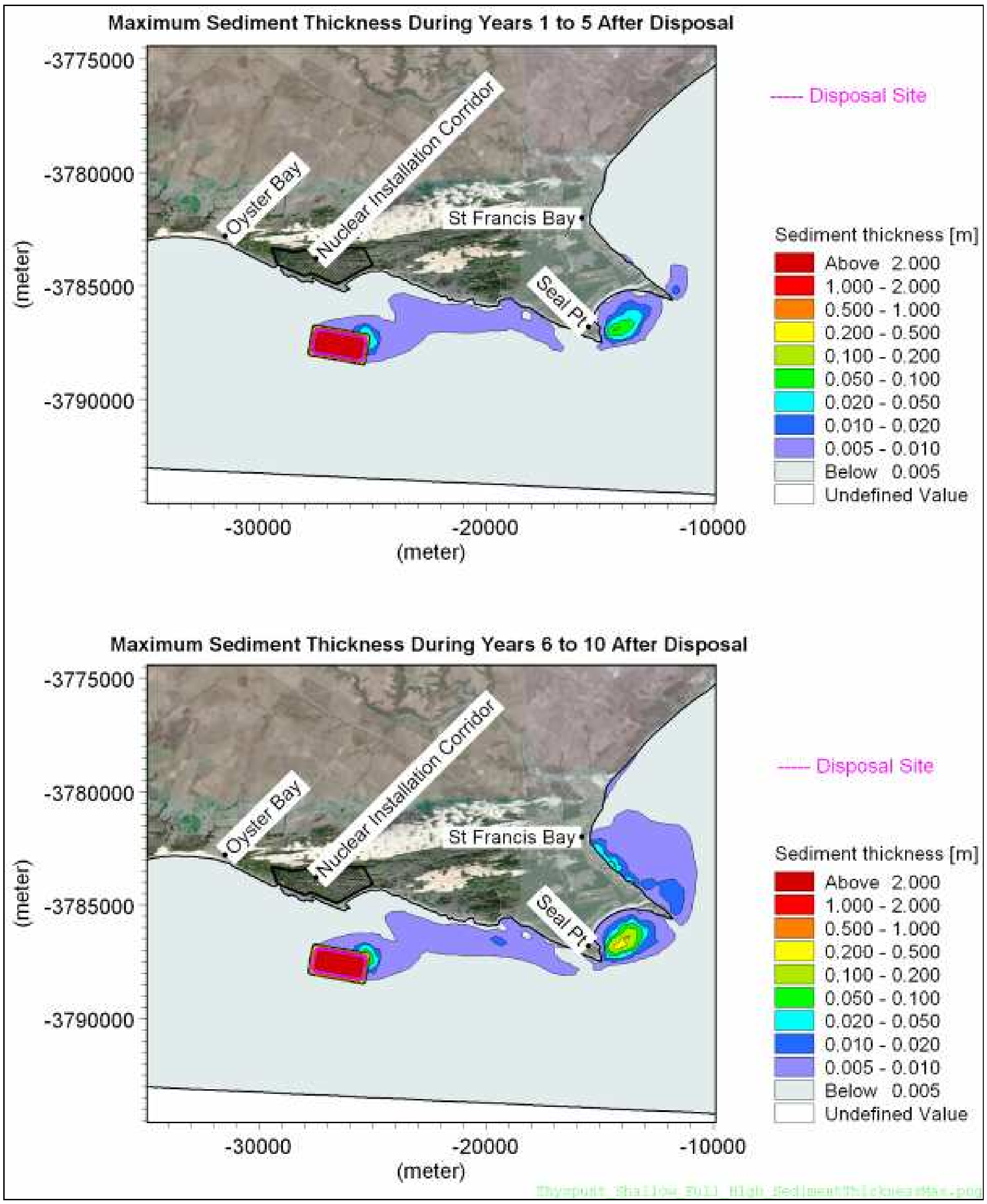


Figure 9-19: Maximum sediment thickness at Thyspunt (shallow disposal site, full sediment volume, high discharge rate)

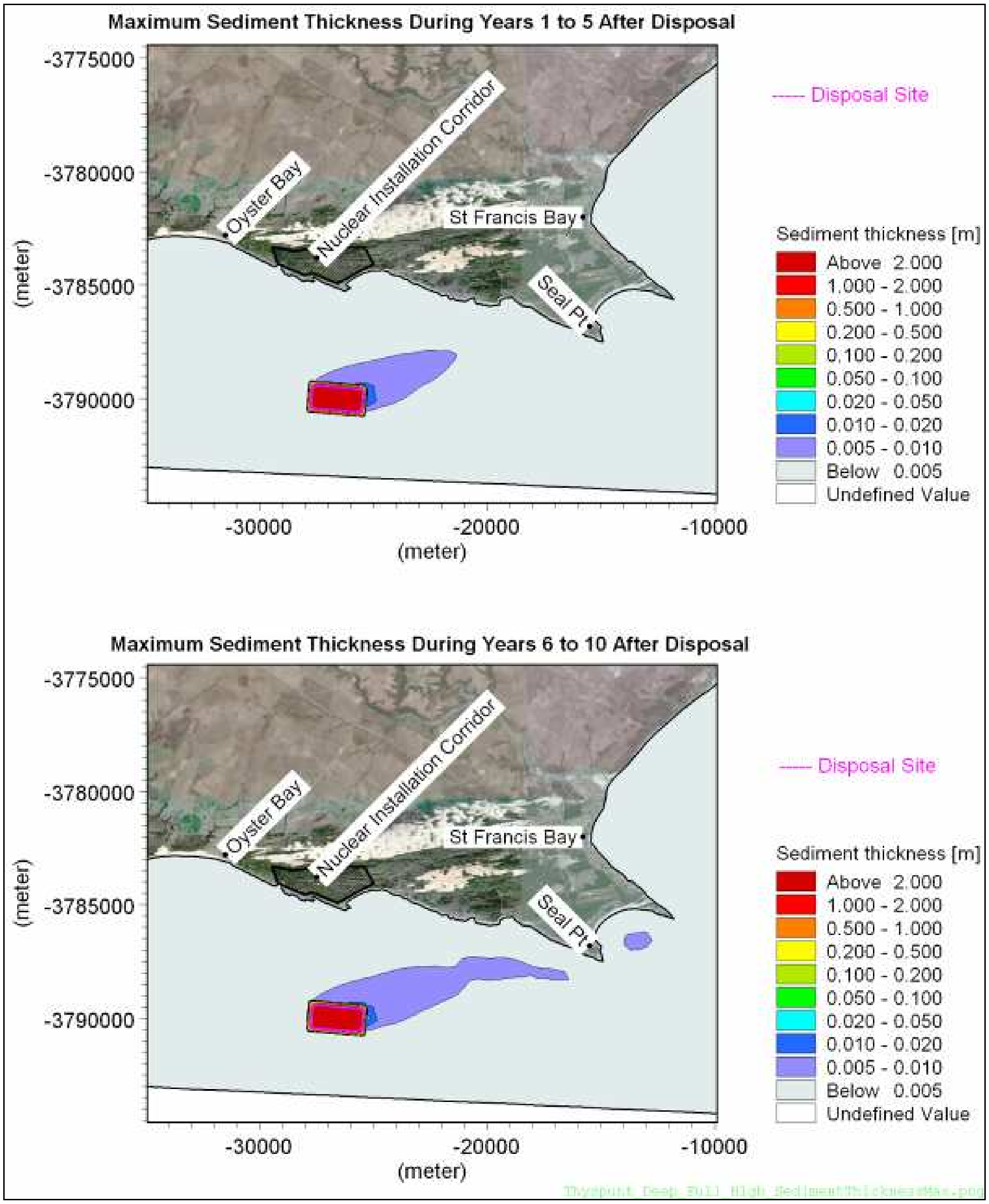


Figure 9-20: Maximum sediment thickness at Thyspunt (deep disposal site, full sediment volume, high discharge rate)

(i) Impacts on surf conditions at Seal Point

<u>Disposal at a shallow site</u>

The disposal of spoil at the shallow disposal site would results in transport of sediment in an easterly direction. The sediment would move rapidly across the reef as a thin sheet (< 5 mm) and then slow down and accumulate in the bay between Seal Point and Cape St. Francis. After approximately five years some sediment would bypass Cape St. Francis and move towards St. Francis Bay. The areas where the sediment is predicted to accumulate are likely to have a naturally sandy seabed. An increase in sediment thickness at Seal Point may

alter the topography of the seafloor, subsequently changing the way the wave currently breaks.

<u>Disposal at a deep site</u>

The disposal of spoil at the deep disposal site would result in a column of sand between 0.005m (0.5 cm) and 0.010 m (1 cm) thick extending towards Seal Point, with another small portion of spoil settling in the bay (at approximately 10m depth) between Seal Point and Cape St. Francis 10 years after disposal. The increase in sediment thickness in this bay, whilst significantly less than disposal at the shallow site, may result in an increase in sediment at Seal Point and subsequently changes in the bottom topography. This in turn may affect the manner in which the wave breaks, however to a far lesser extent than the spoil discharged at the shallow disposal site.

(ii) Impacts on surf conditions at Bruce's Beauties

<u>Disposal at a shallow site</u>

Bruce's Beauties has been negatively affected since development on and stabilisation of the Oyster Bay - St. Francis headland by-pass dune system. This has significantly reduced the supply of fine grained sand that once abundantly covered the reef. Bruce's Beauties is now considered to be not nearly as good or consistent as when it was first ridden. Modelling indicates that after approximately five years some sediment would bypass Cape St. Francis and move towards St Francis Bay. The increase in sediment is therefore likely to have a minor, positive effect on the surf at Bruce's Beauties.

<u>Disposal at a deep site</u>

Modelling indicates that sand migrating from the deep disposal site would not result in an increase sediment thickness in St. Francis Bay. Therefore no impact on Bruce's Beauties due to deep disposal of sediment is expected.

(iii) Impact on surf conditions at Jeffreys Bay

Modelling of the movement of sediment indicates that sediment would not reach as far north as Jeffreys Bay and therefore no impact is expected on the surf conditions there.

9.16.4 Mitigation

Mitigation measures applicable to all three sites are as follows:

(a) Erosion across the beach from brine discharge

Brine from the Desalinisation Plant will erode a channel from discharge point to the surf zone. The erosion will be quickly reversed once the discharge has ceased, however discharging the brine into a soakaway or infiltration gallery above the high water mark will result in minor impact to the beach profile. Furthermore discharging the brine to ground will increase dilution prior to mixing in the surf zone. Discharging brine into an infiltration gallery does however have the potential to negatively affect ground water resources on the site. The impact on local aquifers and groundwater fed surface water systems should be assessed at each site prior to considering discharging brine to ground.

(b) Disposal of spoil

The results of the marine sediment disposal modelling identifies three options for mitigating the potential impacts associated with the disposal of spoil; reducing the discharge rate, reducing the volume and / or disposing of the spoil in deeper water.

The modelling demonstrates that halving the sediment discharge rate significantly reduces the suspended sediment concentrations. However, halving the sediment discharge rate does not reduce the sediment thickness, since the transport of the coarser sediment away from the disposal mound occurs on a much longer time scale than the disposal operation.

Reducing the volume of sand disposed reduces the number of days that the threshold suspended sediment of 80 mg/l is exceeded, but has little influence on the maximum suspended sediment concentration.

Moving to deeper water reduces the suspended sediment concentrations (since there is more water depth available for mixing) and reduces the transport of the coarser sediment away from the disposal site (due the reduced orbital velocities of the waves).

Spoil disposal should cease during stormy conditions where sediments are less likely to settle upon the seafloor. The sediment plume should also be monitored visually and via water quality sampling frequently to ensure that the relevant water quality objectives established for the project are met.

(c) Extreme water levels

Flooding from sea will occur if the level of the sea rises due to climate change, storm events or a tsunami to a level above the footprint of the development. This can be mitigated during the design stage of the project by building the nuclear power station above the maximum predicted rise in sea level for each of the sites. At each of the three sites the highest predicted sea level rise is brought about by a tsunami combined with the effects of climate change. The IAEA (2003) does not state a level above the maximum run-up that the facility should be built. However, an elevation of at least 0.5 m above the maximum run-up is recommended. The maximum predicted rise in sea level for each site and the recommend elevation to prevent flooding is indicated in the table below.

Table 9-44: Recommended elevation of nuclear power station sites

Alternative	Meteo-tsunami Best estimate (m MSL)	Meteo-tsunami Upper 95% confidence level (m MSL)	Recommended elevation (m MSL)
Duynefontein	9.51	10.54	**>11.04**
Bantamsklip	9.98	11.03	**>11.53**
Thyspunt	13.61	14.77	**>14.27**

(c) Thermal Plume Dispersion

The key mitigation measures for minimising the potential impacts of a thermal plume are already in place. The outfalls will be placed a number of kilometres offshore at a depth of between 25 and 30 m. The mixing zones resulting from deep offshore outfalls are typically far smaller than nearshore channel outfalls. Moving the plume away from the shoreline and shallow nearshore area also ensures that the potential for ecological impacts is minimised.

Each outfall ends in a 200 m long diffuser with 5 ports at 50 m spacing. The ports have a diameter of 2 m and discharge vertically upwards from a height of 2 m above the seabed. The diffuser layout was selected to achieve an initial dilution of at least 10 and to ensure that the plume surfaces under all current and ambient stratification conditions. It is preferable that the plume is not trapped near the seabed as there is then an increased risk of ecological impacts at the seabed and also of recirculation back to the intakes, which in this case are located near the seabed in a depth of 20 m.

(d) Monitoring recommended by the IAEA

The International Atomic Energy Agency (IAEA, 2003) recommends that the following monitoring networks should be considered when constructing a nuclear power station:

- Monitoring of basic atmospheric conditions through a weather station; and
- A water level gauge system at Cape Town, Hermanus and Port Elizabeth for Duynefontein, Bantamsklip and Thyspunt respectively.

(e) Construction and Operational Environmental Monitoring

It is recommended that the construction and operation environmental management plans developed for the project include the methodology for monitoring key oceanographic parameters during construction and operation.

During construction this should include monitoring the levels of total suspended sediments within the water column during all marine works and spoil disposal operations. During operation ambient temperature and concentrations of co-discharges should be frequently measured.

The following mitigation related to the conditions of the surf breaks (only at the Thyspunt site) is indicated below.

(f) Mitigation to prevent impacts on surf breaks

It is recommended that if sediment is disposed offshore, a deep disposal site should be used. This would minimise changes to the sea floor and hence on surf break conditions at Seal Point and Bruce's Beauties close to Cape St. Francis. In fact a small positive impact could result at Bruce's Beauties over time.

9.16.5 Conclusions

All three of the sites are suitable for the construction of the nuclear power station. However, different impacts of varying significance are expected at each of the alternative sites.

Construction related oceanographic impacts are likely to be similar at each of the project sites. However, the potential for suspended sediment plumes to impact upon tourism (in particular shark cage diving at Dyer Island) should be considered if Bantamsklip is selected. Analysis of the thermal plume dispersion at each of the sites indicates that relatively unfavourable dispersion takes place at Thyspunt, where the plume is seen to hug the coastline and shallow near shore areas. The most efficient dispersal of the thermal plume will occur at Duynefontein.

There is the potential for water levels to exceed the proposed elevation (+10 m MSL) of the nuclear power station at all three sites should a tsunami coincide with extreme meteorological conditions (a meteo-tsunami event). However, the occurrence of a tsunami is improbable, given the low risk of seismic activity in the surrounding ocean. Thyspunt is the only site where extreme high water levels resulting purely from meteorological factors are predicted to exceed + 10 m MSL during the expected lifetime of the installation. Consequently, the predicted water levels at Thyspunt during a meteo-tsunami are also significantly higher than at Bantamsklip and Duynefontein.

The impacts of the disposal of spoil would be minimal, assuming that a deep marine disposal site is used. The modelling of sand movement indicates that spoil will not reach as far north as Jeffreys Bay and will therefore not impact surf conditions there. There may, be limited impacts of medium significance on surf breaks at St. Francis if a shallow disposal site is used. If a deep disposal site is used for spoil at Thyspunt, the impact on surf breaks will reduce to low significance.

Table 9-45: Summary of oceanographic impacts at Duynefontein

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Construction								
1A: Short term disruption of sediment transport	***Negative***	***Low***	***Medium***	***Low***	***Medium***		***Medium***	***Low***
1B: Mitigated (no mitigation applicable)	***Negative***	***Low***	***Medium***	***Low***	***Medium***		***Medium***	***Low***
2A: Beach erosion due to brine discharge	***Negative***	***Low***	***Low***	***Low***	***Medium***		***High***	***Low – Medium***
2B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Medium***		***Low***	***Low***
Operation								
3A: Long term disruption of sediment transport	***Negative***	***Low***	***Medium***	***High***	***Medium***		***Low***	***Low - Medium***
3B: Mitigated (no mitigation applicable)	***Negative***	***Low***	***Medium***	***High***	***Medium***		***Low***	***Low - Medium***
4A: Extreme sea levels affecting operation of nuclear power station	***Negative***	***Medium***	***Low***	***High***	***Low***		***Low***	***Low - Medium***
4B: Mitigated	***Negative***	***Medium***	***Low***	***High***	***Low***		***Low***	***Low - Medium***

Table 9-46: Summary of oceanographic impacts at Bantamsklip

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Construction								
1A: Short term disruption of sediment transport outfall option 1	*Negative*	*Low*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Low*
1B: Mitigated (no mitigation applicable)	*Negative*	*Low*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Low*
2A: Short term disruption of sediment transport outfall option 2	*Negative*	*Low*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Low*
2B: Mitigated								
3A: Disposal of spoil	*Negative*	*Medium*	*High*	*Low*	*High*	*Medium*	*High*	*Medium*
3B: Mitigated (no mitigation applicable)	*Negative*	*Medium*	*High*	*Low*	*High*	*Medium*	*High*	*Medium*
4A: Beach erosion due to brine discharge	*Negative*	*Low*	*Low*	*Low*	*Medium*	*Low*	*High*	*Low - Medium*
4B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
Operation								
5A: Long term disruption of sediment transport by outfall option 1	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*Low*	*Low - Medium*
5B: Mitigated (no mitigation applicable)	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*Low*	*Low - Medium*
6A: Long term disruption of sediment transport by outfall option 2	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
6B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*Low*	*Low - Medium*

Table 9-47: Summary of oceanographic impacts at Thyspunt

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Construction								
1A: Short term disruption of sediment transport	***Negative***	***Low***	***Medium***	***Low***	***Medium***	***Low***	***Medium***	***Low***
1B: Mitigated (no mitigation applicable)	***Negative***	***Low***	***Medium***	***Low***	***Medium***	***Low***	***Medium***	***Low***
2A: Beach erosion due to brine discharge	***Negative***	***Low***	***Low***	***Low***	***Medium***	***Low***	***High***	***Low-Medium***
2B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Medium***	***Low***	***Low***	***Low***
3A: Disposal of spoil – St Francis marina	***Negative***	***Low***	***Medium***	***Medium***	***Medium***	***Low***	***Medium***	***Low***
3B: Mitigated (no mitigation applicable)	***Negative***	***Low***	***Medium***	***Medium***	***Medium***	***Low***	***Medium***	***Low***
Operation								
4A: Long term disruption of sediment transport	***Negative***	***Low***	***Medium***	***High***	***Medium***	***Medium***	***Low***	***Low-Medium***
4B: Mitigated (no mitigation applicable)	***Negative***	***Low***	***Medium***	***High***	***Medium***	***Medium***	***Low***	***Low-Medium***
5A: Extreme sea levels affecting operation of nuclear power station	***Negative***	***Medium***	***Low***	***High***	***Low***	***Medium***	***High***	***Medium***
5B: Mitigated	***Negative***	***Medium***	***Low***	***High***	***Low***	***Medium***	***Low***	***Low-Medium***

Table 9-48: Assessment of impacts on surf breaks at St. Francis

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Construction								
1A: Effect of sediment on Seal Point – Shallow Disposal Site[10]	***Negative***	***Medium***	***Medium***	***Medium***	***Medium***	***Medium***	***Medium***	***Medium***
1B: Mitigated	***N.A.***							
2A: Effect of sediment dumping on Seal Point - Deep Disposal Site	***Negative****	***Medium***	***Medium***	***Medium***	***Medium***	***Medium***	***Low***	***Low***
2B: Mitigated	***N.A.***							
3A: Effect of sediment dumping on Bruce's Beauties - Shallow Disposal Site	***Positive***	***Medium***	***Medium***	***Medium***	***Medium***	***Medium***	***Low***	***Low***
3B: Mitigated	***N.A.***							

[10] ***Small volumes of sand may smooth bottom topography resulting in a positive impact on the wave. However large volumes of sediment have the potential to significantly alter the bottom topography and subsequently significantly alter the break currently experienced at Seal Point. The impact is therefore considered to be negative.***

9.17 Impacts on marine ecology

Impacts on marine ecology are dealt with in the Marine Ecology specialist report (Appendix E15).

The development of a nuclear power station at any of the three alternative sites could have a combination of the following potential impacts during construction, operation and decommissioning:

- Disruption of surrounding marine habitats;
- The entrainment and death of organisms associated with the intake of cooling water;
- The release of warm water used for cooling purposes;
- The release of desalination effluent;
- The unintentional release of radiation emissions;
- The positive impacts of the protection of organisms from exploitation due to a safety exclusion zone; and
- Pollution of the marine environment by the discharge of groundwater polluted by organic, bacterial or hydrocarbon compounds.

9.17.1 Duynefontein

(a) Disruption of surrounding marine habitats

When associated with the construction of the cooling water intake and outfall system, this effect will be focused within the construction phase and will be localised, of medium duration and significance. When associated with the discarding of spoil, disruption to the marine environment is significant. The discarding of spoil will have long-term effects, and therefore even when mitigated by disposing spoil offshore, the impact is reduced to one of medium consequence and significance.

(b) The entrainment and death of organisms

The entrainment and death of organisms associated with the intake of cooling water. At Duynefontein entrainment it is not anticipated to have significant ecological impacts.

(c) The release of warm water used for cooling purposes

A tunneled design of the release system mitigates potential negative impacts through multiple points of release to aid dissipation of excess heat, by releasing cooling water above the sea bottom to minimise effects on the benthic environment and by utilising a very high flow rate at the point of release to maximise mixing with cool surrounding water. Comprehensive oceanographic modeling has demonstrated that the effects of elevated temperature are expected to be focused on the open water habitat.

(d) The release of desalination effluent

During construction small volumes of hypersaline effluent will be released directly into the surf zone where high energy water movement will result in adequate mixing with surrounding seawater to ensure minimal impact on the marine environment. During the operational phase the desalinisation effluent will be co-released with cooling water. As brine will be diluted to undetectable levels prior to release no impact on the marine environment is predicted during this phase of the development.

(e) The unintentional release of radiation emissions

Since the 1940s human activity has resulted in varying degrees of contamination of the world's marine environment with anthropogenic radionuclides. Globally, the primary source of this contamination is fallout from over 520 atmospheric nuclear weapons tests. These radionuclides now occur alongside naturally occurring radioactive compounds at varying concentrations throughout the world's oceans. In a recent review of radionuclides in the marine environment quoted in the marine impact assessment (see Appendix E15), the occurrence of a number of these compounds in marine organisms is confirmed. Specifically, Cesium (Cs-137) and Strontium (Sr-90) have been found in bivalves along the west and east coast of America, in fish, molluscs, algae, seawater and sediment in Japan, in fish, seawater and sediments from the Arctic and related seas, and in fish, molluscs and crustaceans in the north Atlantic region. Equivalent data are not available for the southern hemisphere.

During routine environmental monitoring designed to detect radioactive releases into the marine environment from the KNPS, West Coast rock lobster, sediment and seawater samples have been found to be free of non-naturally occurring radionuclides. Activation and fission products have, however, been detected in abalone, black mussel, fish and White sand mussel. The levels detected at the KNPS have been below the levels at which further investigations or compulsory reporting to the NNR is required. Importantly, due to radionuclides having been recorded in very few individual organisms at KNPS, the low concentrations at which they have been recorded and the fact that compounds at equivalent levels of radioactivity have previously been recorded in these species under natural conditions, these findings are not considered indicative of any significant effect resulting from the power station on the surrounding marine environment.

The likelihood of a nuclear accident affecting the marine environment is very low, as such an incident would require a breach of the entire cooling system. However, should such an event take place, the impacts are likely to be reflected in mortality focused in the general area of the power station. Highly mobile species, such as fish, exposed to low to intermediate levels of radiation may, however, move great distances. This could pose a threat to the general public if these fish were later caught and consumed.

Technical design of the cooling system has minimised ***the risk of radiation releases to the marine environment,*** so that this potential impact is rated as having low consequence and low significance.

(f) The positive impacts of the protection of organisms from exploitation due to a safety exclusion zone

There would be negligible positive impact at Duynefontein, ***since there is already a marine exclusion zone established for the KNPS. Should Nuclear-1 be established at Duynefontein, the current exclusion zone will be expanded towards the north, providing protection to a larger area***

(g) Pollution of the marine environment by the discharge of groundwater polluted by organic, bacterial or hydrocarbon compounds

This impact is unlikely to occur and will be spatially and temporally restricted. It is therefore is considered to be of low consequence and significance at all three sites.

9.17.2 Bantamsklip

(a) Disruption of surrounding marine habitats

The nature of the impact will be similar in nature to that at Duynefontein. This impact will negatively affect the marine environment. If spoil is placed at a shallow nearshore

site, this impact will have a high intensity. The intensity is reduced to medium when the disposal site is placed further offshore at a deep site. The impact will act over the long-term on the benthic habitat and is rated as having high consequence and high significance when placed at a nearshore site. Placement offshore results in these ratings being reduced to medium consequence and significance.

(b) The entrainment and death of organisms

The entrainment and death of organisms associated with the intake of cooling water. At Bantamsklip this is likely to have significant negative effects on stocks of the abalone *Haliotis midae*.

(c) The release of warm water used for cooling purposes

A tunneled design of the release system mitigates potential negative impacts through multiple points of release to aid dissipation of excess heat, by releasing cooling water above the sea bottom to minimise effects on the benthic environment and by utilising a very high flow rate at the point of release to maximise mixing with cool surrounding water. Comprehensive oceanographic modeling has demonstrated that the effects of elevated temperature are expected to be focused on the open water habitat. This is of particular relevance at Bantamsklip, as it would help to mitigate impacts on abalone. It is strongly recommended that at Bantamsklip an offshore tunnel outfall be utilised for the release of warmed water in an effort to further mitigate impact on abalone. Importantly a channel release system at this site is considered to pose an unacceptable risk to abalone populations.

The release of heated cooling water is expected to affect the marine environment with a medium extent, although over the long term at Bantamsklip. The intensity of the impact is rated as low. This impact is considered to be of medium consequence and medium significance.

(d) The release of desalination effluent

The nature of the potential impacts will be the same as at Duynefontein.

(e) The unintentional release of radiation emissions

The nature of the potential impacts will be the same as at Duynefontein.

(f) The positive impacts of the protection of organisms from exploitation due to a safety exclusion zone

Bantamsklip is the only site that would benefit from such an exclusion zone, as this could be of great benefit to what are currently illegally harvested abalone populations. However, for such a benefit to be realised adequate and strict enforcement of the exclusion zone must be provided.

(g) Pollution of the marine environment by the discharge of groundwater polluted by organic, bacterial or hydrocarbon compounds

This impact is unlikely to occur and will be spatially and temporally restricted. It is therefore is considered to be of low consequence and significance at all three sites.

9.17.3 Thyspunt

(a) Disruption of surrounding marine habitats

The nature of the potential impact will be similar to that at Duynefontein. ***The impact would have a high intensity if spoil is placed at a shallow nearshore site. This impact will have long term effects, resulting in this impact being rated as having medium consequence and medium significance. If a deep offshore disposal site is used for spoil disposal, the***

intensity of the impact is reduced to medium, although the consequence and significance remains medium.

The temporal and spatial limitations of the impacts associated with the disposal of spoil on chokka squid at Thyspunt will have limited impact on the overall squid stock, when taken within the context of the extensive area over which this species spawns.

(b) The entrainment and death of organisms

The entrainment and death of organisms associated with the intake of cooling water. At Thyspunt entrainment it is not anticipated to have important ecological impacts.

(c) The release of warm water used for cooling purposes

The nature of the potential impacts would be similar to that at Duynefontein. Comprehensive oceanographic modelling has demonstrated that the effects of elevated temperature are expected to be focused on the open water habitat. As at the other sites, the construction of an intake and outflow system for cooling water will result in temporary disruption to the marine environment. Under such circumstances the benthic habitat and in particular egg beds of the chokka squid *Loligo vulgaris* are at risk of damage, while turbidity ***due to offshore spoil disposal*** may result in adults temporarily moving out of the area. This disturbance will be focussed within the construction phase and is likely to be localised and of short duration.

If cooling water is released at a depth of 5 m, the impact will act with medium intensity and with a medium spatial extent and consequently this impact is rated as having medium consequence. Thus the significance of the impact is considered to be medium. If released at a depth greater than 35 m, the intensity of the impact of warmed cooling water will be reduced to a rating of low, but the consequence and significance will remain medium.

While chokka squid at the Thyspunt site are expected to avoid water temperatures elevated above their thermal tolerance range, the area predicted to be affected represents less than one percent of the coastal spawning ground of this species.

(d) The release of desalination effluent

The nature of the potential impacts will be the same as at Duynefontein.

(e) The unintentional release of radiation emissions

The nature of the potential impacts will be the same as at Duynefontein.

(f) The positive impacts of the protection of organisms from exploitation due to a safety exclusion zone

There would be negligible positive potential impact at Thyspunt.

(g) Pollution of the marine environment by the discharge of groundwater polluted by organic, bacterial or hydrocarbon compounds

This potential impact is unlikely to occur and will be spatially and temporally restricted. It is therefore is considered to be of low consequence and significance at all three sites.

9.17.4 The no-go alternative

The no-go alternative will reduce or negate any negative impact on the marine environment at all sites (although Duynefontein already houses the existing KNPS, which has had very limited demonstrable environmental impacts on the marine environment). At Bantamsklip and Thyspunt the respective species of specific concern

(not significant at Duynefontein) are abalone and chokka squid. At least some impact on these commercially important stocks can be anticipated for the no-go alternative, At Bantamsklip any loss of abalone needs to be balanced against the potential positive impact associated with the exclusion of abalone poaching at this site. It is important to note, however, that there is uncertainty about how effective the policing of the exclusion zone will be and thus how much of a potential positive impact would be derived from a power station at Bantamsklip. Therefore it cannot be said with certainty that the proposed development alternative at Bantamsklip would result in a positive impact in comparison to the current negative impacts resulting from poaching.

9.17.5 Mitigation

The majority of the potential impacts are inherently mitigated by the design of the nuclear power station facility and its associated infrastructure. ***As the recommended mitigation measures take place during the construction phase and reduce the severity of the particular impacts, it is not possible to define mitigation targets or measure 'success' of these actions as we have no measure of the impact without mitigation. The approach applied has been that it is better to minimise impacts, rather than allow them to happen and then try to rehabilitate the environment. As such, in the context of the marine impact assessment, no performance criteria are applicable.***

The following mitigation measure will be necessary:

(a) Disruption of the marine environment during construction

The potential impacts associated with tunnelling for intake pipes and laying of outlet pipes will occur only within the construction phase. No mitigation measures are possible, but due to the localised and short-lived nature of this impact this is considered acceptable. Marine impacts will be mitigated by the placement of disposal sites offshore (and the use of a medium pumping rate at Thyspunt).

(b) Abstraction of cooling water and the subsequent entrainment of organisms

The technical design of the intake system will result in water being drawn into the intake pipe at a rate of 1 $m.s^{-1}$. This very slow rate of intake means that large organisms, such as fish and marine mammals, will easily be able to swim against the flow and will avoid entrainment without difficulty. In addition, the use of screens will further help to prevent the intake of large organisms. Despite the above, eggs, sperm and larvae will be impossible to exclude, due to their small size. While this is of concern in the context of the abalone *Haliotis midae* at Bantamsklip, no measures can be applied to mitigate this potential impact without compromising the efficiency of the cooling system. Due to the sound design of the intake system no further mitigation measures are possible to further reduce entrainment of marine organisms.

(c) The release of warm cooling water

At Duynefontein and Thyspunt current design of the release system does in itself significantly mitigate negative potential impacts associated with the release of warmed cooling water. Due to the low consequence and medium significance of this impact at these sites, no further mitigation measures are recommended. However, due to the potential impacts on the abalone it is recommended that at Bantamsklip an offshore tunnel outflow be used to prevent the thermal pollution of the nearshore benthic environment which would be associated with a nearshore channel outflow.

(d) Desalination

The effect of the release of hypersaline effluent will be avoided during the operational phase of the development as desalinisation effluent will be co-released with cooling water and adequate mixing will occur prior to release from the outflow pipe. During the construction phase brine will be released independently but into the surf zone to ensure mixing with surrounding seawater. Sufficient dilution will be achieved within 110 m from the point of release. Due to the effectiveness of this design in minimising impacts on the marine environment no additional mitigation measures are required.

(e) Radiation emissions

At a design level the risk of radiological releases into the marine environment has been minimised through the incorporation a 'three loop cooling system' whereby at no stage is there direct contact between the reactor and the coolant or between the coolant and the sea water. No further mitigation measures are necessary.

(f) Closure of site to exploitation

No additional benefit will be gained at the Duynefontein and Thyspunt sites, but a positive effect on the marine environment is possible at Bantamsklip. However, the level of organisation and the brazenness of poachers in this area will necessitate dedicated active policing of this exclusion zone for this benefit is to be realised. ***Since this level of protection cannot be guaranteed at this stage, the positive impact at Bantamsklip must be regarded as speculative and uncertain.***

(g) Release of sewage water

As the effluent to be released will meet the standards set out in the South African Water Quality Guidelines no further mitigation measures are necessary.

(h) Unintentional release of polluted groundwater

In order to reduce environmental risks it is recommended that mitigation measures prescribed in the geo-hydrological specialist study to minimise organic, bacterial and hydrocarbon pollution of groundwater (and subsequently the marine environment) should be applied.

(i) Monitoring of intertidal and shallow benthic environments during the construction phase

In order to track recovery in the intertidal and nearshore habitats following the unavoidable disruption to these areas caused during the construction of the cooling water intake and outfall systems, sandy and rocky shores, as well sandy benthic and rocky reefs (if present) should be monitored. Sites should be chosen to represent increasing distances away from the site. If appropriate habitat is present, sites should be placed at the construction site, and 50 m, 100 m, 500 m and 1 km away from the site of the construction activities. Sites should be sampled before construction activities start and then annually after completion of the intake system the same time of the year as the initial samples and for at least ten years.

(j) Monitoring of coastal dolphin in the area around Bantamsklip

Should Bantamsklip be chosen as the site for the power station, Professor Peter Best of the University of Pretoria should be asked to evaluate whether a monitoring programme considering behaviour and density of the Indo-Pacific humpback dolphin (Sousa chinensis) and the Indo-Pacific bottlenosed dolphin (Tursiops aduncus) should be designed and implemented. Such monitoring could, inter alia, take into account the potential affects of noise levels and turbidity during the construction phase, noise levels and the thermal plume during the operational phase. Note: the Dyer Island Conservation Trust is involved in cetacean research in the area and any monitoring programme should be placed within the context of existing research.

(k) <u>Monitoring of African penguin (*Spheniscus demersus*) populations on Dyer Island</u>

Should Bantamsklip be chosen as the site for the power station, a long-term monitoring programme should be established to track populations of African penguins on Dyer Island. Monitoring should take place before, during and after construction. Such monitoring should take place in conjunction with the penguin monitoring programme which is currently underway on the island and is run by the Avian Demography Unit at the University of Cape Town.

9.17.6 Conclusions

The nature of the marine potential impacts is fairly similar at all the sites. Potentially the most significant impacts are the disruption of the marine environment through the offshore disposal of sediment, and the release of warmed cooling water. Secondly, disturbance will be associated with the potential discarding of spoil from excavation of the take tunnel, intake basin, nuclear island and turbine hall. In an effort to minimise this potential impact, it is recommended that spoil only be discarded ***at deep*** offshore ***locations*** and (at Thyspunt) only a medium pumping rate ***should*** be used. This would limit ecological impacts particularly on abalone at Bantamsklip and chokka squid at Thyspunt.

It should be noted that the temporal and spatial limitations of the impacts associated with the disposal of spoil result in little potential impact on the squid at Thyspunt when taken within the context of the extensive area over which this species spawns. Additionally, the inshore chokka fishery as a whole is unlikely to be seriously affected by the disposal of spoil as only a small proportion of catches are taken in the area expected to be affected.

Heating of seawater will be mitigated by a tunnelled design of the release system through multiple points of release to aid dissipation of excess heat. Water will be released above the sea bottom to minimise effects on the benthic environment and by utilising a very high flow rate at the point of release to maximise mixing with cool surrounding water. ***While chokka squid at Thyspunt are expected to avoid water temperatures elevated above their thermal tolerance range, the area predicted to be affected represents less than one percent of the coastal spawning ground.***

From a marine biology perspective, there is no clearly preferred site. All sites would have similar levels of negative impacts, and the impacts on all sites could be effectively mitigated if the proposed designs are implemented as planned. Thyspunt would require a medium pumping rate for offshore discard of spoil. **Bantamsklip would potentially gain the most from the declaration of a marine "no-go" security zone.** However, the real benefits of this positive impact are uncertain, as very strict policing of this zone would be required to prevent access by abalone poachers.

<u>NOTE</u>: Virtually all marine impacts have the same significance with and without mitigation, because mitigation measures are already integrated in the design of the marine infrastructure.

Table 9-49: Summary of impacts on the marine environment at Duynefontein

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1B: Disruption during construction: Due to construction of the cooling water intake and outflow systems	***Negative***	***Medium***	***Low***	***Medium***	***Low***	***Medium***	***High***	***Medium***
2A: Disruption during construction: Due to discarding of spoil at a shallow nearshore site	***Negative***	***Medium***	***Medium***	***High***	***Low***	***Medium***	***High***	***Medium***
2B: Mitigated (discarding of spoil at a deep offshore site)	***Negative***	***Low***	***Medium***	***High***	***Low***	***Medium***	***High***	***Medium***
3B: Abstraction of cooling water & entrainment of organisms	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***High***	***Low - Medium***
4B: Impact on marine organisms due to release of warmed cooling water	***Negative***	***Low***	***Medium***	***High***	***Low***	***Medium***	***High***	***Medium***
5B: Release of desalination effluent during the construction phase	***Negative***	***Low***	***Low***	***Medium***	***Low***	***Low***	***High***	***Low - Medium***
6B: Release of radiation emissions	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
7A: Unintentional discharge of polluted groundwater	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

Table 9-50: Summary of impacts on the marine environment at Bantamsklip

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1B: Disruption during construction: Due to construction of the cooling water intake and outflow systems	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
2A; Disruption during construction: Due to discarding of spoil at a shallow nearshore site	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
2B: Mitigated (discarding of spoil at a deep offshore site)	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*High*	*Low - Medium*
3B: Abstraction of cooling water & entrainment of organisms	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Low*	*High*	*Low - Medium*
4B: Impact on marine organisms due to release of warmed cooling water	*Negative*	*Low*	*Low*	*Medium*	*Medium*	*Low*	*High*	*Low - Medium*
5B: Release of desalination effluent during the construction phase	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
6B: Release of radiation emissions	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
7A; Unintentional discharge of polluted groundwater	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*

Table 9-51: Summary of impacts on the marine environment at Thyspunt

Impact	Nature	Intensity	Extent	Duration	Consequence	Impact on irreplaceable resources	Probability	SIGNIFICANCE
1B1A: Disruption during construction: Due to construction of the cooling water intake and outflow systems	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*High*	*Low - Medium*
2A: Disruption during construction: Due to discarding of spoil at a shallow nearshore site	*Negative*	*Medium*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
2B: Mitigated (discarding of spoil at a deep offshore site)	*Negative*	*Medium*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
3B3A: Abstraction of cooling water & entrainment of organisms	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*High*	*Low - Medium*
4B4A: Impact on marine organisms due to release of warmed cooling water	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Medium*
5B5A: Release of desalination effluent during the construction phase	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*High*	*Low - Medium*
6B6A: Release of radiation emissions	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
7B7A: Unintentional discharge of polluted groundwater	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*

9.18 Impacts on heritage resources

Impacts on heritage resource are dealt with in the Heritage Impact Assessment contained in Appendix E20.

All three alternative sites contain significant heritage resources, being situated in areas which are known to be archaeologically and palaeontologically sensitive and in scenic areas with strong wilderness qualities.

The fact that certain kinds of heritage are finite means that any form of impact assessment automatically invokes the maximum scores in terms of the criteria of replaceability, reversibility and duration. Tangible heritage resources such as protected structures, archaeological sites, palaeontological material is finite. Once they are damaged or destroyed, that state endures forever. It can never be replaced, or reversed. It is possible to mimic or reconstruct certain kinds of heritage such as buildings and individual objects, and to an extent it may be possible to reinstate a landscape but with loss of authenticity. The main sources of potential impact to heritage fall into two broad categories – a) the destruction of the physical heritage object itself, b) the destruction or change of its context.

The nature and mechanisms of potential impact will be similar at all three sites – extensive excavation, landscape modification and disturbance.

(a) Construction phase impacts

Destruction of tangible heritage (structures, archaeological sites, fossils) almost always takes place during the construction process of development activities as the main source of potential impact to heritage is from the disturbance of ground or landscape and/or demolition of structures and places.

Archaeological sites, Pleistocene[11] palaeontology, and graves are highly fragile and context sensitive, which means that their value is very easily destroyed when the landscape in which they are situated is disturbed by bulk excavation, installation of services and roads. Palaeontological material is destroyed by bulk earthmoving, cutting and mining operations, however palaeontological resources tend to be extensive (depending on the resource) and are rather more resistant to impact than archaeological material for the simple reason is that there is more of it. Because palaeontological material is often very deeply buried, scientists often rely on human intervention in the land surface to collect data. Provided that palaeontologists can use the opportunity arising from construction works to sample and record profiles and exposed material as part of the environmental management process, a potential negative impact can be transformed into a positive opportunity to increase the levels of knowledge about a locality and the species of fauna and flora that were present in the past.

Landscapes are highly sensitive to accumulative impacts and large scale development activities that change the character and public memory of a place. In terms of the NHRA a cultural landscape may also include a natural landscape of high rarity value and scientific significance. Certainly the construction of a large facility such as a nuclear power station is likely to result in profound changes to the overall sense of place of a locality, if not a region. On a smaller scale comparatively minor factors such as ill-conceived and distasteful signage, “overpowering” entrance gates to sites or security fences adjacent to natural areas and scenic drives will constitute an aesthetic irritation than can cause serious cumulative damage to the “sense of place”. It may be argued that it is possible to a degree to rectify damage to a

[11] ***3 million – 10 000 years ago***

landscape through demolition of intrusive elements. However, this seldom happens – the impacts to all intents and purposes are permanent. Given the nature and scale of the proposed activity, which will involve massive intrusive permanent bulk in what are considered significant natural heritage areas, mitigation is not feasible. ***However,*** careful environmental planning may assist in lessening the effects of infrastructure "sprawl".

(b) Operational phase impacts

During the operational phase of the plant, it is expected that impacts will be largely neutral provided that the applicant manages the heritage resources on the affected properties adequately. Impacts on a minor scale will occur when certain operational decisions are made in response to the needs of the facility – road construction, construction of peripheral buildings, pipelines etc. It is expected that significant changes will independently trigger EIAs or ***Heritage Impact Assessments***.

(c) Decommissioning phase impacts

Heritage impacts can occur during the decommissioning phases of large operations. The process of rehabilitation will involve surface disturbance and earthmoving operations. The effect of this, like during the construction phase, will be the destruction of context in which archaeological heritage is situated, the demolition of buildings that are greater then 60 years old. In terms of the current protections of the NHRA, the Nuclear Infrastructure could be greater than 60 years old once demolition and rehabilitation is required. This would invoke the general protection of the NHRA in its present form.

9.18.1 Duynefontein

- Impacts to ephemeral Late Stone Age heritage will be minimal.
- Duynefontein is palaeontologically highly sensitive ***and its heritage significance is dominated by its internationally recognised palaeontological wealth.*** Extensive mitigation will be required, ***with the results that the impacts of these resources are rated to have a medium significance.*** If ***Eskom commits to a comprehensive mitigation programme, there is real scientific benefit to be had from the opportunity to collect fossils, record their context and examine the profiles of deep excavations into Caenozoic deposits. These potential positive impacts are rated to have a medium significance.***
- No colonial period heritage is likely to be impacted.
- ***The significance of the destruction of Late Stone Age heritage at Duynefontein is regarded to have low significance. This is substantially less than that of Bantamsklip and Thyspunt, with the result that the impact on the National Estate will be far less acute than at the other two alternative sites.***
- ***In landscape terms the nuclear industrial presence is already established and accepted as a landmark by most Capetonians. Any additions to this will be additions to an already established identity as a nuclear power station site. In terms of landscape impacts, Duynefontein is therefore less sensitive than Thyspunt or Bantamsklip.***

9.18.2 Bantamsklip

- The preservation and volume of archaeological sites is exceptional. Extensive mitigation will be required.
- ***Bantamsklip is almost as sensitive in terms of its heritage richness as Thyspunt. However, mitigation measures will have a better chance of success at Bantamsklip as heritage resources at this site are more visible and accessible than at Thyspunt. The significance of impacts on Pleistocene and Holocene[12] archaeological resources is regarded as medium and high, respectively at***

[12] ***Within the last 10000 years.***

Bantamsklip. Holocene archaeological impacts are therefore regarded as more significant at Bantamsklip than at Duynefontein.

- The natural landscape ***quality*** of the place ***is*** excellent and makes a contribution to sense of place in the region. Given the mass and bulk of the proposed activity, un-mitigable cultural landscape impacts are expected. ***The destruction of landscape is regarded to be an impact of high significance.***
- ***Cumulative impacts related to transmission lines across the relatively unspoilt natural landscape are regarded to be of high significance without mitigation, and medium significance with mitigation.***
- ***Mitigation will be lengthy, expensive and resource-intensive, requiring up to a year's lead up time (depending on where the nuclear power station is to be sited) before construction work can commence. The proposed power station position will ensure that the bulk of the archaeological sites are avoided as there will be a minimum 200 m offset from the coastline.***

9.18.3 Thyspunt

- ***Both the*** archaeological and palaeontological heritage is diverse and prolific, ***representing a very wide range of material, much of it is very well preserved. However, in contrast to the other two alternative sites (where the impact is rated to be Medium), the impact on Miocene palaeontology is regarded to be of Low significance without mitigation at Thyspunt. Pleistocene and Holocene archaeological impacts at Thyspunt are regarded to be high without mitigation – higher significance than at Bantamsklip, where unmitigated Pleistocene archaeological impacts are regarded to be a medium significance.***
- Mitigation without excessive impacts is going to be technically difficult to achieve due to the character of the site and difficulties with respect to accessibility. However, the final location of the proposed facility will play a role in the degree of impact expected. ***The proposed power station position will ensure that the bulk of the archaeological sites are avoided. The EIR's recommendation is to place the footprint of the power station away from the highest concentration of archaeological sites. The minimum 200 m offset from the coastline will allow these sites to remain unaffected. However, there are a number of sites that will continue to be affected.***
- The wilderness qualities of this portion of the coast are exceptional and make a substantial contribution to the character of the region. Given the mass and bulk of the proposed activity, un-mitigable cultural landscape impacts are expected.
- ***The landscape quality of the study area is made up of the combination of its natural heritage, high biodiversity and person-made landscape in the distinct geographical area defined by Cape St. Francis (east), Oyster Bay (west) and the outer (north) perimeter of the dune system. The landscape, together with the archaeological sites it contains, may be viewed as a single holistic entity, which retains the spatial patterning of human use of the landscape in a largely intact natural coastal environment that has not changed significantly since prehistoric times. A particularly rare aspect of the area is the headland bypass dune field system (described in Section 9.11). Together with the wide range of archaeological and palaeontological resources, this places the site among a few surviving landforms of this kind and size around the country. This dune field, together with the coastal thicket vegetation, the rich shoreline with its natural springs, represents a uniquely intact environment in which KhoeKhoen pastoralists and San hunter-gatherers existed. Organisations such as the Gamtkwa (Gamtkwabaktwa) Khoisan Council have indicated their opinion that the completeness of this natural and human environment must be seen as a holistic entity of extraordinary heritage value to all Khoisan descendents.***

- ***Bearing the above point in mind, in terms of the UNESCO definition of a "Cultural Landscape"[13] , Thyspunt and environs is a uniquely intact pre-colonial Cultural Landscape. The impacts on this Cultural Landscape will be permanent and virtually irreversible.***
- ***As at Bantamsklip, cumulative impacts are regarded to be of High significance without mitigation, and Medium significance with mitigation.***
- ***Of the three sites, mitigation of impacts to heritage material at this site is going to be the most difficult due to accessibility problems. This could result in localised delays during construction if mitigation excavations cannot be performed in time for the planned start of construction. Without extremely lengthy and costly mitigation, a great deal of Pleistocene palaeontological and archaeological material will be lost during construction.***

9.18.4 Cumulative impacts

Cumulative impacts of the Thyspunt and Duynefontein sites below are considered with reference to the findings of the Heritage Impact Assessments of the power station and the transmission lines. The Heritage Impacts Assessment of the transmission lines for these sites were made available to GIBB. However, no Heritage Impact Assessment for the Bantamsklip transmission linse was available at the time of writing this EIR.

