PROJECT INFORMATION

Title:	**Revised Draft Environmental Impact Assessment Report Version 2** for the Eskom Nuclear Power Station and Associated Infrastructure (Nuclear-1)
Environmental Authority:	Department of Environmental Affairs (DEA)
DEA Reference No.:	12/12/20/944
Applicant:	Eskom Holdings Limited
Environmental Consultants:	GIBB (Pty) Ltd
Date:	August 2015

Afrikaans and Xhosa versions of this Executive Summary are attached to this report as well as available from the GIBB Public Participation Office (Tel: 012 348 5880 Office Hours: Mon to Fri – 09h00 to 13h00 excl. public holidays; Fax: 012 348 5878 and Email: nuclear1@gibb.co.za). The English Version of this document is the Master Copy.

EXECUTIVE SUMMARY

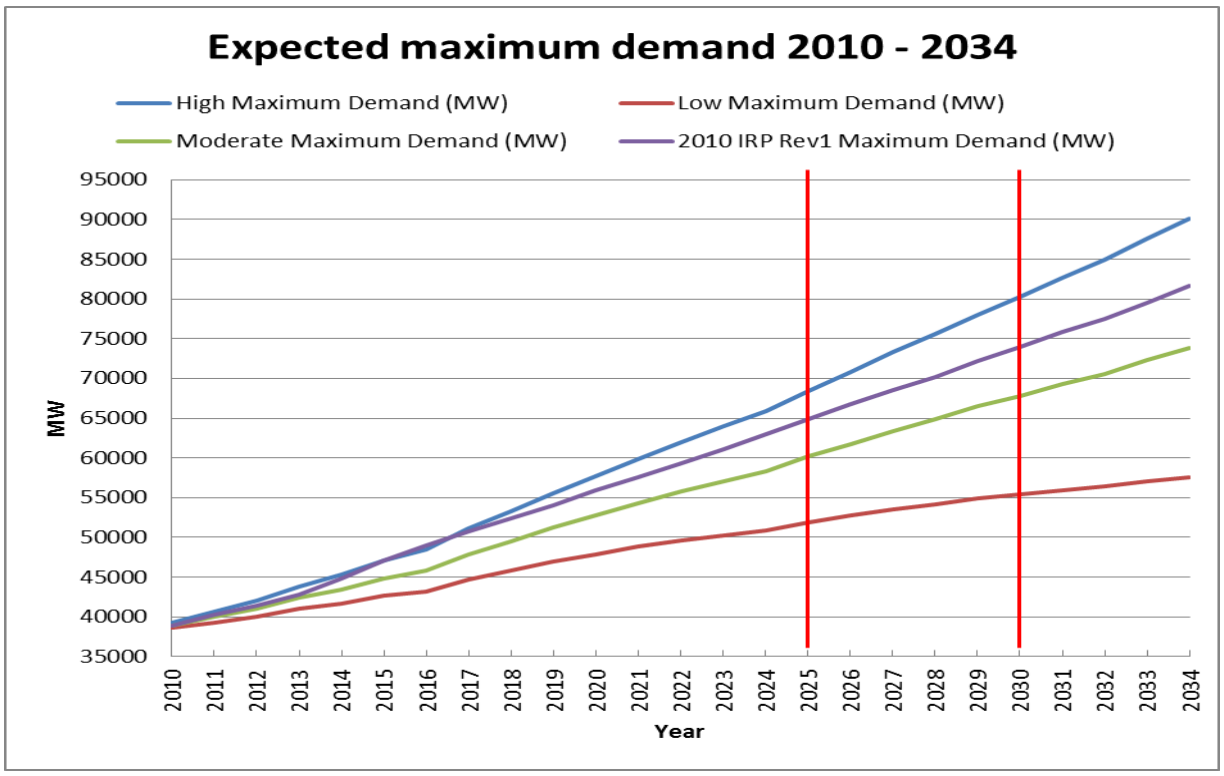
SUMMARY

The key finding of this Revised Draft Environmental Impact Report Version 2 is that it is recommended that the DEA consider authorising the Thyspunt site for the Eskom Nuclear-1 Power Station, with conditions.

INTRODUCTION

Eskom Holdings (SOC) Limited (Eskom) proposes to construct, operate and decommission a conventional nuclear power station in South Africa in order to meet the total demand for electricity. In many countries, including South Africa, economic growth and social needs are resulting in substantially greater energy demands, in spite of continued and accelerated energy efficiency advancements. As a result, new generating capacity must be installed to cater for the growth in energy demand.

Several different projections for the future increase in electricity demand have been produced, based on different scenarios for the development of South Africa's economy. One such study of these projections undertaken for the IRP 2010 indicates different scenarios investigated. The scenario used in the "policy adjusted" IRP 2010 is the Moderate Maximum Demand as illustrated by the figure below. This scenario shows a growth in maximum demand from approximately 39GW in 2010 to about 74 GW in 2034. It should be emphasised that Eskom is planning new capacity based on the IRP 2010 (and future revisions thereof) in conjunction with the Department of Energy.



Projected electricity requirements for South Africa to 2034 based on different scenarios (IRP 2010)

The National Development Plan (National Planning Commission 2012) further seeks an increase of Gross Domestic Product (GDP) by 2.7 in real terms by 2030, which implies GDP growth of 5.4 % per year. If this growth rate or even a more modest growth rate is realised, the growth in electricity demand can be expected to continue and it will remain necessary to build new electricity generating capacity in South Africa. Thus, taking these figures into account, the IRP 2010 predicts an increase of around 21 GW of maximum demand by 2025 and around 29 GW by 2030.

Eskom is thus, in response to this demand planning for the construction of additional base-load generation capacity in parallel with energy efficiency advancements and the development of renewable energy generation capacity. As stated, based on projections, there is a requirement for more than 40 000 Megawatts (MW) of new electricity generating capacity over the next 20 years. The approved Integrated Resource Plan 2010, which outlines government's strategy for meeting the increasing energy needs, indicates government's commitment to the construction of 9 600 MW of nuclear power by 2030. It is Eskom's intention to investigate the feasibility of pursuing the nuclear power generating capacity required by South Africa.

The legislative requirements for nuclear facilities in South Africa are extensive. In the case of a nuclear power station, two key authorisations are needed from two regulatory authorities namely the Department of Environmental Affairs (DEA[1]) and the National Nuclear Regulator (NNR). These authorisations, and a number of others, are needed prior to the commencement of construction activities.

Environmental authorisation in terms of the National Environmental Management Act (NEMA, Act No. 107 of 1998) and the EIA Regulations (2006) is required before the proposed nuclear power station can be built, as it involves 'listed activities' (i.e. activities which may have potentially detrimental impacts on the environment), the primary ones being:

- *(1a) The construction of facilities or infrastructure, including associated structures or infrastructure, for the generation of electricity where the energy generation is greater than 20 Megawatts and the facility exceeds an area of one hectare; and*
- *(1b) The construction of facilities or infrastructure, including associated structures or infrastructure, for nuclear reaction including the production, enrichment, processing, reprocessing storage or disposal of nuclear fuels, radioactive products and waste.*

GIBB (Pty) Ltd (GIBB)[2] was appointed by Eskom as the independent Environmental Assessment Practitioner (EAP), to undertake the Environmental Impact Assessment (EIA) process and compile an Environmental Impact Report (EIR) and Environmental Management Plan (EMP) for the proposed nuclear power station (hereafter referred to as Nuclear-1) and associated infrastructure. A number of specialists assisted with the EIA and compiled the necessary specialist reports.

The EIA process for Nuclear-1 comprised of two phases, the Scoping Phase and EIA Phase. An application was submitted to the DEA in May 2007 and then amended in July 2008 for a single nuclear power station of up to 4 000 MW. The Scoping Phase of the EIA is complete. The DEA received comments from the relevant provincial environmental authorities and approved the Scoping Report in November 2008. This approval included the recommendation that two of the original five alternative sites assessed during the Scoping Phase, namely Brazil and Schulpfontein in the Northern Cape, be excluded from further consideration in the EIA. The exclusion of these sites was based on limited local demand and the lack of existing electricity transmission corridors associated with these sites. The DEA approved the Final Plan of Study for the EIA in January 2010.

Based on comments received on the Draft EIR that was provided for public and authority comment during 2010, the Draft EIR was revised. The Revised Draft EIR (Version 1) for Nuclear-1 was made available for public comment from May 2011 – August 2011. Based on comments from the DEA and the public on this report additional specialist studies and investigations were required. The current document is thus the Revised Draft Environmental Impact Report (Version 2). It documents the EIA

[1] Previously the Department of Environmental Affairs and Tourism
[2] Previously Arcus GIBB (Pty) Ltd

process that has been undertaken to assess the potential environmental impacts of the proposed nuclear power station at any one of the three alternative sites, namely Duynefontein and Bantamsklip in the Western Cape and Thyspunt in the Eastern Cape. It includes revisions to certain specialist reports and makes recommendations with regards to the siting and authorisation and recommended siting of Nuclear-1, based on the outcomes of the EIA.