(a) Duynefontein

The addition of a nuclear power station (twice the capacity of the existing KNPS) will add to the prominence of the existing structure. However, the KNPS is already an established landmark and the site is therefore known as a nuclear power station site. Thus, the cumulative effect will be somewhat moderated.

Given that very little is known about the full extent of either the Miocene or Pleistocene palaeontology or archaeology at Duynefontein, it is not possible to quantify the cumulative impacts, other than to state that the Nuclear-1 footprint, together with the KNPS footprint, represents a substantial transformation of the environment with commensurate impacts to a finite resource.

The heritage impacts assessments for the "Koeberg Integration Project" (transmission lines for the proposed Nuclear-1 project) have been made available to GIBB, in order to assess the potential cumulative heritage impacts of the power station and associated transmission lines. These reports (Hart et al. 2010a, 2010b and 2010c) indicate that the palaeontological impact of the transmission lines will be limited, due to the small size of the pylons bases. The reports also indicate that although there are archaeological sites close to the proposed transmission line routes, these sites are located in highly transformed landscapes. Therefore, the sites are not of significant heritage value. There will be no physical impact on built heritage structures in the vicinity of the transmission lines. However, from a cultural landscape point of view, there will be an increase in the visibility of the transmission lines in the existing corridors. These studies found that the addition of new transmission lines would add additional visual impacts to an already disturbed sense of place, since the new transmission lines are proposed to follow existing Eskom transmission servitudes.

Based on these findings, the cumulative heritage impacts of the power station and transmission lines will not be significant. The Nuclear-1 Duynefontein site itself is already transformed by the presence of the KNPS. The potentially most significant

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[13] ***"Cultural Landscape" is defined by UNESCO as "a distinct area containing the combined works of nature and people". These landscapes are illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal.***
The term "cultural landscape" embraces a diversity of manifestations of the interaction between humankind and its natural environment. Cultural landscapes often reflect specific techniques of sustainable land-use, considering the characteristics and limits of the natural environment they are established in, and a specific spiritual relation to nature.

impacts of Nuclear-1 at Duynefontein will be those impacts on paleontological resources within the footprint.

(b) Bantamsklip

Given the extent of littoral sprawl of urban development from Hermanus to Gansbaai and the low proportion of coastal landscapes that are protected, a worst case scenario (i.e. destruction of a large proportion of archaeological sites in the study area) would make a significant impact on the 'regional estate' of archaeological sites. A concern is the loss of wilderness landscape and un-interrupted views, which gives the Overstrand region its particular character, and makes the R43 a scenic drive.

Indications are that the construction of transmission lines that will integrate the power station with the national grid will need to cross iconic Western Cape landscapes, resulting in significant impacts in terms of setting and scenery. Public response with respect to the scoping phase of the EIA has been vigorous with respect to these issues and therefore the cumulative impact of the transmission lines, in addition to the nuclear power station itself, can be expected to be high.

(c) Thyspunt

SAHRA has not conducted a systematic assessment of the potential population of archaeological sites on the Eastern Cape south coast or the extent of undisturbed shoreline that survives. Subject experts of the Albany Museum have expressed concern at the number of archaeological sites that have been previously recorded by the Museum, that have been recently destroyed by prolific development in the Cape St. Francis area, often without mitigation. Conservation issues are acute in the Eastern Cape due to lack of professional staff available to control the situation. Thyspunt is highly heritage rich and the quality and quantity of archaeological material is extraordinary. It is essential to consider this background in the context of the proposed Nuclear-1 development, as it related to the cumulative heritage impact in the wider St. Francis area. The cumulative impact of the proposed activity and future expansion areas will be significant, unless there is a regional effort to conserve the coastal landscapes.

The draft heritage impact assessments for the transmission lines from the proposed Thyspunt site were made available to GIBB at the time of preparing this EIR, thus allowing consideration of the cumulative impacts of the power station and transmission lines.

A particular concern at Thyspunt is the loss of wilderness landscape and un-interrupted views, which give the region its character. The recent proposal to construct a wind energy facility at a site to the north of Thyspunt and Oyster Bay (not an Eskom project) will negatively affect the sense of country and wilderness that can currently be experienced in the area. According to the Thyspunt transmission line EIA Scoping Report (Van Schalkwyk, 2010), the grasslands between Thyspunt and Humansdorp have high scenic values and these will be negatively impacted.

With regards to palaeontological heritage, Rubidge (2011) concludes that from a desktop study utilizing a geological base map, it is not possible to determine the nature of outcrops and the degree of plant and overburden cover. However, it is evident, when considering that all the rocks in the area are sedimentary, that it is most likely that the development will have a bearing on palaeontological heritage. As much of the area is covered by vegetation and soil (some of which will be cleared in the process of erecting of the power lines), the transmission development offers great opportunity for palaeontological exploration and research (Rubidge, 2011).

With regards to pre-colonial heritage sites, Van Schalkwyk (2010) found that sites of all phases of the Stone Age occur in the study area. The Thyspunt transmission corridors would result mostly in indirect impacts on these sites, e.g. the power line crossing over

a site. In other areas of the transmission lines, even though the impact will be focused on a particular node, i.e. tower positions or access/ inspection roads, it will give rise to the physical disturbance of the material and its context. This would result in irreplaceable loss of resources.,

As far as colonial heritage is concerned, Van Schalkwyk (2011) found that the power lines are to cross a rural landscape for the most part, and that the impact would mostly be indirect, e.g. the power line crossing over a site. In other areas of the proposed transmission lines, the impact will be focused on a particular node, i.e. tower positions or access/ inspection roads and will therefore give rise to the physical damage of the features or structures and its context. Places where this would occur are not identified in the report.

Van Schalkwyk (2011) further states that where a high density of sites occurs, such as at the Thyspunt end of the corridors (i.e. at the power station site), exclusion zones where no development is to take place should be set aside. This has been done through the recommendation in this EIR that the area around the immediate power station footprint should be managed as a nature reserve.

Since the positions of the transmission line pylons have not yet been determined, the exact nature of the direct impacts of the transmission lines has not been confirmed. In any event, it will be much easier to mitigate the impacts of the transmission lines than it would be to mitigate the impacts of the power station, as the positions of individual pylons could be relatively easily moved, and since the footprint of each pylons is very small when compared to the footprint of the power station (more than 200 ha).

In summary, therefore, direct impacts on heritage resources would be caused primarily by the nuclear power station, whilst few if any direct impacts would result from the transmission lines. Thus, there is little potential for direct cumulative impacts of heritage resources. With regards to cultural landscape issues, however, the cumulative impacts of the power station and transmission line would be significant. The transmission lines would contribute more to this impact than would the power station, since the transmission lines would be visible over a far wider area than the power station. Furthermore, the power station's visibility is relatively low (compared to the transmission lines) due to its low position in the landscape (close to sea level) and the screening provided by the tall (more than 100 m) mobile and vegetated dunes immediately inland of the proposed power station position.

9.18.5 Impacts of the no-go alternative

The no-go alternative will result in retention of the *status quo* until such time that alternative land uses are found. In the medium to long term heritage impacts could be expected depending on future land use. Should any of the sites be used for property development, it is likely that heritage impacts in terms of archaeology and landscape will be severe. The westward expansion of Cape St. Francis and the development of associated golf estates is a case in point, as this has already resulted in highly significant impacts on heritage resources.

While the development of a nuclear power station on any of the proposed sites will result in substantial impacts, the conservation of landscapes within the owner-controlled zone, as well as possible biodiversity offsets could be advantageous for heritage conservation in the long-term, provided that the recommended intensive heritage mitigation programmes are implemented before construction at the alternative sites.

9.18.6 Mitigation

Since heritage is a finite resource that is sensitive to physical impact and change of context, other than avoidance or active conservation of the resource, mitigation options are limited and seldom wholly satisfactory. When a situation arises where the destruction of a resource is inevitable and cannot be avoided, mitigation actions tend

to focus on "the rescue of knowledge". While this can be construed as a benefit for any community involved in the development and accumulation of knowledge, the end result is that the resource is either destroyed or its context (and therefore much of its meaning) is lost. Very often the success of mitigation is variable, as it depends on the skill of the heritage professional involved, his/her cultural biases and his/her access to resources and funding.

(a) Mitigation objectives

<u>Palaeontological material</u>

Mitigation has a good prognosis for success and can result in a benefit gain for science, knowledge and education provided that the work that is required is adequately resourced and professionally accomplished. Typically mitigation will require the physical rescue of material from open pits, the recording and logging of cores, profiles and sections as well as curation and indefinite storage of any fossil material found. The success (or not) of mitigation is directly proportional to time and resources afforded to the palaeontologists and the ability of the construction operation to tolerate their work.

In the case of this project (all of the three sites), the object of mitigation is to use the rare opportunity of a deep excavation to increase scientific knowledge for the common good, and thereby derive benefit from what would otherwise be a thoroughly destructive process and an irretrievable loss.

<u>Archaeological heritage</u>

In-situ conservation of archaeological resources on the remainder of the sites that is not affected by the power station footprints is the preferred mitigation method. In the case of all three sites, the offset of 200 m from the high water mark has ensured the conservation of the majority of the archaeological sites, which are generally concentrated along the coastal portions of the properties. At Thyspunt, there is a particularly high concentration of archaeological sites along the rocky shoreline to the west of the Thyspunt which has been avoided by the placement of the power station 200 m inland from the high water mark. For those archaeological resources that will be affected by the footprint of the power station infrastructure, mitigation needs to be achieved though archaeological sampling. The goal of such sampling must be to ensure that as representative as possible a range of sites are thoroughly sampled and studied before they are destroyed by construction activities.

The affected sites will need to be excavated in a scientific way, the resulting material sorted, curated and stored in an approved facility so that a physical archive of information is stored for the benefit of anyone who would wish to utilise it in an appropriate way. The process is time and resource-consuming and the skills required are demanding and expensive. Furthermore, all excavated material has to be stored indefinitely, which in turn is a huge burden on cash-strapped museums with limited storage space. It will be necessary in the case of this project for a dedicated facility in each province to be constructed to house heritage material in a controlled environment.

<u>Cultural landscapes</u>

Conservation of landscape is normally achieved by making heritage and aesthetics (in the broadest sense of the word) a key informant in any planning process. In the context of this project the sheer bulk and un-negotiable design qualities of a nuclear power station, high voltage yards and transmission lines do not lend themselves to mitigation, since the presence of a new massive intrusion will destroy the completeness of the cultural landscape and alter the

context of the heritage. Unfortunately, therefore, the bulk and scale of the proposed activities can largely not be mitigated

(b) Recommended mitigation measures

<u>Mitigation prior to construction</u>

As much mitigation work as possible should happen in advance of commencement of construction activities, as attempting archaeological or palaeontological rescue work on a busy 24-hour construction site is extremely difficult. Since all three alternative sites have serious heritage issues to be mitigated, Eskom must be pro-active by commissioning the required work as soon as possible. The construction activities must be so scheduled so that archaeological mitigation can be completed in particular areas before site clearance starts. At Thyspunt, due to the high concentration of heritage sites, the sampling process will require six months to a year to complete.

In the event of personnel having to undertake archaeological or palaeontological rescue work during the course of construction, they will need the co-operation of construction staff to allow them the necessary time to do the required rescue work. This could vary between two hours and two weeks. Unless suitable circumstances can be created for this to be achieved, mitigation will fail.

<u>Mitigation of finds during construction</u>

As a guiding principle it is important that a clear chain of communication be developed between the construction team and a heritage consultant who can be on call to attend meetings, conduct site inspections, conduct emergency rescue work and resolve queries. The heritage consultant should be a professional archaeologist or palaeontologist. This process needs to be in place before the inception of construction work. The success of any mitigation measures for both palaeontology and archaeology is dependent on the willingness and co-operation of the construction team. It is recommended that key construction personnel should attend a short heritage course to enable them to assist in the recognition of fossil material and work out a process for consultation, collections of specimens and temporary on-site curation.

<u>Mitigation plan</u>

A "mitigation plan" should be developed for the site that is chosen for development. This plan should be compiled through consultation with the respective archaeology and palaeontology committees of SAHRA and Heritage Western Cape. These organisations and the applicant will need to be satisfied that the proposed sampling strategy is appropriate and realistic before excavation and destruction permits can be issued. The mitigation measures detailed in this report form a basis from which such a plan could be developed.

<u>Maritime heritage</u>

Since all three sites are coastal and will involve engineering work off-shore, there is a remote possibility that impacts to protected shipwrecks may occur. The impact would depend on the form of engineering taking place. This issue will need to be addressed by means of specific heritage impact assessments once there is further clarity as to the details of the proposed spoil outfall pipelines and cooling water intakes and outlets.

Human remains

Human remains can be found anywhere on the landscape, and almost inevitably in areas where there are concentrations of archaeological sites. SAHRA has not yet developed clear protocols with respect to human remains. However, special permitting requirements need to be fulfilled, and the excavation work may only be done by an archaeologist. Certain communities have sensitivities with respect to the manner in which their ancestral remains are treated. At Thyspunt, for example, the Gamtkwa community who are listed as I&APs must be informed and consulted when human remains are uncovered, and if necessary the reburial of any human remains should be facilitated.

Education and science

A principle worthy of consideration is that of developing the information that will be gained from the heritage management process into an educational resource – a booklet, pamphlet or even a small display that could be included within a visitor or information centre. In view of the extensive excavations that are expected at all of the alternative sites, it is recommended that a permanent display or museum of appropriate size for the volume of material should be established and that the curation of the museum should be funded by Eskom.

Site-specific mitigation measures

Section 5.2.2 of the Heritage Impact Assessment (Appendix E20 of the Revised Draft EIR) contains site-specific mitigation measures that must be implemented, depending on the site that is authorised by the environmental authority.

Building a suitable heritage mitigation team

It is a concern that the heritage community in South Africa may not be able to properly respond to the mitigation requirements of a project of this size. There are little more than 60 professional archaeologists in South Africa, of which roughly half specialise in field archaeology. Of those, even fewer are professionally accredited for coastal archaeology. South African universities, despite strict heritage legislation that should create job opportunities, fail to produce skilled field specialists, as the focus remains on academic archaeology. In a project such as this it is important that information is collected and archived in the best possible way. This can only be done by an experienced professional team and with good financial and logistical support from the applicant. This means that any professional team that is contracted to undertake mitigation will need to undertake a staff recruiting drive or work in consortia with other Universities and institutions. It is imperative that the applicant identifies a heritage specialist to build the necessary team as early as possible in the process, as lead time will be required to get the work underway.

Monitoring and evaluation

Since heritage practitioners have no quantifiable data about the extent of the "National Estate" even at a regional level, there is no yardstick that can be used to measure the effectiveness of a mitigation programme. The heritage specialist responsible for this Heritage Impact Assessment recommends that if an archive of information and materials derived from rescue sampling can be used by others in dissertations, research publications or dissemination of public knowledge, then mitigation is deemed to be partially successful. The following criteria are recommended as yardsticks of mitigation effectiveness:

- ***The audit of heritage resources on the power station site should be an ongoing process. In order to measure the success of mitigation, as***

much as possible needs to be known about population diversity and age of heritage sites.

- ***During construction a book should be maintained to record as much as possible with respect to sites that are found in buried sediments during construction. Not only would this be a critical contribution towards judging the amount of palaeo- and archaeo-heritage that lies buried on the property, but it would also assist in establishing an overall conservation goal. Ideally heritage casualties should be less than the number of heritage sites which are actively conserved – a site conserved for every one that is destroyed should be a minimal goal to aspire to.***

9.18.7 Conclusion

The amount of Late Stone Age heritage that will be impacted at Duynefontein will be substantially less than that of Bantamsklip and Thyspunt. However, Duynefontein is palaeontologically highly sensitive. If Eskom commits to a comprehensive mitigation programme there is real scientific benefit to be had from the opportunity to collect fossils, record their context and examining the profiles of deep excavations into Caenozoic deposits. Thus, in spite of the high sensitivity of palaeontological resources, a comprehensive mitigation strategy may actually result in significant benefits by contributing to greater knowledge. Bantamsklip is almost as sensitive as Thyspunt in terms of its heritage richness. However, mitigation measures will have a better chance of success at Bantamsklip, as heritage sites are more visible and accessible at Bantamsklip. Much of the necessary sampling can be done prior to commencement of construction work. The preservation and volume of archaeological sites is exceptional. Mitigation will be lengthy, expensive and resource intensive requiring up to a year's lead time.Mitigation of impacts at Thyspunt is going to be the most difficult due to accessibility problems. This could result in localised delays during construction if mitigation excavations cannot be performed in time for the planned start of construction. Both the archaeological and palaeontological heritage is prolific, representing a very wide range of material, much of which is very well preserved. Without extremely lengthy mitigation, a great deal of Pleistocene palaeontological and archaeological material will be lost during construction. The wilderness qualities of this portion of the coast are exceptional and make a substantial contribution to the character of the region, ***contributing to the conclusion that the Thyspunt conforms to the "Cultural Landscape" definition under the UNESCO World Heritage Convention. This is a significant difference between the landscape impacts at Thyspunt and the other sites: Thyspunt is regarded as a <u>pre-colonial</u> cultural landscape, while the landscapes at Duynefontein and Bantamsklip are not regarded to conform to the UNESCO World Heritage definition of "Cultural Landscapes".***

In conclusion, therefore, the impacts on human cultural heritage and landscape will be more significant at Thyspunt than at Bantamsklip or Duynefontein. Human heritage resources at Thyspunt are prolific, although there is still some uncertainty about the nature of the heritage resources in the inland areas, due to the density of vegetation, which prohibited access for the heritage study. Mitigation at Thyspunt will also be a mammoth task and would in all probability require the largest ever heritage mitigation operation in South Africa, which may have an impact on the construction programme for the proposed power station. If the precautionary principle required by the NEMA is applied and it is assumed that the mitigation operation will not necessarily be successful, then Thyspunt would be the least preferred site from a heritage point of view. Even though impacts on archaeological sites at Thyspunt can be mitigated through excavation, the impacts on the cultural landscape cannot be mitigated. This contributes to the conclusion that Thyspunt is the least preferred site from a heritage perspective. If it is assumed that mitigation will be successful at Thyspunt (with respect to archaeological sites), it is the heritage specialist's professional opinion that Thyspunt could be developed with strict conditions relating to excavation and strictly controlled curation of the excavated heritage resources. It would be the SAHRA's decision as to whether the potential impacts (after mitigation including the implementation of the comprehensive heritage mitigation plan) on the heritage resources identified, including cultural landscape, are acceptable or not. The heritage authority would need to take the potential positive impacts of the proposed development, as highlighted by the heritage specialist, into account during decision-making. GIBB's recommendation that the DEA authorise Thyspunt for Nuclear-1 (refer to sections 9.32.5 and 9.32.6 as well as section 10.2.1), is conditional on Eskom undergoing the necessary heritage mitigation plan and obtaining the SAHRA's 'authorisation' in terms of the Heritage Resources Act, 1999 (Act. 25 of 1999).

Table 9-52: Summary of heritage impacts at Duynefontein

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Destruction of Miocene palaeontology	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
1B: Mitigated	*Positive*	*High*	*Low*	*High*	*Low*	*Medium*	*High*	*Medium*
2A: Destruction of Pleistocene archaeology and palaeontology	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
2B: Mitigated	*Negative*	*Medium*	*Low*	*High*	*Low*	*Medium*	*High*	*Medium*
3A: Destruction of Holocene archaeology	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
3B: Mitigated	*Positive*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
4A: Destruction of Colonial Heritage	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
4B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
5A: Destruction of Landscape	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
5B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
6A: Cumulative impacts	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
6B: Mitigated	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*

Table 9-53: Summary of heritage impacts at Bantamsklip

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Destruction of Miocene palaeontology	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
1B: Mitigated	*Positive*	*High*	*Low*	*High*	*Low*	*Medium*	*Medium*	*Medium*
2A: Destruction of Pleistocene archaeology and palaeontology	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
2B: Mitigated	*Negative*	*Medium*	*Low*	*High*	*Low*	*Medium*	*High*	*Medium*
3A: Destruction of Holocene archaeology	*Negative*	*High*	*Low*	*High*	*High*	*High*	*High*	*High*
3B: Mitigated	*Negative*	*High*	*Low*	*High*	*Low*	*Medium*	*Medium*	*Medium*
4A: Destruction of colonial Heritage	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Medium*	*Low*
4B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
5A: Destruction of Landscape	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
5B: Mitigated	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
6A: Cumulative impacts	*Negative*	*High*	*Medium*	*High*	*Medium*	*High*	*High*	*High*
6B: Mitigated	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*

Table 9-54: Summary of heritage impacts at Thyspunt

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Destruction of Miocene palaeontology	*Negative*	*Low*	*High*	*High*	*Medium*	*Medium*	*Low*	*Low - Medium*
1B: Mitigated	*Positive*	*Low*	*High*	*High*	*Low*	*Medium*	*Low*	*Low - Medium*
2A: Destruction of Pleistocene archaeology and palaeontology	*Negative*	*Low*	*High*	*High*	*High*	*High*	*High*	*High*
2B: Mitigated	*Negative*	*Low*	*Medium*	*High*	*High*	*Medium*	*High*	*Medium*
3A: Destruction of Holocene archaeology	*Negative*	*Low*	*High*	*High*	*High*	*High*	*High*	*High*
3B: Mitigated	*Negative*	*Low*	*High*	*High*	*Medium*	*Medium*	*High*	*Medium*
4A: Destruction of colonial Heritage	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Medium*	*Low*
4B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
5A: Destruction of Cultural Landscape	*Negative*	*Medium*	*High*	*High*	*Medium*	*High*	*High*	*High*
5B: Mitigated	*Negative*	*Medium*	*High*	*High*	*Medium*	*High*	*High*	*High*
6A: Cumulative impacts	*Negative*	*Medium*	*High*	*High*	*Medium*	*High*	*High*	*High*
6B: Mitigated	*Negative*	*Medium*	*Medium*	*High*	*Medium*	*Medium*	*High*	*Medium*
7A: Heritage impacts of the Northern Access Road	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
7B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
8A: Heritage impacts of the Western Access Road	*Negative*	*Medium*	*low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
8B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
9A: Heritage impacts of the Eastern Access Road	*Negative*	*Medium*	*Low*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
9B: Mitigated	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*

9.19 Noise impacts

Impacts on noise are dealt with in the Noise Impact Assessment specialist report contained in Appendix E23.

Described in simplest terms a nuclear power station consists of a source of heat provided by nuclear reaction to generate steam that causes the rotation of a steam turbine. The shaft of the steam turbine is coupled to an electrical generator that generates electrical power. Noise that might have a potential environmental impact is produced by the turbines, electrical generators and associated machinery/equipment. No audible noise emanates from the nuclear reactor itself.

To simulate noise that would be produced by the proposed Nuclear-1 facilities, noise measurements were taken from the KNPS. From these measurements, it is evident that the oil cooler fans are the main sources of noise of the entire nuclear power station. However, at a distance of about 375 m from these fans, and within direct line of sight, no noise is perceptible from the cooler fans above the sound of the surf.

Apart from the potential operational impacts, noise will be caused by the construction of new roads and by transport of materials and people to the construction sites.

9.19.1 Duynefontein

(a) Construction noise impacts

No new construction roads would be constructed outside the site and therefore no construction phase impact associated with road construction would occur around Duynefontein.

The impacts of site works, construction and demolition are indicated in **Table 9-55..** This indicates that the noise impact of construction would have a low insignificance at Duynefontein.

(b) Operational noise impacts

The most stringent outdoor noise rating level, according to SANS 10103, would be 45 dBA during daytime and 35 dBA during night-time in a rural residential district. Over unobstructed land the 45 dBA $L_{Aeq,T}$ contour is located approximately 400 m from the oil cooler fans, whereas the 35 dBA $L_{Aeq,T}$ noise contours occurs at approximately 750 m from a noise source. At both ranges noise from the source would be inaudible above the sound of the surf. These distances are well within the 2000 m distant boundary of the Duynefontein site with the R27 (the closest public road).

(c) Transporting of materials to site

With the addition of Eskom traffic the noise impact would remain the same as the current situation. The <u>relative</u> impact due to Eskom construction traffic throughout the first 8 years of the construction period would be low, reducing to negligible thereafter.

(d) Cumulative impacts

With regard to the potential cumulative effect of noise emanating from Nuclear-1 and from Koeberg, the separation distance between the two infrastructure sites would be such that the combined noise may, at most, increase the noise level midway along a line joining the noise sources between the two sites from 30 dBA to 35 dBA. Noise from the Koeberg plant would not influence the levels of noise northwest of Nuclear-1, nor would that from Nuclear-1 influence the levels of noise southeast of the Koeberg plant There would be no difference in noise levels at perpendicular distances, namely, in northeast and southwest directions.

9.19.2 Bantamsklip

(a) Construction noise impacts

The nearest noise sensitive land to the Bantamsklip site is a farm situated more than 2 000 m from the R43 and thus the distance to the nearest source of noise during construction of roads on site. No noise impact due to internal road construction is anticipated at Bantamsklip.

The potential impacts of site works, construction and demolition are indicated in **Table 9-56**. This indicates that the noise impact of construction would have a low significance at Bantamsklip.

(b) Operational noise impacts

The most stringent outdoor noise rating level, according to SANS 10103, would be 45 dBA during daytime and 35 dBA during night-time in a rural residential district. The 45 dBA $L_{Aeq,T}$ contour is located approximately 220 m from each noise. This distance is shorter than at Duynefontein due to greater noise screening provided by the rugged coastline. The 35 dBA $L_{Aeq,T}$ noise contours occur at approximately 700 m from a noise source. At both ranges noise from the source would be inaudible above the surf noise.

The flatter inland terrain provides a similar unobstructed propagation path as the Duynefontein site and noise from the fans would reduce to 45 dBA at approximately the same distance as at Duynefontein, namely 400 m from the fans. It would further reduce to 35 dBA at an approximate distance of 750 m from a noise source. Both distances are well within the shortest distance to the property boundary of 1125 m.

(c) Transporting of materials to site

Existing hourly traffic flow on the R43 past Pearly Beach and the Bantamsklip site is low, with an average daytime flow of the order of 23 vehicles per hour. The distance between the R43 and the nearest Pearly Beach residence is more than 1100 m. The nearest distance to farm residences situated northeast of Pearly Beach is 580 m. In terms of SANS 10103 a "Rural" district would apply to these residences with a typical outdoor $L_{Req,d}$ of 45 dBA.

The calculated $L_{Req,d}$ due to existing, non-Eskom traffic is well below the typical outdoor $L_{Req,d}$ of 45 dBA for a "rural district" and is expected to remain so over the subsequent 9 years. Refer to row 1 of Table 17. The noise impact due to non-Eskom traffic would remain very low. With the addition of Eskom traffic the noise impact would be medium up to the peak construction period. It would reduce to low in the period following peak construction, whereafter it would become very low.

Because of the low volume of non-Eskom traffic flow, the relative impact due to Eskom construction traffic throughout the first 7 years of the construction period would be high reducing to medium in eighth and ninth year. It is anticipated that the high relative noise impact would elicit a strong response from the farm residents. The predicted $L_{Req,d}$ during all years of construction would comply with the NCR 65 dBA limit. No noise mitigation would be required in terms of the NCR.

(d) Cumulative impacts

The results indicate that there would be no potential impact of noise during daytime or night-time on land beyond the Bantamsklip property boundary during operation of Nuclear-1. Thus, whether or not Nuclear-1 was to be located at the Bantamsklip site, would not have any effect on the impact of noise beyond the Bantamsklip property boundary.

9.19.3 Thyspunt

(a) Construction noise impacts

For Thyspunt the nearest noise sensitive land to the proposed eastern access road off the R330 would be an informal settlement near Sea Vista, approximately 3 km from the noise source. No noise impact due to the construction of the eastern access road is anticipated.

Construction of northern and western access roads to the Thyspunt site is proposed initially to be used to transport construction equipment to the site and thereafter for light vehicle access. The northern route would be more than 1 000 m from farm residences along its route. No noise impact is anticipated during the construction of the northern route.

The western route would pass within 230 m of the Umzamowethu township. For continuous operation during 8 hours the $L_{Req,d}$ would be between 56 dBA and 53 dBA at the township boundary. The estimated maximum noise impact on the township for the duration of the construction of the road in the vicinity of the township would be medium. The Oyster Bay residential suburb would be screened from the western route by sand dunes and therefore no noise impact is anticipated during the construction of the western route at Oyster Bay.

The potential impacts of site works, construction and demolition are indicated in **Table 9-40.** This indicates that the noise impact of construction would have a low significance at Thyspunt.

(b) Operational noise impacts

The most stringent outdoor noise rating level, according to SANS 10103, would be 45 dBA during daytime and 35 dBA during night-time in a rural residential district. The 45 dBA $L_{Aeq,T}$ contour would occur approximately 400 m from each noise source (oil cooler fans) with the 35 dBA $L_{Aeq,T}$ noise contours occurring at approximately 750 m from the noise source. The nearest eastern property boundary along Thyspunt Beach would be 700 m from the infrastructure site. With reference to Section 3.1.3, the noise emanating from Nuclear-1 would not be audible above surf noise at this distance. The nearest residential land would be Oyster Bay situated 4.2 km from the site. No noise from Nuclear-1 would be audible at that distance.

It is considered probable that a 50 MW Open Cycle Gas Turbine peaking power plant proposed for the Thyspunt site would result in a noise impact on residences situated within 1 000 m of the plant. It is recommended that this be confirmed by a noise prediction study once quantitative noise emission data of the actual plant to be installed becomes available. Any required noise mitigation procedures would flow from the results of that study.

(c) Transporting of materials to site

An estimate of the traffic to the Thyspunt site during a nine year construction period was made available by Eskom. It was construed that this traffic to the Thyspunt site would be via the R330 and the eastern site access. The R330 south of Humansdorp passes through mainly undeveloped land, excepting for a few residences on the south bank of Kromrivier, of which the nearest is located some 20 m from the R330 and a large informal settlement west of Sea Vista that extends to 10 m from the road edge. Other than a residence at 40 m, all other residences are located 70 m or more from the road edge.

The results of the calculations indicated that the existing, non-Eskom traffic causes and will continue to cause a medium potential noise impact with reference to an “urban district” during the following nine years. However, the existing and future $L_{Req,d}$ would comply with the 65 dBA limit. With the addition of Eskom traffic the cumulative noise impact would be high throughout the construction period. The combined road traffic would cause the noise level to exceed the 65 dBA limit contained in the NCR, necessitating noise mitigation procedures to be implemented. However, the situation has arisen due to the uncontrolled use of land typical of informal settlements. It may well be debated whether the onus for compliance with the NCR would rest with Eskom.

(d) Cumulative impacts

The results indicate that there would be no potential impact of noise during daytime or night-time on land beyond the Thyspunt property boundary during operation of Nuclear-1. Thus, whether or not Nuclear-1 was to be located at the Thyspunt site, would not have any effect on the impact of noise beyond the Thyspunt property boundary.

With the removal of the proposed OCGT peaking power plant from the HV Yard and its placement in the power station complex, it will no longer have a noise impact of high intensity on occupants of a farm situated immediately to the east of the proposed HV yard. In the absence of the OCGT plant there would be no potential cumulative impact at this farm.

9.19.4

9.19.5 Mitigation

The results of the noise study indicate that there would be no potential noise impact on land surrounding any of the three sites during construction and operation of Nuclear-1***, with the exception of the western access road to the Thyspunt site. This road would pass within 230 m of the Umzamowethu township. In the latter instance the following recommendations are made:***

- ***Construction processes and machinery/vehicles with the lowest noise emission levels available are utilised;***
- ***A well planned and co-ordinated "fast track" procedure is implemented to complete the total construction process in the shortest possible time; and***
- ***Construction work near residences only takes place during normal daytime working hours.***

Where road construction is to take place within approximately 500 m of residences, the intensity of noise impact can be reduced by selecting construction vehicles/machinery with low noise emission levels. The significance of the potential impact can be reduced by minimizing the total construction time.

Little can be done to reduce the levels of noise emitted by abnormal load vehicles. The human subjective response to such noise is likely to be minimised by prior knowledge that exposure to such noise will be infrequent, on which day/night it will occur and the duration of the exposure. It is therefore recommended that residents must be informed prior to any such transportation taking place.

9.19.6 Conclusion

The vast majority of the potential noise impacts are of low or very low significance. There would be no potential noise impact on land surrounding any of the three sites during construction and operation of Nuclear-1. No noise mitigation measures would therefore be required.

It is probable that the OCGT peaking power plant proposed for Thyspunt would result in a noise impact on residences situated within 1 000 m of the plant. It is recommended that this be confirmed by a noise prediction study once quantitative noise emission data of the actual plant to be installed is available. Any required noise mitigation procedures would flow from the results of that study.

No noise impact associated with the construction of new roads to the alternative sites is anticipated, excepting the western access road to the Thyspunt site that would pass within 230 m of the Umzamowethu township.

In view of the conclusion that no noise mitigation measures are required, only impacts without mitigation are reflected in these tables.

Table 9-55: Significance rating for noise impacts at Duynefontein (all impacts without mitigation)

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Noise impacts of oil cooler fans during operation	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
2A: Noise impacts of road construction	***Negative***	***Low***	***Medium***	***Medium***	***Low***	***Low***	***Low***	***Low***
3A: Noise impacts of site works and construction	***Negative***	***Low***	***Medium***	***Medium***	***Low***	***Low***	***Low***	***Low***
4A: Impact of transportation noise	***Negative***	***Low***	***Medium***	***Medium***	***Low***	***Low***	***Low***	***Low***

Table 9-56: Significance rating for noise impacts at Bantamsklip (all impacts without mitigation)

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Noise impacts of oil cooler fans during operation	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
2A: Noise impacts of road construction	***Negative***	***Low***	***Medium***	***Medium***	***Low***	***Low***	***Low***	***Low***
3A: Noise impacts of site works and construction	***Negative***	***Low***	***Medium***	***Medium***	***Low***	***Low***	***Low***	***Low***
4A: Impact of transportation noise	***Negative***	***Medium***	***Medium***	***Medium***	***Low***	***Medium***	***Medium***	***Medium***

Table 9-57: Significance rating for noise impacts at Thyspunt (all impacts without mitigation)

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Noise impacts of oil cooler fans during operation	*Negative*	*Low*	*Low*	*High*	*Low*	*Low*	*Low*	*Low*
2A: Noise impacts of road construction	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
3A: Noise impacts of site works and construction	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Low*	*Low*
4A: Impact of transportation noise 10m from the R330	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
5A: Impact of transportation noise 70m from the R330	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
6A: Impact of the OCGT plant on adjacent farms	*Negative*	*High*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*
6A: Impact of the OCGT plant farms within 1000m	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*
6A: Impact of the OCGT on residences farther than 1000 m	*Negative*	*Low*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*

9.20 Impacts on tourism

Impacts on tourism are dealt with in the Tourism Impact Assessment specialist report in Appendix E22.

The following section describes the economic ramifications of the various identified potential impacts on the tourism industry at each site. The assessment is summarised in **Tables 9-43 to 9-45** below.

9.20.1 Duynefontein

The tourism industry around the Duynefontein site shows a dynamic and growing sector with most of this growth occurring since the opening of the KNPS in 1976. In other words, the tourism sector in the Koeberg-Duynefontein area has grown and has attracted a number of up-market developments such as golf estates, despite the presence of Koeberg.

The tourism industry in the area also did not express any particular concerns regarding the construction of a second nuclear power station. This is indicative of the dynamic and adaptive nature of the tourism industry. The longer a community or tourism product is allowed to acclimatise to the proximity and function of a nuclear power station, the more integrated the tourism industry becomes with it.

As the greater Cape Town area is a large tourism base to start with, the positive impact of the influx of business tourists and the required extended stays of specialists, engineers and consultants during construction and operation of Nuclear-1 is relatively small as indicated in the hospitality systems row. This influx, along with significant presence of the extensive on-site labour force, will also initially change the social amenity of the area. Site works and traffic during construction, and the associated inaccessibility relating to safety and security, will result in a reduced terrestrial asset. However, as there are no viable commercial or tourism-orientated marine activities off the proposed site, there is no loss in marine asset. It is expected that, during normal operation, the social amenity of the area will return to the pre-construction equilibrium as the community adapts and acclimatises to a second nuclear power station. This has been demonstrated before through the KNPS experience. Moreover, with the opening of further nature reserve areas to tourists, the terrestrial asset loss from the construction phase will also be mitigated.

It is unfortunate that data on the potential impact of construction of the KNPS on the local tourism industry, and especially on the effect of the influx of white-collar workers on bed-nights, were not recorded at the time. It is logical to assume that the effect must have been substantial, and also that business visitors from out of town during the operational period must have contributed to the increased sale of bed-nights in the area. This was certainly the impression gained during field interviews. It must again be stressed that the growth of Melkbosstrand and environs (including Atlantic Beach Golf Estate and other upmarket housing and leisure developments) has occurred subsequent to the construction of the KNPS.

Seasonality is of some concern as during peak periods of tourism activity in the greater Cape Town area (Christmas and New Year) and the West Coast (school holidays and the spring flower period), there is heavy congestion on major routes across the area. This is compounded by the fact that public transport in Cape Town and the province as a whole is minimal, thus forcing commercial travelers and tourists to hire vehicles.

Furthermore, as the Duynefontein area falls within the northern access and growth corridor of Cape Town, and forms part of the primary transport route to the West Coast (which is the third most popular region for domestic tourists after the Cape Peninsula and the Garden Route), congestion and road access need to be considered, particularly during nuclear power station construction.

A Nuclear-1 facility, together with the training centre on the Duynefontein site is likely to have a negligible impact on tourism as the sensitivity levels of residents and visitors are tempered by the presence of the existing KNPS which has not deterred the growth of upmarket residential areas and leisure resorts to the south and north of the site. The Visual Impact Assessment supports this by documenting a low impact of change in the sense of place as the KNPS has already changed the desolation and remoteness of the location. The majority of impacts will be absorbed into the Greater Cape Town tourism sector. However, as alluded to earlier in this sub-section, business tourism (in the form of visits by engineers, technicians and other specialists) in Duynefontein will increase during construction and, to a lesser extent, during operation. The enlarged exclusion zone will affect the amount of available land and the accessible sea area, but only to a small degree, and the enlarged reserve area will promote the environmental preservation ideals of the Integrated Development Plan and the Integrated Tourism Development Framework.

Of all the sites, though, the conceivable impact of the sea-level rise scenario and storm frequency will be most severely experienced at Duynefontein. The postulated effects are most prevalent at this site mainly due to its topographical character. A shallow seabed gradient and low coastal contour make the proposed nuclear power station platform site the most exposed in terms of potential sea-level rise. Consequently, not only would the proposed nuclear power station platform require considerable protective construction measures, but the severity of associated storm damage, flooding and land, property and tourism asset loss would be likely to be exacerbated more than at the other sites. Affected areas would include Blaauwbergstrand, Melkbosstrand, Milnerton, Sunset Beach and Table View. The impact of a nuclear power station on tourism in the sea-level rise scenario then becomes almost a moot discussion. However, it is conceivable that the impact would be even further reduced than at all the other sites as the extent of damage and loss to the local terrestrial tourism asset and the value thereof within the Greater Northern Cape Town tourism region would be of such magnitude that all reconstruction and tourism development efforts would incorporate the pre-existence of a nuclear power station, as has occurred already, for example, in Melkbosstrand in relation to Koeberg.

9.20.2 Bantamsklip

The community in the Bantamsklip area expressed concern with regard to adverse visual impacts of the nuclear power station and transmission lines. A nuclear power station at Bantamsklip would be visible from Pearly Beach and Dyer Island but not from Gansbaai. Concerns with regard to a perceived negative social impact of migrant construction workers were also mentioned. An additional concern was raised relating to the impact of heavy-vehicle traffic during the construction period on local roads. These roads are not built for such traffic, and it was felt that there would be a need for strict control both over the routes to be used and over noise pollution from heavy vehicles which could be a factor in Gansbaai with potential negative impacts on tourism.

The national, provincial and local tourism policy issues mentioned in Section 4.1 of the Tourism Impact Assessment apply here to the greater region in which Bantamsklip is situated. Of specific relevance to this site, the Integrated Development Plan for the local municipality, states that the district, with its largely rural character and high dependence on agriculture and tourism, is hugely reliant on the natural environment for its existence. Tourism is further emphasised as a priority building block for economic development in the area. In terms of the study area, the smaller holiday towns in the vicinity of Gansbaai are regarded by the IDP as having little or no potential for development outside of housing and recreation.

Due to the small-scale base of the industry, the relatively undeveloped infrastructure and the basic nature of tourism services, along with the current heavy reliance on shark and whale tourism, the Bantamsklip tourism economy is expected to experience a large expansion in facilities, from increases in restaurants to increases in the number of private houses being let out, as a result of the construction and operation of a nuclear power station. The immediate increase is expected to continue as the community services the influx of nuclear power station staff and their associated needs and spending. This also mitigates local concerns about seasonality: the local tourism service industry is dependent on holiday peaks around Christmas and Easter for its financial survival, but a higher local permanent population and influx of personnel from a nuclear power station could stabilise the industry. However, the influx of labour during construction and staff during operation will change the current social amenity of the area.

Road infrastructure is specifically identified by the Integrated Tourism Development Framework as an important element in realising the tourism potential of the Bantamsklip area. Most notably, to the west of Pearly Beach and Gansbaai, the traveller encounters gravel roads of varying quality. These roads are the “missing links” in tourism flows from the Cape Metropole to Cape Agulhas, and act as a barrier to the development of tourism in the region and a deterrent to the average tourist. As a result of a nuclear power station, there will be considerable improvement of general road access in the area and an acceleration of the broader opening of the Agulhas and Bredasdorp corridors, further encouraging access and improving local tourism traffic.

However, as a result of the required exclusion zone that surrounds a nuclear power station, there will be a loss in the marine assets along the owner-controlled boundary. Of the three proposed alternative Nuclear-1 sites, Bantamsklip has the most locally significant marine tourism asset offshore of the site, and access to the whale-watching area will be reduced, especially during construction. Information from Eskom is that the exclusion zone will extend for 1 km along the shore and 1km out to sea. The shark-cage diving and whale-watching tourism industries in the Bantamsklip area are of such dominance and importance to local tourism and the local economy that they are worthy of specific attention.

The significance of 'Shark Alley', the open stretch of water between the mainland and Dyer Island off Gansbaai, is indicated by the fact that it is popularly referred to as the White Shark Diving capital of the world. There are currently two licensed whale-watching and eight licensed white shark cage-diving operators conducting tours within the sphere of direct nuclear power station influence. Shark-cage diving occurs mainly around Dyer Island while 80 % of whale-watching trips are undertaken to the west of the trawler wreck in the Bantamsklip exclusion zone. Thus, the impact will principally be on whale-watching but, as the marine exclusion zone is expected to be only 1km in extent, this will be not directly affect more than 10 % of current activities which would then have to move to the larger area. An even lesser potential impact is possible if Eskom is successful in applying (as it has indicated to the authors that it intends doing) for permission to allow access for whale-watching trips.

Moreover, according to the Marine Ecology Impact Assessment (Appendix E15 of this Revised Draft EIR), no negative impacts of a nuclear power station are expected at Bantamsklip on the Great White sharks and Southern Right whales (especially in terms of disposal of spoil, abstraction of cooling water, release of warmed cooling water, and potential radiation emissions).

Nature–based tourism in the Bantamsklip area is related mainly to the Agulhas National Park run by South African National Parks (SanParks) and Grootbos Private Nature Reserve. Agulhas National Park extends from Cape Agulhas to the border of the nuclear power station site. Grootbos serves the 5-star lodge market and also specialises in eco-tourism and conservation education. Nature-based tourism is not expected to be adversely affected by a nuclear power station. The experience of the nature reserve around Koeberg shows that eco-tourists are not detracted by the presence of a nuclear power station, and it is the policy of Eskom to maintain and expand the existing nature reserve around the power station site. There are significant opportunities for Eskom to work together with Grootbos and SanParks in developing and marketing the local tourism product for the Cape Floristic Region.

A concern for local holiday and residential communities (e.g., Pearly Beach) around Bantamsklip is that of the potential visual impact. The Visual Impact Assessment states that there will be a high level of visual intrusion and potential impact. The proposed Bantamsklip platform is a dominant feature on mostly flat landscape. The result is high visual intrusion in terms of visual contrast and direct line of sight for areas both east and west of the site. The high potential visual impact on high-quality scenic views emphasises the effect on the sense of place with the landscape setting being irrevocably changed. There is also a high level of light pollution because of the absence of other conspicuous light sources.

This could affect the immediately foreseeable demand for property and the decision to visit the area. Directly affected communities such as Pearly Beach consist predominantly of holiday-house owners, some of whom could perceive the effects of the nuclear station on their sense of place to be so adverse that they would in all likelihood attempt to sell their properties. However, they are likely to be replaced by new owners (including staff of Nuclear-1) who would be buying into the affected sense of place and environment, thereby adjusting the sense-of-place impact over the operational phase of the nuclear power station.

The Bantamsklip area is likely to experience an immediate and perceptible boost in tourism infrastructure and an increase in both the local resident population and business visitors. The resultant increase in bed-nights sold would have a stimulating effect on what is at present a relatively small albeit growing tourism market. In the long-term the wider effects of Nuclear-1 should also be positive. Although whale-watching might be restricted (unless permits are granted) in the zone adjoining the Nuclear-1 site, this appears to be mitigable by being moved to the larger area of the bay. Moreover, in that the natural resources and nature attractions of the site are currently inaccessible to tourists, the opening of the reserve areas that surround the proposed nuclear power station would result in an increased terrestrial asset to leverage wider tourism for the area as a whole. This would be important in the light of eco-tourism being identified in the local municipality’s IDP as one of the main economic and social development strategies for the future of the area.

In terms of the sea-level rise scenario potential impacts on the local Bantamsklip area, induced by climate change, there are a number of considerations for tourism. First, as in the case of the Thyspunt site, the sea-level rise scenario at Bantamsklip would cause considerable loss of property and coastal land along with infrastructure damage e.g., roads, utilities, etc. However, the topographical nature of the Bantamsklip coastline, with elevated rock contour at the location of the terrestrial tourism developments such as the residential areas and holiday villages (De Kelders, Gansbaai, Kleinbaai, Franskraal, Pearly Beach, Buffeljagsbaai and Die Dam) suggests a lesser impact than that postulated for the Thyspunt tourism industry. This is also supported by the fact that the Bantamsklip area has a less developed general tourism infrastructure, mitigating the extent and cost of comparative plausible damage.

Secondly, according to the Marine Biology Specialist study, the identified sea-level change possibilities and storm frequencies will not affect local marine wildlife, specifically whales and sharks. However, marine-based tourism is weather dependent as tourist charter boats and other recreational watercraft cannot safely operate in storm conditions, and this could affect these activities. So as far as Nuclear-1 is concerned, as with Thyspunt, the identified platform at Bantamsklip is outside a 2.5 m sea-level rise scenario. Thus, these two considerations outlined above are independent of whether there is a nuclear power station or not: Nuclear-1 would not affect climate change and climate change would not influence the impact of Nuclear-1 on tourism.

9.20.3 Thyspunt

Although the Economic Impact Specialist Report (**Appendix E17**) states that the business sector (including organised agriculture) is in favour of the construction of Nuclear-1 at Thyspunt, there is an active and organised lobby of residents who are strongly opposed to the idea. This group believes that the area’s sense of place will be invaded and that lifestyles and tourism will be affected by the visual impact of the nuclear power station and the transmission lines which will need to be built. There is a wider concern within the community as a whole (including the business sector) about the possible negative social effects arising from the influx of relatively unskilled workers during the construction phase. The point was made that, in the recent past, the construction of the harbour at Port St. Francis was supposed have been undertaken by local labour but it was in fact undertaken by migrants from the Ciskei and Transkei who remained in the area afterwards, leading to a growth of informal housing, which has detracted from the up-market and affluent nature of the rest of the area.

With regard to tourism policies relevant to Thyspunt, the Eastern Cape Tourism Board (ECTB) has the stated priority of protecting and upgrading the diverse natural environment that serves as a core tourism attraction in the province. The primary identified method of achieving this priority is to expand the area with long-term conservation status. This would entail not only expanding the area under control of nature conservation bodies but also encouraging the expansion of conservation areas under private management. The ECTB further recognises that the need for land with conservation status should be balanced with the need for other land uses.

The associated nature reserve and marine exclusion zones of a nuclear power station could arguably fulfil the conservation priorities and strategies of the ECTB, However, according to the Visual Impact Assessment, the remote sense of place of the Thyspunt site, the high impact on the sense of place and high visual intrusion do undermine the positive impacts on potential tourism development (although in terms of light pollution at night, a nuclear power station would have a lower impact than the lights of the chokka boats). Nonetheless, the positive impact of environmental exclusion zones is lessened at the Thyspunt site as the area has been protected from all forms of utilisation for over a decade (Marine Environmental Specialist Report).

In terms of climate change considerations, the greater Thyspunt tourism product has already experienced storm damage in the form of beach erosion and extensive flooding, most significantly in St. Francis. However, the proposed nuclear power station construction site is located beyond the parameters of a 2.5 m sea-level rise scenario and will not be affected. But, if the wider coastal tourism asset of Thyspunt (including Oyster Bay, St Francis Bay, Cape St Francis and Port St Francis) is considered, the rise in sea-level could conceivably result in severe damage to the tourism attractions, facilities and general infrastructure, thereby resulting in extensive property, land and natural environment loss. The tourism asset and product of the area would then have to undergo massive reconstruction and rebranding which could incorporate the existence and operation of a nuclear power station, as is exemplified by current tourism initiatives surrounding Koeberg. The existence of a nuclear power station, though, would not affect climate change or its impact on tourism.

From a tourist perspective, the discerning visitor might choose not to visit the Thyspunt area and the eastern section of the Garden Route as a result of the construction and operation of a nuclear power station, as reflected through the loss in sense of place. However, any associated short-term reduction in the number of leisure tourists would be expected to be offset by the associated growth in the local population brought by Nuclear-1 that would increase the local demand for tourism-related services such as restaurants and accommodation. There would also be increased business tourism with specialists and consultants being brought in, especially during the construction phase, although an influx of construction labour and nuclear power station staff would alter the current social amenity of the area. Bed-nights sold to business visitors would help to offset the loss of traditional leisure tourists.

Despite the likelihood of a loss in traditional holiday tourism being offset by the growth of business tourism, it is predicted that there would be a negative impact during construction and a neutral impact during operation. A cautious approach has been taken in making this assessment, placing emphasis on the short-term effects of a change in the nature of the tourism product and hence on the image and brand of the St. Francis area. The fact is that there will be a dramatic change in the tourism product from that of an isolated, premium recreation and destination area, and therefore it may be expected that there will be a transition in adjusting perceptions on the part of the existing market.

However, the desertion of the area by leisure tourists is not likely to extend into the operational period of Nuclear-1 once its benign nature is realised. Road access would improve, particularly to Oyster Bay, and although a portion of natural assets would be lost to the station, overall access would be improved to more remote areas associated with the nuclear power station property.

The seasonal nature of tourism in the area could lead to congestion, crowding and limited access, particularly during the construction phase of a nuclear power station as tourists would be competing with construction staff and vehicles for local services and facilities. Eskom has advised the authors that construction would continue throughout this peak tourism period. However, these effects could be mitigated if construction is halted for the customary labour holiday period from 16 December until early January. Ultimately, the current marketed tourism brand and image of the area will change in nature, and an associated loss of sense of place will be experienced.

9.20.4 Mitigation

The main mitigation measure is a community-orientated and comprehensive public relations campaign to address popular misconceptions, specifically the impacts of nuclear power generation on the marine and immediate environment. An expressed and comprehensive integration of the relevant tourism agencies and organisations into Eskom's nuclear intentions and activities at each site, will facilitate a timely adaptation of the destination marketing and tourism branding initiatives, thereby expediting the acclimatisation of each site's tourism products and destination image toward the potential new nuclear environment; as emphasised by the commercial buy-in and stakeholder support experienced for Koeberg.

9.20.5 Conclusion

The Thyspunt and Bantamsklip communities have expressed the most adamant opposition to the proposed nuclear power station. The Thyspunt community has expressly highlighted the premium nature of the top-end coastal vacation destination, and the Bantamsklip community has emphasised the new and fragile nature of the developing tourism product and the local dependence thereon. ***The difference in size and type of tourism at these two sites explains why the short-term impact at Thyspunt is shown to be negative. A loss of some of the current holiday market might not be entirely offset by the growth of business tourism at Thyspunt, whereas business tourism is likely to significantly increase the size of the smaller market at Bantamsklip.***

While some Duynefontein tourism stakeholders have personal objections to the construction and operation of another nuclear power station, they recognise the potential for increased business and promote a generally positive outlook for tourism.

A weighted matrix of potential tourism impacts was set up and annual values of the indicative impacts on tourism were calculated using the bed-night figures. A summary is depicted in **Table 9-43**.

Table 9-58: Indicative tourism impacts in terms of bed nights[14]

Site	Current Tourism Value (Rands)	Construction Phase (yrs 1-6)		Operational Phase (yrs 7-20[15])	
		Annual Impact (Rands)	Impact (%)	Annual Impact (Rands)	Impact (%)
Duynefontein	497,827,951	0	0.00%	7,111,828	1.43%
Bantamsklip	62,247,100	3,112,355	5.00%	5,335,466	8.57%
Thyspunt	77,745,000	-6,108,536	-7.86%	0	0.00%

As can be seen from this table, it is predicted that there would be very little potential impact at Duynefontein during construction, Bantamsklip is predicted to experience a 5 % positive impact during construction and Thyspunt is predicted to experience a 7.86 % negative impact on tourism.

During operation, Duynefontein is predicted to experience a 1.43 % improvement in tourism, Bantamsklip is predicted to experience an 8.57 % improvement and Thyspunt is predicted to experience zero potential impact.

[14] These figures indicate the potential net effect, taking into account a potential decrease in nature-based tourism as well as an expected increase in business tourism.

[15] Although the operational life of the proposed power station is 60 years, the tourism impact assessment has predicted up to a 20 year margin. This is because prediction of predicting tourism trends and impacts in the decommissioning phase 60 plus years into the future is not feasible. Prediction more than 60 years into the future could result in misleading or inaccurate information.

The rapid growth of the tourism sector in the area near the KNPS since the opening of that nuclear power station suggests that tourism and a nuclear plant can coexist comfortably. Similar experiences have occurred in Europe. There is therefore no long-term South African evidence to indicate why a similar state of affairs should develop around the Bantamsklip and Thyspunt sites. The fears of the tourism industry in those two areas are likely to be allayed once the proposed Nuclear-1 plant is in operation.

However, the temporal and dynamic nature of the tourism industry is re-emphasised, as it must be acknowledged that there could be potential shorter-term negative impacts on the current public perception of the established tourism "sense of place". This could lead to an associated impact on the nature and extent of the tourism product and attractions as they currently exist. Conceptually, these perceptions are adaptive over time, as evidenced in the KNPS experience, where surrounding communities and tourism industries such as Melkbosstrand, Blaauwberg, Atlantic Beach and Big Bay evolving into a longer-term integration of mutual proximity and acclimatisation to the presence of a nuclear power station.

In summary, the impacts on tourism at the alternative three sites are expected to be as follows:

- ***<u>Duynefontein</u> – the proposed power station would be most easily absorbed into the local tourism economy. All impacts are predicted to be of low significance with and without mitigation. There would be no short-term discernible impact on tourism and there is expected to be a small-scale, long-term discernible positive impact on tourism.***
- ***<u>Bantamsklip</u> – It is predicted that there would be a small-scale, short-term and long-term positive discernible impact on tourism. The majority of the impacts at Bantamsklip would be of medium significance, with and without mitigation, and there would be an impact of high significance on visual amenity, without mitigation (and medium significance with mitigation); and***
- ***<u>Thyspunt</u> – it is predicted that there would be a small-scale, short-term, negative discernible impact on tourism but no overall discernible long-term impact on tourism once the tourism market gets used to the presence of a nuclear power station (as has happened at the KNPS). The majority of the impacts at Thyspunt would be of medium significance, and there would be an impact of high significance on sense of place, without mitigation (and medium significance with mitigation).***

Thus, holistically speaking, the impacts of highest negative significance would occur at Thyspunt and Bantamsklip, whilst very relatively small positive and negative impacts are predicted at Duynefontein.

Table 9-59: Summary of Tourism Impacts for the Duynefontein site

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Impact on hospitality systems	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Medium*	*Low*
1B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Medium*	*Low*
2A: Impacts on general infrastructure used by tourists	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*
2B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*
3A: Impact on visual amenity enjoyed by tourists	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*
3B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*
4A: Impact on sense of place from tourism point of view	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*
4B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*
5A: Impact on marine assets used by tourists	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*
5B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*
6A: Impact on social amenity	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*
6B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*
7A: Impact on terrestrial assets used by tourists	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*
7B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*

Table 9-60: Summary of Tourism Impacts for the Bantamsklip site

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A; Impact on hospitality systems	*Negative*	*High*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
1B: Mitigated	*Negative*	*High*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
2A: Impacts on general infrastructure used by tourists	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
2B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
3A: Impact on visual amenity enjoyed by tourists	*Negative*	*High*	*Medium*	*Medium*	*Medium*	*High*	*High*	*High*
3B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*High*	*Medium*
4A: Impact on sense of place from tourism point of view	*Negative*	*High*	*High*	*High*	*Medium*	*High*	*High*	*High*
4B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*High*	*Medium*
5A: Impact on marine assets used by tourists	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
5B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
6A: Impact on social amenity	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
6B: Impact on social amenity (mitigated)	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
7A: Impact on terrestrial assets used by tourists	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
7B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*

Table 9-61: Summary of Tourism Impacts for the Thyspunt site

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Impact on hospitality systems	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
1B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
2A: Impacts on general infrastructure used by tourists	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Low*
2B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Low*
3A: Impact on visual amenity enjoyed by tourists	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*High*	*Medium*
3B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*High*	*Medium*
4A: Impact on sense of place from tourism point of view	*Negative*	*High*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
4B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*High*	*Medium*
5A: Impact on marine assets used by tourists	*Negative*	*Low*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Low*
5B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*
6A: Impact on social amenity	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
6B; Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
7A: Impact on terrestrial assets used by tourists	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*
7B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*

9.21 Impacts on agriculture

Impacts on agriculture are dealt with in the Agricultural Impact Assessment specialist report in Appendix E21.

There is existing agricultural production around all three sites. The types of agricultural production differ markedly, with the area around Duynefontein being characterised by mixed farming, although wheat and grape farming dominate. Milk farming dominates around Thyspunt and fynbos flower farming predominates around Bantamsklip. The latter is also characterised by some dairy farming, beef, sheep and game farming.

The impacts of a nuclear power station on farming activities at all three alternative sites can take several forms, as follows:

- Road congestion (negative);
- Dust deposition on crops (negative);
- Impacts on the job market (negative);
- Stimulation of the agricultural economy (positive); and
- Impacts of crop and livestock production in the event of a nuclear accident (negative).

(a) Road congestion

Construction of the nuclear power station may result is some congestion on local roads due to the large amount of building materials that will be brought into the site. This increased traffic is likely to have some impact on the local farmers because they transport produce to market on a daily basis. The impact on transport systems is assessed in Section 9.24 of this report and will not be discussed here.

(b) Dust deposition

Dust deposition on crops during construction, both in close proximity to the construction site the site and along dirt access roads. It is expected that, as a result of the large amount of transport involved in construction, there will be a certain amount of dust generated over an extended period. Dust in the air or deposited on plant foliage will reduce photosynthesis in the plants. Reduced photosynthesis will mean less energy for growth and lower crop yields.

The amount of dust will depend to a great degree on the surface of the roads[16]. If access roads are mainly dirt roads, a considerable amount of dust will be generated, which is not desirable in a farming operation. This is especially so where fresh produce like milk and vegetables are produced around the Thyspunt and Bantamsklip sites, but also around the Koeberg site where grapes are an important fresh product.

(c) Impacts on the job market

Impacts on the agricultural job market may occur through the influx of job seekers during the construction phase. Construction jobs generally pay higher wages than farm work, which results in demands for higher wages in farm communities and a move away from farm work to construction work and a shortage of labour in the agricultural sector. It must be noted that the Social Impact Assessment found that the personalities and lifestyle of farm workers very different to those of construction workers, to such an extent that competition is unlikely to occur on any significant scale. If this impact does occur, its duration would be of short-to medium-term as it would mainly be felt mainly during the construction phase of the

[16] The air quality report recommends that construction roads must be tarred and that an air quality management plan must be implemented to mitigate dust emissions from roads.

development, and would only continue until labour from other areas moves into the affected areas to fill the vacuum left by labourers who move into construction.

(d) Stimulation of the agricultural economy

A nuclear power station will increase the market demand of local agricultural production in the area of the proposed sites, due to an influx of construction personnel, job seekers and operational personnel. This potential impact could be negated to some extent by the perceived consumer concern of produce grown in the proximity of a nuclear plant. During normal operation of the nuclear plant this perception has no scientific basis (**Table 9-46**) but could be a short-term impact until the consumer becomes more knowledgeable about the environmental impacts of a nuclear plant on agricultural production. It is important to note however that agricultural activity occurring in the proximity of Koeberg for many years has had no negative impacts on the environment.

Notwithstanding the above, an estimate has been made of the potential market increase for each site, given the potential to increase agricultural production in each area. This estimate is based on the potential of a region to increase its agricultural production as a result of increased demand within the region. If the region is not able to increase production then the increased production to meet the demand will come from another region.

(e) Impacts of crop and livestock production in the event of a nuclear accident

Radionuclides released from the nuclear power station may accumulate in crops and livestock, if emitted at high concentrations. The findings of the air quality assessment (reflected in **Section 9.15** of this report) found that the maximum predicted doses of µSv/ annum under normal operating conditions for the three sites and two different engineering designs for a nuclear power station will be as indicated in **Table 9-62**.

Table 9-62: Maximum Inhalation and External Effective Dose of radionuclides

Site	Effective Dose (µSv/annum)	
	EPR	AP1000
Duynefontein	4.07	2.56
Bantamsklip	4.60	2.19
Thyspunt	11.31	4.56

The annual effective dose limit for members of the public from all authorised actions is 1 000 µSv, with an additional provision of an annual dose constraint of 250 µSv. The highest predicted inhalation and external effective dose of 11.3 µSv is therefore about 4.5 % of the dose constraint and about 1 % of the annual effective dose limit. Accumulation of radionuclides during normal operation of the nuclear power station will therefore be negligible to non-existent. It is only in the event of a nuclear emergency that significant radionuclide accumulation could occur in livestock. Whilst this impact could have a high consequence in the event of an emergency, the probability of such an impact is very low.

During the decommissioning phase, impacts on livestock and crops should be similarly low. Eskom has provided a decommissioning plan for the nuclear power station with Koeberg as the basis. The plan is based on the United States Nuclear Regulatory Commission (US NRC) “Decon” alternative.

Given this the exposure to radiation would therefore be kept to a minimum and below the required dose stipulated by the National Nuclear Regulator (NNR) through continued radiation measurement. Since these dose limits are based on safe exposure levels, it is expected that the radiation exposure during decommissioning would be low. Therefore decommissioning operation of the reactors should not affect livestock producers or their livestock or livestock produce in any substantial way.

Since this impact is predicted to be of no significance during construction, operation or decommissioning, it is not discussed further under the individual sites.

9.21.1 Duynefontein

(a) Dust deposition

The coastline at Koeberg lies north-west to south-east, and therefore dust from construction during summer will mainly affect beaches. The south-westerly winds are associated with rain which will settle the dust and therefore reduce dust depositions on farms inland of the coast. ***Dust deposition at this site will be less than at either of the other two sites, as the majority of the roads around the site are already tarred.***

(b) Impacts on the labour market

Labour-intensive farming activities such as grape harvesting (which occurs in the Duynefontein environment) may be negatively impacted during the construction phase when local labour costs, mainly for unskilled persons, will increase because of demand for labour. However, given the location of the site at the edge of a large urban area, it can be assumed that the impact on the agricultural labour market will be less serious than at the other two sites, due to the demands from other economic activities that have been active in this area for several decades. As apparent from the social impact assessment, this potential impact is expected to be of low significance.

(c) Stimulation of the agricultural economy

It is estimated that there would be no stimulation of the agricultural sector around Duynefontein. The site is adjacent to an expanding urban area and any possible stimulation of agricultural production would probably be negated by urban expansion, which reduces the available agricultural land.

9.21.2 Bantamsklip

(a) Dust deposition

The risk of dust during construction will be highest at Bantamsklip, where farming mainly involves harvesting of flowers from fynbos grown under dryland conditions. Dust on leaves of perennial fynbos plants will result in some loss of photosynthetic activity and reduced flower yields, apart from the fact that dust-covered cut flowers will not be able to suitable to sell. ***Dust deposition will be limited to a short period (less than 3 years) whilst the access road to the site is tarred during the initial construction period.***

(b) Impacts on the labour market

Labour-intensive farming activities such as flower harvesting (which occurs in the Bantamsklip environment) may be negatively impacted during the construction phase when local labour costs, mainly for unskilled persons, will increase because of demand for labour. However, as apparent from the social impact assessment, this impact will be of low significance.

(c) Stimulation of the agricultural economy

The agricultural economy around Bantamsklip would not be significantly stimulated, since the main limiting factor for agricultural production in this region is the scarcity of irrigation water. In addition to this, the current agricultural production is heavily based on flower production, which is a form of production that will not necessarily be stimulated by a nuclear power station. The resultant predicted increase in agricultural production is estimated at less than 5 % (R29 million per annum).

9.21.3 Thyspunt

(a) Dust deposition

At Thyspunt the pastures of most farms used for dairy production are too far downwind of the proposed nuclear power station, and are therefore not likely to be impacted by dust. The farms Welgelegen, Penny Bee and Buffelsbosch may encounter some loss of fodder production due to dust. In summer the prevailing wind at Thyspunt (Cape St. Francis) is mainly off-shore, thus farms will be upwind from the construction dust generated at the coast. ***Dust deposition will be limited to a short period (less than 3 years) whilst the access roads to the site are tarred during the initial construction period.***

(b) Impacts on the labour market

Potential impacts would be similar to Bantamsklip above and are therefore not repeated.

(c) Stimulation of the agricultural economy

It is estimated that the stimulation of the agricultural economy would be the greatest at Thyspunt. A 10 % to 15 % increase (with a value of R150 million per annum) is predicted around this site.

9.21.4 Mitigation

In order to minimise dust from construction the following measures should be implemented:

- Build the roads serving the nuclear power station as a first priority, and have these tarred or lined with concrete and implement an air quality management plan, as recommended by the air quality impact assessment; and
- Regular spraying of water on bare soil at site to reduce generation of dust.

In terms of negative market perspective of agricultural produce grown near a nuclear plant, an awareness programme showing the impacts of a nuclear plant on agricultural production ***(with reference to the experience the KNPS, which has had no discernible impact)*** needs to be implemented.

With regard to labour, an awareness campaign needs to be undertaken among existing farm labour highlighting the benefits of permanent work on farms as against the essentially short-term nature of construction work on a nuclear power station.

In the event of a nuclear emergency, appropriate mitigation measures need to be implemented to mitigate impacts on the food chain, as per Eskom's emergency response plan, as according to the Food and Agriculture Organisation and World Health Organisation's Codex Alimentarius.

9.21.5 Conclusions

Agriculture around Thyspunt is based substantially on milk production; fynbos prevails in the Bantamsklip area although there is some dairy as well as beef, sheep and game farming; while the Duynefontein area is based on mixed farming. It is estimated that the current annual value of farm production in 2008 was R150 million in the Thyspunt area, R29 million for Bantamsklip and R75 million for Duynefontein. The estimated ***potential*** changes in production as a result of the nuclear power station are reflected in **Table 9-63**. From this it can be seen that the ***potential for the largest increase in agricultural production*** would be at Thyspunt, followed by Bantamsklip ***(with a smaller increase in production)*** and then Duynefontein (with zero increase in production).

Table 9-63: Estimated economic impact on the markets for agricultural produce

Site	Gross Value R (million)	Estimated impact
Bantamsklip	29	Increase by 0-5%
Duynefontein	75	No change
Thyspunt	150	Increase by 10-15%

The major impacts of a nuclear power station on agriculture would be the generation of dust during the initial construction phase ***(before tarring of the access roads is completed),*** possible agricultural labour shortages and market effects. On the positive side, the presence of a nuclear power station will lead to an increased demand for agricultural goods, which ***creates the potential for stimulating*** agricultural production ***and improving the local agricultural economy.*** This increase would be most significant at Thyspunt, less significant at Bantamsklip, but there would be a potential zero increase around Duynefontein.

The area around Duynefontein would experience the lowest significance negative agricultural impacts, and would experience positive agricultural impacts of low significance. The Bantamsklip environment would experience the negative impacts of medium significance in terms of dust pollution and the availability of agricultural labour (without mitigation), and positive impacts of low significance. The Thyspunt environment would experience negative impacts of medium significance in terms of dust pollution and the availability of agricultural labour (without mitigation), but is the only site predicted to experience potential positive impacts of medium significance.

Depending on the avoidance of negative impacts or the stimulation of positive impacts, different sites could be regarded as preferred alternatives. If the avoidance of negative impacts is weighed more heavily, then clearly Duynefontein could be regarded as the preferred site for Nuclear-1, as the negative impacts at this site are all of low significance. However, if potential positive impacts are weighed more highly, then Thyspunt emerges as the preferred alternative, from an agricultural point of view. In this assessment, the positive impacts have been weighed more heavily than the negative impacts, as the negative impacts are of shorter duration than the positive impacts. Thyspunt is therefore regarded as the preferred site from an agricultural point of view. Thyspunt is followed ***in preference*** by Bantamsklip and then Duynefontein.

Table 9-64: Summary of agricultural impacts at Duynefontein

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Dust pollution	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*High*	*Low - medium*
1B: mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
2A: Availability/ Cost of labour	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Medium*	*Low*
2B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Medium*	*Low*
3A: Change in market condition (Positive)	*Positive*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Medium*	*Low*
3B: Optimised	*Positive*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Medium*	*Low*

Table 9-65: Summary of agricultural impacts at Bantamsklip

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Dust pollution	*Negative*	*Medium*	*Low*	*Low*	*Low*	*Medium*	*High*	*Medium*
1B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
2A: Availability/Cost of labour	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
2B: Mitigated	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
3A: Change in market condition (Positive)	*Positive*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Medium*	*Low*
3B: Optimised	*Positive*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Medium*	*Low*

Table 9-66: Summary of agricultural impacts at Thyspunt

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Dust pollution	*Negative*	*Medium*	*Low*	*Low*	*Low*	*Medium*	*High*	*Medium*
1B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
2A: Availability/ Cost of labour	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
2B: Mitigated	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
3A: Change in market condition (Positive)	*Positive*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
3B: Optimised	*Positive*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*

9.22 Economic impacts

Impacts on the economic environment are dealt with in the Economic Impact Assessment specialist report contained in Appendix E17.

The objective of the economic impact assessment was to analyse the economic cost-effectiveness of the three alternative sites from a broad community prospective. This includes the capital and operational costs of the service provider as well as the costs to the community, taking into account the positive and negative externalities on the economy and the environment. The study also considers the broader macroeconomic impacts of the three sites on their relevant provincial economies.

9.22.1 Cost-effectiveness comparison of the three sites

The detailed results, as obtained from the cost comparison model, for the three proposed nuclear sites are reflected in **Table 9-67**. In this table a negative value represents a relative benefit to a specific site.

Table 9-67: Comparison of Cost-effectiveness Values of three nuclear power station sites (2008 prices R million)

	Discount Rate: 8 %	**Thyspunt**	**Bantamsklip**	**Duynefontein**
	Cost Factors	**Present Value[17] (R million)**		
1	Land	5.92	3.38	0
2	Construction			
2.1	Site Preparation			
2.1.1	Sand removal and Disposal on site	95.28	150.63	96.89
2.1.4	Bedrock removal and disposal	42.37	71.69	76.70
2.2	Reactor			
2.2.1	Reactor Constant Cost	101 902.31	101 902.31	101 902.31
2.2.2	Reactor Relative variable Cost Items			
2.2.2.1	Construction Support Services Transport	156.50	167.45	54.77
2.2.2.2	Construction Steel - transport	96.04	122.06	115.28
2.2.2.3	Construction Concrete and Bricks – transport	89.79	158.47	55.45
2.2.3	Foreign Import Material			
2.2.3.1	Import Material, Port to site (Abnormal load)	489.40	1 441.49	350.23
2.2.3.2	Import Material, Port to site (Normal load)	39.56	29.36	8.27
2.2.4	Construction Labour Cost			
2.2.4.1	Construction village Capital	1 969.58	1 969.58	1 792.48
2.2.4.2	Construction village Transport cost	314.83	125.93	198.69
2.2.4.3	Construction Camp Capital	227.35	227.35	227.35

[17] **Present Value** is the value on a given date of a future payment or series of future payments, discounted to reflect the time value of money.

	Discount Rate: 8 %	Thyspunt	Bantamsklip	Duynefontein
	Cost Factors	**Present Value[17] (R million)**		
2.2.4.4	Construction Camp Transport cost	123.96	49.58	84.29
2.2.4.5	Labour Difference in Numbers during Construction	0	0	0
2.3	Access Roads			
2.3.1	Capital Costs of access roads	539.39	122.59	204.31
2.4	Connection National Grid			
2.4.1	Capital Costs of Connection National Grid	3 778.63	9 068.71	3 636.04
2.4.2	Capital Cost – 132kV line – Duynefontein	119.07	0	0
2.5	Operational Externalities / Side effects			
2.5.1	Tourism Impacted construction phase	43.20	-81.85	24.99
2.5.2	Value of unskilled Job creation Construction Phase	-949.25	-444.19	0
3	Operational – Plant			
3.1	Electricity savings			
3.1.1	Power balancing	-1 339.99	-888.42	-833.84
3.1.2	Commencement delay	00	222.02	156.13
3.2	Operational Labour Cost			
3.2.1	Labour Difference in numbers	0	0	0
3.2.2	Labour Travel cost	229.60	91.84	156.13
3.3	Waste Removal			
3.3.1	Waste Removal Transport cost	6.83	6.91	5.31
3.4	Supporting Service Industries			
3.4.1	Supporting Service Transport Costs	2.15	2.66	0.28
3.5	Operational Externalities / Side effects			
3.5.1	Tourism Impacted operational phase	26.83	-332.01	0
3.5.2	***Agriculture Normal***	***18.75***	***0.75***	***0.00***
3.5.3	***Aquaculture***	***0.00***	***0.00***	***0.00***
3.5.4	Fishing	84.20	0	0
3.5.5	Value of unskilled Job creation	-263.62	-88.03	0
	Total	107 711.85	114 100.01	108 281.58

Table 9-68 shows the cost differences between the three sites.

Table 9-68: Cost Differences between the proposed Nuclear-1 Sites

	Thyspunt	Bantamsklip	Duynefontein
Difference relative to Thyspunt (R million)	Not applicable	6 388	570
Difference relative to Thyspunt (%)	Not applicable	5.93%	0.53%
Difference relative to Duynefontein (R million)	Not applicable	5 818	Not applicable
Difference relative to Duynefontein (%)	Not applicable	5.37%	Not applicable

It is evident that the three sites do not differ significantly. Thyspunt is about 6 % more cost-effective than Bantamsklip, and less than 1 % more cost-effective than Duynefontein. This constitutes a difference between Duynefontein and Bantamsklip of R6 388 million, and between Thyspunt and Duynefontein of R 570 million. It must be mentioned that although R6 388 million and R 570 million are large amounts, they are relatively small amounts in terms of the total estimated cost of a nuclear power station (R170 billion in 2008 prices).

To test the confidence level of the above-mentioned results, sensitivity analyses were performed with various real discount rates, i.e., 5 %, 8 % and 10 %. The 5 % is used as it is often the accepted discount rate for projects affecting the environment, while 10 % is the rate used by the World Bank to evaluate projects. The conclusion of these analyses is that there is no significant difference in the cost-effectiveness comparison between the three sites. Although there are noticeable differences in the magnitude of certain cost elements, the relative differences are minor, ***and that the outcome still favours the Thyspunt site***.

9.22.2 Macro-economic analysis

(a) Methodology

In order to quantify the macroeconomic impact associated with the possible construction and operation of a new nuclear power station, a partial general macroeconomic equilibrium analysis was conducted. The nuclear power station is such a large capital investment (equivalent to that of six times the capital investment in Gautrain) that the economic ripple effects will go far beyond its direct boundaries. For this purpose the Eastern Cape was used as the economic service and support area for Thyspunt, and the Western Cape for the proposed nuclear facilities of Bantamsklip and Duynefontein. Potential macroeconomic impacts have been measured in terms of the following standard macroeconomic performance criteria:

- GDP (in order to assess the contribution to economic growth);
- capital formation (as an indicator of the demand for scarce production resources);
- employment creation (as an indicator of the impact on income distribution);
- low-income household income (as an indicator of the impact on poverty relief; and
- a series of social indicators.

Table 9-77 and **Table 9-78** below present a comparison of the various cost components that were used to generate the macroeconomic model for the construction and operation of a nuclear power station at each of the three alternative sites.

Table 9-69: Comparison of the construction costs of a nuclear power station (constant 2008 prices, R millions)

		Thyspunt	Bantamsklip	Duynefontein
1	Land	7	4	0
2	Sand removal and disposal on site	127	201	130
3	Advantage for St Francis (Beach Repair)	- 50	0	0
4	Water removal	1.3	0.9	1.1
5	Bedrock removal and disposal	57	96	5 103
6	Reactor – constant cost	160 275	160 275	160 275
7	Construction support services, transport	231	247	81
8	Construction steel – transport cost	142	180	170
9	Concrete and bricks – transport	133	234	82
10	Import material, port to site (abnormal loads)	793	2,339	R 567
11	Import material, port to site (normal load)	52	39	11
12	Construction village – capital	2 024	2 024	1 513
13	Construction village – transport cost	503	201	317
14	Construction camp – capital	265	265	R 265
15	Construction camp – transport cost	199	79	134
16	Labour – difference in numbers	0	0	- 173
17	Capital cost of access roads	660	150	250
18	Capital cost of connection – national grid	5 300	12 720	5 100
19	Tourism impact	65	- 124	38
20	Value of job creation	- 1 399	- 655	0
	Total	**169 535**	**178 277**	**R 168 863**

Table 9-70: Comparison of the operational cost of a nuclear power station (constant 2008 prices, R millions)

		Thyspunt	Bantamsklip	Duynefontein
1	Power balancing	0	0	0
2	Commencement date	0	22	12
3	Labour – difference in numbers	0	0	- 54
4	Labour – travel cost	45	18	26
5	Waste – removable – transport cost	1	1	1
6	Supporting services – transport cost	0.4	0.5	0.06
7	Tourism impact	7	0	0
8	Agriculture –normal	0	R0	0
9	Aquaculture	0	1	0
10	Fishing	17	0	0
11	Value of job creation	0	0	0
12	Selling of electricity	6 093	6 093	6 093
	Total	**6 163**	**6 135**	**6 078**

The costs of decommissioning were not included in the above analysis, since these costs would be relatively uniform across the three sites. In international practice, it is customary to use a figure of 15 % in estimating the cost of decommissioning a nuclear power station. If this is applied to the constant estimated reactor cost, a figure of between R17.5 and R20.0 billion (in 2009 prices) is projected as the cost to decommission the power station at the end of its operational life span.

(b) Results of the macro-economic analysis

The results of the macroeconomic impact analysis indicate that the construction and operation of Nuclear-1 will have a significant impact on the economies of the Eastern and Western Cape provinces.

The predicted macro-economic impacts of the construction and operational phases of nuclear power station are indicated in **Table 9-79** and **Table 9-80** respectively.

Table 9-71: Comparison of the macroeconomic impact of the construction phase

Macroeconomic indicators	Thyspunt	Bantamsklip	Duynefontein
a. GDP (R millions)	5 527	6 961	6 546
b. Capital formation (R millions)	10 186	12 943	12 143
c. Employment (numbers)	67 673	94 906	91 194
d. Household income:			
• Low-income households (R millions)	352	109	104
• Medium and high-income households (R millions)	2 347	2 656	2 479
• Total household (R millions)	2 699	2 766	2 583

Table 9-72: Comparison of the macroeconomic impacts of the operational phase

Macroeconomic Indicators	Thyspunt	Bantamsklip	Duynefontein
a. GDP (R millions)	9 369	5 587	5 562
b. Capital formation (R millions)	172 066	178 198	172 572
c. Employment (numbers)	9 425	11 863	11 560
d. Household income:			
• Low-income household (R millions)	299	57	56
• Med and high-income household (R millions)	1 200	1 606	1 577
• Total household income (R millions)	1 499	1 664	1 633
Social indicators			
a. Additional number of educators	3 157	2 858	2 842
b. Additional number of hospital beds serviced	680	615	612
c. Additional number of doctors	71	64	64
d. Additional number of low-cost houses	2 968	2 687	2 672

9.22.3 Impacts on the chokka squid fishing industry at Thyspunt

Although the potential economic impact on squid fishery is very small compared to the overall project costs, it is important to deal with this impact, as it affects the livelihoods of people in the fishing industry in the area around Thyspunt. Data from the South African Squid Management Industry Association (SASMIA) show that in 2005 the Eastern Cape squid industry employed 2 300 fishing crew, 150 management staff and 1 500 factory staff. This potential impact therefore warrants special attention.

As indicated in Marine Impact Assessment (Appendix E15), Thyspunt occurs in the chokka squid (Loligo reynaudii) fishing areas. This distribution range for this is from southern Namibia to approximately East London, but coastal spawning of this species is largely focused in shallow bays along the South African south coast, with the most important spawning grounds occurring between Plettenberg Bay and Algoa Bay. The Thyspunt site is located within 12 km of Port St. Francis, which acts primarily as a centre for chokka fishing.

There is concern within the chokka fishing industry that the chokka could be negatively affected by outflows of warmed cooling water, the marine disposal of spoil and by a proposed marine security exclusion zone within 1 km of the high water mark. To place these concerns in perspective, the Marine Impact Assessment found that the temporal and spatial limitations of the impacts associated with the disposal of spoil on chokka squid at Thyspunt will have limited impact on the overall squid stock, when taken within the context of the extensive area over which this species spawns. Furthermore, it was found that while chokka squid at the Thyspunt site are expected to avoid water temperatures elevated above their thermal tolerance range, the area predicted to be affected represents less than one percent of the coastal spawning ground of this species.

In the Thyspunt area, the annual range for catches 0-5 km offshore from 1998 to 2007 was between 479 and 1 316 tons, with a mean of 914 tons. However, most squid are caught 0-22 km offshore. The annual average for the catches in this area between 1998 and 2007 was 587 tons per annum. The average annual value of squid caught 0-2 km offshore in the Thyspunt area is €4.1 million (R50.65 million at an exchange rate of €1 to R12.65 when the Economic Asssessment was revised in 2010). At the 2011 exchange rate applicable at the time of writing this revised Draft EIR (€1 to R10.00), the Rand value would be R41 million.

An exclusion zone of 1 km width would account for roughly 1.8% of the total average catch of 7,000 tons per annum. This would amount to approximately 127 tons per annum with an export value of €0.88 million (R10.87 million) per annum. It is important to understand the significance of this impact with respect to the following:

- ***The Marine Ecology Assessment, in dealing with the impact of the release of warmed cooling water on squid spawning grounds, states that adult squid would avoid an area of 0.55 km^2, i.e., 0.225 x 0.225 km, at Thyspunt. Thus, the result would be that the export value affected would be less than €0.88 million (R10.87 million) per annum.***
- ***Secondly, the squid that avoid the 0.55 km^2 area are not expected to avoid the rest of the bay area in general, so in fact the loss could be even lower.***
- ***Thirdly, the loss would not be borne solely by Port St. Francis-based boats since Port Elizabeth-based boats also fish off Thyspunt. As the Marine Ecology Assessment states, the exclusion zone is not anticipated to significantly affect the chokka squid industry due to its small size relative to the area over which fishing boats operate.***

The economic impact would be further mitigated if, as indicated by Eskom, it intends to apply for access to the exclusion zone to be granted to commercial fishing vessels.

The finding of the Marine Biology Assessment is that the temporal and spatial limitations of the impacts associated with the disposal of spoil on chokka squid at Thyspunt will have limited impact on the overall squid stock, when taken within the context of the extensive area over which this species spawns.

The estimated economic impact of the proposed power station on the fishing industry is indicated in Table 9-73.

Table 9-73: Estimated Impact of the Nuclear Power station on the Fishing Industry during the Operational Phase (2007 prices)

	Unit	*Thyspunt*	*Bantamsklip*	*Duynefontein*
Annual turnover	*R million*	*400*	*100*	*n/a*
Impact – Years 7 to 20	*%*	*-1.8%*	*n/a*	*n/a*
Impact – Years 7 to 20	*R million*	*-7.2*	*n/a*	*n/a*

This estimate is based on interviews with fishing industry stakeholders. However, based on the findings of the Marine Biology Assessment, this estimate should be regarded as a worst case scenario.

9.22.4 No-go alternative

If no Nuclear-1 is built, the differential effects on the three alternative sites would be zero. However, based on the increasing electricity demands associated with increased economic growth in South Africa, the No-Go (no development) alternative is not considered to be a feasible alternative to the development of a nuclear power station or, for that matter, any other type of energy-generating facility.

The power outages experienced in 2008 affected all sectors of the economy, and illustrated that the provision of additional power is imperative if new large development projects (especially those that are energy-intensive, e.g., the proposed aluminium smelter at Coega) are to go ahead. Indeed, Eskom has a considerable programme for producing additional power: it has to provide additional large-scale, base-load power stations, either through nuclear power or through the development of additional coal-fired power stations. If it does not, the economic growth of the country will grind to a halt since a modern economy requires constant additions to its power supplies if it is to grow. It is clear, therefore, that the No-Go alternative is not a practical proposition for the South African economy.

9.22.5 Mitigation

There is a widespread (and, in field interviews, openly acknowledged) lack of information on the part of the public regarding the impact of a nuclear power station. Proposed mitigation measures are:

- ***An active public information campaign directed at the local community to inform them of the pros and cons of nuclear power. This should involve the wide dissemination in easily understandable form of all the specialist studies in order to overcome public fears regarding, inter alia, loss of sense of place (visual impacts, pollution), impact on the marine environment (ocean temperatures, waves, fish), and social impacts (unemployment, squatter housing, crime) all of which could have an impact on the economy. This is an avoidance measure.***
- ***A similar campaign should be aimed at international product markets (e.g., in the case of squid fishing) or international bodies (e.g., the International Association of Surfing Professionals) to counter negative perceptions and boycotts of local products and events. This campaign would probably involve extensive and expensive advertising; if the negative market perception for squid***

is related to forms of contamination, the campaign could include regular testing of squid for contamination[18] and the issuing of certificates (e.g. certification) stipulating that the product is free of contamination.

- ***Restoration of any damage to the ecology of the area that might occur in the construction phase, the expansion and enhancement of the nature reserves surrounding each site, and the establishment of visitor information and educational centres in order to attract tourists to the area. This would be a rectification measure.***
- ***Controls on heavy-vehicle traffic during the construction phase in order to mitigate negative impacts such as noise, night-time visual effects (vehicle lights), road damage and congestion. These impacts affect the local economy but differ from one nuclear power station to another, and therefore the intensity of the measures will also differ. However, they should all at least encompass a scaling up of traffic policing. This would be an avoidance measure.***
- ***The transfer, wherever possible, of construction workers to new nuclear power station sites once their involvement at Nuclear-1 is complete. This would be a reduction measure to mitigate the adverse impacts of unemployment and attendant social ills that could affect the local economy.***

9.22.6 Conclusion

The overall positive macro-economic impacts will be greater in the Western Cape (i.e., at Bantamsklip or Duynefontein) than in the Eastern Cape (Thyspunt) because the Western Cape has a larger, more diversified economy. More of the inputs required to construct and operate Nuclear-1 can be provided from within the Western Cape provincial economy, and more of the household income that flows from this project will be spent within the boundaries of the province. By contrast, the smaller, less-diversified Eastern Cape economy will not be able to supply as many of the inputs required, nor will it be able to retain as much of the household income, with the result that the macroeconomic impact of establishing a nuclear power station at Thyspunt produces less of a positive impact for this province’s economy. Thus, Nuclear-1 would result in less dislocation of economic activities if located at Duynefontein than at either of the other two sites.

Macroeconomic indicators favour the Western Cape sites of Duynefontein and Bantamsklip. However, the **cost-effectiveness analysis indicates that Thyspunt has a very slight edge over Duynefontein and a somewhat larger edge over Bantamsklip**. Thus, if one considers poverty alleviation as an important criterion in the location decision, then factors such as the impact on low-income households, the impact of the social indicators, and the opportunity to grow the economy of a province as reflected by the potential impact on GDP become much more significant. Giving greater weight to these social factors tends to suggest that locating a nuclear power station at Thyspunt would produce a larger positive impact than at the two Western Cape sites.

The differences between the alternative sites are slight, and all the sites would have large positive economic impacts both on the local area and the province in which they are situated.

The economic impact assessment gives greater weight to the cost-effectiveness analysis. This favours Thyspunt as the preferred site, followed by Duynefontein and Bantamsklip.

Perceptions regarding a nuclear power station are frequently based on a lack of scientific information about perceived impacts. The public’s level of concern is lower in the area around Duynefontein because of their experience with Koeberg. Public concern is also relatively low at Bantamsklip but is highest in the area around Thyspunt. In general, the business sectors around all three sites see opportunities arising from the establishment of a nuclear power station, quite apart from the importance of stabilising the electricity supply.

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[18] ***The Marine Biology Assessment has also recommended an ongoing monitoring programme for marine organisms.***

The two most sensitive industries in terms of their perceptions about the impacts of Nuclear-1 on their activities are fishing and tourism. However, the analysis shows that any negative impacts are likely to be slight and that in fact there would be overall positive impacts on tourism.

Table 9-74: Economic impacts at all three alternative sites

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Construction phase macroeconomic impacts – Local (positive)	*Positive*	*High*	*High*	*Medium*	*Medium*	*High*	*High*	*High*
2A: Construction phase macroeconomic impacts – Regional (positive)	*Positive*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
3A: Construction phase macroeconomic impacts – national (positive)	*Positive*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
4A; Operational phase macroeconomic impacts – Local (positive)	*Positive*	*Medium*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*
5A; Operational phase macroeconomic impacts – Regional (positive)	*Positive*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Medium*	*Low*
6A: Operational phase macroeconomic impacts – national (positive)	*Positive*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*

Table 9-75: Economic impacts at Thyspunt

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Loss of income arising from loss of part of fishing grounds	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*

Table 9-76: Economic impacts at Bantamsklip

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A; Loss of income arising from loss of access to part of whale watching area	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

9.23 Emergency response

Emergency response systems are dealt with in the Emergency Response specialist report (Appendix E26).

The approach of this specialist report is different to the other specialist reports, in the sense that it has not identified and assessed impacts. The purpose of this study is to investigate the feasibility of emergency planning feasibility (nuclear- related) within each the study area.

The key findings presented here are based on a qualitative assessment. Further detailed technical proof of the acceptability of all three sites in respect of nuclear emergency plans is included in the Site Safety Reports (SSR) and the Safety Analysis Report (SAR) to be submitted to the National Nuclear Regulator as part of the safety case to license a new nuclear power station.

Emergency preparedness in the context of a nuclear power station is defined as the measures that enable individuals and organisations to stage a rapid and effective emergency response in the context of nuclear emergencies. Protective actions include measures to limit the exposure of the public to radioactive contamination through external exposure, inhalation and ingestion. The objectives of these actions are to prevent early acute radiation effects referred to as "deterministic" effects and to reduce the likelihood of late radiation effects referred to as "stochastic" effects, principally cancer).

For nuclear emergencies, two sets of requirements have to be fulfilled.

- ***Functional (response) requirements; and***
- ***Infrastructure (preparedness) requirements***

<u>Functional response requirements</u> refer to the "capability" to perform an activity. The "capability" includes having in place the necessary authority and responsibility, organisation, personnel, procedures, facilities, equipment and training to effectively perform the task or function when needed during an emergency.

The "capability" includes having in place the necessary authority and responsibility, organization, personnel, procedures, facilities, equipment and training to perform the task or function when needed during an emergency. In this context, infrastructure means transport and communications networks, industrial activities and, in general, anything that may influence the rapid and free movement of people and vehicles in the region of the site.

In demonstrating the feasibility of a nuclear emergency plan, many site related factors are taken into account. The factors are:

- ***Population density and distribution***
- ***Special geographical features, such as mountainous terrains, rivers, capabilities of local transport and communication network***
- ***Agricultural activities that are sensitive to possible discharges of radionuclides, and***
- ***Disastrous external events or foreseeable natural phenomena***

The importance of these site related factors are dependent on the nuclear hazard posed by a nuclear power station). Safety objectives of the new generation nuclear power station envisaged for ESKOM entail enhanced safety design features when compared to most existing operating nuclear reactors in the world today. Design features are included in these reactors to practically eliminate severe accidents and to enable

simplification of the emergency planning and off-site countermeasures in the following manner:

- ***Minimal emergency protection action beyond 800 m from the reactor during early releases from the reactor containment;***
- ***No delayed action such as temporary transfer of people at any time beyond approximately 3 km from the reactor;***
- ***No long term action involving permanent (longer than 1 year) resettlement of the public at any distance beyond 800 m from the reactor; and***
- ***Restriction on the consumption of foodstuff and crops should be limited in terms of timescale and ground area in order to limit the economic impact***

9.23.1 Key findings regarding emergency response

The key findings and recommendations of the Emergency Response Assessment can be summarised as follows:

(a) Infrastructure considerations

Duynefontein

Transport
The R27 and the N7 serve primarily as north-south national and regional distributors, with the additional function of providing local rural access. The R27 links the Cape Town metropolitan area with the north western coastal areas, traversing the farm Duynefontein at approximately 2.3 km from the Koeberg 900 PWR units 1 and 2. This road provides the major access to the Duynefontein site and is a dual carriageway from Table Bay Boulevard to approximately 400 m north of Porterfield Road, Table View.

Telephone exchanges
There are a total of 15 telephone exchanges within a 25 km radius of the Duynefontein site.

Radio and television transmitters
Sentech (Pty) Ltd controls all radio and television transmitters in the region. There are no radio or television installations within the 25 km radius of the Koeberg site. However, the Sentech Tygerberg Transmitter station is the closest. It is located on Tierkop approximately 27.6 km SE of the site. The regional operations centre of Sentech, situated approximately 23 km south of the Koeberg site, handles all transmissions of radio and television programmes.

Bantamsklip

Transport
The major road in the network with the highest traffic volumes is the MR00028 between Ratelrivier and Gansbaai with a traffic volume of approximately 7 861 vehicles per day (vpd). TR02802 (R43) serves as a link to Hermanus and to the N2 via the MR00267 (R326) and carries a volume of approximately 4 966 vpd. MR00267 which serves as the main link on the eastern side of the Bantamsklip site to the N2 carries a vehicle volume of 1 668 vpd. MR00262 runs between Vogelvlei and Bredasdorp and carries a low vehicle volume of approximately 450 vpd. MR00261 connects Agulhas to Bredasdorp and further extends to Goudini and Caledon and carries an approximate vehicle volume of 2 945 vpd.

Telephone exchanges

There are a total of four telephone exchanges within a 25 km radius of the Bantamsklip site.

<u>Radio and television transmitters</u>
Sentech (Pty) Ltd controls the radio and television transmitters in the region. There are no radio or television transmitters within a 25 km radius of the site. The nearest transmitter to Bantamsklip is located at Napier (34° 31' 45" S, 19° 53' 33" E) and transmits KFM, RSG, SAFM as well as SABC1 and SABC2. This transmitter is approximately 37 km from the Bantamsklip site.

<u>Thyspunt</u>

<u>Transport</u>
Current traffic volumes on the N2 in the vicinity of Humansdorp is in the order of 3 768 vpd in both directions, with the percentage of trucks being 18.38%. Information on accident hotspots and accident statistics are not available. However, road signs warn motorists that the 5 km section to the east of the N2/R330 interchange is an accident hotspot.

<u>Telephone exchanges</u>
There are a total of six telephone exchanges within a 25 km radius of the Thyspunt site.

<u>Radio and television transmitters</u>
Sentech (Pty) Ltd controls the radio and television transmitters in the region. The nearest transmitter to Thyspunt is located at Port Elizabeth (33° 56' 10" S, 25° 26' 29" E) and transmits RSG, S AFM, R2000, LOBO, 5FM, METRO FM, LOTUS FM and ALGOA Radio as well as SABC1, 2, 3, eTV and MNET. This transmitter is approximately 90 km from the Thyspunt site.

In summary, the <u>Duynefontein</u> Site includes the existing KNPS, therefore the emergency response infrastructure and systems are in place. The outcomes of the Safety Analyses, done prior to commissioning as part of the Safety Analysis Report has to confirm that the current infrastructure would be adequate to cope with the demands of the additional and proposed Nuclear-1 Power Station.

The <u>Bantamsklip</u> and <u>Thyspunt</u> sites may require only limited upgrading of infrastructure, for example roads leading to and from the power station.

(b) Population distribution

The <u>Thyspunt</u> and <u>Bantamsklip</u> sites are located in low population areas. The <u>Duynefontein</u> site has a higher population density. However, an extensive nuclear emergency plan is already in place because of the existing KNPS. A new nuclear power station will be integrated into this emergency plan.

<u>Duynefontein</u>

There is a maximum cumulative population of approximately 3.9 million people within 80 km of the nuclear power station site (estimated 2008). If the population distribution results per sector are viewed, it is clear that the Cape Town region, South Peninsula region, Blaauwberg region, Tygerberg region, Oostenberg region, and Helderberg region are most densely populated, as is the Atlantis area NNE of the site. A population of approximately 83 358 people resides within 16 km of the nuclear power station site (estimated 2008), with Avondale and Saxonsea in Atlantis containing the highest population densities.

<u>Bantamsklip</u>

There is a maximum cumulative population of approximately 227 284 people within 80 km of the Bantamsklip site (based on 2008 statistics). If the population distribution results per sector are viewed, it is clear that the main towns of Gansbaai, Hermanus, Hawston, Kleinmond, Betty's Bay, Grabouw, Caledon, Greyton and Bredasdorp contain higher population concentrations. A relatively small population resides within 16 km of the Bantamsklip site (approximately 2 560 people in 2008) with Pearly Beach to the NW containing the highest population density in this radius.