ROLES OF GOVERNMENT AUTHORITIES

In addition to the environmental authorisation in terms of NEMA, the proposed nuclear power station requires another key authorisation from the National Nuclear Regulator (NNR) prior to construction. Furthermore, many other authorisations from various departments, such as the Department of Mineral Resources, the Department of Water Affairs (DWA), the Department of Environment Affairs (DEA), provincial environmental authorities and the South African Heritage Resources Agency, as well as other regulatory authorities such as the National Energy Regulator of South Africa (NERSA) are required prior to construction.

The National Nuclear Regulator (NNR) is mandated by the National Nuclear Regulator Act (NNRA, Act No. 47 of 1999) to provide for the protection of persons, property and the environment against nuclear damage through the establishment of safety standards and regulatory practices. In terms of Section 20 of the NNRA, no person may site, construct, operate, decontaminate or decommission a nuclear installation, except under the authority of a nuclear installation licence. Section 21 of the NNRA makes provision for a person wishing to engage in any of these activities to apply to the Chief Executive Officer of the NNR for such a licence. However, in terms of the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996) ("the Constitution") and the NEMA, the DEA has a responsibility for decision-making regarding the potential impacts of the power station on the environment, even though these impacts are likely to include those relating to certain aspects of the radiological hazards associated with the facility.

In recognition of the dual but distinct responsibility with respect to the assessment of radiation issues, a co-operative agreement concluded between the DEA and the NNR was gazetted on 18 July 2008. One of the main purposes of this agreement is to "prevent unnecessary and unavoidable duplication of effort" between the NNR and DEA. The NNR authorisation process applies specifically to issues of nuclear and radiation safety related to the siting, design, construction, operation and decommissioning of nuclear installations. Furthermore, the Director General of the DEA issued a statement in January 2009 (Appendix B4) to further clarify the purpose of the agreement. The statement indicates that nuclear safety, radiation and radiology "are better placed within the regulatory process of the NNRA and that consideration of the same issues in an EIA process will result in unnecessary and avoidable duplication."

In recognition of this agreement, the approach in the EIA, up to and including the Revised Draft EIR (Version 1) that was released for public comment in 2011, was that "Site Safety Reports"[3] prepared as part of the authorisation process for nuclear licensing are included as appendices in the draft EIR, but that radiological issues will not be assessed in detail in the EIA. However, in recognition of requirements in the NEMA, associated legislation such as the Promotion of Administrative Justice Act, 2000 (Act No. 3 of 2000) and other legal precedents that require the consideration of all relevant socio-economic factors in an EIA process, an assessment of radiological impacts of the proposed power station is included in the current version of the EIR. Although this approach of including an assessment of the radiological impacts of the proposed power station results in a risk of duplication between the EIA and the NNR licensing processes, the risk to the EIA in terms of possible appeals, based on the exclusion of substantive issues such as health issues from the EIA process, is regarded as greater than the risk of duplication. The current version of the EIR therefore departs substantially from the approach in the previous versions of the EIR in terms of the consideration of radiological impacts.

In this context, it must be mentioned that the approaches of the EIA process and the NNR licensing process differ substantially. The focus of the EIA process is to assess the potential impacts of radiological releases (including normal operational releases and upset conditions). However, the focus

[3] The Emergency Response Assessment, Site Access Control Report and Human Health Risk Assessment

of the NNR licensing process is to demonstrate beyond reasonable doubt that defence-in-depth measures (multiple, redundant, and independent layers of safety systems) employed in the proposed power station design and operation are sufficient to reduce the probability of a failure leading to core meltdown or a failure of reactor containment to acceptable and highly-unlikely levels. Thus, the EIA process focuses on the consequences of radioactive releases. The NNR licensing process also focuses on consequences but is also designed to reduce the probability of such releases.

PROJECT DESCRIPTION

Pressurised Water Reactor (PWR) technology, which uses water as a coolant and moderator, was chosen by Eskom for Nuclear-1. PWRs are the most commonly used nuclear reactors internationally. Eskom is familiar with this technology from a health and safety, as well as an operational perspective, having used it for the past 30 years at the Koeberg Nuclear Power Station (KNPS). A nuclear power station of standard Generation III design is favoured by Eskom due to the operational simplicity and rugged design, availability, reduced possibility of core melt accidents, minimal effect on the environment, optimal fuel use and minimal waste output.

Detailed descriptions of the proposed nuclear plant are not available, as a preferred supplier has not been selected. The approach used in this EIA process has thus been to specify enveloping environmental and other relevant requirements, to which the power station design and placement on site must comply. The enveloping criteria have been developed to ensure that they represent the most conservative parameters associated with the various plant alternatives within the PWR technologies.

The area of the footprint assessed in this EIA makes provision for the potential future expansion of the power station, should this be environmentally or technically feasible at that stage. It is estimated that the total footprint required for Nuclear-1 (4 000 MW) (this application) is 200 to 280 hectares and the current application for Environmental Authorisation is therefore for 4 000 MW only. In addition to the footprint of the nuclear power station, there will be two categories of exclusion zone for emergency planning purposes, around the power station complex. Internationally accepted exclusion zones are being considered for Nuclear-1. The NNR will make the final decision regarding the size of the EPZ (emergency planning zones) , as per the NNRA.

The proposed power station complex will include *inter alia* the nuclear reactor, turbine halls, fuel storage facilities, waste handling facilities, intake and outfall structures required to obtain / release water used to cool the process, a desalinisation plant, power lines within the plant site, roads, the high voltage yard, and any other auxiliary service infrastructure. An Open Cycle Gas Turbine Plant (OCGT) will be used for emergency power generation at the Thyspunt site.

In the event that the proposed project is authorised, it is anticipated that the construction will last for approximately 9 years. The first units will start producing electricity commercially 2023 / 2024[4].

LOCATION OF THE NUCLEAR POWER STATION

The three site alternatives assessed in the EIA Phase are:

- Duynefontein, which is situated adjacent and to the north of the KNPS on the Cape West Coast, approximately 35 km north of Cape Town. The site falls within the existing Eskom-owned property, which includes a nature reserve.
- Bantamsklip, which is situated on the Southern Cape coast, mid-way between Danger and Quoin Points. The site forms a part of the total Bantamsklip Eskom-owned property, and is primarily utilised for flower harvesting and fishing.
- Thyspunt, which is situated on the Eastern Cape coast between Oyster Bay and St. Francis Bay. The site for the proposed Nuclear-1 is currently Eskom-owned, but there are a number of houses on the adjacent properties, outside the proposed nuclear power station's Emergency Planning Zones (EPZs).

[4] These dates may differ from dates included in other chapters of the EIR. However 2023 / 2024 is in line with the recently approved 2010 IRP.

EIA PROCESS, PUBLIC PARTICIPATION AND IMPACT ASSESSMENT

The EIA process which is being undertaken in accordance with the 2006 EIA Regulations, includes the Public Participation Process (PPP) and the technical specialist studies as well as the issues that have been identified and assessed.

The proposed project was announced mid-2007 when registration of Interested and Affected Parties (I&APs) commenced and which has continued throughout the EIA. Extensive Public Open Days, Key Focus Group Meetings and Key Stakeholder Workshops were held to enable I&APs to discuss the findings of the Draft Scoping Report (DSR) with the EIA Team. I&AP comments were integrated into an updated Issues and Response Report (IRR) and the Final Scoping Report.

The potential impacts associated with Nuclear-1 were identified in the Scoping Phase. A range of alternatives for the proposed project were highlighted and taken forward for further consideration in the EIA Phase.

The baseline environment at each of the alternative sites was investigated by the environmental specialists and described in terms of the physical, biophysical and social aspects. Additional potential impacts were identified through the various specialist studies (desktop and field-based studies) and through the ongoing consultation process with I&APs. Specialists then evaluated the significance of the identified potential impacts and proposed appropriate mitigation measures where necessary. During the EIA Phase the public also contributed relevant local information and knowledge to the EIA and ensured that issues had been considered in the environmental investigations. The specialist study findings have been integrated and evaluated in the Revised Draft EIR (Version 1) and in the current report.

A further key component of the EIA Phase is the public review of the findings presented in this Revised Draft EIR (Version 2). All registered I&APs have been notified of the Report's availability and of the planned Public Meetings. Key Stakeholder Workshops are being held in the Western and Eastern Cape. The availability of the Revised Draft EIR (Version 2) and arrangements for the Public Meetings have been advertised in the newspapers.

The Revised Draft EIR (Version 2) and accompanying reports will be amended, where appropriate, following comment received from I&APs during the review period. The final reports will then be submitted to the DEA for consideration and decision making.

KEY CHANGES IN FINDINGS

Key changes in this Revised Draft EIR (Version 2) since the publication of the Draft EIR and Revised Draft EIR (Version 1) for comment in 2010 and 2011 respectively are:

Pebble Bed Modular Reactor (PBMR)

- The abandonment of the plans for the Pebble Bed Modular Reactor (PBMR) Demonstration Power Plant at the KNPS. This Revised Draft EIR (Version 2) therefore contains no mention of the PBMR plans.