<u>Thyspunt</u>

There is a maximum cumulative population of approximately 339 400 people within 80 km of the Thyspunt site (estimated 2008). If the population distribution results per sector are viewed, it is clear that the main settlements are Nompumelelo Village, Zitzikama, Kareedouw, Humansdorp/Kruisfontein, Hankey, Jeffreys Bay, Uitenhage and the Greater Nelson Mandela Bay/Port Elizabeth. A relatively small population resides within a 16 km of the nuclear power station site (approximately 4 724 people in 2008) with Sea Vista to the ENE containing the highest population density within this radius.

9.23.2 Mitigation

For future sites (Thyspunt and Bantamsklip), Eskom has developed a document [NSIP - 01344] on a framework for demonstrating that a proposed nuclear installation can be built in South Africa without the need for off-site short-term emergency interventions like sheltering, evacuation or iodine prophylaxis, in line with the philosophy of the EUR requirements. These documents prescribe that modern nuclear power plants should have no or only minimal need for emergency interventions (e.g., evacuation) beyond 800 m from the reactor, and provide a set of criteria that a reactor must meet in order to demonstrate that it can be built without such emergency planning requirements. Off-site short-term emergency would therefore only be applicable to Duynefontein because of the older technology used in the KNPS.

Protective actions related to food may be required following an unlikely severe accident. These protective measures could include:

- ***An immediate ban on the consumption of locally grown food in the affected area;***
- ***The protection of local food and water supplies by, for example, covering open wells and sheltering animals and animal feed;***
- ***Long term sampling and control of locally grown food and feed.***

Control of milk production and distributors is generally considered particularly important because it is a significant part of children's diets.

9.23.3 Conclusion

All three sites are acceptable for emergency planning considerations because of the EUR approach to emergency planning followed by Eskom. Proposed nuclear installations with enhanced safety design features will be built in South Africa without the need for off-site short-term emergency interventions like sheltering, evacuation or iodine prophylaxis.

The final and detailed emergency plan for each site has to be approved by the NNR. This approval will be based on detailed plant specific safety assessments that have to provide final justification for the technical basis of a site's emergency plan.

9.24 Site control and access

Site control and access issues are dealt with in the Site Control specialist report (Appendix E27).

In general, the impacts that will be experienced at all three sites, to varying degrees, are <u>restriction of public access</u> and <u>improved protection of the environment</u> within the fenced boundary. The positive impact of improved protection of the environment is dealt with in the respective biophysical specialist studies (e.g. wetlands, vertebrate fauna and vegetation) and is therefore not repeated here, although this impact is dealt with in the site control specialist study. Another reason for the repeating the impact of improved environmental protection here is that the site control report provides a generic assessment, whilst the various biophysical specialist reports provide more detailed assessments from an expert point of view.

9.24.1 Duynefontein

Access to the site is already largely controlled as the proposed site falls partly within the existing outer property boundary of the existing KNPS. The KNPS's site control system would be extended to include the proposed Nuclear-1 power station. The area of the site currently lying outside of the KNPS controlled area is also currently fenced as it is private property and thus not legally accessible to the general public. Due to its proximity to the KNPS, the site is not known to be an important access point to the coast for the public at present.

The overall impact of the restricted access at the site during construction and operation are considered to be of low-medium (negative) significance without mitigation.

9.24.2 Bantamsklip

The site is currently fenced as it is private property and thus not legally accessible to the general public. There are a number of holiday homes located in the greater area surrounding the site, for which coastal access is an important attraction for tourists. However, legal coastal access can be obtained at a number of alternative sites.

An important assumption in this assessment is that the access to and along the R43 where it lies within the site will be maintained for the public.

The overall impact of the restricted access at the site during construction and operation are considered to be of low-medium (negative) significance without mitigation.

An additional benefit, besides general environmental protection that would be experienced at the other two alternative sites, is restriction of access to poachers of abalone. This potential benefit is dealt with in the Marine Assessment (Appendix E15 and Section of this EIR) and is therefore not repeated here.

9.24.3 Thyspunt

The site is currently partially fenced as it is private property and thus not legally accessible to the general public. There are a number of holiday towns and residences located in the greater area surrounding the site, for which coastal access is an important attraction for tourists. However, coastal access can be obtained at a number of alternative sites, and the site is not known to be an important access point to the coast at present.

The overall impacts of the restricted access at the site during construction and operation are considered to be of low-medium (negative) significance without mitigation.

9.24.4 No-go alternative

In the event that the sites are not developed for nuclear power stations, Eskom will sell the Bantamsklip and Thyspunt properties and non-essential parts of Duynefontein could also be sold. In this scenario the impact is seen to be low intensity, neutral consequence and low significance for the Duynefontein site but of medium intensity, negative consequence and high significance for the Thyspunt and Bantamsklip sites as it is unlikely that a similar level of site control and preservation of ecological and heritage features could be enforced or afforded by private land owners/developers as would have been the case with a power station site.

9.24.5 Mitigation measures

The following mitigation measures are proposed:

- ***Clearly communicate access policy for the properties to the public, using notice boards on access gates and by directly communicating with the communities nearby;***
- ***Consider providing permits to allow access for fishing activities and whale watching in any coastal exclusion zone;***
- ***Maintain public access to the R43 where it traverses the Bantamsklip site;***
- ***Implement mitigation measures recommended in the Visual Impact Assessment;***
- ***Establish a nature reserve within the owner-controlled area and provide access for scientific research;***
- ***Maintain or re-establish indigenous vegetation;***
- ***Retain and maintain environmental features on sites such as wetlands;***
- ***Preserve heritage features;***
- ***Facilitate a review of site control issues raised in this EIR on National Key Points via the Minister of Police;***
- ***Confirm the availability of any required support for site control from the relevant police, military, naval and coastal management agencies;***
- ***Integrate the site-specific control measures with existing local and regional security measures;***
- ***Develop an Environmental Management Plan prior to construction. Define mitigation measures, monitoring parameters, target 'goals' and responsibilities in the EMP; and***
- ***Appoint an Environmental Control Officer.***

Table 9-77: Summary of site control impacts at Duynefontein

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Construction								
1A: Restricted access to site	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
1B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
Operation								
2A: Restricted access to site	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***High***	***Low - Medium***
2B: Mitigated	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***High***	***Low - Medium***

Table 9-78: Summary of site control impacts at Bantamsklip

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Construction								
1A: Restricted access to site	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
1B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
Operation								
2A: Restricted access to site	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***High***	***Low - Medium***
2B: Mitigated	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***High***	***Low - Medium***

Table 9-79: Summary of site control impacts at Thyspunt

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
Construction								
1A: Restricted access to site	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
1B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***	***Low - Medium***
Operation								
2A: Restricted access to site	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***High***	***Low - Medium***
2B: Mitigated	***Negative***	***Medium***	***Low***	***High***	***Low***	***Low***	***High***	***Low***

9.25 Visual impacts

Impacts on the visual environment are dealt with in the Visual Impact Assessment specialist report contained in Appendix E19.

Due to the sheer size of a nuclear power station their location in relative open, treeless landscapes along the coast, where there is limited to negligible visual screening by landforms, visual impacts at all three sites may be significant. Apart from the impacts on residents, potential visual impacts may also be experienced by visitors to the area. This is important at sites where tourism and recreational is one of the mainstays of the local economy. Apart from the turbine building itself, other ancillary structures that may have a significant impact include the meteorological mast (120 m tall), the radio mast (95 m), the transmission lines[19] within the EIA corridor, spoil and rock dumps and the access roads to the site from adjacent roads.

Visual risk sources for all three sites relate primarily to the increase in visual intrusion of the Nuclear Power Station as an entity and in combination with ancillary elements such as the construction offices, sheds, access roads, switch yards, transmission lines, masts and spoil dumps. At Duynefontein site the visual risk sources relate primarily to the increase in visual intrusion in combination with KNPS adjacent to the southern boundary of the site. The additional risks for each site have been identified as the accommodation of the large volume of excavated material, the alteration of areas surrounding the site during construction and the new access road/s for the Thyspunt site specifically.

Spoil dumps especially have the potential to create a significant visual impact due to their large scale and artificial form (unless they are shaped to resemble natural landforms. Assuming a constant width of 480 m and a height of 40 m, the length of the spoil dumps will vary between 500 m and 780 m at the different sites. Even considering shaping to resemble natural landforms, the spoil dumps will look out of place as all the sites are situated on a gently sloping to flat coastal plain where hills are uncommon.

Table 9-62 indicates the approximate size of the spoil dumps, based on the assumption that all spoil has to be disposed of on land (i.e. no pumping of spoil out to sea). In reality, the spoil dumps may be smaller, but the assessment has been based on a worst case scenario.

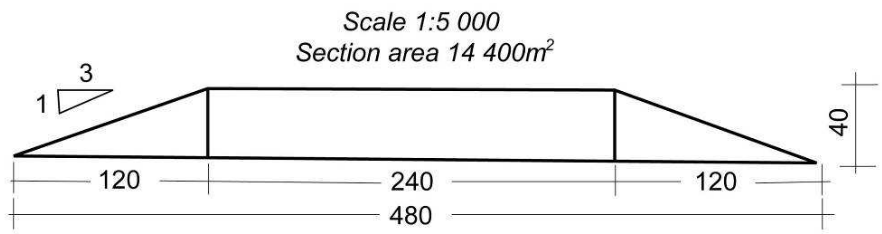
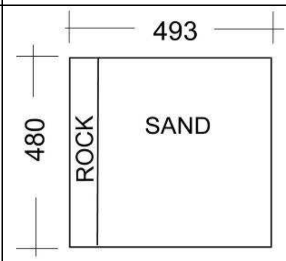
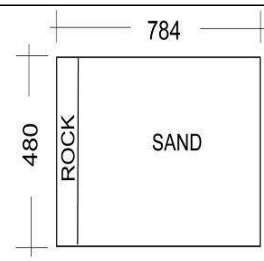
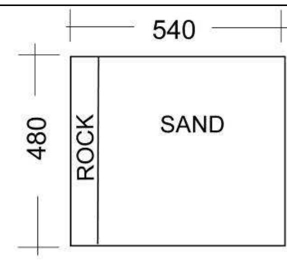
Significant potential visual impacts that will occur during the various phases of development are as follows:

(a) Construction

- Visible dust over extensive areas caused by earthmoving equipment and vehicles on dirt roads;
- Degradation of visual quality of local settings that result from landform change and vegetation removal;
- Visual clutter that will result from structures associated with the project such as site offices, on-site accommodation of personnel, lay-down areas, storage sheds and workshops, cement batching plants, temporary stockpiles of topsoil, rock and backfill material, vehicle and machine storage/parking and the maintenance and manufacturing of workshops;
- Visual change to local setting caused by
  - Large spoil dumps;
  - Alteration of visual quality of the local night scene from lighting required for safety and construction; and
  - Visual change to sense of place by the large level cleared areas.

[19] Subject to a separate EIA process outside the boundaries of the nuclear power station site

Table 9-80: Size of sand and rock spoil dumps at all three sites

CHARACTERISTICS	THYSPUNT m^3	BANTAMSKLIP m^3	DUYNEFONTEIN m^3
Height – 40 m Width – 480 m Side slope – 1:3			
<u>Volume</u> - m^3 Sand Rock <u>Length</u> (m) Sand dump Rock dump	 6 370 000 708 400 443 50	 10 100 000 1 198 600 701 83	 6 500 000 1 282 400 451 89
Area comparison			

(b) Operation

- There will be a visual change to the sense of place of coastal and inland areas experienced by visitors and local communities due to the large scale of new elements in the landscape, including the nuclear power station, the transmission lines within the site, new access roads, permanent spoil dumps and tall radio and meteorological masts;
- Changes in visual quality of the local landscape will be caused by new landforms arising from new access roads, platforms and spoil resulting from and required for the nuclear power station and ancillary buildings; and
- Changes in visual quality of the local night scene of the area will result from safety and security lighting of the nuclear power station, perimeter fence, access control buildings and roads.

(c) Decommissioning

- Visible dust will be caused by heavy machinery and on-site haulage;
- Visual clutter will result from structures associated with site offices and accommodation;
- Visual change to the landscape will result from new landforms that are created by removal or addition of soil or building rubble from temporary dumps to cover or screen areas;
- Visual intrusion will result from new fencing and lighting for safety and security; and
- Visual nuisance will result from heavy traffic on main roads.

9.25.1 Duynefontein

Figure 9-16 shows a viewshed analysis, indicating the areas from where the nuclear power station and 95m high stack will be visible. **Figure 9-17** shows an analysis of the intensity of visibility of these elements, based on distance from the site.

The viewshed analysis shows that the proposed Duynefontein nuclear power station and the KNPS to be located at the low point of half a shallow basin of radius approximately 8 - 10 km with a raised rim of low consolidated dunes. This topographical form effectively limits views of the site to those within a 10 km radius.

The actual visibility is further restricted by the gentle slope towards the site, because any structure or vegetation taller than 2 m that is near the observer will block any views of the Duynefontein nuclear power station. There will be no 120m meteorological mast, since the existing mast of Koeberg will be used.

(a) Access roads

Two existing roads will be upgraded for heavy and for light vehicles. The heavy vehicles access road is 1.2 km north and the light vehicle road is 2.7 km north of the existing entrance to Koeberg. The ground cover is low Strandveld type vegetation over a relatively flat sand terrace of low hummock type dunes. The visual impact in the context of the existing setting and access roads on the Koeberg site is not considered to be visually intrusive as minimal earthworks are required for the road. The visual intrusion of the road is limited, given the flat terrain and short distance and the use of existing road alignments.

9.25.2 Bantamsklip

Figure 9-18 shows a viewshed analysis, indicating the areas from where the nuclear power station and 95m high stack will be visible**. Figure 9-19** shows an analysis of the intensity of visibility of these elements, based on distance from the site.

Viewshed analysis shows that the proposed Bantamsklip nuclear power station is theoretically visible from most areas along the 30 km coastal strip and from the higher ground on the seaward side of the hills north of the site.

The actual visibility of the Bantamsklip nuclear power station is restricted by tall vegetation on the southern side of the R43 and the vegetated dunes to the north of the site

(a) Access road

Two access roads, approximately 2.6 km apart, from the coast road R43 are proposed. Both travel directly southwards to the nuclear power station and each will be approximately 1.5 km long.

The existing 2 to 3 m tall vegetation will screen the access road from the R43. However, for security reasons this vegetation may be removed. Much of the vegetation near the R43 is alien invader species such as Rooikrans and Port Jackson and this will be removed, leaving the Fynbos to regenerate. The access roads will be seen from the higher ground to the north, as will the entire nuclear power station and ancillary structures. The visibility of the road in the context of the change in the sense of place caused by the construction, power lines and spoil heaps, and the operation of the nuclear power station, will be negligible by comparison. The visual intrusion of the road will be limited, given the flat terrain and short distance.

9.25.3 Thyspunt

Figure 9-20 shows a viewshed analysis, indicating the areas from where the nuclear power station and 95m high stack will be visible. **Figure 9-21** shows an analysis of the intensity of visibility of these elements, based on distance from the site.

The viewshed analysis shows that the proposed Thyspunt nuclear power station to be located at the low point on the north-west to south-east orientated valley between Oyster Bay and Cape St. Francis. This valley extends inland to the north-west with the northern rim being the stabilised ancient dune ridge 5 km from the site. This topographical form effectively limits views southwards to the site from beyond the 10 km radius line.

The actual visibility is further restricted on the west as the dunes converge on the coast east of Oyster Bay. Existing vegetation on these dunes further screens views of the Thyspunt nuclear power station from Oyster Bay.

(a) Eastern Access Road

Because the topography is characterised by ridges and troughs orientated in a west to east direction due to the prevailing wind, there will need to be a substantial amount of cut and fill. The visual impact of new landforms and the removal of dune vegetation will change the present sense of place of relatively remote and scenic dune vegetation in various forms of development. Despite the mitigation and the fact that the road will not be seen, the visual integrity and sense of place will be degraded along the entire road corridor. The new access provided will most probably cause further degradation of the vegetation. Given the undulating terrain, the long distance and the wide reserve that will be cleared for road construction, the road will be visible from higher dunes in the area.

(b) Northern Access Road

Approximately one third of the route ***would have passed*** through the sensitive dune vegetation on the northern and southern side. The other two thirds of the road are within old or fallow land and a short portion of coastal fynbos on thin soils over the sandstone. The road is approximately 4 km long.

The new road will be visible from the southbound traffic on the Oyster Bay Road because it will rise with the approach to the dunes. The cutting through the dunes will be highly visible until these slopes have been re-vegetated. The sense of place will be marginally altered because the area is an agricultural landscape with gravel roads. If this access route is selected, the road from Humansdorp will be upgraded in alignment and tarred.

It is important to note that this alternative has been rejected on the basis of a consensus opinion of the EIA specialist team.

(c) Western Access Road

This route leaves the Oyster Bay Road just north of the town and then alternately cuts through and along the vegetated dunes that lie to the north of the town. This road is approximately 3 km long. The cutting through the east-west dunes and then along the ‘slack’ (the depression between dune crests) will mean that the sand cut and fill slopes will require effective re-vegetation to prevent erosion and ‘blow outs’. This modification of the landscape will change its natural coastal vegetation character and significantly change the sense of place, which in this case is unique due to the presence of indigenous vegetation and wildlife. In fact that area is a nature conservancy. This road will not be seen from Oyster Bay, but the visual degradation of the sense of place and character of the natural area will be significant, as this is a place that the Oyster Bay residents frequently use for recreational pursuits such as walking and birding.

9.25.4 Cumulative impacts of wind farm sites

A number of wind farms are being planned for the region around Thyspunt. As can be seen from **Figure 9-22,** one of these sites is planned directly to the north of the proposed Thyspunt nuclear power station site. Another is planned north of St. Francis Bay and a 3rd one is planned west of Slangbaai, approximately 12km west of Thyspunt.

The visual combination of the central wind farm and the Thyspunt nuclear power station location will have a large potential cumulative visual impact on the region.

The reasons for this are as follows:

- Although the main nuclear power station structures are mostly screened by the east-west dune ridge, the transmission lines and the HV yard, haul road (visually preferred northern route) and possibly large spoil heaps all lie within the central wind farm's location and therefore this wind farms will add to the visual complexity.
- The central wind farm site will be experienced by communities nearby and by persons travelling to and from Oyster Bay along the district road that runs along the northern boundary of the wind farm site and through it on its western section.
- The wind turbines of the central wind farm will be experienced at close range (less than 1 km) by all who travel the district roads to Oyster Bay, Humansdorp and St Francis Bay.
- The visual perception of an energy generation node will be reinforced by the combined visibility of the two projects.
- The landscape character and sense of place of the setting will be altered over a large area within a 5 km radius of the Thyspunt nuclear power station.
- The viewshed for the central Wind Farm will be extended into the Krom River Valley both westwards and eastwards for a distance of at least 10 km from the Thyspunt nuclear power station.
- The potential cumulative visual impact of the Thyspunt HV yard and transmission lines and wind farm will be experienced by a large number of people who will be both transient and resident.

Although the potential cumulative visual impact will be high if the Central location is selected, it can be argued that it is preferable to contain the visual change to the landscape character and sense of place to one location, than to have two large facilities that change coastal character and sense of place in two locations within a popular residential and holiday / tourist region.

The western and the eastern proposed wind farm sites are too far to be visually associated with the Thyspunt nuclear power station.

9.25.5 The no-go option

(a) Duynefontein

Land to the north of the site is mostly owned by developers who intend to build housing estates. It is therefore probable that Eskom land sold will be included in this long term scenario because it will be unlikely that a developer will purchase the land to retain as a nature reserve. In this situation the scenic coast line that represents and retains particularly the character and sense of place of the desolate but unique elements of two dune types and threatened vegetation communities will be damaged by subdivision into erven crossed by roads and contained by fences.

An accessible and highly scenic public amenity will be lost by transformation into a housing estate or other urban type land use. The visual impact of the new land use will further degrade the visual quality of the extensive portion of the coastline currently under Eskom's management.

(b) Bantamsklip

The risk of the no-go alternative associated with this site is the systematic visual degradation of its features that may be caused by later developments in the form of residential estates and holiday resorts. This scenario can be expected given the adjacent Pearly Beach community and the holiday/residential towns of Gansbaai and Franskraal further west along the coast. Should an uncontrolled development scenario be realised, the long-term visual sense of place will be irreparably damaged. The visual impact on the existing setting can be greater and over a larger area than the visual impact of a large nuclear power station if housing is developed over the associated HV switchyard and transmission lines. The assumption is made that the property will not be bought by a private individual or company to primarily conserve the landscape. Alternatively if the area is managed solely for conservation purposes, the visual uniqueness and sense of place will be retained in its current condition.

(c) Thyspunt

The scenario of encroaching residential and commercial resort development can become a reality given that Oyster Bay and Cape St. Francis would consider expanding eastwards and westwards respectively. There are presently applications for residential developments on land west of Cape St Francis and along the landform between the dune filed and the coastline. On the other hand if the area is managed solely for conservation purposes the visual uniqueness and sense of place will be retained in its current condition.

9.25.6 Impacts on lighthouses

Potential impacts of the power station’s lighting on lighthouses at Danger Point (near Thyspunt) and Gansbaai (near Bantamsklip) have also been raised as potential issues in the scoping phase of the public participation process.

A lighthouse is a rotating intense beam-seen as white light in a predetermined position (Red or green for instance) to orientate vessels of sea worthy bearings. Sector lights may additionally have a red or green filter on parts of the lantern house to distinguish safe water areas from dangerous shoals. The light cannot be confused with background lights at the nuclear power station for this reason.

At Bantamsklip (Quion Point) and Thyspunt (Danger Point) the lighting at the nuclear power station has been identified as being highly visually intrusive in that setting and mitigation measures that recommend detail design to limit light spill have been proposed. This includes using a special light source and fitting that directs the light downward and not outward. Flood lighting should only be used where absolutely necessary and be fixed in that condition.

9.25.7 Mitigation

The following generic mitigation measures are proposed at all three sites:

(a) Colour

It is recommended that a light blue-grey is used for the large structures (namely the Turbine-Generator Building), with the stack (chimney) a very light grey. The nuclear power station is a concrete structure, which will have a light grey colour. A darker band around the large structures will reduce their vertical scale. The masts should be a grey colour due to their galvanised finish. However this may be in conflict with the regulatory requirements that they are red and white bands.

(b) Alternative technology to monitor meteorological conditions

It is recommended that serious consideration should be given to replacing the proposed meteorological mast with a Doppler Sodar (SOnic Detection And Ranging) system[20], which is not dependent on a mast. Doppler Sodar is a meteorological technology, also known as a wind profiler, which measures the scattering of sound waves by atmospheric turbulence. Such technology has been used at other recently constructed nuclear facilities, e.g. in Finland.

(c) Screens

It is recommended that temporary screens, in the form of shade cloth on fences around the construction site, working areas and lay-down areas must be used to obstruct views of most of the construction elements at the level of the fence.

Earth berms of significant proportions must be created along the site boundary nearest to sensitive land uses, e.g. residential areas and roads, to screen portions of the structures. However, consideration should be given to the associated impacts caused during their construction and stabilisation, such as dust, noise, rehabilitation and the destruction of existing coastal flora. A thorough assessment should be carried out on site before any decision is made regarding a screen berm. This is necessary in the context of possible residential land uses in the coastal area east of the Thyspunt site and west of Cape St. Francis, as well as east of Bantamsklip, which may result from the extension of the R43 to link with Bredasdorp.

(d) Lighting

The lighting of the structures and areas within the nuclear power station site should be designed by a suitably experienced person with the objective to reduce “light spill”[21]. Aspects to be incorporated will be down lighting, lighting colour, extent of necessary illumination, light fittings that direct the light and elimination of the visible light source.

(e) Spoil dumps

Large spoil dumps must be integrated into the selected setting by varying their form and side slopes to fit the scale of existing landforms. In addition their re-vegetation with typical indigenous species of the surrounding landscape is essential to create a visual fit of the dump’s elements to the existing landscape character.

(f) Landscape Architect appointment

A Landscape Architect should be appointed to the design team to advise on the visual integration of the project on a detailed level during design and construction. The Landscape Architect’s input must be obtained especially for the design of the spoil dumps and roads.

(g) Mitigation measures for roads

- The cut and fill sections need to be designed or shaped on site to blend with the adjacent landform and materials. A standard slope angle will not be appropriate.
- The rehabilitation of the road reserves (especially at Thyspunt) requires a detailed plan showing stabilisation methods and a specification of planting type and species together with maintenance requirements. A landscape architect and an experienced rehabilitation contractor should be engaged at the detailed design stage of the road.

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[20] SODAR systems are used to measure wind speed at various heights above the ground, and the thermodynamic structure of the lower layer of the atmosphere. Sodar systems are similar to radar (radio detection and ranging) systems, except that sound waves rather than radio waves are used for detection.

[21] This concurs with the recommendation with respect to the impact on invertebrate fauna.

(g) Mitigation measures for sand dumps

- The form of the spoil dump is most important because this will determine the primary impact. The form should therefore be considered in detail in the context of the surrounding scale and form of the dunes as well as the need to accommodate access roads and transmission lines and security patrolling of the secure areas.
- The side slopes should ideally be 1:3 but not steeper than 1:2. The landform on its long axis should be the same as that of the dune axis in the case of Thyspunt; for Bantamsklip the form is to be taken from the existing dune to the west and for Duynefontein the barchan dunes on the site. The direction of the prevailing wind and the way in which this has formed the dunes is an important consideration in order to reduce dust and fine sand from blowing into the works area.
- The top 300 mm of soil must be removed from the dump area and stockpiled nearby for later re-vegetation of the final dump.

9.25.8 Conclusions

The nuclear power station will exert a significant visual impact on the existing visual condition and character of the landscape at all three sites within a radius of 5 km. The meteorological and radio masts will be clearly visible on a cloudless day from at least 10 km away. The red light on top of the 120m high meteorological mast will be visible at night from beyond 10 km. The climatic conditions will influence the masts' visibility as cloudy or misty conditions can almost totally obscure these elements. This is due to the following:

- The scale and prominent position on the coast will make the nuclear power station a dominant feature in all three settings. The visibility from communities and residences within a 5 km radius is considered to be high. This includes the town of Pearly Beach for Bantamsklip, Oyster Bay and Cape St. Francis for Thyspunt and Duynefontein and Altantis for the Duynefontein site. Included are the various houses east and west of the first two sites.
- The landscape character and sense of place of the landscape setting will be irrevocably changed by the nuclear power station.
- The visual intrusion of the nuclear power station into views from the surrounding residential areas will be significant, because of the visual contrast and the direct line of sight.
- The general high quality scenic coastal views will be intruded upon by the large scale of the nuclear power station.
- The visual intrusion of the nuclear power station on the night scene is considered to be high, due to the concentration of light in an area that presently has no conspicuous lighting. The exception is the Duynefontein site where the illuminated area will increase northwards.

The large scale and prominent location of the nuclear power station on the coastline at all three sites allows little opportunity for effective visual mitigation. Particular visual aspects that relate to sites are as follows:

- Masts will be visible from further away than the nuclear power station, particularly at night, due to the flashing red light at the top. The mast will be slender, which will reduce its visual intrusion;
- Transmission lines within the EIA corridor will add to the visual intrusion of the project by their height and number;
- Access roads for Bantamsklip and Duynefontein will have negligible visual intrusion on the sense of place;
- Roads for Thyspunt will have the most negative impact on the sense of place, with the northern route identified as having the least negative impact as a result of it being visually integrated with the highly visible transmission lines, 2 x 400kV out and 1 x 132kV line in, as well as the HV Yard; and

- The spoil dumps are very large and have been considered to be placed within the EIA corridor. This position will result in the dumps being visually dominant and can serve as large screens of the nuclear power station in views from the provincial roads.

The potential cumulative impact of nuclear power station together with the proposed wind farm at Thyspunt directly to the north of the nuclear power station could be highly significant.

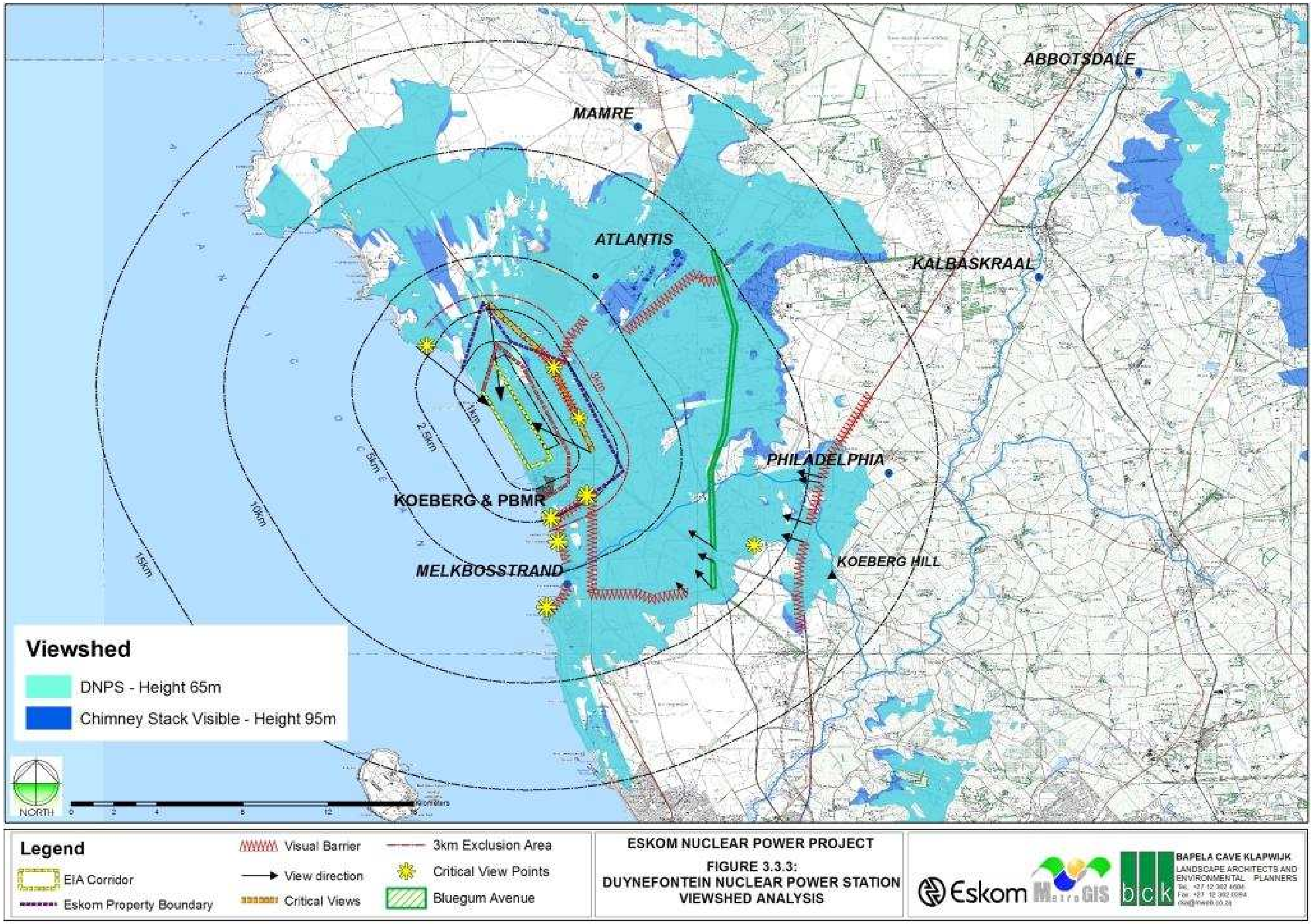

Figure 9-21: Duynefontein viewshed analysis

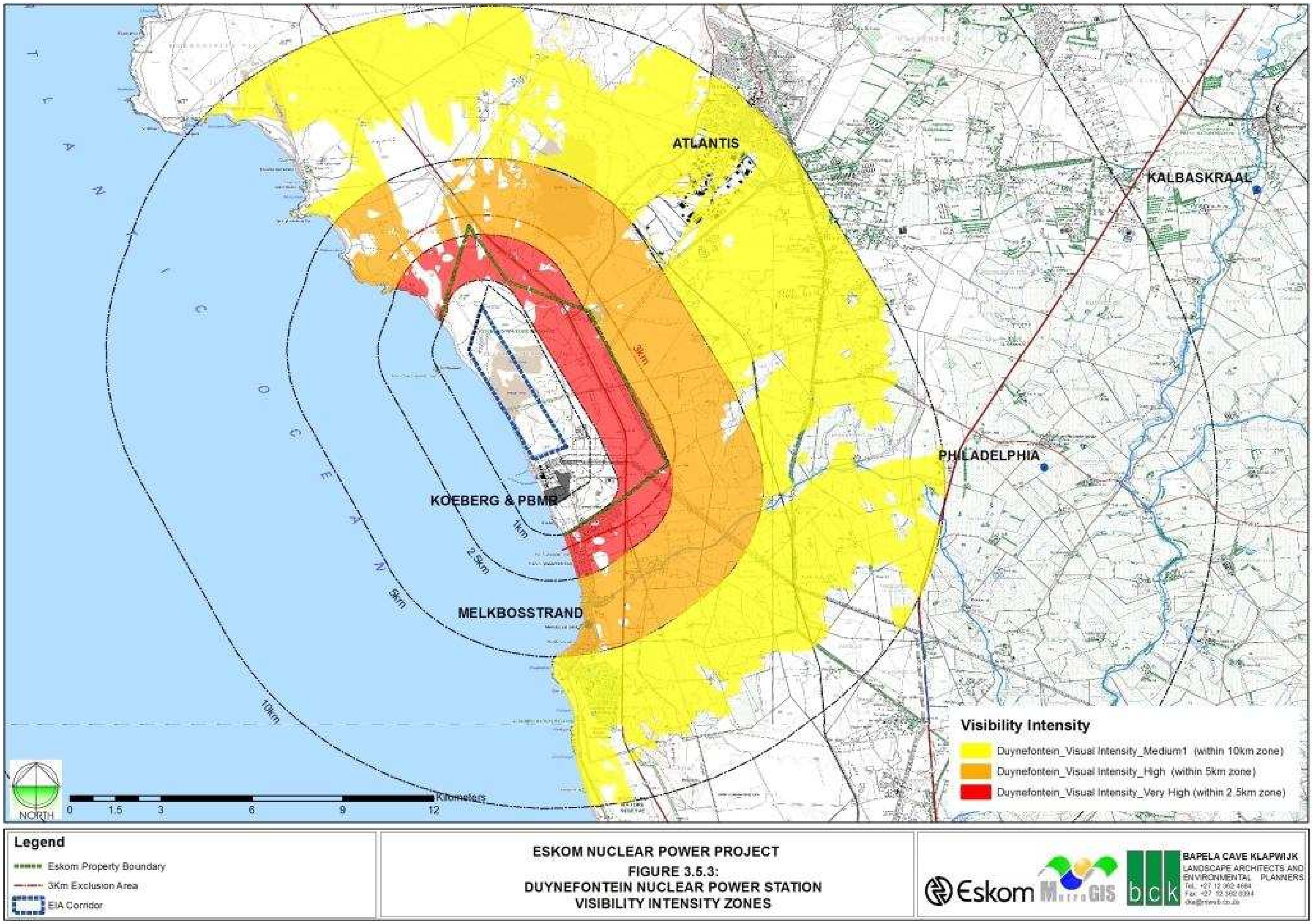

Figure 9-22: Duynefontein visibility intensity zones

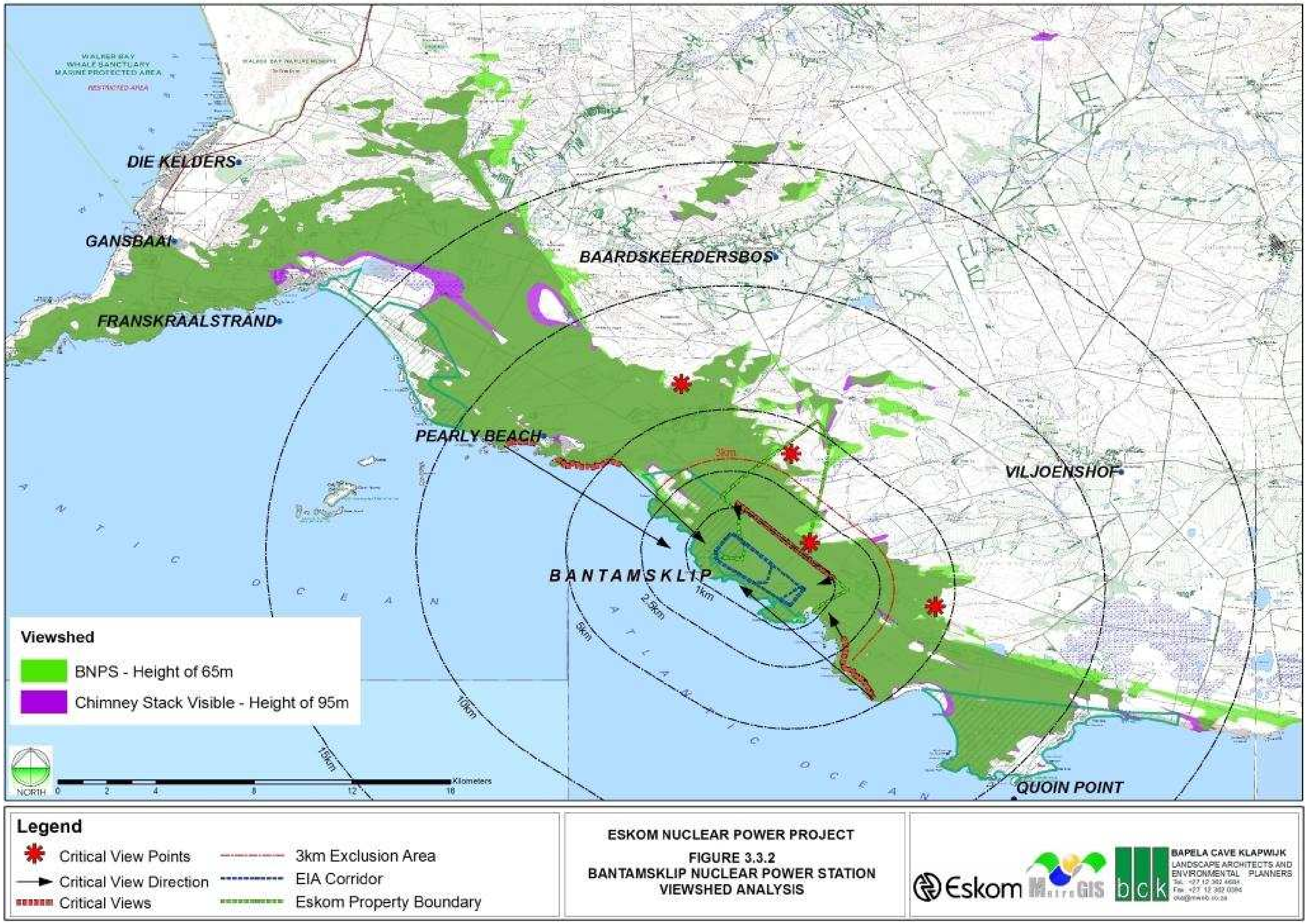

Figure 9-23: Bantamsklip viewshed analysis

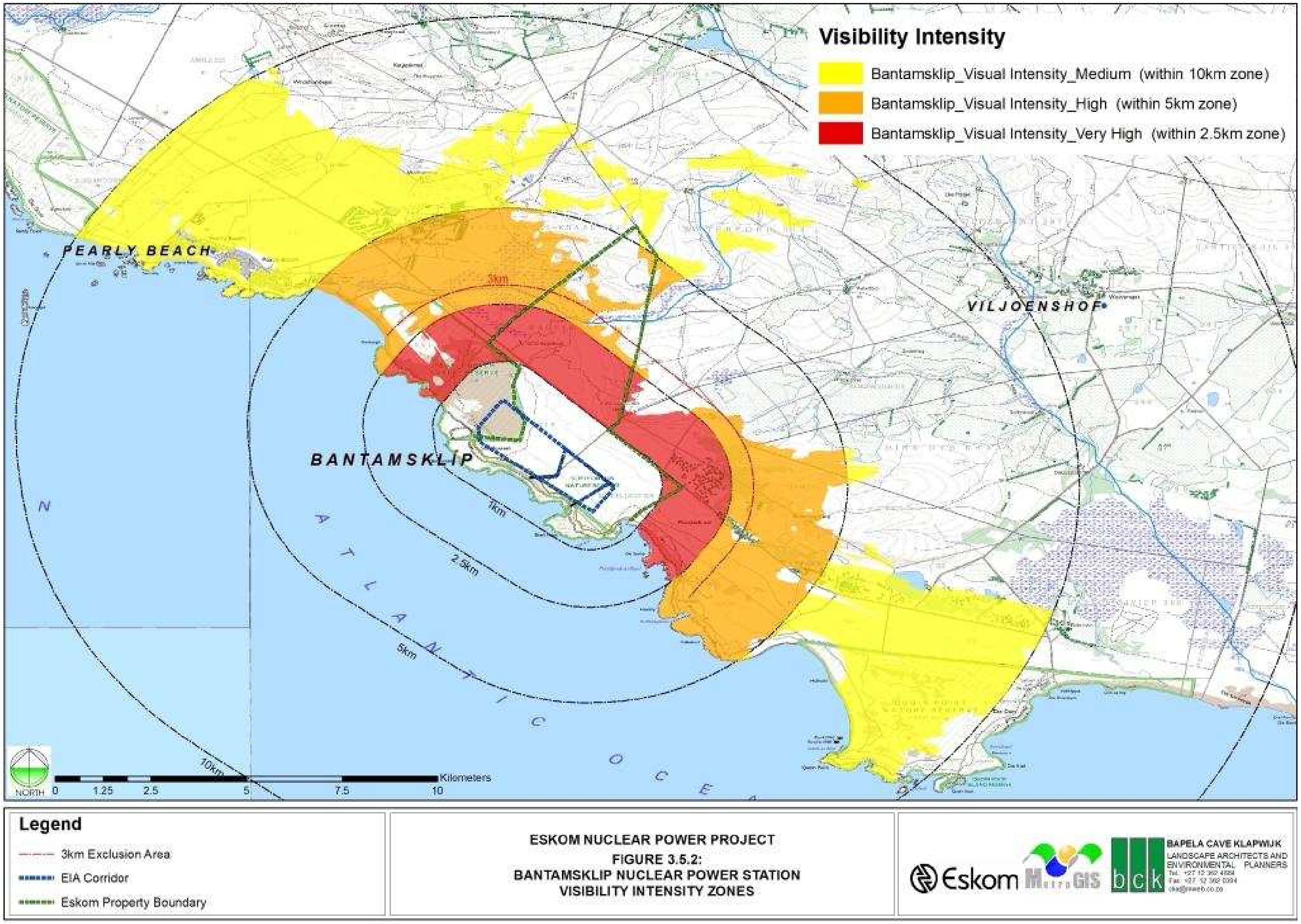

Figure 9-24: Bantamsklip visibility intensity zones

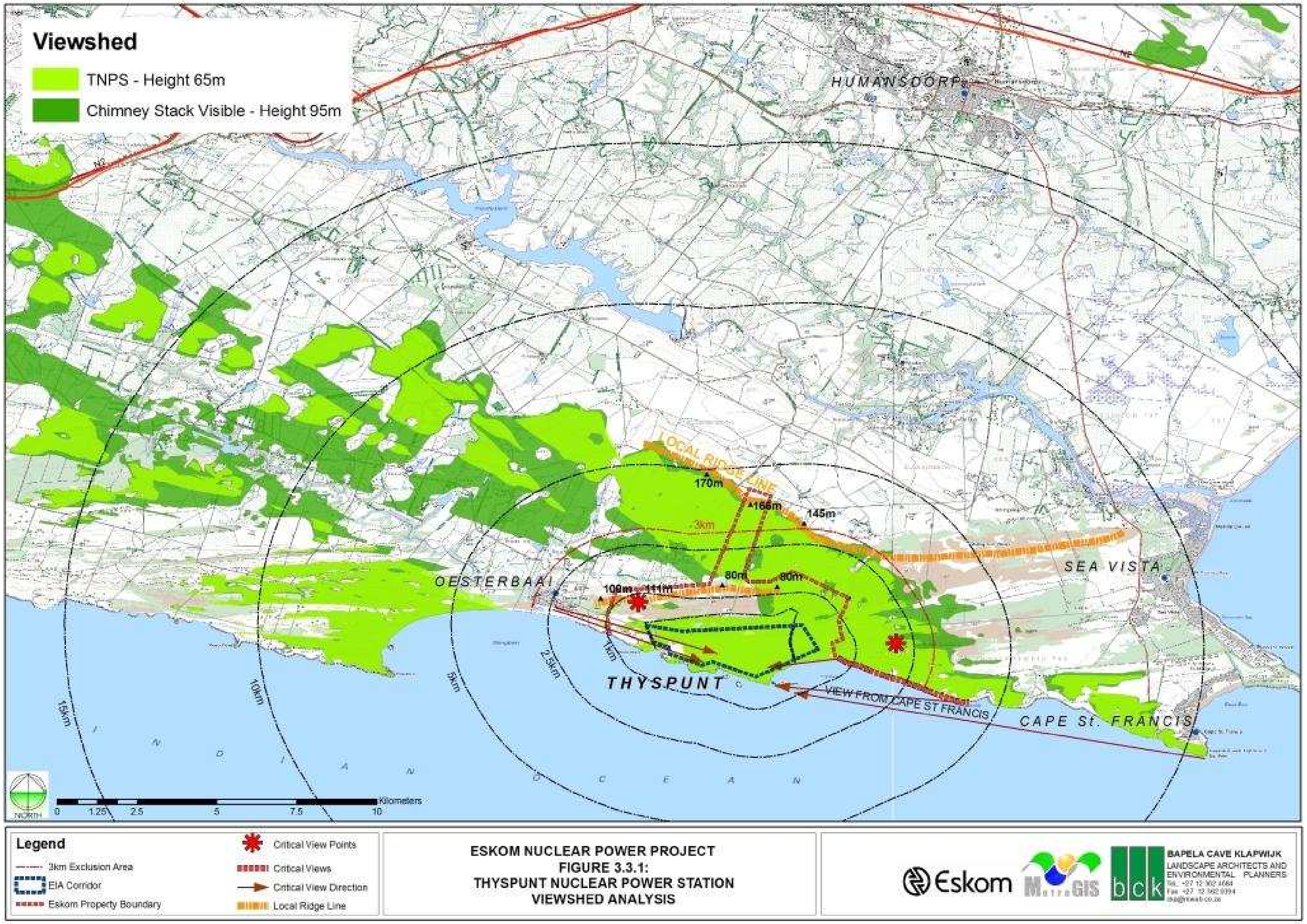

Figure 9-25: Thyspunt viewshed analysis

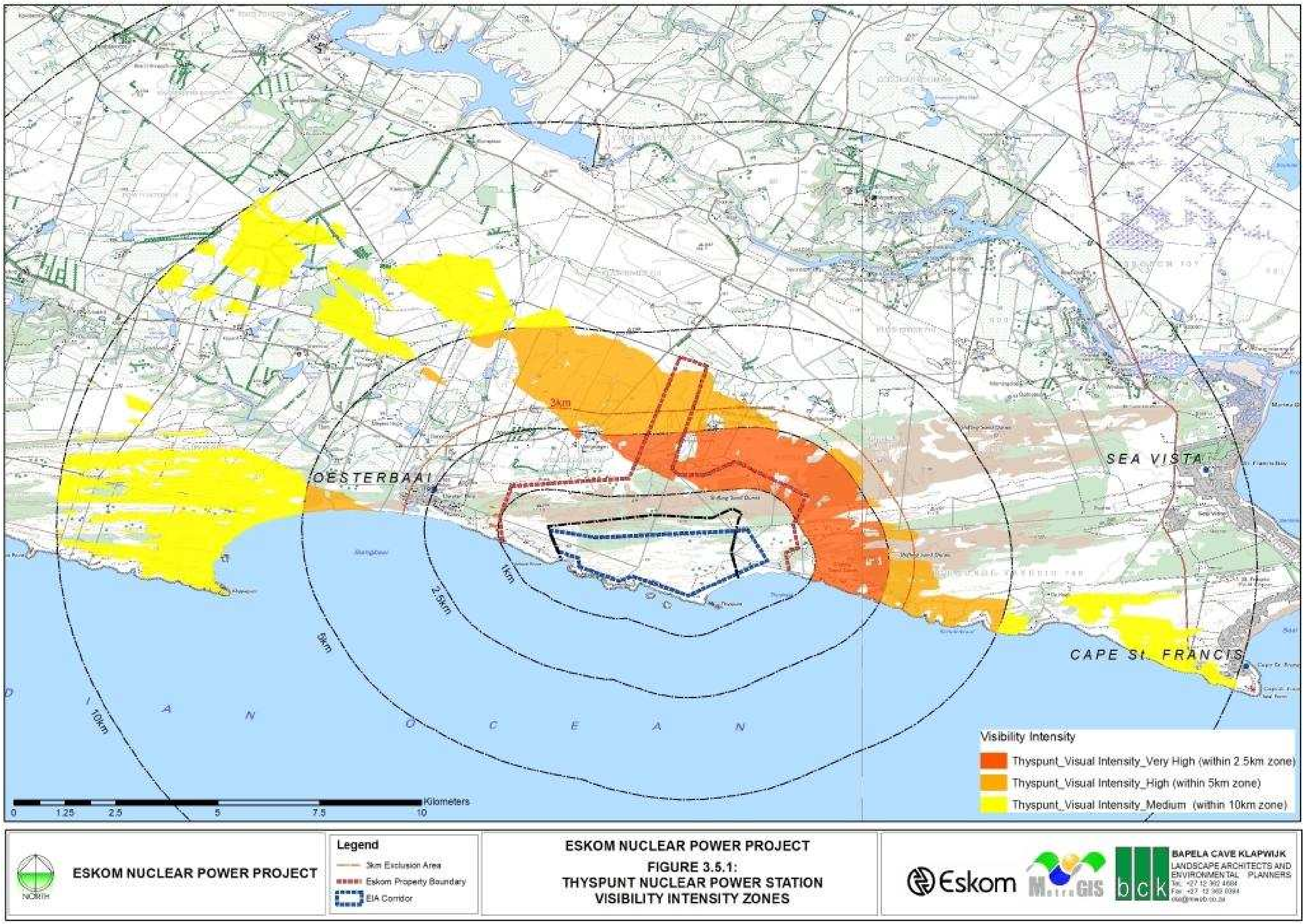

Figure 9-26: Thyspunt visibility intensity zones

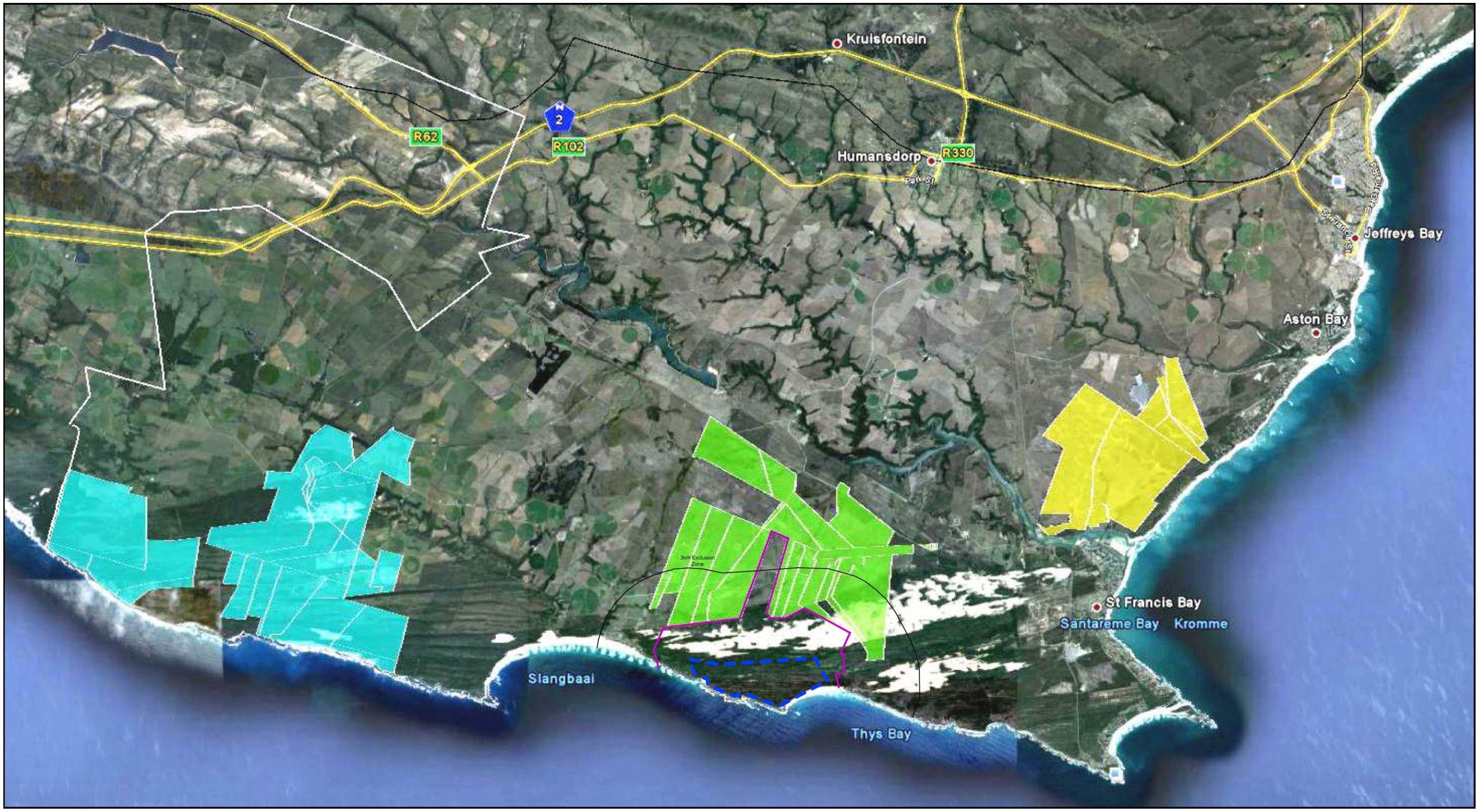

Figure 9-27: Proposed wind farm sites in proximity to Thyspunt (From BCK 2010)

Table 9-81: Visual impacts at all three alternative sites

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	Significance
Pre-construction phase								
1A: Visual intrusion of drill rigs and ancillary equipment	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Medium*	*Low*
2A: Visual degradation of vegetation clearance, access roads and site camps	*Negative*	*Low*	*Low*	*Low*	*Medium*	*Low*	*Medium*	*Low*
3A; Degradation of Sense of Place	*Negative*	*Low*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Low*
Construction Phase								
4A: Visible dust	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*Medium*	*Low*
5A: Degradation of visual quality resulting from change to vegetation and landform	*Negative*	*Low*	*Low*	*Medium*	*High*	*Medium*	*High*	*Medium*
6A: Visual clutter resulting from structures, site offices, laydown areas and site accommodation	*Negative*	*Low*	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*Low*
7A: Visual quality change cause by large spoil dumps	*Negative*	*Low*	*Medium*	*High*	*Medium*	*Low*	*High*	*Low - Medium*
8A: Visual alteration of night scene by lighting	*Negative*	*Medium*	*Medium*	*Medium*	*High*	*Medium*	*High*	*Medium*
9A: Visual change to Sense of Place	*Negative*	*Medium*	*Medium*	*Medium*	*High*	*Medium*	*High*	*Medium*
Operational Phase								

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	Significance
10A; Visual change to Sense of Place of local coastal and inland area due to large scale and extent of structures	***Negative***	***Medium***	***Medium***	***High***	***High***	***Medium***	***High***	***Medium***
11A: Change in visual quality of local area caused by new landforms and roads	***Negative***	***Medium***	***Medium***	***High***	***High***	***Medium***	***High***	***Medium***
12A; Change in visual quality of local night scene by lighting	***Negative***	***Medium***	***Medium***	***High***	***High***	***Medium***	***High***	***Medium***
Decommissioning Phase								
13A: Visible dust	***Negative***	***Low***	***Low***	***Medium***	***Low***	***Low***	***Medium***	***Low***
14A; Visual clutter resulting from structures, site offices and on site accommodation	***Negative***	***Low***	***Low***	***Medium***	***Medium***	***Low***	***Medium***	***Low***
15A; Visual change to local landscape due to earthworks and spoil dumps	***Negative***	***Medium***	***Medium***	***Low***	***Medium***	***Medium***	***High***	***Medium***
16A: Visual nuisance of heavy traffic on local roads	***Negative***	***Low***	***Medium***	***Medium***	***Low***	***Low***	***Medium***	***Low***

9.26 Social impacts

Impacts on the social environment are dealt with in the Social Impact Assessment specialist report contained in Appendix E18.

The discussion below includes impacts identified and assessed in the social impact assessment. To some extent there is an overlap between the assessment of potential impacts in this specialist study (discussed in this section) and other specialist studies, like the agricultural impact assessment, noise impact assessment and visual impact assessment. Rather than being regarded as duplications, the assessments of similar issues from different points of view are regarded as important and complimentary, because the issues are assessed differently depending on the background of the particular specialist, and because it is important to understand how I&APs perceive the possible potential impacts, whether on not these perceptions are based in fact. Where perceptions are not supported by objective and scientifically-based assessments, is pointed out.

The Social Impact Assessment (SIA) assessed the following categories of potential impacts:

- Accommodation of staff and construction workers;
- Influx of job seekers;
- Increase in number of informal illegal dwellings;
- Creation of employment opportunities;
- Business opportunities;
- Impact on criminal activities;
- Risk of STDs, HIV and AIDS;
- Municipal services;
- Traffic impacts;
- Noise and dust impact;
- Loss of employment after construction;
- Visual impacts;
- Impact on social infrastructure and facilities;
- Impact on sense of place;
- Future land use; and
- Perceived risks associated with nuclear incidents.

The identification and assessment of these issues in the SIA was based on the following:

- Issues identified during the scoping process;
- Planning and policy documents pertaining to the area;
- Interviews with key I&APs;
- The experience of the SIA specialist with social impacts in similar developments; and
- The experience of the author in the field of social assessment.

Owing to the fact that the nature of impacts is fairly similar across all three alternative sites, the potential impacts will not be discussed per site, as this would lead to unnecessary repetition. Instead, potential impacts will first be discussed generically, where after the difference in the consequence and significance of the impacts per site will be discussed.

9.26.1 Generic social impacts

(a) Accommodation of staff and construction workers

Large numbers of workers will place tremendous strain on the provision of temporary and permanent accommodation. The Vendor and Eskom staff requirements implicates an estimated influx of 3 837 workers (peak period) and their families to the nuclear power station project area. The total population influx is estimated at 10 500 people, to be accommodated on an area of approximately 167.2 ha.

A Construction Village will be required to accommodate approximately 3 750 people. The positioning of the Construction Village still needs to be determined, and is a sensitive issue with valuable opportunities and benefits, but also the potential for negative impacts on human well-being.

(b) Influx of job seekers

This potential impact deals with the influx of job seekers to the site during the construction phase. These job seekers, including those from areas outside the "local" area, enter the area with the hope of securing employment. When they do not secure employment, the potential exists that they will contribute to problems experienced with informal settlement, pressure on existing resources, services and infrastructure. The possibility further exists that they may contribute towards crime and other social problems such as alcohol abuse and prostitution.

(c) Informal developments and settlements

Related to the above–mentioned influx of people, there will be an increase in unplanned development and informal settlements surrounding the nuclear power station site. If not carefully managed, this type of uncontrolled development is also likely to result in an increase in an array of social pathologies such as crime, prostitution and alcohol and drug abuse.

(d) Creation of employment opportunities

The nuclear power station offers the potential for unemployed people to gain meaningful employment during the construction phase. It is estimated that the construction phase could take up to 9 years from the commencement of construction until commissioning of the nuclear power station. It is envisaged that at least 25 % of the construction workers will be sourced from the local labour force.

(e) Business opportunities

A significant number of business opportunities will be created for local companies / service providers and SMMEs. The utilisation of local suppliers and service providers can be promoted through local procurement and pro-active targeting processes via an open and transparent tender process for all construction related activities.

(f) Impact on criminal activities

The result of a large influx of people into the area as employees or in search of work could result in an increase in criminal activities. It is also possible that, during the construction phase of the project, an opportunistic criminal element may take advantage of increased activities in certain areas around construction sites.

(g) Increased risk of sexually-transmitted diseases

Due to the influx of construction workers and transport workers into the area, it is likely that there will be an increase in the prevalence of sexually-transmitted diseases (STDs), including HIV and AIDS. It is well documented that an increase in the risk of STDs is associated with an influx of workers, particularly migrant workers, and/or any increase in truck traffic into or through an area.

(h) Pressure on municipal services

The influx of construction personnel, operational personnel and others seeking economic opportunities will result in an increased demand for municipal services, including water, sanitation, roads, waste and waste removal. Increased vehicular movement during the construction phase may influence daily living and movement patterns of community members in the surrounding communities.

Provided that the tax base of local municipalities increases in parallel to the influx of people, the municipalities will be able to fund the increase in service provision, but inevitably there will be some people who will not enter the formal economy and will not pay rates and taxes. The limited availability of certain resources (e.g. water), also needs to be considered. According to the specialist report on water provision to the nuclear power station sites, there are severe limitations on the availability of fresh water, which is one of the prime reasons why Eskom has opted for desalination to provide fresh water for construction and operation.

(i) Noise and dust impacts

Increased levels of noise and dust may impact negatively on the quality of life of people living close to the proposed nuclear power station site and along transport routes close to the sites.

(i) Loss of employment after construction

Unskilled workers would lose their jobs once construction of the nuclear power station has been completed. Unless alternative employment is available, these workers will be left without income and may then become an additional burden on social services.

(i) Visual impact and change in the sense of place

The nuclear power station will change the visual character and quality of the local regions in which they are located. With the exception of Duynefontein, where there is already an adjacent nuclear power station, and which lies on the boundary of a metropolitan area, A nuclear power station at both other sites will result in a marked change in the sense of place, from primarily nature-based and agricultural to a noisy industrial environment, particularly during the construction phase. However, once construction has ceased, the planned maintenance of the Eskom property around the nuclear power station as a nature reserve (as evidenced at Koeberg), will to some extent (apart from the continued visual presence of the nuclear power station) return the natural sense of place to the area.

(j) Impact on land use

As indicated in Chapter 3 of this report, it is likely that, following final agreement from the NNR, that an Emergency Planning Zone of 800 m, within which no development may occur, will be established around the proposed power station. At all alternative sites, this zone will fall entirely within the Eskom owned property, and it would therefore have no direct impact on private development. At Duynefontein, the EPZ for the proposed Nuclear-1 nuclear power station will be substantially smaller than the current EPZ for Koeberg. The proposed power station would therefore not directly restrict future land use patterns outside the 800 m EPZ. The direct impact will relate to aspects such as ensuring proper and safe access to the power station and not to land use restrictions.

The proposed power station may lead to an indirect change in land use. It could well be that the presence of a power station will influence the nature of the land use in the vicinity in the same way as an industrial area influences its surroundings, however to a lesser extent than an industrial area, as there will be a distance of at least 800 m between the proposed power station and the closest development. It will thus be important that the development of the power station be planned for in a proper manner within the context of local and regional spatial development frameworks. At locations such as Thyspunt and Bantamsklip, where the power station is located in an undeveloped or remote area the change of land use might not occur at all, as there will be no .

It is therefore foreseen that the development of the power station is unlikely to result in the restriction of land uses, which cannot be appropriately dealt with through existing planning tools / legislation.

(k) Perceived risks of nuclear incidents

During the process of public consultation, it was stated clearly by various participants that they fear the impact of possible risks related to nuclear incidents. These risks are related to the following:

- Design safety;
- Nuclear accidents;
- Potential terrorist acts;
- Capacity and capability of people operating the nuclear power station;
- Strikes and labour unrest affecting daily management; and
- Reliability of communication flow, especially with reference to perception on potential risks and negative impacts on good health.

Given the generic impacts above that will apply to all three sites, the relative significance of the impacts at each site is discussed below.

9.26.2 Duynefontein

The area around the Duynefontein site may find it easier to accommodate large numbers of staff and construction workers than the other two sites, due to the development level of the area. A construction village will contribute positively to provide required accommodation for construction workers who do not have the option of alternative accommodation. Other developments in the area have the potential to absorb some of the influx of job seekers into the area. Municipal services and social infrastructure and facilities will experience additional strain. Implementation of mitigation measures is of high importance to cope with large numbers of people flowing into the area.

9.26.3 Bantamsklip

Accommodation for large numbers of staff and construction workers poses a serious problem, but can be mitigated. The erection of a construction village seems to be the preferred way to provide accommodation for construction workers, and should be done to enhance and support the building of sustainable human settlements. The exact location of the construction village, however, needs to be determined. The future of the construction village, after the construction phase has been completed, requires a proactive negotiated decision between Eskom and the local municipality. The influx of job seekers into the area will impact negatively on the rural character of the area, especially if an increase in the number of informal illegal dwellings is experienced. Municipal services and social infrastructure are inadequate to cope with the expected growth in the number of people working and living in the area. The implementation of mitigation measures is a pre-requisite to ensure proper provision of services and infrastructure.

9.26.4 Thyspunt

The situation in Thyspunt is very similar to that of Bantamsklip. However, the relative proximity of Humansdorp and Jeffreys Bay does offer some alternative options to address some of the impacts. Accommodation for large numbers of staff and construction workers poses a serious problem but can be mitigated. The erection of a construction village seems to be the preferred way to provide accommodation for construction workers, and should be done to enhance and support the building of sustainable human settlements. As in the case of Bantamsklip, the actual site for the village needs to be determined. The future of the construction village after the construction phase has been completed requires a proactive negotiated decision between Eskom and the local municipality. The influx of large numbers of job seekers into the area will impact negatively on the rural character of the area, especially if there is an increase in the number of informal illegal dwellings around the site and towards St. Francis Bay. Municipal services and social infrastructure are inadequate to cope with growth in the number of people working and living in the area. Implementation of mitigation measures is a pre-requisite to ensure proper provision of services and infrastructure.

9.26.5 The no-go alternative

In general, the "no-go" alternative will imply that virtually none of the identified impacts of proceeding with the project will be incurred for any of the three proposed alternative sites. Conversely, this alternative would also result in the benefits of the project not being realised. In addition, should the "no-go" alternative be selected, the positive impact of the nuclear power station on macro-economic performance indicators will be lost. The "no-development" development option would result in a significant loss in opportunity costs. The opportunity costs would include the loss of employment and business opportunities in both the construction and operation phases of the project.

The selection of the "no-development" alternative will also result in negative impacts of the project not being realised. Aspects like the inflow of unemployed job seekers, negative impact of perceived risks, additional pressure on service delivery, negative impacts on individual, family and community living and crime issues would not be realised if the "no-development" alternative were selected.

9.26.6 Mitigation and optimisation measures

Accommodation of staff and construction workers:

- ***Draw up the development and location criteria / conditions for the establishment of the staff, vendor and construction village;***
- ***Identify the suitable location for these facilities and draw up Site Development Plans in line with development planning legislation, policies and guidelines;***
- ***Follow a transparent public participation process with role-players and I&APs;***
- ***Make use of local labour and local suppliers of material for the construction as far as possible;***
- ***Monitor the situation after the occupation of these facilities and involve the relevant role-players in such processes; and***
- ***The accommodation facilities (including all associated infrastructure) should be located in such a manner that the buildings and facilities can be utilised by the surrounding community after the construction period, in order to ensure sustainability of such infrastructure.***

Influx of job seekers:

- ***A proactive, broad-based information campaign (including site notices) to clarify the number of job opportunities that will be available. The objective is to dispel rumours and unrealistic expectations and thereby seek to curtail the inflow/settlement of job seekers;***
- ***Proactive engagement by the appointed contractor(s) with local authorities/SAPS/Community Policing Forums PFs to ensure that job seekers do not settle in the vicinity of Construction Villages or the construction terrain;***
- ***Follow a transparent public participation process with role-players and I&APs;***
- ***Make use of local labour and local suppliers of material for the construction as far as possible; and***
- ***Monitor the situation after the occupation of the Construction Village, Staff Village and housing projects, and involve the relevant role-players in such process.***

Increase in number of informal illegal dwellings:

- ***Ensure that all discarded construction material that can be utilised to build informal structures, is properly disposed of after construction;***
- ***Ensure that any temporary accommodation utilised to house construction workers, is completely dismantled and properly disposed of after use, unless a different alternative exist;***

- ***Cooperate with local authorities to ensure that all legislation preventing illegal settlement, is enforced at all times; and***
- ***Ensure appropriate housing is available for staff***

Creation of employment opportunities:

- ***Establish a labour policy to facilitate the employment of locals where feasible and as far as possible, as well as clear gender equity criteria. The appointment of local labour should be a priority issue, with clear targets during the pre-construction phase. Targets must be clear for B-BBEE compliant suppliers and local employment. Care should be taken to avoid potential conflict between people in the immediate surroundings seeking employment and those from elsewhere. Therefore, the criteria for "local" must be clearly stated. Local can be defined as people living within the borders of the local municipality or within a specified distance from the site e.g. 20/20 km Criteria for 'local labour' be agreed in consultation with local community stakeholders and communicated before construction commences;***
- ***The number of workers required, as well as the specific skills required in respect of each worker, should be specified as soon as possible before the commencement of construction. An employment/skills registration agency or 'labour desk' should be established to identify prospective candidates who would meet the job specifications in consultation with the relevant local authorities. Such an agency/desk will need to take responsibility for accurate information dissemination at community level. It is important to determine the available skills in the area and the level of training required. Experience has shown that formalizing this process through such an agency avoids duplication, misrepresentation, confusion and unrealistic expectations. It is further important to clarify project time frames and when candidates from local communities are anticipated to be needed. The identification of such an agency must be done in consultation with the local community stakeholders;***
- ***Recruitment, and the placement of recruitment offices, must be done in such a way that nobody is excluded from the opportunity to apply for a job. Recruitment must be done in a way that is transparent, fair, equitable, cost-effective, competitive and without any favouritism and nepotism;***
- ***A labour skills, grading and assessment centre should be established to provide specific and relevant information on available employment. This should include the number and type of jobs, skills requirements for the jobs, duration of the jobs, remuneration scales, hours of work, conditions of work, procedures for the application of jobs, procedures for selecting job applicants, and training and certification available on the job. Where possible, on-the-job training should be provided to locals, to develop their existing skills and to ensure that they receive skills that are transferable to other sectors. Besides training directly done by Eskom, a process of coordination must be facilitated by Eskom to involve appropriate training providers with regards to targeting of employment and skills development initiatives;***
- ***Cooperation with provincial and district authorities is crucial;***
- ***Where feasible, create opportunities for the employment of women;***
- ***Where possible, use labour-intensive methods of construction;***
- ***Develop a community labour agreement with targets for employment and for career progression;***
- ***Remunerate beyond the minimum wage rate and invest in local staff; and***
- ***The Medupi Power Station Legacy Programme Mission must also apply to the new nuclear power station: "To ensure that the immediate socio-economic concerns of the local community are addressed. These being health and education infrastructure development, employment creation and procurement opportunities. At the same time the foundation for sustainable growth and development is laid through skills, enterprise and general infrastructure development."***

Business opportunities:

The following specific measures are suggested before commencement of construction in addition to during the construction process:

- ***Open tender processes, which include improved communication of tender opportunities through advertising in local community media (including the local radio station). Eskom and the main contractor must take up this responsibility before and during construction;***
- ***Expedite the process of registering local service providers on Eskom's procurement database as an ongoing concern. A supplier development programme can go a long way to assist local suppliers of goods and services with registration on Eskom's database. Assistance is required with meeting compliance standards and understanding tender requirements. Establish a Contractor Academy and incubator program as in the case at Medupi Power Station;***
- ***Provide information and create networks (e.g. through supplier forums and information office) regarding the types of business opportunities and economic spin-offs that may arise from the proposed development to the various structures and institutions actively involved in the first and second economy;***
- ***Eskom must set clear targets for B-BBEE compliance as a minimum requirement and local procurement; Include basic business and entrepreneurial skills as part of a skills development component of the development to ensure social capital development and empowerment of the local entrepreneurs;***
- ***Eskom must engage in participatory workshops in which interested members of local communities can be guided regarding types of business opportunities that could arise;***
- ***Investigate ways of enabling potential subcontractors from low-income areas to tender with the support of Red Door and other economic institutions;***
- ***Set up linkages for small business loans, as well as small business skills training. In this regard, the role of partnerships with other role-players who could assist in these matters, should be considered, (i.e. Red Door);***
- ***Closer interaction with institutions that could assist with provision of support to small businesses, including the possible identification of agencies that could assist with the provision of seed finance and entrepreneurial counselling (Red Door, LED Forum, Local Council); and***
- ***Feedback by Eskom to local suppliers and the broader community on numbers of local people employed, tenders awarded and business opportunities created to the advantage of the local community. This could strengthen the relationship between Eskom and the various role-players around the proposed nuclear power station***

Impact on criminal activities:

- ***The need to establish an Environmental Monitoring Committee (EMC) for the construction phase should be discussed with representatives from the local community. The role of the EMC would be to ensure that the conditions set out in the EMP are implemented and that they address any problems that arise, such as increase in thefts and burglaries associated with the construction workers. The South African Police Services (SAPS) as well as local appropriate policing should be urged by Eskom and the community forum, or a Social Monitoring and Steering Committee, to ensure that baseline statistics are available on a monthly basis regarding existing crime rates. This forum or committee should proactively engage with Eskom in developing mechanisms for the monitoring and distribution of information to counter potential community perceptions that there are perceived changes in the crime rate directly as a result of construction workers being in the immediate area;***
- ***Eskom should arrange meetings with residents associations, community-policing forums, as well as the local police staff to discuss contractors' plans, procedures, schedules and possible difficulties, and safety and security concerns. The number of meetings and the timing of these meetings need to be***

discussed with I&APs and a work plan needs to be put forward. Experience in other projects has shown that members of the community readily attribute crimes committed to the presence of construction workers, particularly where there are significant pre-existing levels of crime. This perception is entrenched by the actions of workers who may enter private properties to access taps or to ask domestic workers for water. Pro-active discussions between the contractor(s) and project proponent have proved effective in addressing concerns and putting possible preventative measures in place. Despite being simple, cheap and effective, a measure such as compelling workers to wear identification badges at all times is often not instituted or enforced by contractors to the discontent of local residents who find it impossible to separate workers from possible criminal 'elements';

- ***Should an EMC be established the option of drafting a code of conduct for contractors and construction workers should be considered;***
- ***The conduct of contract workers will have to be specified in worker related management plans and employment contracts by contractors and service providers. It is recommended that a peer-group based incentive/fine scheme, which has been successfully used in other projects to achieve compliance, be introduced. It is suggested that such a scheme should involve the introduction of a bonus before commencement of construction. A pre-designated group, e.g. the environmental officer and/or the local community/property owners and/or fellow workers monitor compliance/ transgressions. Every transgression carries a fine with a pre-determined value. These fines are subtracted from the bonus and the balance is divided between workers at the end of the construction period. All contraventions are displayed in the site-office together with the name of the "offender". The rationale for this system is to promote peer-group monitoring and penalizing. This has been effective on other projects, and also benefit from keeping the bonus at the maximum. In order to keep motivation levels high it could be a consideration that the bonus period be reduced to one year, or even six months.***

<u>Risk of STDs, HIV and AIDS:</u>

- ***In consultation with local and international HIV and AIDS organisations and government structures, design and implement an STD, HIV and AIDS awareness and prevention campaign. This campaign should utilise various common practice methodologies in order to ensure social and cultural sensitivity;***
- ***Where possible, attempt to minimise population influx by utilising local labour;***
- ***State STD and HIV and AIDS awareness and prevention programmes as a condition of contract for all suppliers and sub-contractors;***
- ***Provide an adequate supply of free condoms to all workers. Condoms should be located in the bathrooms and other communal areas on the construction site;***
- ***A voluntary counselling and testing programme should be introduced during the construction phase and should continue during operations; and***
- ***Undertake a voluntary STD and HIV and AIDS prevalence survey amongst all workers on a regular basis. This would involve a voluntary test made available to 100% of the workforce. The results of the survey will assist in determining the HIV and AIDS and STD strategy. When results are obtained (on assumption that the results are statistically representative), the results should be made available to management and workers at the same time. Results should be presented as statistical returns that ensure confidentiality.***

<u>Municipal services:</u>

- ***Liaise closely with the appropriate municipal, provincial and other relevant authorities;***
- ***Ensure that a proper plan is in place well before any development process commences;***

- ***Ensure that all essential services are in place prior to the development. In instances where it is evident that the capacity of existing municipal services will be exceeded by construction or operation of the proposed power station, Eskom and the responsible service providers must agree on the apportionment of responsibilities for the upgrade of this infrastructure prior to the start of construction.***
- ***Ensure that non-essential facilities are upgraded in accordance with the development;***
- ***Ensure that the implementation process is carefully monitored and that any disruptions are immediately identified and appropriately managed; and***
- ***Ensure that all affected communities is kept well informed of the process and of all significant dates attached to the development process.***

<u>Traffic impacts:</u>

- ***Mitigation for traffic impacts is dealt with in detail in the Traffic Impact Assessment (Appendix E23 of the Revised Draft EIR) and Section 9.25 of this Revised Draft EIR.***

<u>Noise and dust impacts:</u>

- ***Detailed mitigation measures are included in the relevant specialist assessments for air quality (Appendix E10) and noise (Appendix E23).***

<u>Loss of employment after construction;</u>

- ***Introduce training initiatives aimed at up-skilling, particularly unskilled and semi-skilled workers, during construction;***
- ***Absorb as many workers into the operational phase of the project as is feasible;***
- ***Transfer as many workers as possible to other related projects available;***
- ***Eskom's declared policy is to transfer construction workers from Nuclear-1 to Nuclear-2 as the construction phases are likely to overlap. Such transfers might not always be possible, depending on the location of Nuclear-2, but should nevertheless be maximised wherever possible in order to mitigate the perceived adverse impacts of unemployment once the construction phase of Nuclear-1 is completed; and***
- ***Introduce community self-help projects as part of the corporate social investment programme.***

<u>Visual impacts and impact on sense of place</u>

- ***Detailed mitigation measures are included in the relevant specialist assessments for visual impact (Appendix E19).***

<u>Impact on social infrastructure and facilities:</u>

Health care facilities

- ***The involved authorities, local municipality as well as the Department of Health should be notified about additional needs for medical care;***
- ***Proper planning processes should be followed and provision of medical facilities should be based on the sustainable human settlement strategy;***
- ***The provision of health facilities for all staff involved as proposed for the Construction Village and Staff Village will be vital to ensure a sustainable human settlement; and***
- ***As in the case of the Medupi Legacy Programme, Eskom with Government Partnerships could invest in health and related services.***

Law enforcement facilities:

- ***The involved authorities, local municipality as well as the SAPS should be notified about additional needs for law enforcement services; and***
- ***Proper planning processes should be followed and provision of law enforcement services should be based on the sustainable human settlement strategy.***

Educational facilities

- ***Provision should be made for schools to accommodate approximately 950 children into the area of the nuclear power station. This signifies that either existing schools should be enlarged, or a new schools should be built in the area where staff will be residing;***
- ***Eskom could continue with their investment in school development based on the example of the Medupi Legacy Programme;***
- ***The provision of schools for the children of all staff involved, as proposed for the Staff Village (and possible other areas), will be vital to ensure a sustainable human settlement; and***
- ***The relevant Department of Education should be made aware of the current schooling needs in the area as well as the potential impact that the proposed development will have on the status quo.***

Sport facilities

- ***The provision of sport facilities for all staff involved as proposed for the Construction Village and Staff Village will be vital to ensure a sustainable human settlement; and***
- ***Recreational facilities and sport facilities should be developed or contributed to, in order to cater for the increase in population in specific areas.***

<u>Future land use:</u>

- ***Follow a transparent public participation process with role-players and I&APs regarding future planning and land use needs;***
- ***After the location of the nuclear power station has been finalised, an intensive planning process should be engaged in order to:***
  - ***Ensure adherence to applicable legislation, e.g. environmental, water, roads, sustainability, etc.;***
  - ***Ensure revision of existing planning policy and guidelines at National, Provincial and Local level (e.g. IDPs, SDFs, WSDPs, ITPs, etc.);***
  - ***Ensure comprehensive and transparent public participation in all planning processes; and***
  - ***Optimise the creation of economic opportunities at all levels; and***
  - ***More detailed Spatial Development Plans should be developed as soon as the location has been finalised. These plans will also enable more detailed impact assessments to be done.***

<u>Perceived risks associated with nuclear incidents:</u>

- ***Due to the identified complexity of the community and the highlighted impact of public perceptions and image, the first mitigation measure is an active community-oriented and comprehensive public information campaign. The lack of information and the overwhelming amount of misinformation regarding nuclear power as a whole, and specifically Eskom's Nuclear-1 plans, has generated all manner of popular myth and worst-case scenarios, scepticism and doubt regarding the intentions and trustworthiness of Eskom;***
- ***The proposed public information campaign should address popular misconceptions regarding the Nuclear-1 programme, and specifically the impacts of nuclear power generation on the marine environment, the immediate environment and the sense of place. The better the communications are with the***

local communities, the more measured and balanced their reaction to a nuclear power station can be expected to be;

- ***A community-focused exercise in the provision of such public information in all three nuclear power station areas would contribute to offsetting many concerns, particularly environmental and biological issues. Most importantly, it would provide sufficient knowledge and time to the stakeholders and authorities to start adjusting their marketing strategies and brand focus, assisting to minimise the negative tourism impacts and optimising the benefits; and***
- ***Eskom's policy is to maintain and expand the existing nature reserves at each of the three sites. It should utilise these conservation areas as catalysts to increase tourism and overcome negative public perceptions. It could do this by, for example, establishing visitor information centres with lectures and films, promoting hiking trails, supporting with eco-tourism and conservation education, and working in unison with the Agulhas National Park and Grootbos Private Nature Reserve in the Bantamsklip area (should this site be approved) to further develop nature-based tourism.***

9.26.7

9.26.8 Conclusion

All the identified potential impacts are relevant to all three proposed sites. However, the degree to which particular impacts will affect the social environment around the sites and the resultant rating of potential impact significance will differ between the sites due to the nature of the social environment at each site.

At a social level, a number of important issues associated with the responsibility of generating and supplying a secure source of electricity, is applicable. The first of these issues concerns the scarcity of suitable sites on which to place new infrastructure as, due to rapid development in the Western and Eastern Cape (including rapid tourism development in the St. Francis area), the requirement to upgrade existing infrastructure and the availability of suitable sites are in contradiction. This paradox begs for a need to attempt to balance the interests and welfare of neighbouring communities with the national interests of a secure electricity network. To this end, it is important to select a suitable site and to find compromises to maintain the sense of place of the affected area or at least ensure that the potential impacts on the sense of place are effectively mitigated to the lowest possible level.

The most significant potential negative impacts that may result from the nuclear power station relates to accommodation for temporary workers, particularly during the construction period. The possibility of an influx of job seekers is also a reality. Temporary workers, combined with influx of unsuccessful job seekers, can have a number of social impacts. This includes*, inter alia,* conflict with local communities, apparent competition for employment and the possibility of single men engaging in relations with local women (possibly increasing the risk of STDs, HIV and AIDS and unwanted pregnancies resulting in fatherless children). A potential increase in criminal and other illegal activities cannot be excluded.

The most significant potential positive social impact that may be associated with the proposed nuclear power station development is the provision of electricity and its related linkages to the broader national and regional economies. Additional potential positive impacts that can be optimised through appropriate mitigation include provision of temporary employment, local business opportunities (SMMEs) and possible skills development during construction. Limited employment opportunities for locals exist during the operational phase. The significance and consequence is high in the context of high levels of poverty and unemployment characterising the social environment around the three proposed sites. The extent to which local employment creation during construction can truly be considered positive, depends on the extent to which local labour is utilised and capacitated during the construction process, as well as on ensuring optimal working conditions for labourers.

The most controversial potential impact relates to the perceived risks associated with nuclear incidents. From a social point of view, risk is a "subjective experience" which is felt by, and is different, for everyone. Perceived risks could lead to a change in attitude which, in turn, could change behaviour. It is therefore important to ensure a reliable flow of relevant and correct information in order for communities to differentiate between perceived and real risks.

Table 9-82: Summary of social impacts at Duynefontein during construction

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Accommodation during the construction phase	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Low*	*High*	*Medium*
1B: Mitigated	*Negative*	*Low*	*Low*	*Medium*	*Low*	*Low*	*High*	*Medium*
2A: Influx of job seekers	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
2B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*Low*	*Medium*
3A: Increase in informal illegal dwellings	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*	*Low*
3B: Mitigated	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*	*Low*
4A: Creation of employment opportunities	*Positive*	*High*	*High*	*Medium*	*Low*	*Medium*	*High*	*High*
4B: Optimised	*Positive*	*High*	*High*	*Medium*	*Low*	*Medium*	*High*	*High*
5A: Business opportunities	*Positive*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*High*	*Medium*
5B: Optimised	*Positive*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*High*	*Medium*
6A: Increase in criminal activities	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
6B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Low*
7A: Increase in sexually transmitted diseases	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
7B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Low*	*Medium*
8A: Water & sanitation	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
8B: Mitigated	*Negative*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*	*Low*
9A: Roads & transport	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
9B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Low*	*Low*
10A: Waste and refuse	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
10B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Low*	*Low*
11A: Traffic impacts	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
11B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Low*
12A: Noise impacts	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
12B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Low*	*Low*	*Medium*

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
13A: Loss of employment	*Negative*	*Medium*	*High*	*Low*	*Low*	*Medium*	*Medium*	*Medium*
13B: Mitigated	*Negative*	*Medium*	*High*	*Low*	*Low*	*Medium*	*Medium*	*Medium*
14A: Visual impact	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*High*	*Medium*
14B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*High*	*Medium*
15A: Medical infrastructure	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
15B: Mitigated	*Negative*	*Low*	*High*	*Medium*	*Low*	*Low*	*Low*	*Low*
16A: Law enforcement	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
16B: Mitigated	*Negative*	*Low*	*Medkum*	*Medium*	*Low*	*Low*	*Low*	*Low*
17A: Schools	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
17B: Mitigated	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*	*Low*
18A: Sport infrastructure	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
18B: Mitigated	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*	*Low*
19A: Sense of place	*Negative*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*	*Medium*
19B: Mitigated	*Negative*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Low*	*Medium*
20A: Future land use	*Positive*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
20B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*

Table 9-83: Summary of social impacts at Duynefontein during operation

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Creation of employment opportunities	*Positive*	*Low*	*High*	*Low*	*Low*	*Low*	*High*	*Medium*
1B: Mitigated	*Positive*	*Low*	*High*	*Low*	*Low*	*Low*	*High*	*Medium*
2A: Business opportunities	*Positive*	*Low*	*High*	*High*	*Low*	*Medium*	*Medium*	*Medium*
2B: Mitigated	*Positive*	*Low*	*High*	*High*	*Low*	*Medium*	*High*	*Medium*
3A: Increase in criminal activities	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*	*Low*

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
3B: Mitigated	***Negative***	***Low***	***Medium***	***Low***	***Low***	***Low***	***Low***	***Low***
4A: Water & sanitation	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
4B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Medium***	***Low***	***Low***	***Low***
5A: Roads & transport	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
5B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
6A: Waste and refuse	***Negative***	***Medium***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
6B: Mitigated	***Negative***	***Medium***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
7A: Visual impact	***Negative***	***Medium***	***Low***	***High***	***Low***	***Medium***	***High***	***Medium***
7B: Mitigated	***Negative***	***Medium***	***Low***	***High***	***Low***	***Medium***	***High***	***Medium***
8A: Medical infrastructure	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
8B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
9A: Schools	***Negative***	***Medium***	***Low***	***Low***	***Low***	***Medium***	***Low***	***Low***
9B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
10A: Sport infrastructure	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
10B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
11A: Sense of place	***Negative***	***Medium***	***Low***	***Low***	***Low***	***Medium***	***Low***	***Medium***
11B: Mitigated	***Negative***	***Medium***	***Low***	***Low***	***Low***	***Medium***	***Low***	***Medium***
12A: Future land use planning	***Positive***	***Medium***	***High***	***Medium***	***Medium***	***Medium***	***Medium***	***Medium***
12B: Mitigated	***Negative***	***Medium***	***High***	***Medium***	***Medium***	***Medium***	***Medium***	***Medium***
13A: Perceived risk of nuclear incidents	***Negative***	***Medium***	***High***	***High***	***Low***	***Medium***	***High***	***Medium***
13B: Mitigated	***Negative***	***Medium***	***High***	***High***	***Low***	***Medium***	***High***	***Medium***
14A: No-development option	***Negative***	***Medium***	***High***	***Medium***	***Low***	***Medium***	***High***	***Medium***

Table 9-84: Summary of social impacts at Bantamsklip during construction

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Accommodation during the construction phase	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
1B: Mitigated	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
2A: Influx of job seekers	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*High*	*Medium*
2B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
3A: Increase in informal illegal dwellings	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*	*Low*
3B: Mitigated	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*	*Low*
4A: Creation of employment opportunities	*Positive*	*Medium*	*High*	*Medium*	*Low*	*High*	*High*	*High*
4B: Optimised	*Positive*	*Medium*	*High*	*Medium*	*Low*	*High*	*High*	*High*
5A: Business opportunities	*Positive*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*High*	*Medium*
5B: Optimised	*Positive*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*High*	*Medium*
6A: Increase in criminal activities	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
6B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
7A: Increase in sexually transmitted diseases	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
7B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Low*	*Medium*	*Medium*
8A: Water & sanitation	*Negative*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
8B: Mitigated	*Negative*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*	*Low*
9A: Roads & transport	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
9B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Low*	*Low*
10A: Waste and refuse	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
10B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Low*
11A: Traffic impacts	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
11B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Low*
12A: Noise impacts	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
12B: Mitigated	*Negative*	*Low*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
13A: Loss of employment	*Negative*	*Medium*	*High*	*Low*	*Low*	*Medium*	*High*	*Medium*
13B: Mitigated	*Negative*	*Medium*	*High*	*Low*	*Low*	*Medium*	*Medium*	*Medium*
14A: Visual impact	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*High*	*Medium*
14B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*High*	*Medium*
15A: Medical infrastructure	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
15B: Mitigated	*Negative*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*	*Low*
16A: Law enforcement	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
16B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
17A: Schools	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
17B: Mitigated	*Negative*	*Medium*	*High*	*Low*	*Low*	*Medium*	*Medium*	*Low*
18A: Sport infrastructure	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
18B: Mitigated	*Negative*	*Medium*	*High*	*Low*	*Low*	*Medium*	*Medium*	*Low*
19A: Sense of place	*Negative*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Medium*	*Medium*
19B: Mitigated	*Negative*	*Medium*	*Medium*	*Low*	*Low*	*Medium*	*Medium*	*Medium*
20A: Future land use	*Positive*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
20B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*

Table 9-85: Summary of social impacts at Bantamsklip during operation

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Creation of employment opportunities	*Positive*	*Low*	*High*	*Low*	*Low*	*Low*	*High*	*Medium*
1B: Mitigated	*Positive*	*Low*	*High*	*Low*	*Low*	*Low*	*High*	*Medium*
2A: Business opportunities	*Positive*	*Low*	*High*	*High*	*Low*	*Medium*	*HMedium*	*Medium*
2B: Mitigated	*Positive*	*Low*	*High*	*High*	*Low*	*Medium*	*High*	*Medium*
3A: Increase in criminal activities	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*	*Low*

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
3B: Mitigated	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*	*Low*
4A: Water & sanitation	*Negative*	*Low*	*Low*	*Low*	*Medium*	*Low*	*Medium*	*Low*
4B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Medium*	*Low*	*Medium*	*Low*
5A: Roads & transport	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
5B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
6A: Waste and refuse	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
6B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
7A: Visual impact	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
7B: Mitigated	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
8A: Medical infrastructure	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
8B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
9A: Schools	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
9B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
10A: Sport infrastructure	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
10B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
11A: Sense of place	*Negative*	*Medium*	*High*	*Low*	*Low*	*Medium*	*Medium*	*Medium*
11B: Mitigated	*Negative*	*Medium*	*High*	*Low*	*Low*	*Medium*	*Medium*	*Medium*
12A: Future land use planning	*Positive*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
12B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
13A: Perceived risk of nuclear incidents	*Negative*	*Medium*	*High*	*High*	*Low*	*Medium*	*High*	*Medium*
13B: Mitigated	*Negative*	*Medium*	*High*	*High*	*Low*	*Medium*	*Medium*	*Medium*
14A: No-development option	*Negative*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*

Table 9-86: Summary of social impacts at Thyspunt during construction

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Accommodation during the construction phase	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*High*	*Medium*
1B: Mitigated	*Negative*	*Medium*	*Low*	*Medium*	*Low*	*Medium*	*High*	*Medium*
2A: Influx of job seekers	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*High*	*Medium*
2B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
3A: Increase in informal illegal dwellings	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Medium*	*Low*
3B: Mitigated	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Medium*	*Low*
4A: Creation of employment opportunities	*Positive*	*Medium*	*High*	*Medium*	*Low*	*High*	*High*	*High*
4B: Optimised	*Positive*	*Medium*	*High*	*Medium*	*Low*	*High*	*High*	*High*
5A: Business opportunities	*Positive*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*High*	*Medium*
5B: Optimised	*Positive*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*High*	*Medium*
6A: Increase in criminal activities	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
6B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
7A: Increase in sexually transmitted diseases	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
7B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Low*	*Medium*
8A: Water & sanitation	*Negative*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
8B: Mitigated	*Negative*	*Medium*	*High*	*Low*	*Medium*	*Medium*	*Medium*	*Low*
9A: Roads & transport	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
9B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Low*
10A: Waste and refuse	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
10B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Low*
11A: Traffic impacts	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
11B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Low*
12A: Noise impacts	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
12B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
13A: Loss of employment	*Negative*	*Medium*	*High*	*Low*	*Low*	*Medium*	*High*	*Medium*
13B: Mitigated	*Negative*	*Medium*	*High*	*Low*	*Low*	*Medium*	*Medium*	*Medium*
14A: Visual impact	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*High*	*Medium*
14B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*	*High*	*Medium*
15A: Medical infrastructure	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
15B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Low*
16A: Law enforcement	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
16B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
17A: Schools	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
17B: Mitigated	*Negative*	*Medium*	*High*	*Low*	*Low*	*Medium*	*Medium*	*Low*
18A: Sport infrastructure	*Negative*	*Medium*	*High*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
18B: Mitigated	*Negative*	*Medium*	*High*	*Low*	*Low*	*Medium*	*Medium*	*Low*
19A: Sense of place	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
19B: Mitigated	*Negative*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
20A: Future land use	*Positive*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
20B: Mitigated	*Positive*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*

Table 9-87: Summary of social impacts at Thyspunt during construction

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
1A: Creation of employment opportunities	*Positive*	*Low*	*High*	*Low*	*Low*	*Low*	*High*	*Medium*
1B: Mitigated	*Positive*	*Low*	*High*	*Low*	*Low*	*Low*	*High*	*Medium*
2A: Business opportunities	*Positive*	*Low*	*High*	*High*	*Low*	*Medium*	*Medium*	*Medium*
2B: Mitigated	*Positive*	*Low*	*High*	*High*	*Low*	*Medium*	*High*	*Medium*
3A: Increase in criminal activities	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*	*Low*

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	SIGNIFICANCE
3B: Mitigated	*Negative*	*Low*	*Medium*	*Low*	*Low*	*Low*	*Low*	*Low*
4A: Water & sanitation	*Negative*	*Low*	*Low*	*Low*	*Medium*	*Low*	*Medium*	*Low*
4B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Medium*	*Low*	*Medium*	*Low*
5A: Roads & transport	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
5B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
6A: Waste and refuse	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
6B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
7A: Visual impact	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
7B: Mitigated	*Negative*	*High*	*Low*	*High*	*Medium*	*Medium*	*High*	*Medium*
8A: Medical infrastructure	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
8B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
9A: Schools	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
9B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
10A: Sport infrastructure	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
10B: Mitigated	*Negative*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*	*Low*
11A: Sense of place	*Negative*	*Medium*	*High*	*Low*	*Low*	*Medium*	*Medium*	*Medium*
11B: Mitigated	*Negative*	*Medium*	*High*	*Low*	*Low*	*Medium*	*Medium*	*Medium*
12A: Future land use planning	*Positive*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
12B: Mitigated	*Negative*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*
13A: Perceived risk of nuclear incidents	*Negative*	*Medium*	*High*	*High*	*Low*	*Medium*	*High*	*Medium*
13B: Mitigated	*Negative*	*Medium*	*High*	*High*	*Low*	*Medium*	*Medium*	*Medium*
14A: No-development option	*Negative*	*Medium*	*High*	*Medium*	*Medium*	*Medium*	*Medium*	*Medium*

9.27 Suitability of transport systems

Impacts on transport systems are dealt with in the Transport Impact Assessment specialist report contained in Appendix E25.

9.27.1 Overview of potential transport impacts

The construction phase of a nuclear power station at any location will require the transportation of equipment, people and materials to and from site. Transportation for a nuclear power station construction project, other than normal construction projects, requires the transport of abnormal loads to the sites. The heaviest load to be transported to the sites will be a “Self Propelled Modular Transporter” (SPMT) as indicated in **Figure 9-23** and **Figure 9-24**. An SPMT’s dimensions are approximately 42 m in length and can be either 5.33 m (two trailers wide) or 8.23 m (three trailers wide) in width.