Groundwater Monitoring Study

- At the time that Revised Draft EIR (Version1) was provided for public comment in 2011, the study considered groundwater monitoring results that had been collected in the 2010 calendar year. The geo-hydrological assessment has been updated with groundwater monitoring data that has been collected since then. This improves the confidence in the predictions of impact on groundwater and wetlands and further improves the confidence in the effectiveness of the proposed mitigation measures, especially for the Thyspunt site.

  The additional data collected through the on-going groundwater monitoring programme at all three sites confirm the impact predictions for groundwater and wetlands, and confirms that a hydrological cut-off wall in the excavation for the nuclear island of the proposed power station

will be effective to mitigate the impact on important wetlands, such as the Langefonteinvlei wetland at the Thyspunt site.

Dune-geomorphology and Debris Flows

- Lauren Elkington, a Masters student at Rhodes University, has published a thesis on the Oyster Bay mobile dune field in June 2012 and the results of this thesis have been considered with respect to Nuclear-1. The dune geomorphology assessment has also considered the causes of major flood events in 2011 and 2012, further investigated whether there is evidence for the claims of debris flows in the dune field and investigated the impacts of flooding on the Sand River and the Sand River delta in the Kromme River estuary. The additional research confirmed that there is no evidence of debris flows at the site or that the conditions exist for debris flow. It also confirms that there is no risk of damage to the Nuclear-1 or to the access roads and minimal risk from the liquefaction of sands (or quicksands), provided that standard engineering practice is used for roads and associated structures;

  The assessment of the Sand River delta in the Kromme Estuary was also conducted and it was found that the Kromme estuary is typically sand-choked. The sand is derived from the Sand River and from tidal currents that carry sand into the estuary from the sea. The Sand River delta has never blocked the Kromme estuary completely, and it is not likely to do so. It further was found that the supposed debris flow in the Sand River is a bulldozer deposit, which was made when a berm was built to protect a dam ("Lionel's Dam") from the Sand River.

Heritage Resources at Thyspunt

- The Heritage Impact Assessment (HIA) found that the Thyspunt site is regarded as a "Cultural Landscape" as defined by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Convention. At the time that the revised Draft EIR was published for public comment in May 2011, the heritage sites along the coastline at the Thyspunt had been well-surveyed but there was still uncertainty about the heritage sites in the central portion of the power station footprint at this site, since the density of vegetation had prevented access to the majority of this portion of the site. While the presence of archaeological material was relatively visible in the immediate coastal areas and open dune fields, the densely vegetated areas formed a knowledge gap. This was resolved by means of an additional phase of heritage surveys (test excavations), which was carried out between 30 October and 15 December 2011 under an excavation permit issued by the SAHRA. This second study involved conducting trial excavations/ground surface examinations at 113 localities throughout the proposed nuclear corridor where ground surface visibility was poor. This covered the proposed power station foot print and potential laydown areas. The purpose of the work was to check below surface sediments in densely vegetated areas where previous sampling had been poor. Once it became apparent that there was very little archaeological material in this area of vegetated dunes, SAHRA requested that the sampling level be reduced to one excavation per 400 m grid intersection. This allowed the heritage assessment team to exercise some latitude to avoid impacting indigenous thickets and wetland areas.

  These test excavations found that the central portion of Thyspunt site where the power station footprint is proposed contains very few heritage sites and that the majority of the sites occur along the coastline or in the mobile dune field, where fresh water is available. The findings indicate that it is possible to largely avoid impacts to physical heritage, provided that infrastructure is set back from the shoreline by 200 m and confined to the archaeologically "dead zone'' in the vegetated dunes (south of the Oyster Bay Mobile Dune Field).

Cooling Water Disposal at Thyspunt

- Consideration of two cooling water disposal alternatives at Thyspunt: near-shore and off-shore. The assessment concluded that the near shore outfall is acceptable at Thyspunt from the point of view of marine organisms (e.g. chokka squid). A further chokka squid assessment confirmed that the impacts of the marine disposal of sediment, and warmed cooling water outflows would not result in significant impacts on chokka squid or fishing.

  Despite this assessment and the fact that the offshore and nearshore outlet pipes have an acceptable impact from a marine ecological point of view, it is the recommendation of the EAP

that offshore outlet tunnels be authorised as part of the application in order to further limit the impact on the marine environment at Thyspunt and Duynefontein.

Disposal of Spoil at Thyspunt

- Disposal of spoil on surf breaks at Thyspunt. The assessment concluded that, minimal impacts will occur as long the recommended deep marine disposal is used. Whilst increased sediment at Seal Point may affect the manner in which the wave breaks, no increased sediment thickness at St. Francis Bay, Bruce's Beauties and Jeffrey's Bay would occur. The surf conditions at these locations will therefore not be affected.

Disposal of Brine

- It is recommended that a piped outlet should be used to dispose brine beyond the surf zone during construction instead of disposing of it into the surf zone.

Assessment of the Impact on Marine Mammals

- Descriptions and assessment of impacts on marine mammals have been included in the revised report for all three sites.

Assessment of the Impact on Squid

- The marine assessment's assessment of the impact on squid has been re-assessed in the light of concerns from the squid fishing industry. This included detailed consideration of the commercial fishing data provided by the Department of Agriculture Forestry and Fisheries (DAFF) and a review of the available data and findings of the marine assessments by the Scientific Squid Working Group (SSWG), which provides advice to the DAFF on the management of the squid fishery. The SSWG also compiled assessments of its own in order to test the veracity of the marine assessment's findings. Accordingly, comments of the SSWG are included in Appendix 6 of the marine assessment. The SSWG's findings broadly support those of the marine assessment.

Invertebrate Monitoring

- Additional invertebrate monitoring was conducted at all sites.

Layout Alternatives at each of the Sites

- Preliminary site 'envelope' layouts of the power station footprint were developed by Eskom for each site. These layouts were provided to the EIA Team and were subsequently refined to address some of the issues and concerns that the specialist raised during the specialist integration workshop held on the 25 August 2008, at a second integration meeting with a smaller group of specialists held on the 26 September 2008 (both during the Scoping Phase of the EIA process), as well as a specialist integration workshop held on 24 and 25 November 2009, during the EIA Phase. The proposed positioning of the power station has also been influenced by the sensitivity maps (see end of Chapter 9) that were developed with specialist input.

  One of the main changes that were made to the layouts was the shifting of the proposed power station from 100 m from the ocean to at least 200 m from the high water mark. This shift was to allow for the maintenance of ecological corridors, whilst also limiting the impact on sensitive dunes and heritage features, across all sites. The setback from the high water mark will also assist in preventing impacts on the station due to a sea level rise associated with climate change. The proposed layouts take account of the environmental sensitivity mapping of the sites and place the power stations in the least environmentally sensitive portions of the sites[5]. The specialists assessed the entire possible footprint area (EIA corridor) and provided recommendations on mitigation measures, areas of high sensitivity and no-go areas.

[5] It must be noted that the final position of the nuclear power station will be determined following the appointment of the final vendor and the detailed investigations on the inter-site geological conditions. The positions proposed by the specialists and EAP are to be used as a guideline. Should the position have to be shifted significantly outside that proposed in this EIR, a supplementary environmental assessments may need to be undertaken by Eskom.

Figure 3-16 to Figure 3-21 in Chapter 3 of the Main Report provide an indication of the proposed layout of the nuclear power stations at the alternative sites. These layouts show an "envelope" layout for a vendor that is yet to be chosen.

It is important to note that there are constraints with respect to the Emergency Planning Zones (EPZs) that determine how far a power station position can be moved on the sites in relation to its surroundings. In the case of the alternative sites, there will be a PAZ (refer to Section 3 for an explanation of the EPZ) with a radius of at least 800 m (also referred to as the EZ) from the power station. Thus the power station can be moved no closer than 800 m from the closest road, as no unrestricted public access is allowed within the PAZ. While a single layout has been developed for the Thyspunt site, two layouts were initially developed for the Duynefontein as is explained in the section below.

Duynefontein

Eskom had produced two alternative preliminary layouts for the Duynefontein site. The first alternative extended longitudinally along the coastline, with the second alternative (Figure 3-18 and Figure 3-19) being more compact by having associated infrastructure such as the contractor yards and stockpile areas located inland of the Nuclear island. The second layout was introduced in response to the potentially highly significant impact on botanical processes in the active dunes of the Atlantis corridor dune field[6] as per the 2011 Dune Botany Ecological Assessment. The transverse dune system at Duynefontein is endemic, with this system being poorly represented on the Cape West Coast. However based on further studies and additional field work subsequently conducted at the Duynefontein site (2015 Botanical Dune Report – Appendix E11), suggested a reappraisal situation, due to the stabilisation of the mobile dunes in close proximity to the existing KNPS.