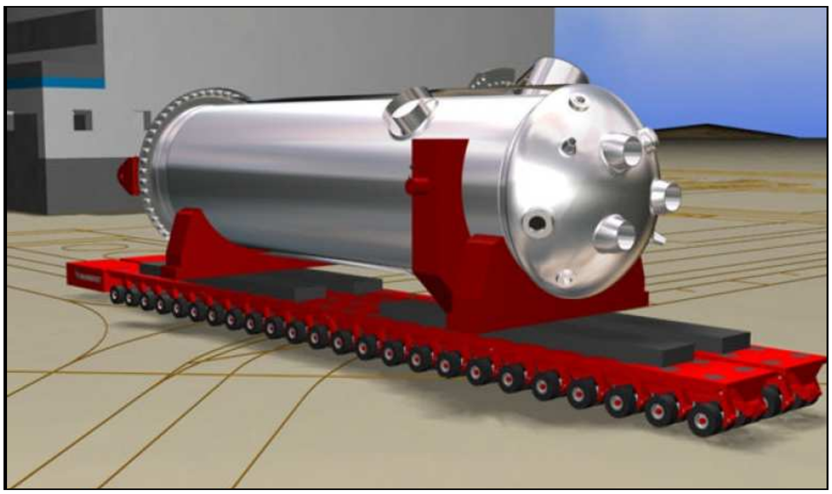

Figure 9-28: Graphic representation of an SPMT

Figure 9-29: A SPMT utilising the entire width of a road

The transportation impact assessment assessed the ability of the current transport systems, including roads and harbours, to accommodate the expected construction and operational traffic to and from the nuclear power station sites and recommends upgrades that need to be made in order to cater for the expected increase in the volume and nature of traffic.

The following construction phase impacts were identified ***in the Transport Assessment***:

- Daily construction related transport impacts:
  - Access;
  - Traffic analysis;
  - Parking;
  - Public transport; and
  - Non-motorised transport.
- Impacts of ***abnormal*** load transport to the Nuclear-1 site; and
- Emergency evacuation impacts.

The following operational phase impacts were identified:

- Normal daily transport impacts
  - Access;
  - Traffic analysis;
  - Parking;
  - Public transport; and
  - Non-motorised transport.
- Low to medium nuclear waste transport;
- Emergency evacuation impacts; and
- Air and shipping route impacts

All road access roiutes to the alternative sites are technically feasible, provided that the recommended upgrading of transport infrastructure and provision of vehicles takes place as recommended in the Transport Assessment (Appendix E25).

No significant constrainst were identified with respect to the road access points to Bantamsklip and Duynefontein, or with respect to other modes of transport. However, the transport routes to and from the Thyspunt site were identified as a significant concern by I&APs during 2010, when the Draft EIR was provided for comment. The discussion below is therefore focused on the Thyspunt transport issues.

Recommended mitigation measures are provided for all three sites.

9.27.2 Thyspunt access roads

(a) Proposed access

The NSIP Eastern Cape Summary Report (Eskom, 1994) identified two access routing options from Humansdorp to Thyspunt. One of the access route options identified is via the untarred Oyster Bay Road from Humansdorp towards Oyster Bay (Route 1). A new road will then have to be constructed from the Oyster Bay Road, approximately 5 km from Oyster Bay, crossing the mobile dune system towards the site.

The second access route option is via the R330 towards St. Francis Bay, with new surfaced road being constructed from the R330 after the Krom River crossing towards the site, crossing the mobile dune system (Route 2).

It has been proposed by Eskom that both routes be utilised during the construction period, with route 2 being mainly used by heavy and ***abnormal*** vehicles and route 1 and 2 being utilised for commuter construction traffic.

Several routes have been investigated to Aaccess to the construction site from Port Elizabeth harbour via the N2 and R102 as shown in Figure 10.1:

- ***Route 1 – R102 through Saffrey Street, R330 to Oyster Bay Road***
- ***Route 2 - R102 through Saffrey Street to the R330***
- ***Route 3 – N2 through the R62 interchange, along the R102 to access road west of the Impofu Dam***
- ***Route 4 – N2 through the R62 interchange, along the R102 to access road east of the Impofu Dam***

The routes were assessed in meeting the requirements of a main access route and a secondary access route as described above. In addition route lengths and impact on settlements were assessed. Route 3 (approx. 85km) and Route 4 (approx. 83km) are considerably longer than Routes 1 and 2 (approx 55km). In addition, the vertical alignment of Route 2 (R330) is much easier to traverse for heavy vehicles than the other routes. Using two routes reduces the overall impact of construction traffic compared to using a single route.

It is recommended that the R330 be used as the main access route and that the Oyster Bay Road be used as a secondary construction route (for smaller construction vehicles and construction workers).

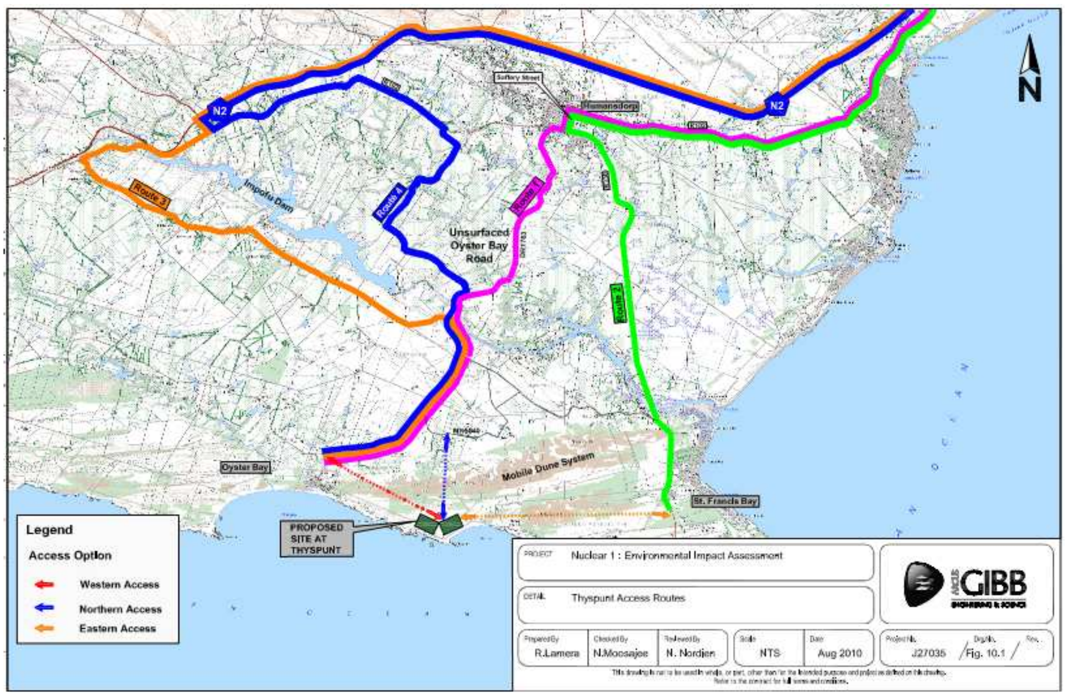

Figure 9-30: Alternative access routes from the N2 investigated for the Thyspunt site

A link between the R330 and route E3 north of St, Francis Links development was considered as traffic would not impact the development. However, this area has been excised from development during the planning of the St. Francis Links estate by the Department of Environmental Affairs as being too environmentally sensitive, therefore this link was not recommended.

(b) Heavy and abnormal loads

Revision 1 of the NSIP Eastern Cape Summary Report (Drennan *et al*. 1988) investigated the feasibility of transporting heavy loads from Port Elizabeth Harbour to the Thyspunt site.

According to this study, no off-loading crane facility exists at Port Elizabeth harbour and either Roll-on-Roll-off vessels or vessels with high capacity ship's derricks would have to be used. Port Elizabeth Harbour is the closest harbour with the infrastructure capabilities to load and offload heavy loads and should be used to transport abnormal loads to Nuclear-1. The main section of the abnormal vehicle route will be from Port Elizabeth Harbour, via the N2 and through Humansdorp via the R330 to the site.

A preliminary assessment of the route from Port Elizabeth Harbour to the site was undertaken as part of the Transport Assessment. The preliminary assessment indicated that the structures (including the Van Staden Bridge) will cope with the additional loads. Alternative routings have also been investigated, including accessing the R330 directly from the N2 / Humansdorp Main Rd intersection instead of driving through the Humansdorp CBD.

The turning circles required for the abnormal load vehicle does not currently allow for the access from the N2 to the off ramp to Humansdorp Main Road and significant intersection geometry upgrades would be required, as shown in the figures below.

Figure 9-31: ***Abnormal load vehicle turning circle exiting N2 onto R330***

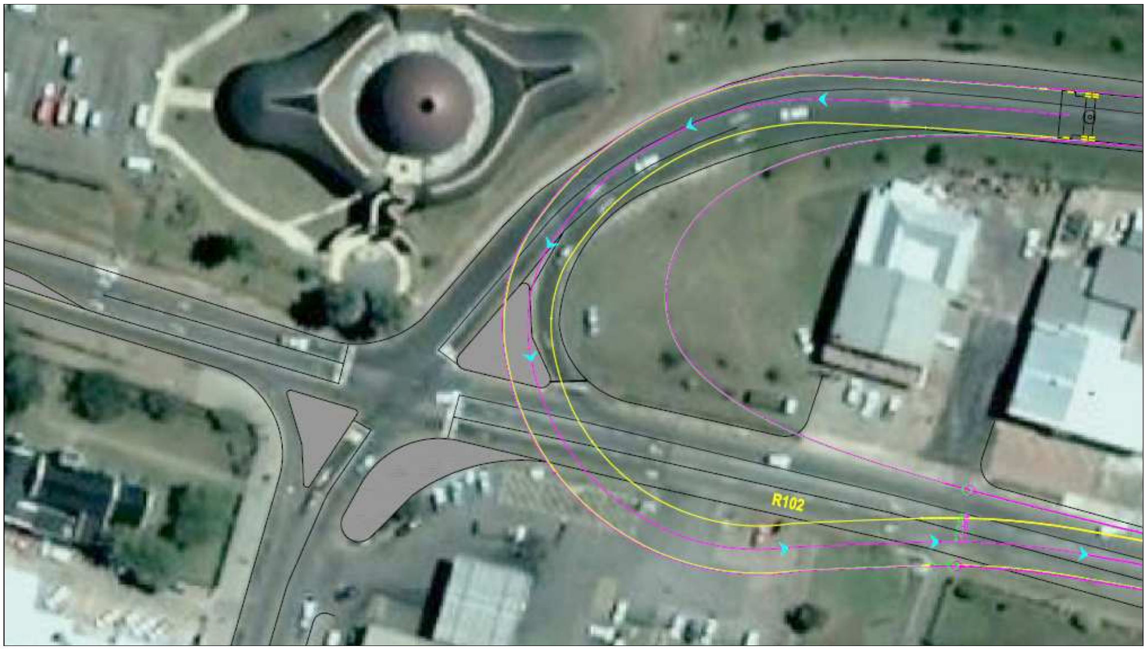

Figure 9-32: ***Abnormal load vehicle turning circle for the R330 and R102 intersection***

From the R102, the route would follow Saffery Road south, before rejoining the R330 to the southeast pf the Humansdorp CBD.

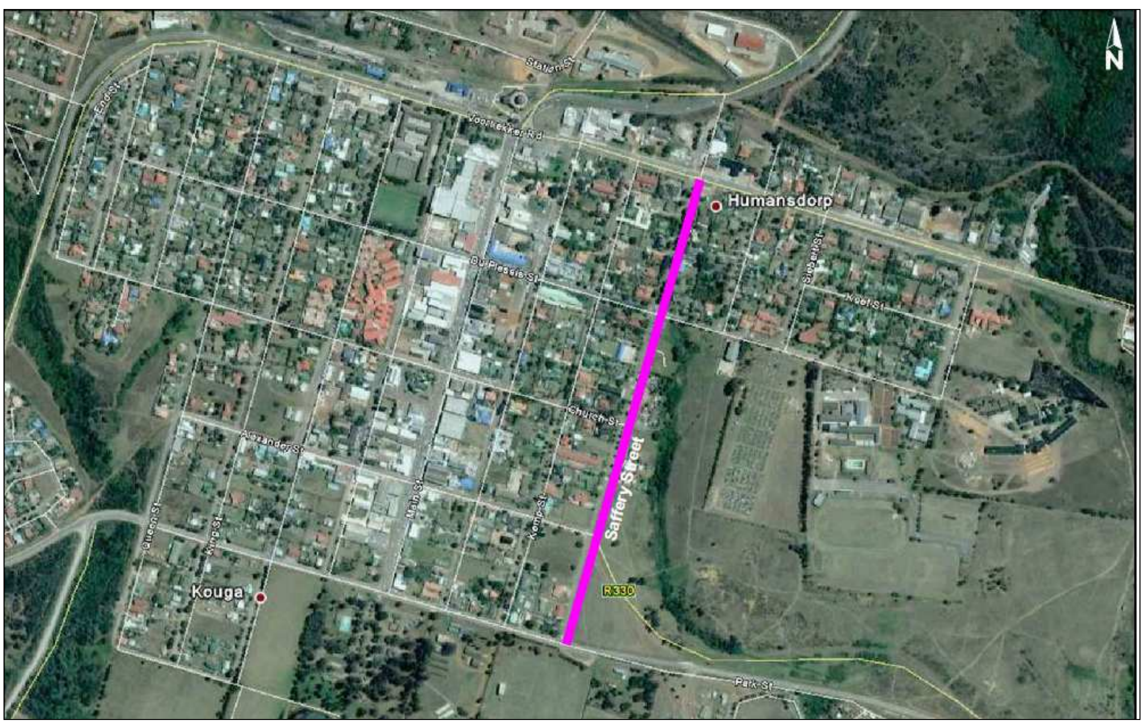

Figure 9-33: ***Alternative heavy vehicle access route avoiding the Humansdorp CBD***

9.27.3 Mitigation measures

(a) Duynefontein

<u>Construction phase mitigation</u>

- ***Construct a level crossing over the railway line at Saldanha Bay Harbour;***
- ***Upgrade two unsurfaced road sections at Saldanha Bay Harbour;***
- ***Three intersection widening upgrades at Saldanha Bay Harbour;***
- ***Construction of a bypass upstream of the Modder River Bridge to traverse the Modder River;***
- ***Construction of an access road to Nuclear-1 off the existing Emergency Access Road to the Nuclear-1 site;***
- ***Abnormal loads be transported during off-peak periods particularly during the night (21h00-0h500).***
- ***The R27 pavement to be investigated to determine its remaining life as well as the impact of construction traffic during the construction phase.***
- ***The R27 / Main Access Road intersection should be upgraded to a signalised intersection as shown in Figure 8.3 of the Transport Assessment.***
- ***The R27 / Napoleon Street intersection should be upgraded to a signalised intersection, as shown in Figure 8.5 of the Transport Assessment. If Access 1 is grade separated then the signalisation of this intersection may not be required. These options are to be discussed with the Provincial Government of the Western Cape 9PGWC);***
- ***The R27 / Access 2 intersection should be upgraded to a temporary signalised intersection as shown in Figure 8.9 of the Transport Assessment. If Access 1 is grade separated, then the signalisation of this intersection may not be required and requires further investigation. These options are to be discussed with the PGWC;***
- ***Relevant signage, street lighting and a reduction of the speed limit from 120 km/hr to 80 km/hr is required to be constructed along the R27 approaching the proposed signalised upgrades of the above-mentioned intersections;***
- ***900 temporary parking bays should be provided;***
- ***The "Koeberg Nuclear Power Station Emergency Plan: Transport Modelling & Evacuation Management Plan" should be updated to include the evacuation of the 6000 Nuclear-1 construction workers; and***
- ***A comprehensive Construction Traffic Management Plan should be completed, in conjunction with the authorities, for the duration of the construction period.***

<u>Operational phase mitigation</u>

- ***Access Road 2 should be used to access Nuclear-1; and***
- ***950 permanent parking bays are to be provided.***

(b) Bantamsklip

<u>Construction phase mitigation</u>

- ***Approximately 600 temporary parking bays should be provided;***
- ***Minibus taxis and buses should be provided to shuttle construction workers to the site;***
- ***Construction of the main access off the R43 to the Nuclear-1 site is required;***
- ***The remaining pavement life of the R43 shall be investigated and the possible improvement of the pavement shall be investigated to support the additional traffic generated during the construction phase.***

- ***A suitable site along the coast near the Bantamsklip site should be identified to allow loading and off-loading of a barge[22], which is proposed to transport heavy loads from Cape Town harbour to the site. A landing facility would be required to be constructed at the appropriate location; and***
- ***A comprehensive Construction Traffic Management Plan should be completed with the relevant authorities before construction commences.***

<u>Operational phase mitigation</u>

- ***The upgrading of the DR1206 to a surfaced road should be considered. The emergency evacuation plan should give guidance;***
- ***950 permanent parking bays are to be provided;***
- ***A total of 30 minibus taxi and 4 bus trips per day need to be provided to transport the Nuclear-1 staff;***
- ***A detailed emergency evacuation plan should be compiled for the Bantamsklip Nuclear-1 site;***
- ***The Bantamsklip site requires the promulgation of a new Restricted / Danger / Prohibited area for the air space over the proposed nuclear power station; and***
- ***The Bantamsklip site requires an application to be put forward to create an internal water exclusion zone required for a nuclear power station as per the Sea Shore Act (No.21 of 1935).***

(c) Thyspunt

<u>Construction phase mitigation</u>

- ***It is recommended that the R330 be used as the main access route, and Oyster Bay Road be used as the secondary construction route (for smaller construction vehicles and construction workers).***
- ***The Oyster-Bay road (DR1763) should be upgraded to a surfaced road to allow access to the site from the west;***
- ***Grade separated structures should be constructed for the communities of Umzamawethu and Kwanomzamo to mitigate the increased road safety risks as a result of high construction volumes.***
- ***An eastern access road off the R330 towards the site is required to be built;***
- ***A new western access is required to be built to connect the site to the DR1763;***
- ***The Main Street / Jeffrey's Bay Access Road intersection should be upgraded to a signalised intersection.***
- ***It is recommended that the bulk of abnormal loads be transported during the evening (21h00-0h500) and in daylight hours during the off-peak periods.***
- ***Investigation of the remaining pavement life for the R330 and upgraded as required to accommodated construction traffic over the construction period.***
- ***The DR1763 should be upgraded to accommodate heavy construction vehicle traffic***
- ***Five undred and seventy six temporary parking bays should be provided on site;***
- ***A comprehensive Construction Traffic Management Plan should be completed in conjunction with the traffic authorities.***

<u>Operational phase mitigation</u>

- ***The upgraded Oyster Bay Road is required to facilitate the evacuation of areas to the west of the site in an event of an emergency at Nuclear-1;***
- ***950 permanent parking bays must be provided on the site;***

[22] ***The proposed requirement for barging, with its resultant impacts on the coastline, weighs heavily against Bantamsklip as a preferred site for Nuclear-1. Details of the landing facilities and barge operation were not assessed in the EIA process for Nuclear-1. Should barging be seriously considered, the landing facilites would be required to undergo an EIA process in their own right.***

- ***A total of 24 minibus taxi and 4 bus trips per day need to be provided to transport the Nuclear-1 staff;***
- ***A detailed emergency evacuation plan should be compiled for the Thyspunt Nuclear-1 site; and***
- ***The Thyspunt site requires the promulgation of a new Restricted / Danger / Prohibited area for the air space over the proposed nuclear power station.***
- ***The Thyspunt site would require an application to be put forward to create an exclusion zone for ships required for a nuclear power station in terms of the Sea-Shore Act (No. 21 of 1935)***

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9.27.4 Conclusions

The Duynefontein site does not require significant upgrades during the construction and operational phases of Nuclear-1 with regard to intersection upgrades and heavy load transport road upgrades. It does, however, require a significant number of stand-by evacuation vehicles to ensure safe evacuation of construction workers if an accident does occur at the KNPS during the construction period. These vehicles can be used to shuttle the construction workers to and from the site during the AM and PM peak periods.

Bantamsklip has a significant impact on the transport network with upgrades required to the public transport system, heavy load routes and road upgrades required for emergency evacuation purposes. Due to the Bantamsklip site's isolated location, transporting heavy loads by road will require significant upgrades, which will have a high financial cost. However, from a biophysical perspective, the construction of landing facilities for barging heavy loads to site is dismissed as an option.

Thyspunt requires significant transport upgrades with regard to public transport and access during the construction phase. The R330 is proposed to be used for heavy load transport and may require pavement structure upgrades to cope with the increased heavy loads. The Oyster Bay road is proposed to be upgraded to a surfaced road to be used during the operational phase for surrounding staff access and as a required emergency evacuation route for areas such as Oyster Bay.

9.28 Risks to human health

Impacts on human health are dealt with in the Human Health Risk Assessment specialist report contained in Appendix E24.

9.28.1 Construction phase

The construction phase is expected to have a short time span relative to the operational phase and would therefore exclude chronic health effects such as cancer. The impact of non-radioactive substances (welding fumes, paint etc.) is expected to be localised to the construction site and it is assumed that members of the public will not be allowed in this area. These exposures should be assessed and managed in accordance with occupational exposure limits. Environmental dust generation from the site will be controlled in accordance with a health risk management plan, based on ambient air quality guidelines and standards.

There will be no nuclear fuel on site during the construction phase and the only radiological impact would be due to natural background levels. These levels may increase slightly due to natural radioactivity in construction materials, but impacts associated with naturally occurring radioactive material (NORM) during construction of a nuclear power station would not be significantly different from other construction projects that use natural materials. Impacts associated with radiation exposure during the construction phase are thus not regarded as significant.

9.28.2 Operational phase

There is no direct evidence of increased risk of non-cancer diseases at doses below about 100 mSv and such health outcomes are not regarded as significant in the impact identification. The NNR dose limits are much lower than 100 mSv. The primary concern about exposure to ionising radiation in the low dose region is the potential for development of radiogenic cancers and heritable disease. These effects are interpreted as stochastic in nature, with no threshold, and they increase in frequency in proportion to the radiation dose. Potential impacts must therefore be assessed in terms of the interpretation of the non-threshold nature of stochastic effects. All exposures must be assessed, even cases where exposures may be very low.

The dose assessment methodology will be applied for quantification of radiological dose to the critical group for each candidate site. The quantified doses for the site-specific exposure scenarios are compared with the NNR dose limits and dose constraints considering also the rigorous application of the As Low As Reasonably Acceptable (ALARA) principle.

9.28.3 Decommissioning

In accordance with Regulation No. R. 388 promulgated by the NNR, a decommissioning strategy must be submitted to the NNR as part of the prior safety assessment that is to be conducted prior to commencement of operations. This decommissioning strategy has to be updated throughout the operation of the nuclear power station as a basis for detailed decommissioning planning and for authorisation of specific actions or phases of decommissioning, with due regard to dose limits and probabilistic risk limits as stipulated in Regulation No. R. 388 and its Annexures 2 and 3. Decommissioning will thus be under rigorous regulatory control, ensuring health risks ALARA. Assessment of radiological impacts during decommissioning should thus be within the same framework as the assessment of the operational phase.

9.28.4 The no-go scenario

Because of the insignificant impacts of an nuclear power station on public health due to regulatory control through dose limits and dose constraints, as well as through the rigorous application of the ALARA principle, there would be no measurable difference at any of the proposed sites in the frequency of cancer, hereditary effects and other diseases that may be associated with exposure to ionising radiation whether an nuclear power station is constructed or not.

9.28.5 Impact Assessment

The NNR will issue a license for a site for construction of a nuclear power station only if full compliance with the dose limits and dose constraints is demonstrated. The dose limits and dose constraints apply to the concept of a technology envelope, within which any reactor technologies can be accommodated for the required generation capacity at a particular site.

Submissions to the NNR will demonstrate that the combined impact of gaseous and liquid discharges of radioactive substances will be below regulatory public dose limits, dose constraints and in accordance with the ALARA objective. The primary concern is the risk of developing radiogenic cancer.

The cancer risk range that is deemed acceptable in various parts of the world is from 1 case in a million to 1 case in ten thousand. This risk range reflects a *de minimis* lifetime risk that is so trivial that any action to reduce risk is not warranted.

The NNR regulatory dose limit of 1 mSv/year is an upper limit of exposure, representing a level of *de manifestis* risk, above which regulatory action would be taken to reduce risks.

The importance of the ALARA objective in controlling exposures of the public is demonstrated by the fact that for nuclear facilities in the USA, the average annual individual dose is only 0.05 per cent of the annual dose limit of 1 mSv for all controlled sources combined. Individuals who receive the highest dose (the critical group) normally do not receive more than about 10 per cent of the dose limit and often substantially less. This is achieved through rigorous application of the ALARA objective. The NNR follows similar rigorous application of the ALARA objective and doses to members of the public will be controlled with similar effectiveness.

Application of this nominal cancer risk coefficient produces cancer risk estimates that in practice would not be higher than the calculated value, but most likely would be lower. For exposures below the annual dose limit of 1 mSv, as required by the ALARA principle, the upper limit of cancer risk would be in the *de minimis* lifetime risk range. This conservative approach confirms that cancer risks to members of the community would be trivial under the application of the rigorous regulatory control of the NNR. Protection against the development of radiogenic cancer is considered to be adequate for protection against hereditary effects and other radiation-associated diseases. The potential impact on human health due to exposure to ionising radiation from a nuclear power station during normal operation under these conditions is therefore assessed as of low significance.

The assessment of design Basis Accidents (DBAs) has indicated that the probability of occurrence of such events is very small during the operational lifetime of a nuclear power station. However, it will be demonstrated in the submission to the NNR that the dose to the critical group during such an event would be within the dose limit of 50 mSv and ALARA. The potential impact due to DBAs is therefore assessed as of low significance over the lifetime of a nuclear power station.

Dose compliance assessments are conducted on the side of caution, because the dose limits apply to members of the so-called critical group, which represents the highest exposed individuals. Other members of the community would receive even lower doses.

9.28.6 Mitigation

The likelihood of adverse health impacts associated with radiological exposure due to a nuclear power station is regarded as remote. A key focus of accident prevention has long been the use of multiple precautionary defences against the consequences of failures. This approach of *'defence in depth'* is aimed at preventing equipment failures and human errors and mitigating their consequences, should any of these happen. Comprehensive assessment methodologies are applied in the design phase of nuclear installations by applying such methods as failure-mode and effects analysis, cause-consequence analysis and fault tree analysis, to select components and materials that have an extremely low probability of failing during operation. Furthermore, should components or materials fail, or should human errors lead to consequences that may have adverse effects on human health and the environment, several layers of backup systems and other controls are automatically introduced to stop the propagation of the ***Initiating Event*** or to mitigate its consequences.

In addition to regulatory dose constraints and dose limits set to protect human health, the NNR also applies the ALARA principle, thereby assuring by a large margin of safety that radiological doses to members of the community would be in the *de minimis* lifetime risk range. Furthermore, should radiological doses approach the *de manifestis* level of risk, the NNR would intervene by taking regulatory action to reduce the risk. There are thus several layers of mitigation to protect human health against the consequences of radiological exposure.

9.28.7 Conclusion

Provided that the NNR's statutory limits are adhered to, and that Eskom can demonstrate to the NNR that the design of the proposed Nuclear-1 will not exceed these statutory constraints, then there should be no impact on human health during normal operations. This finding is supported by the air quality assessment, which found that airborne radionuclide levels would be so low that there would be no effect on human health.

9.29 Impacts of nuclear and non-nuclear waste

Impacts of waste are dealt with in the Nuclear Waste Assessment specialist report contained in Appendix E29. Please note that this report was commissioned after the release of the Draft EIR and was therefore not included as an appendix to the Draft EIR released in March 2010.

9.29.1 Impacts of construction phase waste

The nature of the impacts of this waste is unlikely to have far-reaching effects, is not typically life threatening and is largely a threat to the environment. Unmanaged waste, nonetheless, represents a pollution risk to the environment, will be aesthetically unattractive and generally, will not conform to norms for responsible environmental management. Potential impacts will be felt by flora and fauna and by the surrounding human population in terms of aesthetic degradation.

9.29.2 Impacts of non-radioactive construction waste

Unmanaged waste of this type does represent a threat to human and natural environments. The most significant potential impacts include:

- Potential contamination of surface and groundwater due to poorly managed concrete batching operations and materials handling;
- Potential damage to flora and contamination of surface and groundwater due to poorly managed excavation operations and stockpile management; and
- Air pollution due to excavation and haulage activities, as well as concrete batching (cement and sand dust).

9.29.3 Management of General and Hazardous, non-radioactive, construction waste

The Duynefontein site is favourably located with regard to the availability and proximity of disposal sites licensed to accept both General and Hazardous (non-radioactive) wastes. The municipal Vissershok waste disposal site and the adjacent privately managed Vissershok Waste Management Facility are licensed to handle General and low-hazard waste (**G and H:h**) and General and high–hazard waste (**G and H:H**) respectively. These sites are some 25 km from Duynefontein. With regard to the lifespan of these disposal sites, the City of Cape Town site has a projected life of some 20 years, but a regional facility in the Atlantis area is in an advanced stage of planning.

If a power station is constructed at Thyspunt, Eskom would need to make use of the Aloes waste site, about 20km from Port Elizabeth in the direction of Grahamstown. This site has an **H:H** rating and is estimated to have a remaining lifespan of only approximately 5 years. This site in its current design would therefore run out of capacity prior to completion of construction at Thyspunt. However, expansion of the site is currently being planned. General waste would also have to be disposed at this site.

If a power station is constructed at Bantamsklip, Eskom would need to make use of the Karwyderskraal Regional landfill site, approximately 15 to 20 km from Hermanus. This site has a GMB+ rating and has remaining capacity for more than 20 years. There is also a small disposal site at Gansbaai (30 km east of Hermanus) that could accept general waste. Hazardous waste would need to be transported to the Vissershok facility.

Accordingly, there appears to be sufficient disposal capacity, although long-term agreements should be entered into with the managers of these sites to secure disposal space.

Although the management of wastes generated at the power stations must follow standard procedures, the overall structure will have to ensure that radioactive and non-radioactive wastes are kept separate – both in their generation phase, as well as for transport and disposal. Thus, the potential for recycling will have to be closely examined. The separation of the radioactive fraction is a challenge and may make recycling inefficient and difficult.

9.29.4 Management of radioactive (nuclear) waste

As indicated in **Chapter 3** of the Draft EIR, three types of waste will be generated at the proposed Nuclear-1, irrespective of the location of the plant and its associated infrastructure. ***Sources of radioactive waste that will be generated at the proposed Nuclear-1 Nuclear Power Station, irrespective of the location of the plant and its associated infrastructure, are gaseous, liquid and solid radioactive waste. The latter can be divided further into:***

- ***High level waste (HLW)***
- ***Intermediate-level waste (ILW);***
- ***Low-level waste (LLW).***

ILW and LLW and collectively referred to as LILW.

The potential impacts on human health and the environment associated with radioactive waste relate principally to health effects associated with the irradiation of living tissue in humans and non-human biota. For this impact to occur, humans and non-human biota have to be exposed to the radionuclides associated with the waste either through direct ingestion or inhalation of the radionuclides or through external exposure (gamma radiation).

It is clear from the discussions presented in the foregoing sections that all forms of radioactive wastes are strictly controlled and that numerous specialised systems and management practices are in place to prevent uncontrolled contact with these substances. These controls and practices differ for the different forms of radioactive waste.

Gaseous[23] and liquid wastes[24] are almost exclusively associated with the operation of the proposed Nuclear-1 Nuclear Power Station. Specific systems are included in the design and operation of the Nuclear Power Station to control releases under Normal Operation and Anticipated Operational Occurrences[25]. Authorised Discharge Quantities are defined so that discharges do not exceed a fraction of the dose limit for the public (dose constraint) when applied to the critical group and that such doses are ALARA.

Once released into the environment, radionuclides might migrate through the environmental system along three principle pathways: atmospheric, groundwater and surface water. Due to the physical nature of LILW and HLW disposal concepts, migration along the atmospheric pathway is highly unlikely. The principle environmental pathway of concern is thus the groundwater pathway, with the surface water pathway of secondary concern as an extension of the groundwater pathway. Disposal systems are designed such that the impact is on a small scale and localised.

The potential impacts on the environment associated with gaseous, liquid and solid radioactive waste identified for the Nuclear -1 project are:

- ***Contamination of water resources due to the release of radioactivity contained in liquid waste (Commissioning, Operational and Decommissioning Phase).***

[23] ***Gaseous wastes are dealt with Appendix E10.***
[24] ***Liquid wastes are dealt with in Appendix E15.***
[25] ***An operational process deviating from Normal Operation which is expected to occur at least once during the operating lifetime of a facility but which, in view of appropriate design provisions, does not cause any significant damage to items important to safety or lead to Accident Conditions***

- ***Contamination of the atmosphere due to the release of radioactivity contained in gaseous waste (Commissioning, Operational and Decommissioning Phase).***
- ***Contamination of water resources due to the release of radioactivity contained in LILW or HLW stored at the Nuclear-1 Nuclear Power Station (Commissioning, Operational and Decommissioning Phase).***
- ***Contamination of water resources by radioactivity due to disposal of LILW at Vaalputs (Operational and Post-closure Phase).***
- ***Contamination of water resources by radioactivity due to accidental spillage of radioactive waste during transport of LILW to Vaalputs (Operational Phase).***

9.29.5 (a) Management of Low-Level and Intermediate-Level Radioactive Waste

Low-Level Waste (LLW) and Intermediate-Level Waste (ILW) will be controlled within the radiological zones of the power plant and will be transported by road to Vaalputs for long-term storage, as prescribed by the Eskom operating procedures.

LILW solid waste will be managed according to predefined systems and management practices. These include procedures for the predisposal management (processing, storage and transport) of the waste. Generally, it will be handled similar to the operational waste generated at the KNPS, after which it will be disposed of at the national radioactive waste disposal facility at Vaalputs. The transport of LILW to Vaalputs is done by road according to the provisions of the IAEA Regulations for the Safe Transport of Radioactive Material (IAEA, 2009).

Disposal of radioactive waste at Vaalputs is being done according to an approved disposal concept, defined and developed with due consideration of the nature of the waste to be disposed of and the natural environmental system, collectively referred to as the disposal system. The disposal system developed for this purpose makes provision for the containment of radionuclides until such time that any releases from the waste do not pose a radiological risk to human health and the environment. The safety assessment process used as basis for this purpose, considers both intentional (as part of the design criteria) and unintentional (natural or human induced conditions) releases of radionuclides. Unintentional releases include consideration of unintentional human or animal intrusion conditions, which might lead to direct access and external exposure to radiation.

Using the data obtained from Eskom for the KNPS over the 2007 to 2009 period as an example, it is anticipated that the following shipments of LILW will be made to Vaalputs:

- Steel drums – average of 8 shipments of 120 drums per shipment/ annum i.e. approximately 1 shipment per month
- Concrete drums – average of 39 shipments of 5 drums per shipment / annum and therefore approximately 3 shipments per month. The ILW is mixed in a very specific way with concrete and sealed into appropriately marked concrete drums. Therefore, even in the event of a spillage of ILW, there is no risk of contamination.

It is expected that there will be a maximum of two shipments of waste per week (either in metal or concrete drums) i.e. three days for one shipment and one day rest between shipments.

Vaalputs has been designed and permitted with sufficient capacity for handling the LILW of KNPS plus three additional conventional nuclear power stations. The currently active area used for waste disposal at Vaalputs is 1 km^2, of which only 5% has been used after the more than 20 years of KNPS's operation. The total extent of the property is 10 000 ha (Beyleveldt, pers. comm. 2010).

The concept for the disposal of solid waste at Vaalputs consists of near-surface trenches using metal containers for low-level waste, and concrete containers for intermediate level waste. The long-term safety of the facility, which complies with international best practices for the disposal of low and intermediate level waste, has been demonstrated for a national inventory of radioactive waste.

Provided that the transport of LILW to Vaalputs is carried out strictly according to the IAEA transport regulations, the potential environmental impact are considered to be of low significance, as the transport operations will be well controlled.

9.29.6 (b) Management of High-Level Radioactive Waste

Internationally, spent fuel is sent for reprocessing (for re-use as nuclear fuel), ***kept in storage at the power station*** or it is sent to a national repository for HLW. ***South Africa still has to formulate a strategy for the long-term management of HLW, including spent fuel. Until such time, all spent fuel is stored temporarily either in spent fuel pools (wet storage), or in dry cask storage facilities (dry storage). This allows the shorter-lived isotopes to decay before further handling, a management strategy that is acceptable from a safety perspective.***

At the KNPS, spent fuel is stored under water in storage racks with sufficient capacity to contain these assemblies for the life of the station. Water cools the fuel rods and serves as an effective shield to protect workers in the fuel storage building from radiation. The storage ponds are steel-lined concrete tanks, approximately eight metres deep and filled with water.

Alternatives to on-site storage of HLW will depend on the legislative provisions that are put in place to manage HLW. The South African Cabinet has approved a National Radioactive Management Policy and Strategy in 2005. The purpose of the policy and strategy document is to ensure the establishment of a comprehensive radioactive waste governance framework. In response to that, the National Radioactive Waste Disposal Institute Act, 2008 (Act No. 53 of 2008) was promulgated in January 2009 and came into effect in December 2009. The purpose of this Act is to ensure that the capability and capacity of the institutions to manage radiological waste is addressed. This Act provides for the establishment of a National Radioactive Waste Disposal Agency in order to manage radioactive waste (a function currently managed by NECSA). Although the Act has come into effect, it will still be some time before the Agency is formally constituted.

At present, South Africa does not have an authorised facility for the disposal of HLW. However, Vaalputs is being considered as a site for the disposal of HLW (http://www.engineeringnews.co.za/article/high-level-nuclear-waste-may-be-disposed-at-vaalputs-in-future-2009-03-25 - accessed on 16 February 2010 and Beyleveldt, pers. comm. - 24 February 2010). Before use as a HLW facility, the necessary environmental and NNR licensing processes would need to be followed. Thus, the only currently feasible alternative is for Eskom to store HLW in the Nuclear-1 ***spent fuel pools in the nuclear island***, as is the case at Koeberg. The proposed Nuclear-1 facility must be designed in such a way that such long-term storage within the ***spent fuel pool*** is possible.

The generators of radioactive waste remain responsible for all liabilities in connection with such radioactive waste under their control until such time as the National Radioactive Waste Disposal Agency is able to take responsibility for this waste.

9.29.7 Mitigation

The following mitigation measures must be adhered to ***and incorporated in the relevant EMPs (for construction, operation and decommissioning, where relevant):***

- ***The design of proposed nuclear power station must take into account releases of gaseous and liquid effluent under all possible operating conditions and must ensure the releases are managed to stay ALARA (As Low As Reasonably Achievable).***

- ***The high level waste management system must be designed to safely manage and hold all HLW and spent fuel for the duration of the life span of the Nuclear Power Station.***
- ***The construction, operational and decommissioning EMPs must contain measures to prevent poor waste disposal practices and to mitigate against the irresponsible handling and disposal practices.***
- ***Disposal sites at which waste from Nuclear-1 is disposed must be audited on a periodic basis to ensure that they comply with legal requirements.***
- ***Strict control must be exercised over the transport of non-radioactive waste from the Nuclear-1 site to the appropriate regional waste disposal site. Waste transport contractors must be subjected to regular audits to ensure that waste is disposed at its intended destination.***
- ***An emergency response plan for road transport of LILW must be in place to swiftly deal with any accidental spillages of these wastes during transport to Vaalputs.***
- The fuel assembly must be designed to safely hold HLW spent fuel.

9.29.8 Conclusion

The management of construction waste (General and Hazardous but non radio-active) and the mitigation of impacts will follow standard practices. This process must be adequately described in the Construction Environmental Management Plan

The management of radioactive waste is conducted according to standards as laid down by the International Atomic Energy Agency as follows international best practice. The Vaalputs nuclear waste site has the capacity to handle the additional waste that will be produced by Nuclear-1 and is regarded as a safe and well-managed site. The storage of high-level waste (as has been the practice at Koeberg) on site holds no significant risks, provided that the spent fuel waste is contained within a protected ***area according to management practices approved by the NNR.***

Table 9-88: Impacts caused by waste generation and disposal at all three alternative sites

Impact	Nature	Intensity	Extent	Duration	Impact on irreplaceable resources	Consequence	Probability	Significance
1A: Contamination of water resources due to the release of radioactivity contained in liquid waste (Commissioning, Operational and Decommissioning Phase)	***Negative***	***Low***	***Low***	***Medium***	***Low***	***Low***	***High***	***Low-Medium***
1B; Mitigated	***Negative***	***Low***	***Low***	***Medium***	***Low***	***Low***	***Medium***	***Low***
2A: Contamination of the atmosphere due to the release of radioactivity contained in gaseous waste (Commissioning, Operational and Decommissioning Phase).	***Negative***	***Low***	***Low***	***Medium***	***Low***	***Low***	***High***	***Low-Medium***
2B: Mitigated	***Negative***	***Low***	***Low***	***Medium***	***Low***	***Low***	***Medium***	***Low***
3A: Contamination of water resources due to the release of radioactivity contained in LILW or HLW stored at the Power Station (Commissioning, Operational and Decommissioning Phases)	***Negative***	***Medium***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
3B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
4A: Contamination of water resources by radioactivity due to disposal of LILW at Vaalputs (Operational Phases)	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
4B; Mitigated	***Negative***	***Low***	***Low***	***High***	***Low***	***Low***	***Low***	***Low***
5A; Contamination of water resources by radioactivity due to accidental spillage of radioactive waste during transport (Operational Phase)	***Negative***	***Medium***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***
5B: Mitigated	***Negative***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***	***Low***

9.30 Transmission integration factors

For the electricity generated by the proposed nuclear power station to be made available to end-use customers, it needs to be transmitted from the high voltage yard at the power station through a complex network of high voltage transmission lines and then through a series of distribution lines of ever decreasing voltage, until it reaches to end user. The ease with which electricity produced at the power station can be "integrated" with the rest of the transmission system is dependent on a number of technical factors that Eskom needs to consider. However the Eskom transmission system design philosophy is to connect new base load generation to the closest load wherever possible. These considerations have been presented in an Eskom publication (Eskom 2008) that compares the relative ease of integration in the Eastern and Western Cape Provinces and at all three alternative sites.

Broadly speaking, the transmission integration requirements are categorised as follows:

- System reliability and quality of supply;
- Integration considerations;
- Future potential for generation in each of the provinces.

Considerations of system reliability and quality of supply are indicated in **Table 9-89**. Transmission integration considerations are indicated in **Table 9-90.**

Table 9-89: Factors relating to system reliability, security and quality of supply

Factor	Western Cape (Duynefontein and Bantamsklip)	Eastern Cape (Thyspunt)
Generation versus load balance and system adequacy	• Substantial generation capacity already installed • 80 % of Western Cape can be supplied from existing local generation during peak generation • Nuclear-1 would result in excess generation capacity during peak generation	• Existing Open Cycle Gas Turbine in East London provides only 4 % of the Eastern Cape load. OCGT is only utilised during peak periods to avoid load shedding. • There is no base load supply in the Eastern Cape
Quality of supply impact	Limited improvement in quality of supply	Would result in significant improvement of quality of supply
Islanding capability[26]	Already exists	Would be introduced in the network
Diversity of sources of power	• Able to receive power from local generation pool and the transmission system • Nuclear-1 will increase capacity of the generation pool and will have to export the excess.	• Entirely dependant on the transmission system for power • Nuclear-1 will create a new local generation pool which will supply the local load centres and export the excess..

[26] Islanding refers to the ability to isolate a portion of the network from the remainder of the system. This is particularly helpful during technical problems, because it allows a part of the system to remain stable while other parts of the system are being restored.

Table 9-90: Transmission integration factors

Factor	Duynefontein	Bantamsklip	Thyspunt
Line length required	190 km of 400 kV lines combined with cables	990 km of lines (400kV and 765 kV lines combined)	500 km of 400 kV lines
Infrastructure cost (R billion)	5.1	12.72	5.3
EIA and servitude difficulty	Medium (high between Acacia and Philippi)	Difficult due to extensive 765 kV network	Medium
Implementation time frame	Achievable	Achievable with difficulty due to long network required	Achievable
System transient performance	Good (400 kV network)	Good (with extensive 765 kV network required	Good (400 kV network)
Impact on grid transfer capacity	Defers 3rd Gamma-Omega 765 kV line indefinitely	Defers 3rd Gamma-Omega[27] 765 kV line indefinitely	Defers 3rd Gamma-Grassridge[28] 765 kV line indefinitely
Overall[29]	**2nd best alternative**	**Least preferred alternative**	**Preferred alternative**

In summary, development of a power station in the Eastern Cape would result in substantial improvement in system adequacy and supply security due to a better “generation to load balance” in the local area, as it has no base-load generating capacity.

A power station at Bantamsklip would be less advantageous, as 765 kV transmission lines would be required through difficult terrain, which would result in substantial additional cost at the Bantamsklip site.

Development of the Duynefontein site will result in an increased capacity of the generation pool in the Western Cape, which means a concentration of generation in one area at the expense of another. Strategically this exposes the transmission system to more risk as opposed to diversifying the generation closer to major load centres. This is the overriding strategic transmission advantage of the Thyspunt site, which will provide a new base load generation pool in a weak part of the Eskom network and enable future potential load growth for the Eastern Cape.

From a technical point of view, therefore, the most preferred site alternative is Thyspunt. Strengthening of the Western Cape network is still required, but technically Eskom will be able to delay this until after the construction of a power station in the Eastern Cape.

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27 Eastern Cape substations
28 Eastern Cape substations
29 Preferences in this row indicate Eskom preferences

9.31 Environmental impact statement

This section provides an overview summary of the impacts assessed in Sections 9-3 to 9-30 above.

9.31.1 Technical factors influencing the suitability of the alternative sites for a power station

The majority of the technical factors are of low to low-medium significance after mitigation. The only factors that are of medium significance after mitigation are impacts on the power station in the event of fault causing surface deformation. If such a seismic event were to occur, the <u>consequence</u> on a nuclear power station could be high. However, the probability of such an event occurring, (given the stable seismic environment in South Africa and in the areas of the proposed sites) are low, hence leading to an impact of medium significance. In any event the nuclear power station will be designed, if necessary, to adapt to the specific seismic characteristics of any of the sites.

(a) Geological and geohydrological factors

With respect to technical considerations, the only geo-hydrological impact of any significance is the disturbance of the site adjacent to excavations, due to the loose soil conditions resulting in a high potential for collapse of cuttings. This can, however, be mitigated by putting in appropriate support of excavations.

(b) Seismic risk

It is evident from the seismic report (Appendix E4) that seismic risk is low (with mitigation) at all three of the sites. Based on work completed to date, none of the sites are considered to have any seismic disqualifiers.

However, it must be noted that seismic PGA (Peak Ground Acceleration) values vary significantly between the alternative sites (from 0.16 g at Thyspunt to 0.3g at Duynefontein). The Senior Seismic Hazard Analysis Committee (SSHAC) process that needs to be completed for the purpose of the NNR licensing process may result in the seismic risk rating of the sites either increasing or decreasing The NNR has requested that the SSHAC process must be completed within the next 2 to 3 years. In the case of Duynefontein, a marginal increase could result in the value increasing beyond 0.3 g, which is regarded as the limit for as standard design of nuclear power station. In the case of Thyspunt, there is the lowest risk that the PGA value could exceed 0.3, and at Bantamsklip this risk is intermediate,

The design of aseismic bearings or other design resolutions to deal with a PGA value above 0.3 g may have a significant impact on Eskom's construction programme. The "design basis" for standard nuclear power stations is based on a PGA value of 0.3 g. A rating beyond this value would necessitate redesign of a standard nuclear power station, resulting in financial implications and additional time (2-3 years) for design and construction.

No detailed cost assessment of such additions has been undertaken (since it requires detailed design work and will only be undertaken if it is confirmed through the SSHAC process that the seismic risk exceeds the design basis of 0.3 g). However, the indication from the KNPS experience is that it would add approximately 10 - 12 % to the total construction cost (i.e. approximately an

additional R 17 billion to 20.4 billion based on the 2008 estimate of R 170 billion per nuclear power station). This is a significant additional cost, but the potential time delay would be of even greater consequence, in the sense of a lost opportunity for electricity generation.

(c) Water-related factors

There are no factors related to the availability of water or the potential impacts on surface water flow that are of high or medium significance at any of the alternative sites, a desalination plant will be used at all sites during both construction and operation. Favourable groundwater conditions at Thyspunt may allow for limited groundwater to be utilised at an early stage of construction, in addition to desalinated water. However, this will only be done for a short period of time until the desalination plant produces fresh water. In terms of hydrological suitability, no impacts of more than low-medium significance are predicted.

In terms of geo-hydrological conditions, the most significant impacts (of medium significance without mitigation) that can be expected are the potential intrusion of saline water and flooding of the excavation by groundwater. Water-related factors can therefore be disregarded as far as the choice of site alternative is concerned.

d) Potential for debris flow at Thyspunt

The investigation of the dune geomorphology specialist has indicated that there is no evidence to suggest that debris flow is a real risk at the Thyspunt site. This issue has therefore been found not to have any effect on decision-making regarding the Thyspunt site.

e) Integration with the national transmission grid

Eskom's transmission studies have noted that the development of the Duynefontein site will result in an increased capacity of the generation pool in the Western Cape, which means a concentration of generation in one area at the expense of another. Strategically this exposes the transmission system to more risk as opposed to diversifying the generation closer to major load centres. This is one of the overriding strategic transmission advantages of the Thyspunt site. It will provide a new base load generation pool in a weak part of the Eskom transmission network and enable future potential load growth for the Eastern Cape.

9.31.2 Impacts of the proposed power station on the biophysical and social environment

(a) Impacts on flora

The majority of the impacts on flora at Duynefontein are of potentially high significance without mitigation and medium to low significance with mitigation. The most significant potential impact (regarded by the vegetation specialist as a fatal flaw if the power station is located within the mobile dune system) is the impact on dune dynamics. The power station can be located outside the dune system.

The majority of the floral impacts are of medium significance without mitigation at Bantamsklip and low significance with mitigation, provided that the highly sensitive areas on the site (e.g. the limestone areas) are avoided.

The majority of the floral impacts at Thyspunt are of potentially high to medium significance without mitigation and medium to low significance with mitigation.

The flora specialist also indicated that Thyspunt would have the highest potential positive impacts to conservation if the remainder of the site (outside the immediate power station footprint) could be conserved.

(b) Impacts on dune geomorphology

Potential impacts on dune geomorphology are potentially the highest at Thyspunt, due to the presence of the unique Oyster Bay headland dune bypass system. In view of the fact that the proposed Northern Access Road has been discounted as an environmentally acceptable alternative (based on a consensus decision of the EIA specialists), the impacts on the Oyster Bay Dunefield (with the exception of the impacts of the power line pylons) would in fact not occur.

The impacts on the mobile dunefield due to the transmission line crossing from the power station to the HV Yard are the only ones at Thyspunt of potentially high significance without mitigation (and medium significance with mitigation). By contrast potential impacts on dune geomorphology are relatively insignificant at Duynefontein and Bantamsklip.

In spite of the finding by the vegetation specialist that the impacts on the transverse mobile dune system at Duynefontein would be of high significance, the findings of the dune geomorphology specialist do not support this.

(c) Impacts on wetlands / freshwater ecology

These potential negative impacts on wetlands are of low to negligible significance at Duynefontein and Bantamsklip, provided that the northern portion of the Bantamsklip (north of the R43) is not developed.

The wetlands at Thyspunt could experience potential negative impacts of high significance due to the extensive distribution of wetlands across the site and the linkage between the mobile dune system and the wetlands. If these impacts occur they would be related to dewatering during construction and possibly during operation, disruption of groundwater flows to the coastal seeps (the impacts on coastal seeps cannot be completely mitigated) as well as the impacts of access road construction.

Based on the extensive groundwater monitoring and subsequent modelling of groundwater flows at all the sites since the beginning of 2010, it has been confirmed that impacts caused by dewatering at Thyspunt can be mitigated so that they do not impact on the critically important Langefonteinvlei at Thyspunt. The confirmation that this mitigation is feasible provides an opportunity to manage the Langefonteinvlei and other wetlands on the site as conservation areas. This would secure a large expanse of wetland and dune system that could otherwise be potentially permanently impacted by urban development, which has destroyed similar habitats across the St. Francis region. The opportunity for large-scale active management and conservation of wetland ecosystems as a whole is regarded as an important potential offset for the negative impacts. The positive impact of this offset is noteworthy, since the wetlands (particularly Langefonteinvlei) are unique but have received little if any attention from the conservation community before the Nuclear-1 project. For such offset mitigation to be acceptable, a number of wetlands (as specified in the wetlands report) that are currently outside the Eskom-owned property must be purchased and included in the de facto conservation area to be established on Eskom property around the power station footprint. Provided that this important recommendation of the Wetland Assessment is strictly implemented, Thyspunt is regarded as developable from a wetlands point of view.

(d) Impacts on vertebrate fauna

The potential impact of highest significance at all three alternative sites is the destruction of habitats and populations within the footprints of the proposed power station and associated infrastructure.

At Thyspunt there are concerns around fragmentation of habitats, especially by roads and resultant impacts on fauna. The impacts of medium significance Duynefontein and Bantamsklip (without mitigation) include habitat fragmentation due to associated infrastructure, road mortality, mortality due to transmission lines, disturbance of breeding populations, dust pollution and poaching.

Impacts such as fragmentation of habitats due to associated infrastructure, mortality due to transmission lines, light pollution and faunal impacts associated with impacts on wetlands are potentially of higher significance at Thyspunt. However, with the exception of the impacts on coastal seeps, it has been confirmed (as indicated above) that the potential impact on Langefonteinvlei can be mitigated.

At Thyspunt and Bantamsklip the potential positive impact of offset conservation of undeveloped land around the power station footprint is of high significance, as these sites are not currently conserved. The negative impacts (after mitigation) do not exceed medium significance.

(e) Impacts on invertebrate fauna

The significance of the potential impacts is generally of similar significance across all three alternative sites. A reduction in rare and/or endangered species is of high significance at Thyspunt and Bantamsklip. There are a greater number of impacts of medium-high and high significance (without mitigation) at Thyspunt than at either of the other two sites. However, according to Low (pers. comm. 2010), the particular habitat where the sensitive invertebrate species occur is widespread across the site at Thyspunt (i.e. not limited to the nuclear plant footprint) as well as outside the site. Therefore it would be possible to relocate or alternatively identify the same species elsewhere on the site.

The potential positive impacts of conservation of the remainder of the site that will not be affected by the power station footprint is important, particularly at Thyspunt and Bantamsklip, as such protection does not currently exist at these sites. The greatest benefit (of high significance) would be realised at Bantamsklip, while this benefit would be of medium significance at Duynefontein and Thyspunt. The negative impacts (after mitigation) would not exceed medium significance.

(f) Impacts on marine ecology and fisheries

The potential impacts on marine ecology are generally highest at Bantamsklip, due to the presence of the temperature-sensitive and over-exploited abalone at this site. Thus, the significance of the disruption due to the construction of the cooling water system is highest at this site – the only site where this impact continues to be of high significance after mitigation. The potential positive impacts resulting from the declaration of a security exclusion zone would be highest at Bantamsklip, as such declaration would afford some protection to the heavily poached abalone. However, there is a low level of confidence in the prediction of this positive impact.

Impacts at Duynefontein (disruption due to cooling water system construction, disruption due to discard of spoil, impacts on marine organisms due to warmed cooling water) have a medium significance with mitigation.

At Thyspunt, the same impacts also have a medium significance with mitigation. Although great concern was expressed by I&APs about the potential impacts on the chokka fishery at Thyspunt, the marine assessment concluded (based on all currently available evidence) that the impact resulting from warmed cooling water and spoil disposal would not result in a highly significant impact at this site. The size of the chokka spawning ground that is predicted to be affected by the construction and operation of the power station represents less than one percent of the coastal spawning ground for this species. Importantly, although the previous version of the marine ecology assessment recommended an offshore cooling water outflow, the current version of the report concludes that an inshore shallow (5m) cooling water outflow would not result in an unacceptable impact on chokka squid.

(g) Impacts on heritage resources

In general, the impacts on heritage resources are predicted to be of least significance at Duynefontein, as no impact at this site is predicted to exceed medium negative significance.

At Bantamsklip, Holocene archaeological impacts, impacts on landscape and cumulative impacts of the power station and transmission lines are considered to be of high significance without mitigation. At Thyspunt, these impacts have the same significance without mitigation, but in addition, impacts on Pleistocene archaeology are also considered to be of high significance without mitigation.

The nature of the landscape impacts at Thyspunt are different to the other two alternative sites: the dense concentration of pre-colonial heritage resources and quality of the landscape contribute to the conclusion that Thyspunt is regarded as a "Cultural Landscape" in terms of the definition of the UNESCO World Heritage Convention. Assuming that heritage mitigation is successful, the excavation of Miocene palaeontological resources at Duynefontein and Bantamsklip could result in positive impacts. Mitigation of heritage impacts at Bantamsklip and Thyspunt would need to be on a scale never before seen in South Africa, and would need to start at last a year prior to the commencement of construction. The resources to conduct such mitigation are not currently available in South Africa and would need to be either imported or actively developed to ensure that mitigation is successful.

The heritage impacts of highest significance (after mitigation) are those on the landscape. These impacts continue to be of high significance after mitigation at Thyspunt and Bantamsklip, as these impacts would be extremely difficult to mitigate. Other heritage impacts (on physical heritage resources) can be mitigated to medium significance. Impacts on palaeontological resources can be mitigated to positive and medium significance at Duynefontein and Bantamsklip and to positive low-medium significance at Thyspunt.

(h) Noise impacts

Generally, noise impacts are of low significance at all alternative sites after mitigation. The only exception (both of medium significance after mitigation) of are the impacts within 10m of transport routes at Thyspunt and the impacts of transportation at Bantamsklip.

A potentially significant noise impact, which would occur at Thyspunt, but not at either of the other two alternative sites, is the impact from the Open Cycle Gas Turbine (OCGT) plant, which is proposed located at the HV yard at Thyspunt. Due to the distance to the HV Yard from the nearest farm residents, there could be a significant impact on these residents for short periods of time.

However, the OCGT is a backup power supply plant only and will not be in operation for extended periods of time.

(i) Tourism impacts

At Duynefontein the proposed power station would be most easily absorbed into the local tourism economy and all impacts are predicted to be of low significance with and without mitigation.

At the <u>Bantamsklip</u> site it is predicted that there would be a small-scale, short-term and long-term positive impact on tourism. Five impacts would be of medium significance and two would be of low significance after mitigation at Bantamsklip.

At <u>Thyspunt</u> it is predicted that there would be a small-scale, short-term, negative impact on tourism but no overall long-term negative impact on tourism once the tourism market gets used to the presence of a nuclear power station. This conclusion is based on the KNPS experience. Tourism impacts at Thyspunt would be of low to medium significance after mitigation (four of medium significance and three of low significance).

In conclusion, the impacts of highest negative significance would occur at Thyspunt, followed by Bantamsklip, whilst relatively small positive and negative impacts are predicted at Duynefontein.

(j) Impacts on agriculture

Negative agricultural impacts of medium significance (after mitigation) are predicted only for the Bantamsklip and Thyspunt sites. No negative impacts would exceed low significance after mitigation at Duynefontein.

Thyspunt will experience potentially the most significant improvement of 15% in agricultural production. Bantamsklip will experience a potential increase of 5% and Duynefontein is not predicted to experience any increase. These positive impacts are regarded to be of low significance at Duynefontein (after optimisation) and of medium significance at Thyspunt and Bantamsklip.

(k) Economic impacts

All three sites will experience potential positive macroeconomic impacts of high significance on a local scale and positive impacts of medium significance on a regional to national scale. The greatest macroeconomic benefits would be experienced at Duynefontein and Bantamsklip due to the stronger provincial economy in the Western Cape: this province's economy would be in a better position to provide goods and services to the power station. However, the costs of the Bantamsklip alternative would be highest of all sites due to significant transport system upgrading and high voltage transmission lines that would be required for this alternative. These additional costs at Bantamsklip would make this site alternative approximately R6 billion more expensive than either of the other two alternative sites.

All the sites would experience positive impacts of low significance during the operational phase.

Thyspunt is the only site where a negative impact of medium significance after mitigation (on the chokka squid fishery) is predicted. This impact must be read in the context of the findings of the marine impacts assessment, which concluded that less than 1 % of the chokka spawning ground would be impacted. Bantamsklip would experience a negative impact of low significance (after mitigation) on whale watching.

When considering poverty alleviation, then factors such as the positive impact on low-income households, the impact of social indicators and the opportunity to grow the economy of a province as reflected by the potential impact on GDP slightly favour Thyspunt. However, relative the differences between the Duynefontein and Thyspunt sites are small (less than 1%) and no clear economic preference exists between these sites.

(l) Site control

Site control impacts would not exceed low-medium levels after mitigation at any of the alternative sites. All the sites are currently privately owned land and loss of access would therefore not be a significant issue at any of the sites.

(l) Visual impacts

Negative visual impacts would have a maximum medium significance at all three alternative sites. This applies to the visual degradation due to a change in landform and vegetation, change in sense of place, change of the night scene due to lighting and also to changes to the landscape due to earthworks and spoil dumps. All other negative visual impacts would have a low or low-medium significance at all the alternative sites. There would be no positive visual impact at any of the sites.

(m) Social impacts

In general, with the exception of a single impact (law enforcement), all social impacts would have the same significance after mitigation at all three alternative sites.

At Duynefontein, it is not predicted that there would be any negative impacts exceeding medium significance. The impacts that would reach medium significance at this site (without mitigation) are the impacts on accommodation during construction, the potential increase in STDs and pressure on municipal services. Duynefontein is predicted to experience potential positive impacts of high significance for job creation and impacts of medium significance for the creation of business opportunities.

At Bantamsklip, mitigated impacts on accommodation during construction, the influx of job seekers, the increase in STDs and criminal activities, pressure on municipal services during construction and impacts on transport systems would be of medium significance. The same significance ratings would apply to the Thyspunt site.

Potential positive impacts (creation of employment opportunities and business opportunities) would be of high and medium significance respectively at all three alternative sites during construction. During operation, these positive impacts would be of medium significance at all alternative sites.

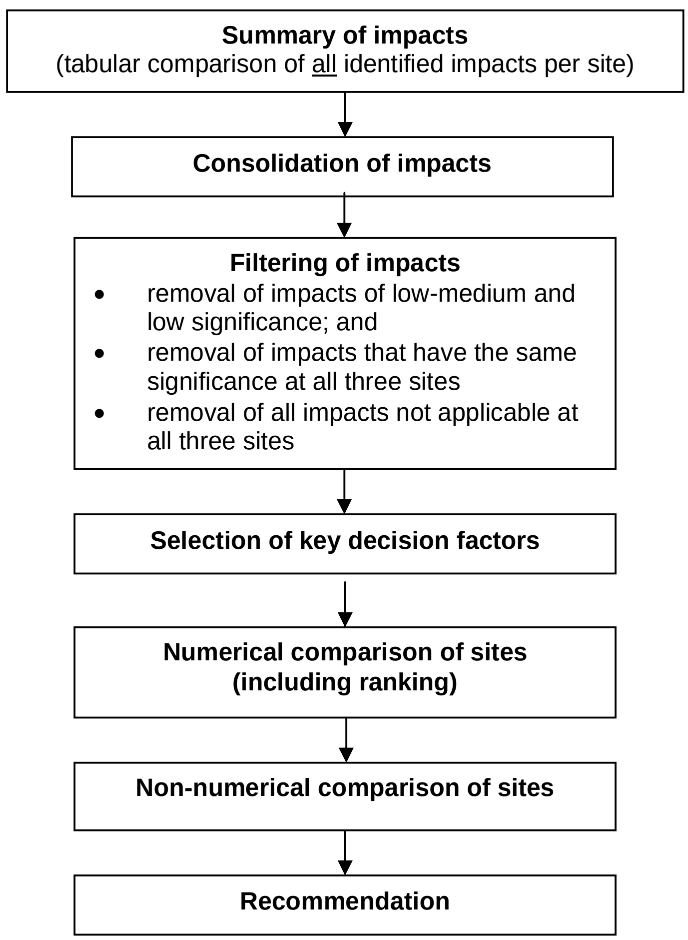
(n) Impacts of nuclear and non-nuclear waste

Although this issue is of concern to many I&APs, the specialist assessment concluded (based to a large extent on the waste management practices currently applied at the KNPS) that the potential impacts caused by waste generation and disposal would not exceed low significance at any of the alternative sites. In view of the strict control that is exercised over nuclear waste management by the NNR, there is a high level of confidence associated with this prediction.

9.32 Evaluation of alternative sites

This section provides an evaluation of the potential impacts identified at the three alternative sites based on the assessment of impacts described in Sections 9-3 to 9-28. This evaluation is based on a combination of the documented specialist assessments (as contained in the specialist reports in Appendix E), and the results of a specialist integration workshop held in November 2009, as well as Arcus GIBB's integration of the findings of all the specialist studies (updated between the release of the Draft EIR in 2010 and the release of the Revised Draft EIR in 2011).

The flow diagram below shows the method that has been followed in evaluating the impacts in order to identify a potentially preferred site from amongst the three alternative sites.



9.32.1 Summary of impacts

All potential environmental impacts are summarised in Table 9-91. This provides an unfiltered summary of the significance of all mitigated impacts (positive and negative) at all three alternative sites.

It is important to note that some impacts in this table will occur only at one site but not at others. Thus, some cells in the table are blank. For convenience, the different levels of impact significance have been colour coded to provide a comparison. Shades from red to light yellow indicate negative impacts and light green to dark green indicate positive impacts.

Key to Table 9-91

Negative impact of high significance

Negative impact of medium-high significance

Negative impact of medium significance

Negative impact of low-medium significance

Negative impact of low significance

Negligible impact (disappears after mitigation)

Positive impact of low significance

Positive impact of low-medium significance

Positive impact of medium significance

Positive impact of high significance

<u>Note</u>: "n.a." indicates that the impact is not applicable to a particular site (i.e. it would not occur at all, even before mitigation.

Table 9-91: Potential impacts at all three sites (after mitigation or after optimisation)

Impact category	Mitigated impact	Duynefontein	Bantamsklip	Thyspunt
Geotechnical suitability	Slope failure, leading to safety risks (Mitigated)	**Low**	**Low**	**Low**
	Failure of rock slopes, leading to safety risks	**Low**	**Low**	**Low**
	Excessive site disturbance, resulting in environmental damage	**Low**	**Low**	**Low**
Seismic suitability	Impact of Vibratory Ground Motion on the power station structure	**Low**	**Low**	**Low**
Geological risk	Surface Rupture: Capable faults that may cause surface deformation as result of tectonic faulting	**Medium**	**Medium**	**Medium**
	Subsurface Stability: Potential subsurface subsidence or uplift	**Low**	**Low**	**Low**
	Volcanic Activity: Any recently active volcanoes within site vicinity	**Low - Medium**	**Low - Medium**	**Low - Medium**
Hydrological impacts of the proposed power station	Increased run-off peaks due to hardened surface	**Low**	**Low**	**Low - Medium**
	Increased run-off volume due to hardened surface	**Low - Medium**	**Low - Medium**	**Low**
	Disruption during construction: Increased erosion potential	**Low**	**Low**	**Low**
	Disruption during construction: Flooding of works	**Low**	**Low**	**Low**
	Changes in flow paths	**Low - Medium**	**Low - Medium**	**Low - Medium**
	Increased silt deposition due to barren soil	**Low**	**Low**	**Low**
	Pollution of surface waters	**Low - Medium**	**Low - Medium**	**Low - Medium**
	Sea level rise	**Low - Medium**	**Low - Medium**	**Low - Medium**
Impacts of the hydrological environmental on a proposed power station	Rising Sea Level	**Low**	**Low**	**Low**
	Highest astronomical tide	**Low**	**Low**	**Low**

	Extreme high water level	**Low**	**Low**	**Low**
	Frequent high rainfall events	**Low**	**Low**	**Low**
Geohydrology (Construction)	Flooding of the excavated areas by groundwater during construction	**Low**	**Low**	**Low**
	Decreased yields of existing production boreholes during construction	**Low**	**Low**	**Low**
	Drying up of coastal springs during construction	**Considered in detail in the Wetlands Assessment**		
	Degradation of wetlands during construction			
	Intrusion of saline water	**Low**	**Low**	**Low**
	Hydrocarbon contamination of groundwater	**Low**	**Low**	**Low**
	Hazardous waste contamination of groundwater	**Low**	**Low**	**Low**
	Organic and bacteriological contamination of groundwater	**Low**	**Low**	**Low**
Geohydrology (Operation)	Radioactive and toxic contamination of groundwater	**Low**	**Low**	**Low**
	Hydrocarbon contamination of groundwater	**Low**	**Low**	**Low**
	Organic and bacteriological contamination of groundwater	**Low**	**Low**	**Low**
	Decreased yields of existing production boreholes	**Low**	**n.a.**	**Low**
	Drying up of coastal springs and/or seeps	**Considered in detail in the Wetlands Assessment**		
	Degradation of wetlands			
	Intrusion of saline water	**Low**	**n.a.**	**Low**
Freshwater Supply	Sea water intrusion during construction	**Low**	**Low**	**Low**
	Installation of beach wells during construction	**Low**	**Low**	**Low**
	Disposal of brine during construction	**Low**	**Low**	**Low**
	Sea water intrusion during operation	**Low**	**Low**	**Low**

	Disposal of brine during operation	Low	Low	Low
Impacts on flora: Nuclear Power Station and Spoil	Loss of important vegetation communities	High	Low	Medium
	Loss of endemic vegetation communities (locate outside of communities)	Medium	Low	Medium
	Loss of locally occurring Red Data species (translocate or grow affected species)	Low	Low	Low
	Loss of coastal habitat due to climate change and rise in sea level (coastal corridor and nuclear power station set back from the coast)	Low	Low	Low
	Cumulative impact of loss of species, habitat and ecosystem functioning (locate footprint outside transverse dune)	Medium	Low	Low
Impacts on flora at Thyspunt: Eastern Access Road	Loss of dune fynbos & thicket (no mitigation for habitat loss, but avoid good quality and rare sites)	n.a.	n.a.	Low
	Loss of wetlands to east of the Langefontein (realign to avoid wetlands; bridge over wetland just east of the Langefontein) (realign away from sensitive wetlands)	n.a.	n.a.	Assessed in Wetlands Assessment
	Loss of locally occurring Red Data species (realign road to avoid RD species, and/or translocate or grow in nursery)	n.a.	n.a.	Low
	Loss of species, habitat and ecosystem functioning (locate road away from mobile dunes and wetlands)	n.a.	n.a.	Low
Impacts on flora at Thyspunt: Western Access Road	Loss of dune fynbos & thicket (no mitigation for habitat loss, but avoid good quality and rare sites)	n.a.	n.a.	Low - Medium
	Loss of wetlands near Oyster Bay	n.a.	n.a.	Assessed in Wetlands Assessment
	Loss of function of part of western transverse dune system & possibly some wetland function (realign away from sensitive dunes & wetlands)	n.a.	n.a.	Medium
	Loss of locally occurring Red Data species (realign road to avoid RD species, and/or translocate or grow on in nursery)	n.a.	n.a.	Low
	Loss of species, habitat and ecosystem functioning (difficult to mitigate totally, but where possible locate road away from mobile dunes and wetlands)	n.a.	n.a.	Medium

Dune geomorphology impacts at Duynefontein	Dune dynamics of mobile dunes upwind of infrastructure (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	**Negligible**	**n.a.**	**n.a.**
	Mobile dunes downwind of infrastructure (none possible)	**Low-Medium**	**n.a.**	**n.a.**
	Stability of the artificially vegetated dunes due to construction of infrastructure and access roads (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	**Negligible**	**n.a.**	**n.a.**
	Stability of the naturally vegetated late Holocene parabolic dunes - constructing infrastructure, transmission lines and access roads due to constructing infrastructure and access roads (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	**Negligible**	**n.a.**	**n.a.**
	mpact on the artificially vegetated dunes due to topsoil stockpile placement on artificially vegetated dunes(stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	**Negligible**	**n.a.**	**n.a.**
	Impact on Holocene parabolic dunes due to topsoil stockpile placement on naturally vegetated Late Holocene dunes (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	**Negligible**	**n.a.**	**n.a.**
	Impact on the artificially vegetated dunes due to spoil stockpile on the artificially vegetated dunes (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	**Negligible**	**n.a.**	**n.a.**
	Impact on Holocene parabolic dunes due to spoils stockpile on the naturally vegetated Late Holocene dunes (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	**Negligible**	**n.a.**	**n.a.**
Dune geomorphology impacts at Bantamsklip	Constructing infrastructure and access roads on the artificially vegetated dunes (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	**n.a.**	**Negligible**	**n.a.**
	Exposure of Pleistocene parabolic dunes soil to wind erosion due to construction of infrastructure and access roads on the artificially vegetated dunes(reduce wind erosion)	**n.a.**	**Low - Medium**	**n.a.**
	Damage of vegetation due to construction of infrastructure and access roads on the artificially vegetated dunes(careful rehabilitation)	**n.a.**	**Negligible**	**n.a.**

	Impact on artificially vegetated dunes due to construction of infrastructure and access roads on the artificially vegetated dunes (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	**n.a.**	**Negligible**	**n.a.**
	Exposure of soil to wind erosion due to topsoil stockpile on the naturally vegetated late Pleistocene parabolic dunes(reduce wind erosion)	**n.a.**	**Low - Medium**	**n.a.**
	Damage of vegetation (careful rehabilitation)	**n.a.**	**Negligible**	**n.a.**
	Impact on the artificially vegetated dunes due to topsoil stockpile on artificially vegetated dunes (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	**n.a.**	**Negligible**	**n.a.**
	Exposure of soil to wind erosion due to spoils stockpile on the naturally vegetated late Pleistocene parabolic dunes (reduce wind erosion)	**n.a.**	**Low - Medium**	**n.a.**
	Damage of vegetation due to spoils stockpile on the naturally vegetated late Pleistocene parabolic dunes(careful rehabilitation)	**n.a.**	**Negligible**	**n.a.**
Dune geomorphology impacts at Thyspunt	Formation of blowouts along Eastern and Western Access Roads across vegetated dunefield (stabilise, rehabilitate)	**n.a.**	**n.a.**	**Low – Medium**
	Usage of Eastern and Western Access Roads during operational phase (no mitigation)	**n.a.**	**n.a.**	**Low - Medium**
	Constructing transmission lines with 300-400 spans across mobile dunes of Oyster Bay Mobilke Dune Field (Careful positioning of towers with ECO)	**n.a.**	**n.a.**	**Medium**
	Constructing infrastructure and access roads (Use helicopters for construction)	**n.a.**	**n.a.**	**Low - Medium**
	Transmission lines with 300-400m span across mobile dunes and interdune wetlands of the Oyster Bay mobile dune field during operation (Use light vehicles for maintenance)	**n.a.**	**n.a.**	**Negligible**
	Constructing transmission lines with 300-400m spans and access road across vegetated dune field (locate towers on broad ridges and wide interridge valleys)	**n.a.**	**n.a.**	**Medium**
	Constructing transmission lines with 300-400m spans and access road across vegetated dune field (Use helicopters for construction)	**n.a.**	**n.a.**	**Low – Medium**

	Transmission lines with 300-400m span across vegetated dune fieldsInfrastructure and access roads - operation (Use light vehicles for maintenance)	**n.a.**	**n.a.**	**Low - Medium**
	Destruction of dune vegetation & topography due to topsoil and spoils stockpile on naturally vegetated dune field (Re-create original topography)	**n.a.**	**n.a.**	**Medium**
Impacts on dune geomorphology at all sites	Creation of new active mobile dunefields due to sea-level rise due to climate change (no mitigation)	**Medium**	**Medium**	**Medium**
	Blowout increase due to rainfall decrease and temperature increase due to climate change (stabilise with drift fences, brushwood and with pioneer indigenous dune vegetation)	**Low - Medium**	**Low - Medium**	**Low - Medium**
Wetland impacts	Loss or degradation of wetlands resulting from dewatering during construction	**Low**	**Low**	**n.a.**
	Loss or degradation of wetlands resulting from seawater contamination during construction, following dewatering	**Low - Medium**	**n.a.**	**n.a.**
	Degradation of wetlands as a result of construction of internal access roads during construction	**Low**	**n.a.**	**n.a.**
	Degradation and fragmentation of wetlands as a result of construction of internal roads	**Low**	**n.a.**	**n.a.**
	Cumulative impacts	**Low - Medium**	**n.a.**	**n.a.**
	Loss or degradation of wetlands as a result of other construction-related impacts on the site south of the R43 (mitigated)	**n.a.**	**Low**	**n.a.**
	Degradation of wetlands as a result of physical disturbance to wetlands north of the R43 during construction (mitigated)	**n.a.**	**Low**	**n.a.**
	Degradation of wetlands associated with the Groot Hagelkraal system through alien encroachment (mitigated)	**n.a.**	**Low**	**n.a.**
	Increased fragmentation of wetlands up- and downstream of the Groot Hagelkraal system as a result of increased road use along the R43	**n.a.**	**Low**	**n.a.**
	Impacts to wetland systems associated with indirect impacts of the proposed nuclear power station development	**n.a.**	**Low**	**n.a.**
	Loss or degradation of the Langefonteinvlei and/or duneslack wetlands as a result of dewatering during construction (Mitigated)	**n.a.**	**n.a.**	**Low - Medium**

	Loss or degradation of coastal seep wetlands as a result of interference with surface or groundwater flows, including dewatering activities during construction (Mitigated)	**n.a.**	**n.a.**	**Medium**
	Degradation of coastal seep wetlands as a result of receipt of concentrated volumes of potentially sediment-rich water from dewatered areas during construction (Mitigated)	**n.a.**	**n.a.**	**Low - Medium**
	Degradation of the Langefonteinvlei (western sector) and other non-coastal hillslope seep wetlands as a result of the proximal location of stockpiles of spoil or topsoil during construction (Mitigated)	**n.a.**	**n.a.**	**Low**
	Degradation of coastal seep wetlands as a result of catchment hardening and runoff from laydown areas during construction	**n.a.**	**n.a.**	**Low - Medium**
	Degradation / drainage / infilling of hillslope seeps and valley bottom wetlands north of the high dune fields during construction	**n.a.**	**n.a.**	**Low**
	Operational Phase	**n.a.**	**n.a.**	**n.a.**
	Loss or degradation of coastal seep wetlands as a result of interference with surface or groundwater flows during operation	**n.a.**	**n.a.**	**Medium**
	Degradation of remnant coastal seepage wetlands as a result of receipt of stormwater runoff during operation	**n.a.**	**n.a.**	**Low**
	Degradation of hillslope seeps and valley bottom wetlands north of the high dune fields during operation	**n.a.**	**n.a.**	**Low**
	Degradation of dune slack wetlands as a result of increased vehicle passage across the dunes during operation	**n.a.**	**n.a.**	**Low**
	Conservation of remaining dune slack, coastal seep and valley bottom wetlands on the site during operation	**n.a.**	**n.a.**	**Medium**
	Treatment of sewage on site: water quality impacts to wetlands	**n.a.**	**n.a.**	**Low – Medium**
	Wetland disturbance, fragmentation and disruption of through-flows as a result of access roads and transmission towers in or across wetlands: both options during operation (use of dual circuit transmission system)	**n.a.**	**n.a.**	**Low - Medium**
	Alternatives 1 to 3: degradation of wetlands along pipeline routes or as a result of abstraction	**n.a.**	**n.a.**	**Low**

	Wetland disturbance, fragmentation and disruption of through-flows as a result of access roads and transmission towers in or across wetlands: both options			**Low - Medium**
	All access routes: Construction phase wetland degradation as a result of disturbance, water quality changes, compaction	**n.a.**	**n.a.**	**Low**
	All access routes: Operational phase: wetland fragmentation; disruption of faunal and hydrological corridors; degradation of wetlands as a result of water quality impacts and erosion; infilling and constriction of wetlands at bridge crossings	**n.a.**	**n.a.**	**Low – Medium**
	Eastern Access Route: disturbance of the eastern valley bottom wetland at crossing point; localised impacts to flow	**n.a.**	**n.a.**	**Low – Medium**
	Western Access Route: infilling of coastal and hillslope seep wetlands and disruption of through-flows	**n.a.**	**n.a.**	**Low**
	Cumulative impacts associated with development, without incorporation of offset mitigation, but with all other mitigation in place	**n.a.**	**n.a.**	**Medium**
Impacts on terrestrial fauna	Destruction of natural habitats and populations, resulting from site clearance, buildings, laydown areas and infrastructure	**Medium**	**Medium**	**Medium**
	Reduction in populations of Threatened species, resulting from habitat destruction and direct mortality	**Medium**	**Medium**	**Medium**
	Fragmentation of natural habitats and patterns of animal movement, resulting from buildings, infrastructure and fences	**Medium**	**Medium**	**Medium**
	Road mortality (roadkills), resulting from traffic on roads through natural habitats	**Low - Medium**	**Low - Medium**	**Low - Medium**
	Mortality associated with overhead-transmission lines and substations, resulting from collisions and electrocutions	**Low**	**Low**	**Low**
	Disturbance of sensitive breeding populations, resulting from construction activities and direct human disturbance	**Low**	**Low**	**Low**
	Dust pollution beyond the building site, resulting from drifting, airborne dust from construction site and roads	**Low - Medium**	**Low**	**Low**
	Pollution of soil and water beyond the building site, resulting from spills of chemicals, fuel and sewage	**Low**	**Low**	**Low**
	Light pollution beyond the building site, resulting from excessive outdoor lighting, and poor choice of lights and fittings	**Medium**	**Medium**	**Medium**

	Alteration of surface and groundwater levels and flows, and knock-on effects on local wetlands, resulting from underground foundation structures and construction methods	Low - Medium	Medium	Medium
	Poaching of local wildlife during construction phase, resulting from hunting and trapping by workers and employees, for sport and for the pot	Low	Low	Low
	Problem-animal scenarios, resulting mainly from human interaction with animals	Low	Low	Low
	Accumulation of radioisotopes in the environment and in the bodies of wild animals, during operational phase, resulting from routine gaseous emissions from the reactors	Low	Low	Low
	Cumulative impacts, resulting from addition of impacts to existing impacts, and the operation of impacts over time	Medium	Medium	Medium
	Improved conservation of undeveloped land, resulting from improved legal status and/or management	Medium	High	High
<u>Impacts on invertebrate fauna</u>	Direct habitat destruction	Medium	Medium	Medium
	Indirect habitat alteration by groundwater disturbance	Low	Low	Low
	Habitat fragmentation	Medium	Medium	Medium
	Reduction in populations of rare/protected species	Low	Low	Low
	Soil and water pollution	Low - Medium	Low - Medium	Low-Medium
	Dust pollution	Low - Medium	Low - Medium	Low-Medium
	Light pollution - construction phase (partially mitigated)	Medium	Medium	Medium
	Light pollution - operational phase (fully mitigated)	Low - Medium	Low - Medium	Low-Medium
	Increased radiation levels	Low - Medium	Low - Medium	Low-Medium
	Road mortality	Medium	Medium	Medium
	Increased risk of fire	Medium	Medium	Medium
	Spread of alien invasive invertebrate species	Medium	Medium	Medium

	Land invasion by employment seekers	**Low**	**Low**	**Low**
	Cumulative impacts	**Medium**	**Medium**	**Medium**
	Climate change	**Medium**	**Medium**	**Medium**
	Positive contribution to conservation	**Medium**	**Medium**	**Medium**
	Impacts of access roads	**Medium**	**Medium**	**Medium**
	Impacts of terrestrial disposal of spoil	**Medium**	**Medium**	**Medium**
	Impacts of the no-go alternative	**Medium**	**Medium**	**Medium**
	Impacts of transmission lines between the power station and HV Yard	**n.a.**	**n.a.**	**Low - Medium**
Air quality impacts	Construction - Gaseous emissions	**Low**	**Low**	**Low**
	Construction - PM10 emissions	**Low**	**Low**	**Low**
	Construction - Fallout	**Low**	**Low**	**Low**
	Operational - Non-radionuclide emissions	**Medium**	**Medium**	**Medium**
	Operational - Radionuclide emissions	**Medium**	**Medium**	**Medium**
	Cumulative impacts	**Medium**	**Medium**	**Medium**
Oceanographic impacts	Short term disruption of sediment transport during construction	**Low**	**Low**	**Low**
	Short term disruption of sediment transport (Outfall Option 2)	**n.a.**	**Low**	**n.a.**
	Beach erosion due to brine discharge during construction	**Low**	**Low**	**Low**
	Disposal of spoil	**n.a.**	**Medium**	**Low**
	Long term disruption of sediment transport during operation	**Low - Medium**	**Low - Medium**	**Low-Medium**
	Long term disruption of sediment transport by (Outfall Option 2) during operation	**n.a.**	**Low - Medium**	**n.a.**
	Extreme sea levels affecting operation of nuclear power station during operation	**Low - Medium**	**Low - Medium**	**Low-Medium**

Impacts on surf breaks	Effect of sediment dumping on surf confitions at Seal Point (Mitigated - deep disposal site)	**n.a.**	**n.a.**	**Low**
	Effect of sediment dumping on Bruce's Beauties (Mitigated - Shallow Disposal Site)	**n.a.**	**n.a.**	**Low**
Marine impacts	Disruption during construction: Due to construction of the cooling water intake and outflow systems	**Medium**	**High**	**Low-Medium**
	Disruption during construction due to discarding of spoil (mitigated by discarding of spoil at a deep offshore site)	**Medium**	**Low-Medium**	**Medium**
	Abstraction of cooling water & entrainment of organisms	**Low-Medium**	**Low-Medium**	**Low-Medium**
	Impact on marine organisms due to release of warmed cooling water	**Medium**	**Low-Medium**	**Medium**
	Release of desalination effluent during the construction phase	**Low-Medium**	**Medium**	**Low-Medium**
	Release of radiation emissions	**Low**	**Low**	**Low**
	Unintentional discharge of polluted groundwater	**Low**	**Low**	**Low**
Heritage	Impact on Miocene palaeontology (positive)	**Medium**	**Medium**	**Low - Medium**
	Destruction of Pleistocene archaeology and palaeontology	**Medium**	**Medium**	**Medium**
	Destruction of Holocene archaeology	**Low**	**Medium**	**Medium**
	Destruction of Colonial Heritage	**Low**	**Low**	**Low**
	Destruction of Landscape	**Medium**	**High**	**High**
	Cumulative impacts	**Medium**	**Medium**	**Medium**
Noise	Noise impacts of oil cooler fans during operation	**Low**	**Low**	**Low**
	Noise impacts of road construction	**Low**	**Low**	**Low**
	Noise impacts of site works and construction	**Low**	**Low**	**Low**
	Impact of transportation noise	**Low**	**Medium**	**n.a.**
	Impact of transportation noise 10m from the R330	**n.a.**	**n.a.**	**Medium**

	Impact of transportation noise 70m from the R330	n.a.	n.a.	Low
Tourism	Impact on hospitality systems	Low	Medium	Medium
	Impacts on general infrastructure used by tourists	Low	Low	Low
	Impact on visual amenity enjoyed by tourists	Low	Medium	Medium
	Impact on sense of place from tourism point of view	Low	Medium	Medium
	Impact on marine assets used by tourists	Low	Low	Low
	Impact on social amenity	Low	Medium	Medium
	Impact on terrestrial assets used by tourists	Low	Medium	Low
Agricultural impacts	Dust pollution	Low	Low	Low
	Availability/ Cost of labour	Low	Medium	Medium
	Change in market condition (Optimised)	Low	Low	Medium
Economic impacts	Construction phase macroeconomic impacts – Local (positive)	High	High	High
	Construction phase macroeconomic impacts – Regional (positive)	Medium	Medium	Medium
	Construction phase macroeconomic impacts –National (positive)	Medium	Medium	Medium
	Operational phase macroeconomic impacts – Local (positive)	Medium	Medium	Medium
	Operational phase macroeconomic impacts – Regional (positive)	Low	Low	Low
	Operational phase macroeconomic impacts – national (positive)	Low	Low	Low
	Loss of income arising from loss of part of fishing grounds	n.a.	n.a.	Medium
	Loss of income arising from loss of access to part of whale watching area	n.a.	Low	n.a.
Site control	Restricted access to site during construction	Low - Medium	Low - Medium	Low - Medium
	Restricted access to site during operation	Low - Medium	Low - Medium	Low

Visual impacts	Visual intrusion of drill rigs and ancillary equipment during pre-construction	**Low**	**Low**	**Low**
	Visual degradation of vegetation clearance, access roads and site camps during pre-construction	**Low**	**Low**	**Low**
	Degradation of Sense of Place during pre-construction	**Low**	**Low**	**Low**
	Visible dust during contruction	**Low**	**Low**	**Low**
	Degradation of visual quality resulting from change to vegetation and landform during construction	**Medium**	**Medium**	**Medium**
	Visual clutter resulting from structures, site offices, laydown areas and site accommodation during construction	**Low**	**Low**	**Low**
	Visual quality change cause by large spoil dumps during construction	**Low - Medium**	**Low - Medium**	**Low - Medium**
	Visual alteration of night scene by lighting during construction	**Medium**	**Medium**	**Medium**
	Visual change to Sense of Place during construction	**Medium**	**Medium**	**Medium**
	Visual change to Sense of Place of local coastal and inland area due to large scale and extent of structures during operation	**Medium**	**Medium**	**Medium**
	Change in visual quality of local area caused by new landforms and roads during operation	**Medium**	**Medium**	**Medium**
	Change in visual quality of local night scene by lighting during operation	**Medium**	**Medium**	**Medium**
	Visible dust during decommissioning	**Low**	**Low**	**Low**
	Visual clutter resulting from structures, site offices and on site accommodation during decommissioning	**Low**	**Low**	**Low**
	Visual change to local landscape due to earthworks and spoil dumps during decommissioning	**Medium**	**Medium**	**Medium**
	Visual nuisance of heavy traffic on local roads during decommissioning	**Low**	**Low**	**Low**
Social impacts	Impact on accommodation during the construction phase (construction)	**Medium**	**Medium**	**Medium**
	Influx of job seekers (construction)	**Medium**	**Medium**	**Medium**
	Increase in informal illegal dwellings (construction)	**Low**	**Low**	**Low**

	Creation of employment opportunities (construction)	High	High	High
	Increase in business opportunities (construction)	Medium	Medium	Medium
	Increase in criminal activities (construction)	Low	Medium	Medium
	Increase in sexually transmitted diseases (construction)	Medium	Medium	Medium
	Impact on water & sanitation (construction)	Low	Low	Low
	Impact on roads & transport (construction)	Low	Low	Low
	Impact on waste and refuse (construction)	Low	Low	Low
	Traffic impact (construction)	Low	Low	Low
	Noise impact (construction)	Medium	Medium	Medium
	Loss of employment (construction)	Medium	Medium	Medium
	Visual impact (construction)	Medium	Medium	Medium
	Impact on medical infrastructure (construction)	Low	Low	Low
	Impact on law enforcement (construction)	Low	Medium	Medium
	Impact on schools (construction)	Low	Low	Low
	Impact on sport infrastructure (construction)	Low	Low	Low
	Impact on sense of place (construction)	Medium	Medium	Medium
	Impact on future land use (construction)	Medium	Medium	Medium
	Creation of employment opportunities (operation)	Medium	Medium	Medium
	Creatrion of business opportunities (operation)	Medium	Medium	Medium
	Increase in criminal activities (operation)	Low	Low	Low
	Impact on water & sanitation (operation)	Low	Low	Low

	Impact on roads & transport (operation)	**Low**	**Low**	**Low**
	Impact on waste and refuse (operation)	**Low**	**Low**	**Low**
	Visual impact (operation)	**Medium**	**Medium**	**Medium**
	Impact on medical infrastructure (operation)	**Low**	**Low**	**Low**
	Impact on schools (operation)	**Low**	**Low**	**Low**
	Impacts on sport infrastructure (operation)	**Low**	**Low**	**Low**
	Impact on sense of place (operation)	**Medium**	**Medium**	**Medium**
	Impact on future land use planning (operation)	**Medium**	**Medium**	**Medium**
	Perceived risk of nuclear incidents (operation)	**Medium**	**Medium**	**Medium**
	Impact of the no-development option (operation)	**Medium**	**Medium**	**Medium**
Nuclear and non-nuclear waste	Contamination of water resources due to the release of radioactivity contained in liquid waste (Commissioning, Operational and Decommissioning Phase)	**Low**	**Low**	**Low**
	Contamination of the atmosphere due to the release of radioactivity contained in gaseous waste (Commissioning, Operational and Decommissioning Phase).	**Low**	**Low**	**Low**
	Contamination of water resources due to the release of radioactivity contained in LILW or HLW stored at the Power Station (Commissioning, Operational and Decommissioning Phases)	**Low**	**Low**	**Low**
	Contamination of water resources by radioactivity due to disposal of LILW at Vaalputs (Operational Phases)	**Low**	**Low**	**Low**
	Contamination of water resources by radioactivity due to accidental spillage of radioactive waste during transport (Operational Phase)	**Low**	**Low**	**Low**

It is evident from Table 9-91 that the vast majority of the more than 250 identified environmental impacts (after mitigation) are of low or low-medium negative significance and many of the impacts are of equal significance at all three of the alternative sites.

It is also evident that there are medium to high significance impacts in the following 16 categories:

- *Geological risk (negative);*
- *Flora (negative);*
- *Dune geomorphology (negative);*
- *Terrestrial vertebrate fauna (negative and positive);*
- *Terrestrial invertebrate fauna (negative and positive);*
- *Air quality (negative);*
- *Oceanographic conditions (negative);*
- *Marine impacts (negative);*
- *Impacts on heritage resources (negative and positive);*
- *Noise (negative);*
- *Tourism (negative);*
- *Agriculture (negative and positive);*
- *Economic impacts (negative and positive);*
- *Site control (negative);*
- *Visual (negative); and*
- *Social impacts (negative and positive).*

Based on these findings from Table 9-94, there is no obvious clear preference for a particular site. In view of this, Arcus GIBB has consolidated the impacts in an attempt to simplify the evaluation procedure and decision making on a potentially preferred site.

9.32.2 Consolidation of impacts

Table 9-92 shows a consolidation of the more than 250 impacts into 40 impact categories. This has been done by assessing the significance of the specific mitigated impacts per category and consolidating them into single categories. By following the precautionary principle, the highest negative or lowest positive significance rating from Table 9-91 was used to prepare Table 9-92.

Table 9-92: Summary of consolidated impacts

Impact category	Duynefontein	Bantamsklip	Thyspunt
Geotechnical suitability	Low	Low	Low
Seismic suitability	Low	Low	Low
Geological risk	Medium	Medium	Medium
Hydrological impacts of the proposed power station	Low - Medium	Low - Medium	Low - Medium
Impacts of the hydrological environmental on a proposed power station r station	Low	Low	Low
Geohydrology (Construction)	Low	Low	Low
Geohydrology (Operation)	Low	Low	Low
Freshwater Supply	Low	Low	Low
Impacts on flora	High	Low	Medium

Impacts on dune geomorphology	**Low-Medium**	**Low-Medium**	**Medium**
Impacts on dune geomorphology duer to climate change	**Medium**	**Medium**	**Medium**
Wetland impacts	**Low-Medium**	**Low**	**Medium**
Impacts on terrestrial vertebrate fauna (Negative)	**Medium**	**Medium**	**Medium**
Impacts on terrestrial vertebrate fauna (Positive)	**Medium**	**High**	**High**
Impacts on terrestial invertebrate fauna (Negative)	**Medium**	**Medium**	**Medium**
Impacts on terrestial invertebrate fauna (Positive)	**Medium**	**Medium**	**Medium**
Air quality impacts (construction)	**Low**	**Low**	**Low**
Air quality impacts (operation)	**Medium**	**Medium**	**Medium**
Oceanographic impacts	**Low-Medium**	**Medium**	**Low-Medium**
Impacts on surf breaks	**n.a.**	**n.a.**	**Low**
Marine impacts	**Medium**	**High**	**Medium**
Heritage (Negative)	**Medium**	**High**	**High**
Heritage (Positive)	**Medium**	**Medium**	**Low - Medium**
Noise	**Low**	**Medium**	**Medium**
Tourism	**Low**	**Medium**	**Medium**
Agricultural impacts (negative)	**Low**	**Medium**	**Medium**
Agricultural impacts (positive)	**Low**	**Low**	**Medium**
Economic impacts (positive, construction)	**Medium**	**Medium**	**Medium**
Economic impacts (positive, operation)	**Low**	**Low**	**Low**
Economic impacts (negative, construction and operation)	**n.a.**	**Low**	**Medium**
Site control (construction)	**Low - Medium**	**Low - Medium**	**Low - Medium**
Site control (operation)	**Low - Medium**	**Low - Medium**	**Low**
Visual impacts (construction)	**Medium**	**Medium**	**Medium**
Visual impacts (operation)	**Medium**	**Medium**	**Medium**
Visual impacts (decommissioning)	**Medium**	**Medium**	**Medium**
Social impacts (construction, negative)	**Medium**	**Medium**	**Medium**
Social impacts (positive, construction)	**Medium**	**Medium**	**Medium**
Social impacts (operation)	**Medium**	**Medium**	**Medium**
Social impacts (positive, operation)	**Medium**	**Medium**	**Medium**
Impacts of nuclear and non-nuclear waste	**Low**	**Low**	**Low**

It is evident from Table 9-92 that many of the impact categories have the same impact significance for all the sites and are thus common to all the sites. In order to simply the table still further, Arcus GIBB has filtered out the impacts that are of low and low-medium significance and has removed the impact categories that have the same significance at all three alternative sites.

9.32.3 Filtering of impacts

Table 9-93 shows the environmental impacts remaining after the filtering process has been completed. This resulted from the removal of all the impacts that have the same significance at all three alternative sites, even if they had a medium to high significance (negative or positive)[30].

Furthermore, impacts of low and low-medium significance have also been filtered out, since these impacts are, by definition, those that should have the least influence on decision-making.

It is important to note that the impacts in Table 9-93 have not been weighted, i.e. it has not yet been decided which impact categories should play a greater role than others in the decision-making process.

Table 9-93: Summary of filtered impacts

Impact category	Duynefontein	Bantamsklip	Thyspunt
Impacts on flora	**High**	**Low**	**Medium**
Impacts on dune geomorphology	**Low-Medium**	**Low-Medium**	**Medium**
Wetland impacts	**Low-Medium**	**Low**	**Medium**
Impacts on terrestrial vertebrate fauna (Positive)	**Medium**	**High**	**High**
Oceanographic impacts	**Low-Medium**	**Medium**	**Low-Medium**
Impacts on surf breaks	**n.a.**	**n.a.**	**Low**
Marine impacts	**Medium**	**High**	**Medium**
Heritage (Negative)	**Medium**	**High**	**High**
Heritage (Positive)	**Medium**	**Medium**	**Low - Medium**
Noise	**Low**	**Medium**	**Medium**
Tourism	**Low**	**Medium**	**Medium**
Agricultural impacts (negative)	**Low**	**Medium**	**Medium**
Agricultural impacts (positive)	**Low**	**Low**	**Medium**
Economic impacts (negative, construction and operation with regards to impacts on firsheries and tourism	**n.a.**	**Low**	**Medium**
Site control (operation)	**Low-Medium**	**Low-Medium**	**Low**

30 Whilst it remains important to understand the nature of these impacts and to apply effective mitigation to prevent and reduce them, the purpose of this section of the report is focused on the recommendation of a preferred site alternative for potential authorisation. Impacts that have the same significance at all three alternative sites provide no basis for comparison between the sites.