Two factors are paramount to this reappraisal: (i) the substantial loss in dune mobility due to development in the south, coupled with increases in vegetal cover have meant the dune can no longer function in its pristine state and (ii) development would be localised to vegetated parts of the dune system, permitting the remaining small mobile system in the north to function in the long term, albeit artificially restricted.

Therefore it is possible to encroach onto the southern portion of the dune system (closer to Nuclear-1 site), with certain provisos in place. However, to maximise the land use and to also be in line with the EIR approach to keep out of the mobile dunes habitat as much as possible, this initial layout will no longer be assessed or considered in this RDEIR Version 2. Therefore the only layout proposed for the Duynefontein site, is the more compact layout as shown in Figure 3-18 and Figure 3-19 and Appendix A).

Transport

- The Thyspunt site requires transport route upgrades with regard to public roads, access and emergency evacuation during the construction phase. The recommended routes in Version 9 of Transport Report were revised after the Revised Draft EIR was provided for public comment in May 2011. Based on this revision, the R330 is now proposed to be used only for passenger vehicle traffic and abnormal load transport, and sections will require upgrading for this purpose. The Oyster Bay Road is now proposed to be upgraded to a surfaced road to be used during the construction and operations phases for staff access and heavy vehicle traffic and as an emergency evacuation route for areas such as Oyster Bay. The DR1762, which links the R330 and Oyster Bay Road is now proposed to be surfaced to provide improved east-west connectivity. Bypass roads to the east and west of Humansdorp are also now proposed to be constructed to reduce the traffic impact on central Humansdorp. Consequently heavy construction vehicles accessing the Thyspunt site will not have to travel through the centre of Humansdorp

[6] It must be noted that from a geomorphological point of view, this habitat is not regarded as sensitive by the Nuclear-1 dune geomorphology specialist.

Thyspunt Western Access Roads

- Four options for the Western Access Road were initially considered, namely W1, W2, W3 and W4. W1 to W3 all originate to the west of Umzamowethu (between Umzamowethu and Oyster Bay), whilst W4 originates from the Humansdorp-Oyster Bay road to the east of Umzamowethu. W4 was initially rejected by the biophysical specialists on the basis of its potential impact on the western portion of the Oyster Bay Mobile Dunefield and associated sensitive ecosystems, its crossing of a drainage line and its length. Of W1, W2 and W3, W1 was preferred by the majority of the specialists.

  In recognition of I&AP concerns about the western access road received during the 2011 round of public comments on the Revised Draft EIR (Version 1), new alternative alignments for the Western Access Road were investigated. These alternatives focused on aligning the Western Access Road to the east of Umzamowethu to prevent the road creating a divide between Umzamowethu and Oyster Bay. A number of alternative alignments to this road were investigated in late 2012 and the inland alternative furthest from Oyster Bay (IR2) has been subsequently recommended. This alignment has some biophysical impacts but not of such significance that they constitute fatal flaws.

Exclusion of Bantamsklip as a Feasible Site

- With the completion and subsequent approval of the Scoping report in 2008, the intention was to conduct a detailed assessment of three alternative sites for Nuclear 1 namely Duynefontein, Bantamsklip and Thyspunt. All three sites have been investigated in equivalent detail subsequently as part of the assessment phase of the EIA. In those investigations it has become clear that while Bantamsklip remains a viable site for a nuclear power station, it is the least favourable of the three sites for Nuclear 1. Given that the detailed assessment of Bantamsklip has already been presented in the public domain as part of earlier drafts of the Environmental Impact Report, the decision has been made to exclude Bantamsklip from further consideration in this EIR in the interests of brevity.

  The three primary reasons for excluding Bantamsklip at this point relate to transportation risks, urban planning and the level of assessment available to the Nuclear-1 EIA team on the transmission lines that will be required to evacuate power from the operational power station. In respect of transportation, the route between Cape Town Harbour and Bantamsklip is both longer and topographically more complex, with the need to traverse Sir Lowry's pass being particularly challenging, in comparison to the access routes to the other two sites. This route therefore poses major technical difficulties to heavy load transportation vehicles and thus has a greater associated safety risk (to other road users and transportation staff) than the other routes. There are also significant bridge obstructions and steep grades along this route, which are not present along the routes that would service the other two sites.

  The second reason is based on an urban planning perspective. All three sites were considered and investigated by the Urban Town Planners (Appendix E34). The sites were ranked and scored in terms of development criteria for a Nuclear Power Station, in which the Bantamsklip site scored the lowest. The scoring is influenced by the limited workforce available in close proximity to the site which is a challenge experienced on the Bantamsklip site as compared to Duynefontein or Thyspunt. This shows that the site is currently not the best choice for Nuclear-1 from an urban planning perspective.

  The third reason is because there is a direct obligation (as required by the EIA regulations) to assess the full suite of impacts that would be associated with not just the nuclear power station but associated infrastructure too. A large-scale associated facility is of course the transmission lines that would be needed to supply power during the construction phase, but also to evacuate power from the operational power station. For both Duynefontein and Thyspunt, detailed assessments of the power lines are available to the EIA team but not yet for Bantamsklip. The detailed environmental assessments conducted for Thyspunt and Duynefontein have been taken into consideration with the impact assessment for these sites, giving effect to cumulative impact assessment as shown in Chapter 10. Due to the fact that similar information is not available for Bantamsklip, the EIA team cannot sufficiently assess the

cumulative impact for the Bantamsklip site. As such it is simply not possible currently to provide an adequately comparative assessment between the three sites.

The EIA team is confident that excluding Bantamsklip from this EIR does not undermine the obligation to thoroughly investigate alternatives or disqualify the site for future nuclear use. The inclusion of the Bantamsklip site would add significant further complexity to an already complex EIR without improving decision-making in any material way. The Bantamsklip site will therefore not be further considered in this EIR. Readers interested in the previous assessment of the Bantamsklip site can access the information at http://projects.gibb.co.za/Projects/Eskom-Nuclear-1-Revised-Draft-EIR.

With the above said readers should be cautioned that this does not mean that Bantamsklip can never be considered for a future Nuclear Power Station. The site is not fatally flawed as per the assessments previously conducted; however with the challenges mentioned above Bantamsklip will not be ready to meet the construction timeframe anticipated for Nuclear-1, and as such will not be further considered for this EIA.

Town planning (new study not included in previous versions of the EIR)

- A town planning study was undertaken to assess the potential impact the proposed power station will have on the surrounding land use. The proposed sites were evaluated in terms of a development matrix which assessed the institutional, economic, social and physical environment.

Radiological Assessment (new study not included in previous versions of the EIR

- A radiological assessment was undertaken to assess the potential radiological impact the proposed power station could have on the adjacent areas. The study looked at the existing background radiation from the sites, potential impact on humans and non-humans during normal operations.

Beyond Design Accident Report (new study not included in previous versions of the EIR

- This study looks at a worst case scenario, in the event that a nuclear accident occurs. Incidents such as Three Mile Island, Chernobyl and Fukushima are considered.

Peer Review of Specialist Studies

- Peer reviews of specialist studies were conducted. The peer reviews found that all studies were adequate and no fatal flaws were identified. Further detail is provided in Chapter 8 of the current report.

ASSESSMENT OF PROJECT ALTERNATIVES

The consideration of alternatives is a key requirement of an EIA as it provides a basis for choice for the competent authority and I&APs. Alternatives that are considered must be reasonable and feasible. Alternatives considered during the EIA include the following:

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

The evaluation of alternatives is based on a combination of the documented specialist assessments, the results of the specialist integration workshop held in November 2009 and GIBB's integration and assessment of the studies' findings, including the revisions to the specialist reports from 2010 to date.

THE COMPARATIVE ASSESSMENT OF THE ALTERNATIVE SITES

The assessment derives from the characterization of the receiving environment and how that receiving environment will be changed as a result of the proposed Nuclear Power Station (NPS) and the activities that will be required to build and operate the same. The assessment presented here is sourced from the various specialist studies that were commissioned as part of the EIA process (as was included in the Revised Draft EIR (Version 1). These studies serve to provide a specialist assessment of the different elements of the Nuclear Power Station and its potential impact on the environment. Each of the specialist studies contains the assessment process together with impacts within that specialist domain as well as an ascription of significance to the impacts so identified.

In the specialist studies, impacts were defined as a potential change to the environment as a result of the construction or operation of the proposed Nuclear Power Station. From thirty-five specialist studies conducted for the EIA some 250 different potential impacts[7] were identified and significance ascribed to each of those impacts, as the EIA regulations require. The 250 impacts are listed in Table below.

Potential impacts at both sites (post mitigation or after optimisation) as identified in the specialist studies conducted for the EIA.

Impact category	Mitigated impact	Duynefontein	Thyspunt
Geotechnical suitability	Slope failure, leading to safety risks (Mitigated)	**Low**	**Low**
	Failure of rock slopes, leading to safety risks	**Low**	**Low**
	Excessive site disturbance, resulting in environmental damage	**Low**	**Low**
Seismic suitability	Impact of Vibratory Ground Motion on the power station structure	**Low**	**Low**
Geological risk	Surface Rupture: Capable faults that may cause surface deformation as result of tectonic faulting	**Low**	**Low**
	Subsurface Stability: Potential subsurface subsidence or uplift	**Low**	**Low**
	Volcanic Activity: Any recently active volcanoes within site vicinity	**Low - Medium**	**Low - Medium**
Hydrological impacts of the proposed power station	Increased run-off peaks due to hardened surface	**Low**	**Low - Medium**
	Increased run-off volume due to hardened surface	**Low - Medium**	**Low**
	Disruption during construction: Increased erosion potential	**Low**	**Low**
	Disruption during construction: Flooding of works	**Low**	**Low**
	Changes in flow paths	**Low - Medium**	**Low - Medium**
	Increased silt deposition due to barren soil	**Low**	**Low**
	Pollution of surface waters	**Low - Medium**	**Low -**

[7] For details of each impact identified by each specialist study, readers are directed to "Chapter 10 Annexure" which is located before Appendix A of the Revised Draft Environmental Impact Report (Version 2).

Impact category	Mitigated impact	Duynefontein	Thyspunt
			Medium
	Sea level rise	**Low - Medium**	**Low - Medium**
Impacts of the hydrological environmental on a proposed power station	Rising Sea Level	**Low**	**Low**
	Highest astronomical tide	**Low**	**Low**
	Extreme high water level	**Low**	**Low**
	Frequent high rainfall events	**Low**	**Low**
Geohydrology (Construction)	Flooding of the excavated areas by groundwater during construction	**Low**	**Low**
	Decreased yields of existing production boreholes during construction	**Low**	**Low**
	Drying up of coastal springs during construction	**Considered in detail in the Wetlands Assessment**	
	Degradation of wetlands during construction	**Considered in detail in the Wetlands Assessment**	
	Intrusion of saline water	**Low**	**Low**
	Hydrocarbon contamination of groundwater	**Low**	**Low**
	Hazardous waste contamination of groundwater	**Low**	**Low**
	Organic and bacteriological contamination of groundwater	**Low**	**Low**
Geohydrology (Operation)	Radioactive and toxic contamination of groundwater	**Low**	**Low**
	Hydrocarbon contamination of groundwater	**Low**	**Low**
	Organic and bacteriological contamination of groundwater	**Low**	**Low**
	Decreased yields of existing production boreholes	**Low**	**Low**
	Drying up of coastal springs and/or seeps	**Considered in detail in the Wetlands Assessment**	
	Degradation of wetlands	**Considered in detail in the Wetlands Assessment**	
	Intrusion of saline water	**Low**	**Low**
Freshwater Supply	Sea water intrusion during construction	**Low**	**Low**
	Installation of beach wells during construction	**Low**	**Low**
	Disposal of brine during construction	**Low**	**Low**
	Sea water intrusion during operation	**Low**	**Low**
	Disposal of brine during operation	**Low**	**Low**
Impacts on flora: Nuclear Power Station and Spoil	Loss of important vegetation communities	**Medium**	**Medium**
	Loss of endemic vegetation communities (locate outside of communities)	**Medium**	**Medium**
	Loss of locally occurring Red Data species (translocate or grow affected species)	**Low**	**Low**

Impact category	Mitigated impact	Duynefontein	Thyspunt
	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**
	Cumulative impact of loss of species, habitat and ecosystem functioning (locate footprint outside transverse dune)	**Medium**	**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**
	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**
	Loss of locally occurring Red Data species (realign road to avoid RD species, and/or translocate or grow in nursery)	**n.a.**	**n.a**
	Loss of species, habitat and ecosystem functioning (locate road away from mobile dunes and wetlands)	**n.a.**	**n.a**
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.**	**Low - Medium**
	Loss of wetlands near Oyster Bay	**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.**	**Medium**
	Loss of locally occurring Red Data species (realign road to avoid RD species, and/or translocate or grow on in nursery)	**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.**	**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.**
	Mobile dunes downwind of infrastructure (none possible)	**Low-Medium**	**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.**

Impact category	Mitigated impact	Duynefontein	Thyspunt
	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.**
	impact 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.**
	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.**
	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.**
Dune geomorphology impacts at Thyspunt	Formation of blowouts along Eastern and Western Access Roads across vegetated dune field (stabilise, rehabilitate)	**n.a.**	**Low – Medium**
	Usage of Eastern and Western Access Roads during operational phase (no mitigation)	**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.**	**Medium**
	Constructing infrastructure and access roads (Use helicopters for construction)	**n.a.**	**Low - Medium**
	Transmission lines with 300-400 m span across mobile dunes and interdune wetlands of the Oyster Bay mobile dune field during operation (Use light vehicles for maintenance)	**n.a.**	**Negligible**
	Constructing transmission lines with 300-400 m spans and access road across vegetated dune field (locate towers on broad ridges and wide interridge valleys)	**n.a.**	**Medium**
	Constructing transmission lines with 300-400 m spans and access road across vegetated dune field (Use helicopters for construction)	**n.a.**	**Low – Medium**

Impact category	Mitigated impact	Duynefontein	Thyspunt
	Transmission lines with 300-400 m span across vegetated dune fields Infrastructure and access roads - operation (Use light vehicles for maintenance)	**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.**	**Medium**
Impacts on dune geomorphology at all sites	Creation of new active mobile dune fields due to sea-level rise due to climate change (no mitigation)	**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**
Wetland impacts	Loss or degradation of wetlands resulting from dewatering during construction	**Low**	**n.a.**
	Loss or degradation of wetlands resulting from seawater contamination during construction, following dewatering	**Low - Medium**	**n.a.**
	Degradation of wetlands as a result of construction of internal access roads during construction	**Low**	**n.a.**
	Degradation and fragmentation of wetlands as a result of construction of internal roads	**Low**	**n.a.**
	Cumulative impacts	**Low - Medium**	**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.**	**n.a.**
	Degradation of wetlands as a result of physical disturbance to wetlands north of the R43 during construction (mitigated)	**n.a.**	**n.a.**
	Degradation of wetlands associated with the Groot Hagelkraal system through alien encroachment (mitigated)	**n.a.**	**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.**	**n.a.**
	Impacts to wetland systems associated with indirect impacts of the proposed nuclear power station development	**n.a.**	**n.a.**
	Loss or degradation of the Langefonteinvlei and/or dune slack wetlands as a result of dewatering during construction (Mitigated)	**n.a.**	**Low - Medium**

Impact category	Mitigated impact	Duynefontein	Thyspunt
	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.**	**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.**	**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 topsoil during construction (Mitigated)	**n.a.**	**Low**
	Degradation of coastal seep wetlands as a result of catchment hardening and runoff from laydown areas during construction	**n.a.**	**Low - Medium**
	Degradation / drainage / infilling of hillslope seeps and valley bottom wetlands north of the high dune fields during construction	**n.a.**	**Low**
	Operational Phase	**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.**	**Medium**
	Degradation of remnant coastal seepage wetlands as a result of receipt of stormwater runoff during operation	**n.a.**	**Low**
	Degradation of hillslope seeps and valley bottom wetlands north of the high dune fields during operation	**n.a.**	**Low**
	Degradation of dune slack wetlands as a result of increased vehicle passage across the dunes during operation	**n.a.**	**Low**
	Conservation of remaining dune slack, coastal seep and valley bottom wetlands on the site during operation	**n.a.**	**Medium**
	Treatment of sewage on site: water quality impacts to wetlands	**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.**	**Low - Medium**
	Alternatives 1 to 3: degradation of wetlands along pipeline routes or as a result of abstraction	**n.a.**	**Low**

Impact category	Mitigated impact	Duynefontein	Thyspunt
	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.**	**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.**	**Low – Medium**
	Eastern Access Route: disturbance of the eastern valley bottom wetland at crossing point; localised impacts to flow	**n.a.**	**Low – Medium**
	Western Access Route: infilling of coastal and hillslope seep wetlands and disruption of through-flows	**n.a.**	**Low**
	Cumulative impacts associated with development, without incorporation of offset mitigation, but with all other mitigation in place	**n.a.**	**Medium**
Impacts on terrestrial fauna	Destruction of natural habitats and populations, resulting from site clearance, buildings, laydown areas and infrastructure	**Medium**	**Medium**
	Reduction in populations of Threatened species, resulting from habitat destruction and direct mortality	**Medium**	**Medium**
	Fragmentation of natural habitats and patterns of animal movement, resulting from buildings, infrastructure and fences	**Medium**	**Medium**
	Road mortality (road kills), resulting from traffic on roads through natural habitats	**Low - Medium**	**Low - Medium**
	Mortality associated with overhead-transmission lines and substations, resulting from collisions and electrocutions	**Low**	**Low**
	Disturbance of sensitive breeding populations, resulting from construction activities and direct human disturbance	**Low**	**Low**
	Dust pollution beyond the building site, resulting from drifting, airborne dust from construction site and roads	**Low - Medium**	**Low**
	Pollution of soil and water beyond the building site, resulting from spills of chemicals, fuel and sewage	**Low**	**Low**