A review of the 16 filtered impact categories in Table 9-93 shows that:

1. ***With respect to positive impacts, Duynefontein has three of medium significance and one of low significance, Bantamsklip has two of high significance, one of medium significance and one of low significance, and Thyspunt has one of high significance, two of medium significance and one of low-medium significance.***
2. ***There is one potential negative impact of high significance at Duynefontein, two at Bantamsklip and one at Thyspunt.***
3. ***There are two negative impacts of medium significance at Duynefontein, four of medium negative significance at Bantamsklip and eight of medium negative significance at Thyspunt.***

On this basis, it would appear that Duynefontein could be the preferred site.

However, it is necessary to consider the relative importance of each of the impacts categories between sites and within a site. For instance, it needs to be considered whether the impact on wetlands would be more or less important than the economic impact. Clearly, it is not a simple exercise to compare impact categories as, for argument's sake, one category may be 10, 100 or 1000 times more important than another.

Furthermore, Table 9-93 only shows the environmental issues (impacts) and does not consider technical issues. Eskom has stated that the seismic suitability of a site, as well as transmission integration factors are vital to decision-making on a preferred site,

9.32.4 Selection of key decision factors

In view of the above findings, and the fact that Table 9-93 does not provide a robust and defendable way to identify a preferred site, Arcus GIBB made use of the findings of a specialists integration workshop, which was conducted in November 2009, to determine which impact categories (both environmental and technical) have more relative importance than others. This led to the ranking of impact categories and determination of the key "decision factors" to be used in site selection. Table 9-94 shows the results of the ranking of the key decision factors.

Consensus was sought at the specialist integration workshop to align the recommendations of the specialist with each other. However, this was not always possible. In many cases recommendations of particular specialists with regards to site preference are opposed to those of other specialists. Therefore, both to reduce the number of decision factors to a manageable number and to ensure that responsible trade-offs can be made between decision factors that point to contrasting preferred sites, the categories of potential impacts have been weighted in order to select a preferred site. The integration meeting therefore included the development of weightings (indications of importance) for the different decision factors (specialist disciplines). The weightings are the results of the weighting developed at the integration meeting in November 2009, as well as the Arcus GIBB team's consideration of the changes to specialist studies after the integration workshop.

EIA SPECIALIST INTEGRATION WORKSHOP

The functions of the integration workshop included the following:

- ***Facilitating understanding of the key specialist findings by Arcus GIBB;***
- ***Ensuring that all specialists understand the key findings of all other specialist studies as it may apply to their fields of specialisation;***
- ***Where appropriate, to ensure that conflicts between specialist studies are eliminated and to align specialist studies with each other;***
- ***Agreeing with Eskom and all specialists on appropriate modifications to the proposed designs of the plant and associated infrastructure in order to mitigate impacts; and***
- ***Agreeing on ranking and rating criteria to choose the most suitable alternative site for the nuclear power station and associated infrastructure.***

In preparation for the integration workshop, specialists were divided into four teams as follows. These teams met before the integration workshop to discuss their findings with each other and agree on relative impact significance for the three alternative sites:

- ***Technical factors (geological and geotechnical suitability and seismological risk);***
- ***Water-related factors (fresh water supply, geo-hydrology and surface water hydrology);***
- ***Social factors (traffic and transportation, noise, social impacts, economic impact, agriculture, tourism, human health risk, emergency response and site control, and safety and visual impact); and***
- ***Biophysical factors (heritage and / archaeology, air quality, freshwater ecology, vertebrate fauna, invertebrate fauna, oceanography, marine biology, botanical and dune geomorphology).***

Table 9-94: ***Selection of key decision-factors for the choice of a preferred site***

Key

(black box)	***Key decision factor***
(white box)	***Not a key decision factor***

	Decision factor	Discussion	Weighted value[31]
Technical factors	*Transmission integration factors*	*Transmission integration factors have a critical influence on the decision, as there are large technical differences between the sites with respect to the need for additional generation capacity in the Eastern and Western Cape provinces and the ease with which electricity produced at the sites can be conveyed into the transmission system.*	*4*
	Seismic suitability	*The seismic values at sites will determine the ability to use a standard nuclear power station design, or whether any additional design work will be required for a non-standard plant, which will impact on timelines and costs. Although there are no seismic disqualifiers at any of the three sites, there are significant differences in the PGA values for each of the sites.*	*4*
Environmental factors	*Impacts on dune geomorphology*	*Major sensitive dune systems at one of the sites result in large differences in significance of impacts between the alternative sites. Moving dune systems are rare features along South Africa's coastline and relatively unimpacted dune systems, such as found at one site, are even rarer. Dune geomorphology influences habitats and communities and therefore indirectly influences species diversity.*	*3*
	Impacts on wetlands	*Wetlands are threatened ecosystems in South Africa and are important life-support systems. Protecting wetlands is regarded as a national priority.*	*3*

[31] ***Scored on a scale of 1 to 5, with 5 being most important for decision-making and 1 being of very low importance for decision-making.***

	Decision factor	Discussion	Weighted value[31]
Environmental factors	***Potential conservation benefits***	***There is a large difference in the potential conservation value between the sites. Duynefontein is currently conserved, and would therefore derive little benefit from the development of a de fact conservation area on Eskom property around the power station. However, Bantamsklip and Thyspunt are currently not conserved. Therefore, conservation of sensitive species, ecosystems and processes on these properties would be of great value.***	***3***
	Impacts on heritage resources[32]	***Since the previous version of this EIR was released for public comment, important differences between the sites have emerged. It has, for instance, been concluded that the landscape at the Thyspunt site can be considered to be a "Cultural Landscape" in terms of the definition of the UNESCO World Heritage Convention. This is applicable only to the Thyspunt site and not to the other alternative sites. Furthermore, the nature of the heritage impacts differs substantially between the three alternative sites.***	***3***
	Economic impacts	***The potential magnitude of the economic impacts is important due to the high costs of a nuclear power station and the potential for significant cost differences and impacts on the provincial economies. Major upgrades to heavy vehicle routes result in cost differences between the alternative sites. Given South Africa's status as an emerging economy, this is an important decision factor to distinguish between the sites.***	***3***
	Invertebrate fauna	***There are significant differences in the sensitivity of the sites from an invertebrate perspective. All alternative sites contain potentially new (undescribed) species and/or varieties.***	***3***
	Vertebrate fauna	***There are a number of threatened vertebrate species at all three of the alternative three sites. The areas of vertebrate sensitivity largely correspond to the wetlands and areas that have been identified as being important from the perspective of other biophysical specialist studies.***	***2***

[32] This decision factor was not regarded to be of such high importance at the time of the specialist integration meeting in 2009. However, Arcus GIBB has increased the weight of this factor in response to a change in the findings of the Heritage Impact Assessment since 2009.

	Decision factor	Discussion	Weighted value[31]
Environmental factors	Geo-hydrology	There is evidence of a strong link between geo-hydrological conditions and wetlands, particularly at Thyspunt. However, impacts on wetlands are considered separately and to avoid double counting, geo-hydrology was not considered in addition to impacts on wetlands.	1
	Floral impact	Potential impacts on flora can be mitigated if the specialist's recommendations regarding placement of the power station and associated infrastructure on the sites are followed.	1
	Marine ecology impact	Marine impacts are similar at all sites, although higher at Bantamsklip, but there are no impacts of critical nature. The marine specialist indicated that the area that will be affected by the disposal of spoil in the sea can be justifiably sacrificed.	1
	Noise impact	Potential noise impacts are similarly insignificant at all alternative sites and no mitigation is required by the applicable legislation.	1
	Tourism impact	Potential impacts on tourism are mostly negative in the short term but positive over the longer term during the operational phase.	1
	Agricultural impact	Agricultural impacts were agreed to be of low importance. None of the sites will have significant negative impacts as no high potential agricultural land will be directly affected.	1
	Social impact	Social impacts are not seen as a critical decision factor because of their similar nature and significance at all three alternative sites	1

Based on the above analysis, the following nine decision factors emerge as most important for decision-making and have been carried forward to the next step in the comparison of alternatives:

- ***Transmission integration factors (4);***
- ***Seismic suitability of the sites (4);***
- ***Impacts on dune geomorphology (3);***
- ***Impacts on wetlands (3);***
- ***Potential conservation benefits[33] (3);***
- ***Impacts on heritage resources[34] (3);***

[33] ***This provides a generalised statement of conservation benefits for flora, terrestrial vertebrate fauna and terrestrial invertebrate fauna.***

- ***Economic impacts (3);***
- ***Impacts on invertebrate fauna (3); and***
- ***Impacts on vertebrate fauna (2).***

9.32.5 Numerical comparison of sites

The three alternative sites have been compared using a numerical ranking model that takes only the weighted (important) decision factors into account. Each decision factor has been scored on a scale of 1 to 5 (for positive impacts) and -1 to -5 (for negative impacts) as indicated in Table 9-95. Thus, the highest total score would be most favourable for a site.

Table 9-95: Values allocated to the various degrees of significance

1	***Low positive impact***
2	***Low to medium positive impact***
3	***Medium positive impact***
4	***Medium to high positive impact***
5	***High positive impact***
-5	***High negative impact***
-4	***Medium to high negative impact***
-3	***Medium negative impact***
-2	***Low-medium negative impact***
-1	***Low negative impact***

Values allocated to the degrees of significance were determined by the Arcus GIBB EIA team considering the overall environmental impact significance at each site (from Table 9-93), the Transmission Integration Report (Appendix E28) and Seismic Risk Report (Appendix E4). The significance values given for each decision factor have been multiplied by the weighting factor given in Table 9-95. The resulting scores for all decision factors were totalled to provide an indication of the numerical ranking of the three alternative sites. The highest numerical ranking indicates the numerically most favoured site. The results of this exercise are shown in Table 9-96 below.

[34] ***This was not regarded as an important decision factor during the specialist integration workshop. Arcus GIBB has adjusted the weighting based on the revised Heritage Impact Assessment, which contains substantively different conclusions to the version considered during the integration workshop in 2009.***

Table 9-96: Weighted comparison of all three alternative sites

Notes:

- ***Value allocated to each site for transmission integration, seismic factors and conservation benefits are based on Arcus GIBB's interpretation of the relevant specialist reports.***
- ***Values allocated to all other decision factors are based on the impact significance in Table 9-93 (from 1 for low significance to 5 for high significance).***

Decision factor	Weighting	Duynefontein	Bantamsklip	Thyspunt	Value (Duynefontein)	Weighted value (Duynefontein)	Value (Bantamsklip)	Weighted value (Bantamsklip)	Value (Thyspunt)	Weighted value (Thyspunt)
Transmission integration factors	***4***	***The Western Cape network is already relatively stable. Addition of a power station in this province would add little value to the transmission system.***	***A power station at Bantamsklip would be less advantageous than at either Duynefontein or Thyspunt, since 765 kV transmission lines would be required through difficult terrain. This would result in substantial additional cost at the Bantamsklip site.***	***Thyspunt site provides opportunity to strengthen the Eastern Cape network, where there is currently insignificant generation capacity.***	***+2***	***+8***	***+1***	***+4***	***+4***	***+16***
Seismic suitability of the sites	***4***	***The Duynefontein site has a PGA value of 0.3g. Should the SSHAC process result in an upward adjustment of this value, a special power station design (with time significant construction time and cost implications) would have to be developed.***	***The Bantamsklip site has a PGA value of 0.23 g, which is 77% of 0.3 g. Should the SSHAC process result in an upward adjustment of the PGA value for this site, there is less of a risk than at Duynefontein that the eventual value could exceed 0.3 g, but more of a risk than at Thyspunt.***	***The Thyspunt site has a PGA value of 0.16g, which is 53% of 0.3 g. Should the SSHAC process result in an upward adjustment of the PGA value for this site, there is a lower risk than either Duynefontein or Bantamsklip that the eventual PGA value could exceed 0.3 g.***	***+2***	***+8***	***+3***	***+12***	***+4***	***+16***

Decision factor	Weighting	Duynefontein	Bantamsklip	Thyspunt	Value (Duynefontein)	Weighted value (Duynefontein)	Value (Bantamsklip)	Weighted value (Bantamsklip)	Value (Thyspunt)	Weighted value (Thyspunt)
Negative impacts on dune geomorphology	***3***	***The power station would impact the southern extremity of the Atlantis mobile dune system. This system has already been impacted by the development of the KNPS and portions have been artificially stabilised with vegetation. Therefore potential impacts at this site would not be as significant as at Thyspunt.***	***Groundwater does not "daylight" in the dunes at Bantamsklip. Thus, there are no impacts related to the interaction between groundwater and dune dynamics at this site. At Bantamsklip, topsoil and spoils stockpiles located on the artificially vegetated dune fields or on the older naturally vegetated parabolic dunes will have low significance operational impacts. There are no mobile dune field as at Thyspunt and Duynefontein.***	***Possible development of transmission lines and an associated construction and maintenance roads across the highly sensitive Oyster Bay dune fields are of high significance, due to the uniqueness of this system and associated sensitive habitats such as the inter-dune wetlands. There is a high degree of hydrological connection between the dune systems and the wetlands on the site.***	***-2***	***-6***	***-2***	***-6***	***-3***	***-9***

Decision factor	Weighting	Duynefontein	Bantamsklip	Thyspunt	Value (Duynefontein)	Weighted value (Duynefontein)	Value (Bantamsklip)	Weighted value (Bantamsklip)	Value (Thyspunt)	Weighted value (Thyspunt)
Negative impacts on wetlands	***3***	***Extent of wetlands at Duynefontein is limited. Very limited potential negative impacts are anticipated.***	***The extent of the wetlands at Bantamsklip is extensive north of the R43 road. However, on the southern portion of the site where the power station is proposed to be constructed, there are no extensive wetlands. Impacts on wetlands will therefore be of low significance.***	***The extent of wetlands is extensive and correlates with the headland dune bypass system, which stretches from east to west across the site. The very sensitive Langefonteinvlei wetlands are located in the eastern portion of the site. Drawdown of groundwater during construction may impact wetlands, although the geohydrological monitoring has confirmed that these impacts on at least the southern and western portions of the Langefonteinvlei can be mitigated. Very little to no mitigation is possible for the sensitive coastal seeps, and it is probable that they will be lost.***	***-2***	***-6***	***-1***	***-3***	***-3***	***-9***

Decision factor	Weighting	Duynefontein	Bantamsklip	Thyspunt	Value (Duynefontein)	Weighted value (Duynefontein)	Value (Bantamsklip)	Weighted value (Bantamsklip)	Value (Thyspunt)	Weighted value (Thyspunt)
Impacts on conservation (positive)	***3***	***The Duynefontein site is already conserved as part of the Koeberg Nature Reserve. Thus, there would be limited additional conservation benefit to establishment of a nuclear power station at this site.***	***The Bantamsklip site has significant conservation value for invertebrates, flora, wetlands (on the northern portion of the site) and in terms of heritage resources. In addition, the declaration of a marine exclusion zone holds the potential for better protection of the currently over-exploited abalone. However, there is low confidence in the success of protecting abalone.***	***The Thyspunt site has significant conservation value for invertebrates, flora, wetlands and the Oyster Bay headland bypass dune system. There is also a number of other small nearby conservation areas / nature reserves with which the site could be linked to form a larger effective conservation area, together with the area of the site outside the development footprint assessed in this EIA. Furthermore with the purchase of the recommended sites outside the EIA corridor, the large conserved area will be an important conservation asset.***	***+1***	***+3***	***+3***	***+9***	***+4***	***+12***

Decision factor	Weighting	Duynefontein	Bantamsklip	Thyspunt	Value (Duynefontein)	Weighted value (Duynefontein)	Value (Bantamsklip)	Weighted value (Bantamsklip)	Value (Thyspunt)	Weighted value (Thyspunt)
Negative impacts on heritage resources	***3***	***Compared to Thyspunt, the impacts on heritage resources are predicted to be of least significance at Duynefontein, as no impact at this site is predicted to exceed medium negative significance. The most significant impacts at Duynefontein would be those on Miocene palaeontological remains. However, if mitigated by responsible excavation (relatively easily achieved compared to Thyspunt), this can be transformed to a positive impact.***	***Bantamsklip is almost as sensitive in terms of its heritage richness as Thyspunt. However, mitigation measures will have a better chance of success at Bantamsklip as heritage resources at this site are more visible and accessible than at Thyspunt. The significance of impacts on Pleistocene and Holocene[35] archaeological resources is regarded as medium and high, respectively at Bantamsklip. Holocene archaeological impacts are therefore regarded as more significant at Bantamsklip than at Duynefontein.***	***In spite of the coastal offset, which protects some of the highest concentrations of archaeological sites, impacts on heritage resources would be substantial and highly significant. Mitigation would be very costly and time-consuming and would have to be conducted at a scale never before seen in South Africa. In addition, non-mitigable impacts on the landscape would occur at Thyspunt. This site is considered a "Cultural Landscape" in terms of the UNESCO definition, owing to the combination of a very rich pre-colonial heritage and the scenic value of landscape.***	***-3***	***-9***	***-5***	***-15***	***-5***	***-15***

[35] ***Within the last 10000 years.***

Decision factor	***Weighting***	***Duynefontein***	***Bantamsklip***	***Thyspunt***	***Value (Duynefontein)***	***Weighted value (Duynefontein)***	***Value (Bantamsklip)***	***Weighted value (Bantamsklip)***	***Value (Thyspunt)***	***Weighted value (Thyspunt)***
Economic impacts (positive)[36]	***3***	***The cost at this site is not significantly different to that at Thyspunt. The overall positive macro-economic impacts will be greater at Duynefontein than at Thyspunt due to the Western Cape having a larger, more diversified economy. However, there will be less positive impact on poverty alleviation at Duynefontein than at Thyspunt. The cost and percentage differences between Duynefontein and Thyspunt are respectively R570 million or 0.53%.***	***Macroeconomic indicators favour the Western Cape sites, including Bantamsklip. However, the cost-effectiveness analysis indicates that Thyspunt has a very slight edge over Duynefontein and a somewhat larger edge over Bantamsklip. The cost and percentage differences between Bantamsklip and Thyspunt are respectively R6.388 billion or 5.93%. This large cost difference is due to the extensive transport upgrades that would be required at Bantamsklip as well as the longer and more expensive transmission lines.***	***The cost efficiency is not significantly different to that at Duynefontein. The cost-effectiveness analysis indicates that Thyspunt has a very slight edge over Duynefontein. When considering poverty alleviation, then factors such as the impact on low-income households, the impact of the social indicators and the opportunity to grow the economy of a province as reflected by the potential impact on GDP, Thyspunt is slightly favoured relative to Duynefontein.***	***+3***	***+9***	***+2***	***+6***	***+3***	***+9***

[36] ***The Economic Assessment (Appendix E17) indicates that the positive economic impacts are of equal significance at all three alternative sites. However, the Economic Assessment concludes that construction of the proposed power station at Bantamsklip will be approximately R5.8 billion more expensive than at Duynefontein and R6.3 billion more expensive than at Thyspunt, The cost difference between Thyspunt and Duynefontein is, however, insignificant. The large difference in the costs at Bantamsklip is due largely to the extensive upgrades of transport infrastructure that would be required for construction at this site. Therefore, in spite of the impact significance being rated equal (medium) for all three sites, the rating value in the above table has been changed to a "2" for Bantamsklip to reflect its higher cost relative to the other two sites.***

Decision factor	Weighting	Duynefontein	Bantamsklip	Thyspunt	Value (Duynefontein)	Weighted value (Duynefontein)	Value (Bantamsklip)	Weighted value (Bantamsklip)	Value (Thyspunt)	Weighted value (Thyspunt)
Negative impacts on invertebrate fauna	***3***	***An undescribed ant species has been found in EIA corridor in the artificially vegetated dunes. However, this is a generalist species that occurs in a number of habitats and it occurs in artificially vegetated dunes, which indicates it has colonised the site from adjacent areas and should therefore be found on the remainder of the site.***	***Bantamsklip is ranked lower than Duynefontein in terms of overall species richness, but considered the high potential for rare, endemic and relictual species at Bantamsklip, its sensitivity ranking can be raised above Duynefontein. There are several other reasons, including the discovery of a probably new mygalomorph spider species and a potentially new specialised ant species, to consider Bantamsklip as highly sensitive.***	***The combination of high butterfly and ant diversity and the Onchyophoran species indicate that the Thyspunt site is sensitive. The specialist has highlighted the need for additional monitoring of the invertebrate populations on the site.***	***-3***	***-9***	***-3***	***-9***	***-3***	***-9***
Negative impacts on vertebrate fauna	***2***	***Sufficient low sensitivity land is available for development on this site, so potential negative impacts are not considered to be highly significant.***	***At Bantamsklip, the amount of land that is not of high faunal sensitivity between the coast and R43 available for development is more than sufficient to allow for the nuclear power station. The portion of the property inland of the R43 is highly sensitive and should not be developed at all.***	***Significant negative impacts, mainly because of the direct impacts on faunal habitats within the footprint areas, the development of two major new access roads that may have significant impacts on their own and the need for a development corridor across a large field of mobile dunes between the power station and the HV Yard.***	***-3***	***-6***	***-3***	***-6***	***-3***	***-6***
				Overall weighted value		***-8***		***-8***		***+5***

The weighted comparison of alternatives undertaken in Table 9-96 shows that the inclusion of both environmental and technical decision factors and the weighting thereof achieved the following scores for the respective sites:

- *Thyspunt: +5*
- *Duynefontein: -8*
- *Bantamsklip: -8*

It is important to note that the resultant values indicate a relative difference between the sites, and that the values are not absolute. Negative scores do not necessarily indicate that a site cannot be developed and positive scores do not necessarily indicate that a site should be developed. Rather, it is the differences in the scores between sites that indicate whether any sites are preferred when compared to other sites.

This result shows that Thyspunt emerges as the numerically preferred site, followed by Duynefontein and Bantamsklip.

In addition to the above comparison of the sites, Arcus GIBB has also compared the alternative sites by including the non-key decision factors shown in Table 9-96. The result of this analysis is that Thyspunt still emerges as the preferred site, with similar relative numerical margins between the three sites..

9.32.6 Non-numerical comparison of the sites

The above conclusion has also been tested by applying a non-numerical comparison to the alternative sites. The reasons for assessing the site comparison from a different (non-numerical) perspective are as follows:

- *The weighting in this instance requires the comparison of impacts of completely different nature, for instance impacts on the cultural landscape, wetlands and technical transmission integration. In a simpler project, with significant impacts that affect only one aspect of the environment, impacts could be more easily weighed up. In the instance of Nuclear-1, however, the impacts are of such diverse nature that it is virtually impossible to compare the sites against each other.*

- *The weighting process requires assigning a weight to, for example, transmission integration, as well as to the ecological and heritage sensitivity of the sites. Although an attempt has been made to weight these factors, there is no fool-proof mechanism to do this consistently, robustly and defendably; and*

- *A numerical site ranking system proves to be very sensitive to changes in the weightings. Small changes in weighting can result in changes in the preferred site.*

It is clear that Thyspunt is more sensitive from a biophysical perspective than either Duynefontein or Bantamsklip, although relatively similar to Bantamsklip from a heritage perspective, while Duynefontein has the lowest heritage sensitivity. However, there are no issues that would disqualify Thyspunt site from being considered for the establishment of a nuclear power station, except for the heritage aspects. This is dependent on confirmation of the heritage specialist's professional opinion (through the currently planned excavations, for which an application has been lodged with the SAHRA) that archaeological sites in the central portion of the recommended power station footprint are not as numerous or of the same importance as the archaeological sites along the coast, and therefore the potential impacts are of an acceptable significance. Also the SAHRA, as the authority responsible for heritage resources, would need to "authorise" the acceptability of these potential impacts as well as the unmitigatable impacts on the cultural landscape of the Thyspunt site.

There is a conservation benefit in establishing the power station at Thyspunt – much more so than at Duynefontein and more so than at Bantamsklip. Although it is difficult to weigh that benefit against the negative impacts in a defendable manner, it is important to note that all the biophysical specialists agreed on the potential conservation benefits to be gained at Bantamsklip and Thyspunt.

The relative differences between the alternative sites (resulting from the numerical and non-numerical comparison) are material enough to be able to choose one site over another. This has been confirmed by using an analysis that considers only key decision factors, as well as an analysis that includes key decision factors and non-key decision factors. The fact that both analyses point to the same site preference is an indication that the analysis is robust and defendable.

It must be emphasised that all specialists agreed that there are no fatal flaws at any of the sites (provided appropriate mitigation is implemented, for instance with respect to the placement of a power station on a site to avoid the areas of highest sensitivity and the successful implementation of the heritage mitigation plan and conclusion that the potential impacts on heritage resources are acceptable). Critical areas identified by the specialists must be avoided and impacts must be mitigated as recommended. Although the botanical specialist has indicated that development on the transverse mobile dune community at Duynefontein would be regarded as a fatal flaw (Low 2011), this could be mitigated be placing the power station to the east of the mobile dune system.

In the absence of fatal flaws, the influence of technical factors needs to be considered. The two technical factors with respect to which Thyspunt is regarded as Eskom's preferred site are transmission integration and the fact that the Thyspunt site has the largest margin between its 0.16 g PGA value and the 0.3 g value to which standard "off-the-shelf" nuclear power stations are designed. The latter factor would mean that, in spite of the SSHAC process (still to be completed), it is unlikely that the eventual PGA value would exceed 0.3 g at Thyspunt (Appendix E4). There is a considerably higher risk of the PGA value exceeding 0.3 g at Duynefontein, as the PGA value at this site would exceed 0.3 g if it were adjusted only marginally upwards. For this reason, as well as the strategic benefit of strengthening electricity generation in the Eastern Cape, Eskom has clearly stated its preference of developing the Thyspunt site first.

Given the high economic cost (both in terms of design and construction of a non-standard nuclear power station to cope with a higher PGA value at Duynefontein, as well as the economic opportunity cost to the national economy of a failure to provide electricity in time to prevent blackouts), it is concluded that Thyspunt is the most suitable site for a nuclear power station, subject to strict adherence to the recommended mitigation measures.

The eventual choice of the construction site depends on the effective mitigation of the impacts and on other authorisations besides the EIA authorisation, in particular, the 'authorisation' of the SAHRA for the excavation and curation of heritage resources and construction of the proposed development, in terms of the Heritage Resources Act, 1999 (Act 25 of 1999) (refer to section 9.18.7).

With regards to Duynefontein and Bantamsklip, which emerge numerically as equals from the numerical analysis, it also needs to be considered whether their numerical comparison is a fair reflection of the their relative qualitative level of potential impact, as identified by the specialists.

As indicated above, Bantamsklip would be approximately R5.8 billion more expensive than Duynefontein, so from an economic point of view, it would not be preferred over Duynefontein.

Secondly, with respect to a number of impacts categories, including marine impacts, impacts on heritage, impacts of oceanographic conditions and tourism, Bantamsklip has a higher level of significance than Duynefontein.

Furthermore, as indicated in the Draft EIR, the potential cumulative impacts of the power station together with the transmission lines, is potentially much more significant at Bantamsklip than at Duynefontein. This is due to the very long distances that the Bantamsklip transmission lines would have to traverse and that fact that the transmission lines would pass through sensitive mountainous areas. In this respect, it must be noted that the EIA process for the Bantamsklip transmission lines is far behind, compared to the EIA processes for the Thyspunt and Duynefontein sites – primarily due to the high environmental sensitivity in the environment of the Bantamsklip transmission lines. The net result is that authorisation for the Bantamsklip transmission lines (if granted), will take much longer than for either of the other two sites. This leads to the <u>conclusion</u> that, in view of the more significant potential cumulative environmental impacts at Bantamsklip, as well as cost and potential timing delays associated with Bantamsklip, it is the least preferred site for Nuclear-1.

9.33 Evaluation of other alternatives

9.33.1 Forms of power generation

The comparative assessment of energy generation technologies undertaken as part of the Scoping Phase gave rise to the following conclusions:

- ***Technological alternatives for power generation involving coal as a resource are not viable alternatives for power stations located in coastal areas as coal resources are concentrated in the Mpumalanga and Limpopo Provinces. Transmitting electricity from this region to the Eastern and Western Cape provinces results in significant line losses / efficiency due to the distance.***
- ***Although Eskom remains committed to identifying ways in which renewable energy (e.g. wind and solar power) may be utilised to assist in the supply side of its operations, such technologies currently do not provide the capacity to provide the large scale power generation facilities needed to supply a reliable base load and easily integrate into the existing power network in South Africa.***
- ***At present the only viable technology for large scale base load electricity production within the borders of South Africa, other than coal, is nuclear power.***
- ***Hydro-electric power is not considered a feasible alternative due to the scarcity of water in South Africa. South Africa and Eskom are committed to work with Southern African countries for supply options however this will take time and the timing of this cannot be guaranteed at this point.***

In terms of South Africa's climate change commitments of reducing CO_2 by 34 %, the country is required to diversify its energy mix. Nuclear as a base load alternative provides a means for a significant reduction in CO_2 emissions and has therefore been included in the Integrated Resource Plan, which was approved in March 2011.

Thus, as far as power generation technologies are concerned, nuclear generation and coal-fired power generation are the only proven base-load technologies. Of these two, is preferable to use coal-fired generation close to coal fields when considering energy efficiencies of transporting coal over extended distances. Apart from these factors, South Africa must make increasing use of nuclear power generation in future to reduce its greenhouse gas emissions in order to comply with its commitments made at the Copenhagen Climate Change Summit in December 2009. The life cycle contributions of nuclear electricity generation to greenhouse gas emissions is small compared to coal-fired electricity generation. The Integrated Resource Plan (IRP) has considered this and allowed for 9 600 MW of Nuclear.

This conclusion does not preclude the development of renewable energy technologies. In addition to all existing and committed power plants, the IRP also includes a nuclear fleet of 9.6 GW (9 600 MW); 6.3 GW of coal; 11.4 GW of renewable energy; and 11.0 GW of other generation sources. As pointed out earlier in this EIR, nuclear generation must not be seen as an alternative to renewable technologies, and both need to be developed in parallel.

9.33.2 Modes of transport (Bantamsklip site only)

Road transport is accepted as the only solution for the transports of heavy loads from the harbours for Duynefontein and Thyspunt. However, at Bantamsklip, due to the extensive road and bridge upgrades that will be required for the transport of heavy equipment from Cape Town harbour, transport by barge from Cape Town harbour has been suggested as an alternative to road transport.

Clearly the social impacts associated with transport by barge would be significantly less than road transport, since road transport would result in significant delays along the route, particularly when extra heavy loads are transported by a Self Propelled Modular Transporter. There are several mountain passes along the route between Cape Town and Bantamsklip that would be very difficult and time-consuming to negotiate by such a vehicle.

If a barge were to be used, Suitable landing and loading / off-loading facilities would need to be constructed along the beach close to Bantamsklip. From an environmental point of view, this option is regarded as unacceptable, due to the expected significant impacts that would result from the construction of landing and intermodal transfer facilities (transfer from the barge to road transport). Although no specific assessment of potential landing points has been conducted, the vertebrate fauna and heritage assessments both identified the coastal strip along the Bantamsklip site as being highly sensitive. In any event, the construction of a landing facility for a barge would require a separate EIA process.

9.33.3 Fresh water supply

9.33.4 (a) Duynefontein

The Site falls within the Berg Water Management Area (WMA). According to the water requirement projections in Appendix D of the DWA's National Water Resource Strategy (DWAF 2004), there is no allowance for water requirements for power generation in this Water Management Area. Potential sources of freshwater, as discussed below, were considered.

<u>Aquifer</u>
The Aquarius Wellfield is located approximately 6 km north-east of Duynefontein. Water was previously abstracted from this well field and used as a source at Koeberg, but it is no longer being used as a result of the poor water quality. On-site use of groundwater is therefore not an option at Duynefontein.

<u>Cape Town metropolitan water supply system</u>
Koeberg currently receives water through the municipal supply line along Otto du Plessis Drive through Van Riebeeckstrand. The site receives the bulk of its water from one source via the local authority. Water to the Duynefontein nuclear power station can be supplied from the 500 mm diameter bulk feeder main along the West Coast Road (R27). However, based on the DWA's National Water Resource Strategy, it is unlikely that this water supply will be allocated to a nuclear power station and it is unlikely that it will sustain the nuclear power station for the duration of its lifetime.

<u>Desalinisation</u>
This alternative presents a guaranteed source of fresh water supply for the lifespan of the proposed nuclear power station without jeopardising the availability of freshwater

to other users. A desalinisation plant is therefore the preferred alternative for the provision of fresh water at Duynefontein.

9.33.5 (b) Bantamsklip

According to water requirement projections in Appendix D of the DWAF's National Water Resource Strategy (2004), there is no allowance for water requirements for power generation in this WMA. Potential sources of freshwater, as discussed below, were considered.

<u>Aquifer</u>
According to Eskom (Services Report), Bantamsklip is not associated with an exploitable groundwater source. This alternative is therefore not feasible.

<u>Local Municipality water supply system</u>
Pearly Beach and Buffelsjag obtain their water supply from boreholes while Gansbaai and Franskraal obtain their water supply from the Kraaibos Dam water treatment works. According to Eskom (Services Report), the current water sources cannot accommodate the water requirements associated with the proposed nuclear power station.

<u>Breede River</u>
Any major industrial undertaking in the Bantamsklip area would entail the acquisition of piped fresh water from a water source located outside the immediate region. The nearest such system is the Breede River. Acquiring water from this source necessitates an application to the DWA for approval and therefore cannot be guaranteed.

<u>Desalinisation</u>
This alternative presents a guaranteed source of fresh water supply for the lifespan of the proposed nuclear power station without jeopardising the availability of freshwater to other users. A desalinisation plant is therefore the preferred alternative for the provision of fresh water at the Bantamsklip site.

(c) Thyspunt

The site falls within the Fish-Tsitsikamma Water Management Area, but large quantities of water are imported from the Upper Orange River Water Management Area. According to water requirement projections in Appendix D of the DWA's National Water Resource Strategy, DWAF (2004), there is no allowance for water requirements for power generation for this WMA. Potential alternative sources of freshwater, as discussed below, were considered.

<u>Aquifer</u>
According to Eskom (Services Report), large quantities of ground water are available in aquifers underlying the Thyspunt region. Existing boreholes are currently used as a source of potable water for the residential areas of Humansdorp, St. Francis Bay and Oyster Bay. Oyster Bay is totally reliant on groundwater as a source of freshwater. There are a number of existing licensed boreholes that could be used for water supply during the initial construction stages.

<u>Kouga Local Municipal water supply system</u>
Water for the Thyspunt site can be drawn off the municipal feeder main at St Francis Bay, which will require the installation of a pipeline along the proposed access road to the Thyspunt site. There is a spare capacity of 79 l/s available on this line, and the portion of this capacity for use at the nuclear power station is still to be determined by the Kouga Municipality.

<u>Orange River scheme</u>
Another alternative is to source fresh water from the Orange River scheme via Port Elizabeth. However, the total capacity available for use for the proposed nuclear power station is currently unknown. In the event that this source is used for the proposed

nuclear power station, it may be possible to place the reservoir at the existing St Francis reservoir rather than on the site.

Desalinisation

This alternative presents a guaranteed source of fresh water supply for the lifespan of the proposed nuclear power station without jeopardising the availability of freshwater to other users. A desalinisation plant is the preferred alternative for the provision of fresh water at the Thyspunt site.

9.33.6 Utilisation of abstracted groundwater

Groundwater will have to be abstracted at all three alternative sites in order to allow the excavation for the construction of a platform for the Nuclear Island.

(a) Transfer to the municipal sewage system

Given that the abstraction of water will occur over a relatively short period of time, it is not feasible to construct pipelines to transfer the water to the local municipality. This alternative is neither sustainable, nor cost effective and is therefore not recommended.

(b) Storage and utilisation

The abstracted water can be stored in dams/ ponds on site and utilised during the construction phase of the nuclear power station for example, dust suppression. It should be noted that storage dams/ ponds exceeding 10 000 m^3 will require authorisation from the DWA. This is the preferred alternative, as it is allows for the effective utilisation of resources. Unfortunately, however, the amount of available space of low environmental sensitivity on the sites precludes this alternative.

(c) Discharge to sea

Should Eskom not be able to use the full volume of abstracted groundwater for human consumption or for construction, it will be discharged into the sea.

In conclusion, the recommended alternative with regards to abstraction of groundwater is discharge into the sea.

9.33.7 Disposal of brine

(a) Disposal of brine directly into the sea

During the construction phase, the brine will be released into the surf zone. The physical mixing with surrounding sea water will result in dilution to 1 g/ℓ above ambient salinity within 110 m from the point of release. According to the Marine Biological Assessment (Appendix E15), any ecological impacts will be focused within the water column due to the high energy of the surf zone. However, the long-term direct disposal of the brine into the ocean, without prior dilution, will induce a significant impact on the marine environment. Thus, this alternative is acceptable for the construction phase only.

(b) Co-disposal of brine and cooling water into the sea

During the operational phase, the brine will be mixed with the sea water used for cooling. The brine and cooling sea water are subsequently co-disposed into the ocean at the outfall structure. The brine is expected to have a salinity of 58 ppt (in comparison with seawater, which has a salinity of 35 ppt). This effluent will account for less than 0.12% of the water released after mixing with the cooling water. Thus, the brine will be diluted to undetectable levels within the outflow pipes prior to release. Thus, the co-

disposal of the cooling water and the brine would result in significant dilution of the brine, thereby inducing a negligible impact on the marine environment.

In conclusion, either alternative is environmentally acceptable. Disposal of brine directly into the sea should be utilised only during construction, and brine should be mixed with cooling water that is discharged into the sea during the operational phase.

9.33.8 Intake of seawater

(a) Utilise the existing intake structures located at KNPS

This alternative is applicable to the Duynefontein site only. It is proposed that the new nuclear power station will be located adjacent and to the north of the existing nuclear power station, which obtains water from an existing harbour. The utilisation of the harbour at KNPS is not considered feasible because the current KNPS intake structure is sized does not have the capacity to support the proposed Nuclear-1.

(b) Installation of intake tunnels and inlet structure

This alternative entails the installation of undersea pipelines, which feed cooling water into a storage area (intake basin). According to the Marine Biology Assessment, (Appendix E15) this alternative is preferred, as the impacts are minimised in comparison with the development of a new harbour.

In conclusion therefore, the installation of intake tunnels is the only feasible alternative for all three alternative sites.

9.33.9 Outlet of water and chemical effluent

(a) Near shore outfall structure

Nearshore release does not facilitate mixing of the water, while release outside of the surf zone allows the heated water to rise to the surface layer and spread laterally. Thus, nearshore cooling release is not recommended for the Duynefontein and Bantamsklip sites. At Thyspunt, however, it has been confirmed by the marine specialist (Appendix E15) that a nearshore outlet at 5m depth would result in an acceptable level of impact.

(b) Offshore outfall tunnels

Offshore outfall tunnels would prevent warmed water being released at a single point source (the more release points, i.e. the more outlet pipes, the better) and would release the cooling water above the sea bottom to minimise thermal pollution of the benthic environment. Mixing is further enhanced by the buoyancy of the warm water, which causes the water to rise. This design will have less potential impact on the benthic environment than a channel release and is therefore the preferred alternative.

Offshore release is recommended for the Bantamsklip and Duynefontein sites. All releases need to occur at the appropriate distances as described by the marine specialists.

9.33.10 Management of spoil material

(a) Spoil discard at sea

The spoil can be hydraulically pumped offshore, where it will be discarded into the sea. According to the marine biologist, discarding of a small portion of spoil that would affect only 3 km² is permissible at all three sites, since movement patterns in the sea would allow for sufficient dilution of the spoil (Appendix E16), provided that the recommended depth of disposal and pumping rates are adhered to.

(b) Spoil Discard on land

The spoil will be discarded in a designated off site spoil dump. The EIA corridors assessed by specialists included an area for a spoil dump. At Thyspunt, another alternative (transporting the spoil to via a conveyor belt to the northern "panhandle" portion of the site) has been rejected.

(c) Use of spoil for development of rock retaining walls

The rock spoil can be used to construct rock retaining walls, which will serve to stabilise landforms. However, the quantity of spoil required to construct the rock retaining walls may be insignificant in comparison to the amount of spoil available for use. Thus, there will be an excess of spoil, which means that this alternative should be pursued in conjunction with other suitable alternatives.

(d) Use of spoil for development of terraces

The spoil can be used to construct the terraces of the nuclear plant. The terraces require engineered fills in order to create a stable platform that is not subject to wind erosion.

(e) Commercial uses for spoil

In accordance with the principle of optimal utilisation of resources, it may be possible to sell the spoil to landscapers or other potential buyers. However, due to the infestation of portions of the Nuclear-1 properties by invasive alien species such as <u>Acacia cyclops</u> (Rooikrans), this alternative may result in the exportation of propagules of these species to other areas.

In conclusion, based on the findings of the oceanographic modelling (Prestedge at al. 2009) and the marine impact assessment (Appendix E15), it is proposed that as much as possible fine spoil must be disposed of in the marine environment, according to the recommendations of the marine sediment study and the marine biology study. The recommendations of these studies with regards to the distance offshore and pumping rates must be strictly adhered to. The remainder, which cannot be pumped to sea, must be disposed of on land and used for activities like levelling of the HV Yard to the greatest extent possible, to minimise amount of spoil that needs to be disposed in discard dumps on land. The spoil dumps that need to be placed on land must be placed and shaped so that they fulfil a visual screening role as well and should be designed to minimise their visual impact. A Landscape Architect should be engaged to assist in the appropriate design of the spoil dumps to maximise their screening potential and to ensure that their appearance is as natural as possible.

9.33.11 Nuclear plant types

Pressurised Water Reactors are the most commonly used nuclear reactors both nationally and globally. The existing KNPS uses PWR technology and it is therefore a tested form of power generation that has been operating safely since 1984. Eskom is familiar with the technology from a health and safety, as well as from an operational perspective.

9.33.12 'No go' (No development alternative)

Given the urgent power demand based on economic growth in South Africa, the No-Go alternative is not considered to be a feasible and realistic alternative. As indicated in the need and desirability section (Section 4 of this EIR), there is a proven need to additional generation capacity in South Africa to ensure that there is sufficient electricity available over the next 20 years.

South Africa, would in all likelihood, have to adapt the IRP to develop more coal-fired power stations if the No-Go alternative for the proposed nuclear power station is adopted, as this is the only alternative proven base load generation option available in South Africa. It would not be economically viable (and difficult to finance these projects as banks are becoming reluctant to finance such projects) to develop more coal-fired power stations in the future, due to carbon taxes that are likely be imposed on countries that continue to emit greenhouse gases.

The No-Go alternative would imply that potential benefits, as listed below, that emanate from the proposed project would not be realised:

- *The supply of base load power from diverse, secure, sustainable energy sources, which have relatively low greenhouse gas emissions;*
- *The reduction of coal fired contributions to power generation that would be in line with Eskom's long-term strategy to diversify its primary energy requirements, and reduce greenhouse gas emissions;*
- *Reduction in transmission line losses; and*
- *The use of uranium, which (apart from coal) is the only primary energy source in South Africa that is suitable and commercially available in sufficient quantities for base load power generation.*

This EIR does not suggest that the current (No-Go) situation) is without negative impacts of its own. Indeed, the majority of the biophysical specialists have indicated that there are significant current sources of environmental degradation around the sites that would be likely to continue. Thyspunt is a case in point, where recent development (in terms of urban development and golf estate development) have resulted in significant degradation and destruction of heritage sites, wetlands and portions of sensitive mobile dune systems. Analysis of these development trends, according to the specialists, shows no indication that the no-go alternative would result in these impacts slowing down or ceasing.

It should further be noted that should Eskom not utilise the sites for nuclear development, it is likely to sell the properties, pending a decision by the Eskom Board. The sale of the properties will be to a willing buyer at the market-related price, which would probably result in an alternative form of land use that may have environmental impacts of its own.

Alternative forms of land use may also be the case at Bantamsklip. However, this option is less likely at Bantamsklip than at Thyspunt, due to the proximity of the Agulhas National Park to the Bantamsklip site and possible expansion of the park through acquisition of the Bantamsklip property.

Until the KNPS is decommissioned, the no-go alternative is also not a realistic alternative at Duynefontein. The No-Go alternative is therefore not recommended at any of the sites.

9.33.13 Position of the nuclear power station on the sites

Preliminary envelopes, within which the power station footprints could be located, were developed for each site. These envelopes were provided to the specialists 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 and at a second integration meeting with a smaller group of specialists held on 26 September 2008. Areas of highest sensitivity were discussed with the specialists during the November 2009 integration meeting. Their sensitivity maps (refer to the individual specialist reports Appendices E2 to E27) were overlaid to produce composite sensitivity maps for the sites, shown below. The least sensitive areas of each of the alternative sites are indicated on these maps.

For all three alternative sites, the area within 800 m from a public road was excluded from consideration in the EIA and HV Yard corridors as no public access is allowed within the Emergency Planning Zone (EPZ), which is expected to be at least 800 m from the proposed nuclear power station (refer to Section 5.5 and Figures 5- 5 to 5-7).

From an environmental perspective the specialists collectively recommended that the following areas <u>not be considered as suitable</u> for the construction of a nuclear power station:

1. ***The area between the low and high water mark and then 200 m inland from the high water mark to allow for the maintenance of ecological corridors, whilst also limiting the potential impact on the sensitive mobile dunes and heritage features along the shoreline of all sites (refer to Section 5.5 and Figures 5-5 to 5-7);***
2. ***At the Bantamsklip site, the area north of the R43 Road due to its conservation significance (Figure 5-6); and***
3. ***The area within 100 m from the high water's edge of any wetland.***

Figures for the combined overlaid sensitivity maps for all three sites are contained at the end of this Chapter.

At the Bantamsklip site the area considered to be suitable for the construction, operation and decommissioning of a nuclear power station is a 172.06 ha area on the north-eastern side of the EIA corridor and the south-eastern side of the HV Yard corridor. None of the specialists indicated the area as environmentally sensitive.

At the Duynefontein site the area considered to be suitable for the construction, operation and decommissioning of a nuclear power station is a 156.51 ha area on the eastern side of the EIA and HV Yard corridor, adjacent to the existing KNPS. Only the flora and invertebrate specialists have indicated that this area is environmentally sensitive. From an invertebrate perspective the specialist has indicated that there is a high level of confidence that, while similar habitat outside the area is limited, the species present (including the undescribed ant species), are adequately represented in other habitats on the site. From a flora perspective the specialist has indicated that development on the transverse mobile dune system would be regarded as a fatal flaw and that the power station must be located east of his system. The botanical specialist's opinion that the transverse dune system at Duynefontein is endemic is not supported by the dune geomorphology specialist. Nevertheless, appropriate placement of the nuclear power station footprint would have to be carefully determined with the assistance of a suitably qualified and experienced botanist, so that the above potential impacts on the flora are mitigated.

At the Thyspunt site the area generally considered to be suitable for a nuclear power station is 225 ha (174 ha for the main plant and 51 ha for the HV Yard). The invertebrate specialist has indicated that the recommended footprint area for the power station is environmentally sensitive. The invertebrate specialist has indicated that whatever the sensitivity of the habitat types within the proposed nuclear power station footprint, there is sufficient scope for protecting adequate amounts of similar habitat elsewhere on the site. The results of the heritage mitigation plan (Appendix E20) also need to confirm that this 225ha area is not sensitive from a heritage perspective, before the site can be considered for authorisation.

It must be noted that the above are only recommendations regarding the areas suitable for the construction of a nuclear power station at any one of the alternative sites and that the final positioning will be determined taking the following aspects into consideration:

1. ***The DEA's decision regarding authorisation of the proposed activity has been announced at the recommended alternative site, or any of the other alternative sites.***

2. ***Should the DEA authorise the construction of a nuclear power station at any one of the alternative sites, associated conditions of authorisation would need to be taken into account.***
3. ***Appointment of the vendor and results of any further detailed geological conditions.***
4. ***Detailed studies need to be undertaken for the disciplines that have indicated medium to high sensitivity within the recommended footprint areas to confirm that the impacts on highly sensitive resources can be mitigated and to carry out mitigation, where necessary.***

9.33.14 The potential for additional nuclear power stations per site

Based on the sizes of the areas that have been identified as suitable for a nuclear power station, and the proposed size of the Nuclear-1 footprint (up to 280 ha), only a single nuclear power station can be constructed per site. As it is, the recommended footprints at Bantamsklip and Thyspunt are smaller than the optimal sizes that Eskom has indicated it requires. Eskom would therefore have to optimise its layout for the plants and use alternatives such as multi-story buildings and stacking of construction materials in order to fit within the recommended footprints.

Given the current information, the sites that have been investigated would not have sufficient space of suitably low environmental sensitivity for additional nuclear power stations of the size of Nuclear-1, or for the addition of extra nuclear units to Nuclear-1. If it were to be considered to add nuclear units or an entirely new power station, such additions would be subject to a separate EIA process.

It must further be emphasized that the current application is for a single nuclear power station of two to three units with a total installed capacity not exceeding 4 000 MW. The cumulative impacts of any additional nuclear power stations or additional nuclear units on a particular site (if authorised) would have to be confirmed in a new EIA process prior to any further development.