Impact category	Mitigated impact	Duynefontein	Thyspunt
	Light pollution beyond the building site, resulting from excessive outdoor lighting, and poor choice of lights and fittings	**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**
	Poaching of local wildlife during construction phase, resulting from hunting and trapping by workers and employees, for sport and for the pot	**Low**	**Low**
	Problem-animal scenarios, resulting mainly from human interaction with animals	**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**
	Cumulative impacts, resulting from addition of impacts to existing impacts, and the operation of impacts over time	**Medium**	**Medium**
	Improved conservation of undeveloped land, resulting from improved legal status and/or management	**Medium**	**High**
Impacts on invertebrate fauna	Direct habitat destruction	**Medium**	**Medium**
	Indirect habitat alteration by groundwater disturbance	**Low**	**Low**
	Habitat fragmentation	**Medium**	**Medium**
	Reduction in populations of rare/protected species	**Low**	**Low**
	Soil and water pollution	**Low - Medium**	**Low-Medium**
	Dust pollution	**Low - Medium**	**Low-Medium**
	Light pollution - construction phase (partially mitigated)	**Medium**	**Medium**
	Light pollution - operational phase (fully mitigated)	**Low - Medium**	**Low-Medium**
	Increased radiation levels	**Low - Medium**	**Low-Medium**
	Road mortality	**Medium**	**Medium**
	Increased risk of fire	**Medium**	**Medium**
	Spread of alien invasive invertebrate species	**Medium**	**Medium**
	Land invasion by employment seekers	**Low**	**Low**
	Cumulative impacts	**Medium**	**Medium**

Impact category	Mitigated impact	Duynefontein	Thyspunt
	Climate change	**Medium**	**Medium**
	Positive contribution to conservation	**Medium**	**Medium**
	Impacts of access roads	**Medium**	**Medium**
	Impacts of terrestrial disposal of spoil	**Medium**	**Medium**
	Impacts of the no-go alternative	**Medium**	**Medium**
	Impacts of transmission lines between the power station and HV Yard	**n.a.**	**Low - Medium**
Air quality impacts	Construction - Gaseous emissions	**Low**	**Low**
	Construction - PM_{10} emissions	**Low**	**Low**
	Construction - Fallout	**Low**	**Low**
	Operational - Non-radionuclide emissions	**Medium**	**Medium**
	Operational - Radionuclide emissions	**Medium**	**Medium**
	Cumulative impacts	**Medium**	**Medium**
Oceanographic impacts	Short term disruption of sediment transport during construction	**Low**	**Low**
	Short term disruption of sediment transport (Outfall Option 2)	**n.a.**	**n.a.**
	Beach erosion due to brine discharge during construction	**Low**	**Low**
	Disposal of spoil	**n.a.**	**Low**
	Long term disruption of sediment transport during operation	**Low - Medium**	**Low-Medium**
	Long term disruption of sediment transport by (Outfall Option 2) during operation	**n.a.**	**n.a.**
	Extreme sea levels affecting operation of nuclear power station during operation	**Low - Medium**	**Low-Medium**
Impacts on surf breaks	Effect of sediment dumping on surf conditions at Seal Point (Mitigated - deep disposal site)	**n.a.**	**Low**
	Effect of sediment dumping on Bruce's Beauties (Mitigated - Shallow Disposal Site)	**n.a.**	**Low**
Marine impacts	Disruption during construction: Due to construction of the cooling water intake and outflow systems	**Medium**	**Low-Medium**
	Disruption during construction due to discarding of spoil (mitigated by discarding of spoil at a deep offshore site)	**Medium**	**Medium**
	Abstraction of cooling water & entrainment of organisms	**Low-Medium**	**Low-Medium**
	Impact on marine organisms due to release of warmed cooling water	**Medium**	**Medium**

Impact category	Mitigated impact	Duynefontein	Thyspunt
	Release of desalination effluent during the construction phase	**Low-Medium**	**Low-Medium**
	Release of radiation emissions	**Low**	**Low**
	Unintentional discharge of polluted groundwater	**Low**	**Low**
Heritage	Impact on Miocene palaeontology	**Medium**	**Low**
	Destruction of Pleistocene archaeology and palaeontology	**Low- Medium**	**Low**
	Destruction of Holocene archaeology	**Low**	**Low**
	Destruction of Colonial Heritage	**Low**	**Low**
	Destruction of Landscape	**High**	**High**
	Cumulative impacts	**Medium**	**Medium**
	Positive contribution to conservation	**Medium**	**Low-Medium**
Noise	Noise impacts of oil cooler fans during operation	**Low**	**Low**
	Noise impacts of road construction	**Low**	**Low**
	Noise impacts of site works and construction	**Low**	**Low**
	Impact of transportation noise	**Low**	**n.a.**
	Impact of transportation noise 10 m from the R330	**n.a.**	**Medium**
	Impact of transportation noise 70 m from the R330	**n.a.**	**Low**
Tourism	Impact on hospitality systems	**Low**	**Medium**
	Impacts on general infrastructure used by tourists	**Low**	**Low**
	Impact on visual amenity enjoyed by tourists	**Low**	**Medium**
	Impact on sense of place from tourism point of view	**Low**	**Medium**
	Impact on marine assets used by tourists	**Low**	**Low**
	Impact on social amenity	**Low**	**Medium**
	Impact on terrestrial assets used by tourists	**Low**	**Low**
Agricultural impacts	Dust pollution	**Low**	**Low**
	Availability/ Cost of labour	**Low**	**Medium**
	Change in market condition (Optimised)	**Low**	**Medium**
Economic impacts	Construction phase macroeconomic impacts – Local (positive)	**High**	**High**
	Construction phase macroeconomic impacts – Regional (positive)	**Medium**	**Medium**
	Construction phase macroeconomic impacts –National (positive)	**Medium**	**Medium**

Impact category	Mitigated impact	Duynefontein	Thyspunt
	Operational phase macroeconomic impacts – Local (positive)	**Medium**	**Medium**
	Operational phase macroeconomic impacts – Regional (positive)	**Low**	**Low**
	Operational phase macroeconomic impacts – national (positive)	**Low**	**Low**
	Loss of income arising from loss of part of fishing grounds	**n.a.**	**Medium**
	Loss of income arising from loss of access to part of whale watching area	**n.a.**	**n.a.**
Site control	Restricted access to site during construction	**Low - Medium**	**Low - Medium**
	Restricted access to site during operation	**Low - Medium**	**Low**
Visual impacts	Visual intrusion of drill rigs and ancillary equipment during pre-construction	**Low**	**Low**
	Visual degradation of vegetation clearance, access roads and site camps during pre-construction	**Low**	**Low**
	Degradation of Sense of Place during pre-construction	**Low**	**Low**
	Visible dust during construction	**Low**	**Low**
	Degradation of visual quality resulting from change to vegetation and landform during construction	**Medium**	**Medium**
	Visual clutter resulting from structures, site offices, laydown areas and site accommodation during construction	**Low**	**Low**
	Visual alteration of night scene by lighting during construction	**Medium**	**Medium**
	Visual change to Sense of Place during construction	**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**
	Change in visual quality of local area caused by new landforms and roads during operation	**Medium**	**Medium**
	Change in visual quality of local night scene by lighting during operation	**Medium**	**Medium**
	Visible dust during decommissioning	**Low**	**Low**
	Visual clutter resulting from structures, site offices and on site accommodation during decommissioning	**Low**	**Low**
	Visual change to local landscape due to earthworks during decommissioning	**Medium**	**Medium**
	Visual nuisance of heavy traffic on local roads during decommissioning	**Low**	**Low**

Impact category	Mitigated impact	Duynefontein	Thyspunt
Social impacts	Impact on accommodation during the construction phase (construction)	**Medium**	**Medium**
	Influx of job seekers (construction)	**Medium**	**Medium**
	Increase in informal illegal dwellings (construction)	**Low**	**Low**
	Creation of employment opportunities (construction)	**High**	**High**
	Increase in business opportunities (construction)	**Medium**	**Medium**
	Increase in criminal activities (construction)	**Low**	**Medium**
	Increase in sexually transmitted diseases (construction)	**Medium**	**Medium**
	Impact on water & sanitation (construction)	**Low**	**Low**
	Impact on roads & transport (construction)	**Low**	**Low**
	Impact on waste and refuse (construction)	**Low**	**Low**
	Traffic impact (construction)	**Low**	**Low**
	Noise impact (construction)	**Medium**	**Medium**
	Loss of employment (construction)	**Medium**	**Medium**
	Visual impact (construction)	**Medium**	**Medium**
	Impact on medical infrastructure (construction)	**Low**	**Low**
	Impact on law enforcement (construction)	**Low**	**Medium**
	Impact on schools (construction)	**Low**	**Low**
	Impact on sport infrastructure (construction)	**Low**	**Low**
	Impact on sense of place (construction)	**Medium**	**Medium**
	Impact on future land use (construction)	**Medium**	**Medium**
	Creation of employment opportunities (operation)	**Medium**	**Medium**
	Creation of business opportunities (operation)	**Medium**	**Medium**
	Increase in criminal activities (operation)	**Low**	**Low**
	Impact on water & sanitation (operation)	**Low**	**Low**
	Impact on roads & transport (operation)	**Low**	**Low**
	Impact on waste and refuse (operation)	**Low**	**Low**
	Visual impact (operation)	**Medium**	**Medium**
	Impact on medical infrastructure (operation)	**Low**	**Low**
	Impact on schools (operation)	**Low**	**Low**

Impact category	Mitigated impact	Duynefontein	Thyspunt
	Impacts on sport infrastructure (operation)	**Low**	**Low**
	Impact on sense of place (operation)	**Medium**	**Medium**
	Impact on future land use planning (operation)	**Medium**	**Medium**
	Perceived risk of nuclear incidents (operation)	**Medium**	**Medium**
	Impact of the no-development option (operation)	**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**
	Contamination of the atmosphere due to the release of radioactivity contained in gaseous waste (Commissioning, Operational and Decommissioning Phase).	**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**
	Contamination of water resources by radioactivity due to disposal of LILW at Vaalputs (Operational Phases)	**Low**	**Low**
	Contamination of water resources by radioactivity due to accidental spillage of radioactive waste during transport (Operational Phase)	**Low**	**Low**

Various comments received from both interested and affected parties and the authorities in particular have indicated that it is difficult to make sense of the multitude of impacts presented in the table above. They have requested that the presentation of impacts be simplified without losing the essence of the specialist findings. In order to provide that simplification it is necessary to recognise that many of the impacts presented, are in fact a series of changes that result in one overarching consequence. For example in the invertebrate fauna assessment mortality of threatened species as a result of habitat loss, collision with motor vehicles, collision with overhead power lines, and off site pollution are all presented as separate impacts but the consequence of all the impacts is to potentially result in reduced populations of threatened species, which is itself listed as an impact. It is this consequence that is central to the decision making process.

As such the approach has been to interrogate the specialist studies and identify and describe the collective implications of all the impacts presented. In the process a distinction is then made between the collective implication of the various impacts (e.g. reduced threatened species populations) and the causes of the implication (e.g. loss of habitat, road mortality, power line mortality and off site pollution). These implications have then been presented as either potential environmental costs (where the implications are negative) or as potential environmental benefits (where the implications are positive).

The following potential environmental costs have thus been identified from the specialist studies that were conducted for the EIA on the proposed Nuclear Power Station namely potential deterioration /reductions in:

- Public health and safety due to the Nuclear Power Station itself;

- Public health and safety due to activities associated with the Nuclear Power Station;
- Livelihoods;
- Marine water quality;
- Surface (fresh) water quality;
- Groundwater quality;
- Availability of water/groundwater;
- Populations of rare/sensitive species;
- Populations of species;
- Heritage resources
- Wetland numbers; and,
- Wetland functioning (including fragmentation).

The following potential benefits have been identified from the specialist studies that were conducted for the EIA on the proposed Nuclear Power Station namely potential improvements / increases in:

- Electricity supply;
- Conservation of heritage resources;
- Jobs;
- Infrastructure upgrades;
- Conservation of biodiversity; and
- Livelihoods.

ASCRIBING SIGNIFICANCE FOR DECISION-MAKING

The best way of expressing these cost benefit implications for decision-making is to present them as risks. Risk is defined as the consequence (implication) of an event multiplied by the probability (likelihood)[8] of that event. Many risks are accepted or tolerated on a daily basis because even if the consequence of the event is serious, the likelihood that the event will occur is low. It is also necessary to distinguish between the event itself (as the cause) and the consequence.

In the table below a scoring system for consequence ranking is shown.

Ranking of Consequence

Environmental Cost	**Inherent risk**
Human health – morbidity / mortality, loss of species	High
Material reductions in faunal populations, loss of livelihoods, individual economic loss	Moderate – high
Material reductions in environmental quality – air, soil, water. Loss of habitat, loss of heritage, amenity	Moderate
Nuisance	Moderate – low
Negative change – with no other consequences	Low
Environmental Benefits	**Inherent benefit**
Net improvement in human welfare	Moderate – high
Improved environmental quality – air, soil, water. Improved individual livelihoods	Moderate
Economic Development	Moderate – Low
Positive change – with no other consequences	Low

Although the principle is one of probability, the term 'likelihood' is used to give expression to a qualitative rather than quantitative assessment, because the term 'probability' tends to denote a mathematical/empirical expression. A set of likelihood descriptors that can be used to characterise the likelihood of the costs and benefits occurring, is presented in the table below,

[8] Because 'probability' has a specific mathematical/empirical connotation the term 'likelihood' is preferred in a qualitative application and is accordingly the term used in this document.

Likelihood Categories and Definitions

Likelihood Descriptors	Definitions
Highly unlikely	The possibility of the consequence occurring is negligible
Unlikely but possible	The possibility of the consequence occurring is low but cannot be discounted entirely
Likely	The consequence may not occur but a balance of probability suggests it will
Highly likely	The consequence may still not occur but it is most likely that it will
Definite	The consequence will definitely occur

The residual risk is then determined by the consequence and the likelihood of that consequence. The residual risk categories are shown in the table below where consequence scoring is shown in the rows and likelihood in the columns. The implications for decision-making of the different residual risk categories are shown in here.

Residual Risk Categories

		Residual risk				
Consequence	High	Moderate	High	High	Fatally flawed	
	Moderate – high	Low	Moderate	High	High	High
	Moderate	Low	Moderate	Moderate	Moderate	Moderate
	Moderate – low	Low	Low	Low	Low	Moderate
	Low	Low	Low	Low	Low	Low
		Highly unlikely	Unlikely but possible	Likely	Highly likely	Definite
		Likelihood				

Therefore considering the above the nature of the implication for the decision maker can be categorised as shown below.

Rating	Nature of implication for Decision – Making
Low	Project can be authorised with low risk of environmental degradation
Moderate	Project can be authorised but with conditions and routine inspections
High	Project can be authorised but with strict conditions and high levels of compliance and enforcement
Fatally Flawed	The project cannot be authorised

Therefore the implication for decision making for each of the consequences identified (with their respective causes) is as follows:

Public Health and Safety Risk

Potential Environmental Cost	Acute radioactive exposure	
Inherent risk	High	
Causes of risk	Likelihood of causes	
	Thyspunt	Duynefontein
Loss of control of fission	Highly unlikely	Highly unlikely
Surface rupture	Highly unlikely	Highly unlikely
Subsurface instability	Highly unlikely	Highly unlikely
Volcanic activity	Highly unlikely	Highly unlikely

Unstable soil/geological unit	Highly unlikely	Highly unlikely
Flooding	Highly unlikely	Highly unlikely
Flood damage to access routes	Highly unlikely	Highly unlikely
Soil liquefaction damage to access routes	Highly unlikely	Highly unlikely
Mobile dunes damaging access routes and infrastructure	Unlikely but possible	Highly unlikely
Meteo-Tsunami	Unlikely but possible	Unlikely but possible
Corrosion due to groundwater	Likely	Likely
Material seismicity	Highly unlikely	Highly unlikely
Likelihood of consequence	**Highly unlikely**	**Highly unlikely**
Residual risk	**Moderate**	**Moderate**

Non-radiological Risks of Death or Serious Injury

Potential Environmental Cost	Non-radiological risks of death or serious Injury	
Inherent risk	**High**	
Causes of risk	**Likelihood of causes**	
	Thyspunt	**Duynefontein**
Vehicle accidents	Likely	Likely
Incidents related to criminal activities	Likely	Likely
Likelihood of consequence	**Likely**	**Likely**
Residual risk	High	High

Potential Environmental Cost	Illness	
Inherent risk	**High**	
Causes of risk	**Likelihood of causes**	
	Thyspunt	**Duynefontein**
Chronic dust exposure	Highly unlikely	Highly unlikely
Chronic radioactive exposure	Highly unlikely	Highly unlikely
Likelihood of consequence	**Highly unlikely**	**Highly unlikely**
Residual risk	**Moderate**	**Moderate**

Potential Environmental Cost	Increased morbidity	
Inherent risk	**High**	
Causes of risk	**Likelihood of causes**	
	Thyspunt	**Duynefontein**
Increase in HIV/AIDS/STDs	Likely	Likely
Likelihood of consequence	**Likely**	**Likely**
Residual risk	**High**	**High**

Compromise in Quality of Fresh Water Resources

Potential Environmental Cost	Contaminated stormwater
Inherent risk	Moderate

Causes of risk	Likelihood of causes	
	Thyspunt	Duynefontein
Radioactive contamination	Highly unlikely	Highly unlikely
Hydrocarbon contamination	Unlikely but possible	Unlikely but possible
Likelihood of consequence	**Unlikely but possible**	**Unlikely but possible**
Residual risk*	**Moderate**	**Moderate**

Compromise in Quality of Groundwater Resources

Potential Environmental Cost	Contaminated groundwater	
Inherent risk	Moderate	
Causes of risk	**Likelihood of causes**	
	Thyspunt	**Duynefontein**
Saline/seawater intrusion	Highly unlikely	Highly unlikely
Radioactive contamination	Highly unlikely	Highly unlikely
Hydrocarbon contamination	Unlikely but possible	Unlikely but possible
Likelihood of consequence	**Unlikely but possible**	**Unlikely but possible**
Residual risk*	Moderate	Moderate

Availability of Groundwater Resources to Other Users

Potential Environmental Cost	Reduced groundwater yields	
Inherent risk	Moderate	
Causes of risk	**Likelihood of causes**	
	Thyspunt	**Duynefontein**
Abstraction	Definite	Definite
Changes in underground flow	Unlikely but possible	Unlikely but possible
Likelihood of consequence	**Highly unlikely**	**Highly unlikely**
Residual risk	Low	Low

Loss of Wetlands and Wetland Function

Potential Environmental Cost	Reduced wetland functioning	
Inherent risk	Moderate	
Causes of risk	**Likelihood of causes**	
	Thyspunt	**Duynefontein**
Physical destruction of wetlands	Highly unlikely	Highly unlikely
Reduced water supply	Highly unlikely	Highly unlikely
Inflow of poor quality water	Highly unlikely	Highly unlikely
Placing of spoil dumps	Highly unlikely	Highly unlikely
Likelihood of consequence	**Highly unlikely**	**Highly unlikely**
Residual risk	**Low**	**Low**

Reduced Marine Environment Quality

Potential Environmental Cost	Reduced marine environmental quality

Inherent risk	Moderate	
Causes of risk	**Likelihood of causes**	
	Thyspunt	**Duynefontein**
Brine and heated water disposal	Definite	Definite
Contaminated runoff	Unlikely but possible	Unlikely but possible
Spoil disposal	Definite	Definite
Likelihood of consequence	**Highly unlikely**	**Highly unlikely**
Residual risk	**Low**	**Low**

Reduced Populations of Threatened Species

Potential Environmental Cost	Material reductions in threatened species populations	
Inherent risk	Moderate-high	
Causes of risk	**Likelihood of causes**	
	Thyspunt	**Duynefontein**
Loss and fragmentation of habitat	Definite	Definite
Road mortality	Likely	Likely
Mortality associated with overhead transmission lines	Likely	Likely
Disturbance of breeding populations	Unlikely but possible	Likely
Pollution of wetlands	Highly unlikely	Highly unlikely
Material reduction in marine water quality	Highly unlikely	Highly unlikely
Likelihood of consequence	**Unlikely but possible**	**Unlikely but possible**
Residual risk	**Moderate**	**Moderate**

Changes in Livelihoods

Potential Environmental Cost	Reduction in livelihoods	
Inherent risk	Moderate	
Causes of risk	**Likelihood of causes**	
	Thyspunt	**Duynefontein**
Change in surf breaks	Highly unlikely	NA
Radiological contamination of agricultural products	Highly unlikely	Definite
Change in sense of place	Definite	Unlikely but possible
Material reductions in chokka squid catches	Unlikely but possible	NA
Likelihood of consequence	**Highly likely**	**Unlikely but possible**
Residual risk	**Moderate**	**Moderate**

Heritage Resources

Potential Environmental Cost	Loss of heritage resources	
Inherent risk	Moderate	
Causes of risk	**Likelihood of causes**	
	Thyspunt	**Duynefontein**
Destruction of heritage artefacts	Unlikely but possible	Unlikely but possible
Change in cultural landscape	Definite	Unlikely but possible
Likelihood of consequence	**Definite**	**Unlikely but possible**
Residual risk	**Moderate**	**Moderate**

Nuisance

Potential Environmental Cost	Nuisance	
Inherent risk	Moderate-low	
	Thyspunt	**Duynefontein**
Noise	Definite	Definite
Visual	Definite	Definite
Informal settlements	Likely	Likely
Traffic congestion	Likely	Likely
Likelihood of consequence	**Definite**	**Unlikely but possible**
Residual risk	**Moderate**	**Low**

CONCLUSIONS AND RECOMMENDATIONS

Location of the power station

The establishment of the NPS at Duynefontein would occur against a backdrop of an existing NPS, large-scale transmission lines, and a far more urbanized environment than exists at Thyspunt. In these terms the changes and the perception of these changes will be far greater at Thyspunt than they will at Duynefontein. The proposed NPS and associated infrastructure will bring about a fundamental change in sense of place at Thyspunt whereas that change has already been experienced at Duynefontein and so were the NPS to be established at Duynefontein, the change would be experienced as a more intense form of the same. Decision-makers need to understand and be empathetic towards the extent of the change at Thyspunt which is deemed to be a high residual impact (as a cause) and which is broadly not possible to mitigate. It is only the passage of time that will steadily mitigate the huge sense of change that will experienced at Thyspunt and for some residents it is a change that they will never get used to. Many of the residents specifically live in that area due to the sense of place that prevails currently and the sense of being in a remote and peaceful environment.

The sheer size of the project and its associated footprint which extends well beyond the direct proposed site in the form of roads, other infrastructure and large-scale transmission lines means potentially significant transformation of land and habitat. The direct footprint of the proposed NPS is 265 ha at Duynefontein that will mean a direct loss of currently conserved land. The conservation area was directly premised on the establishment of the Koeberg NPS and has been judicious use of the land that is owned by Eskom and kept free of development for safety reasons, but that does not change the fact that a conservation area will be lost if the NPS is established at Duynefontein. The loss of that conservation area is material and an offset would need to be created to ensure that there is no net loss of ecological value if the NPS is established at Duynefontein.

The Thyspunt site is biologically more diverse than the Duynefontein site and there are more threatened species of fauna at Thyspunt and the Langefonteinvlei wetland is of special importance. As such the site proposed for the NPS at Thyspunt is more sensitive than that at Duynefontein and decision-makers are encouraged to recognize this sensitivity in their decision-making deliberations. Equally important in those deliberations is of course the fact that a good part of the reason for that higher sensitivity has been the protection afforded to the natural environment by the property not being available for development.

It is simply not possible to speculate as to how or even if the site would have been developed in other ways were it not to have been earmarked for a NPS but there is no doubt that the current ecological value of the site is because development has been prevented. The assessment is one of moderate residual risk of reduced threatened species populations because of the introduction of infrastructure that poses a mortality risk to such species especially roads and transmission lines. Threatened species mortality as a result of this infrastructure is likely and the various mitigation that will be applied, will serve to limit the extent of the mortality so that there is not a material reduction in threatened species populations.

The presence of wetlands at both sites, with an especially sensitive wetland at Thyspunt, presents the risk of the functionality of these wetlands being reduced through sedimentation or hydrocarbon or chemical contamination of stormwater. The planned layout of the sites including the judicious placing of stockpiles, hydrocarbon and chemical spill prevention and countermeasures, and that fact that there are not direct flow lines to the wetlands means that the loss of wetlands or the reduced functioning of wetlands is highly unlikely. At the same time the large buffer areas required for the NPS again provide an opportunity to continue to protect this important ecological area. The planned layout of the power station has been modified to ensure that the key sensitivities in the site area such as the dune headland system and the Langefonteinvlei wetland are avoided.

The proposed NPS could accordingly be developed without a material reduction in the ecological value of the site and the continued protection afforded to the property through the prevention of other developments must also be considered in the decision-making process. It must also be recognized that the most significant disruption will occur during the construction phase and thereafter the operations phase would see far lower level of impact on the natural environment. If the NPS is prevented from being established at Thyspunt it seems highly unlikely that the property would not be further developed but it would be wrong to try and argue that without the NPS that the ecological value of the area is doomed. All that is being argued here is that the ecological value will not be lost if the NPS is developed at Thyspunt an argument that may not necessarily hold true if the property were not to be used for a NPS.

The transmission lines that are required to evacuate the power pose a number of threats to the environment including direct land transformation, visual impact, and bird mortalities through collision or electrocution. In general terms collision risk tends to be higher on the transmission lines with lower risk of electrocution because of the distance between the conductors, than is the case with distribution lines. The transmission lines will also change the sense of place but can be developed in such a way as to prevent the risk of transformation of critical habitats, reduce the impacts on non-critical habitats, and through the adoption of various forms of mitigation reduce the risk of bird mortality. That notwithstanding, transmission lines do have a negative impact on the environment and this must be recognized in the decision-making process, and no power station in the world has yet been built without large-scale transmission lines to evacuate the power. Cumulatively the footprint of electricity generation and transmission is large.

In much the same way that the proposed NPS will result in a much greater change in the sense of place at Thyspunt than at Duynefontein so too there will be a greater return in benefits at Thyspunt. The construction project will result in a substantial injection of spending and employment opportunities and a resultant stimulation of the local economy. The effect of this would be relatively higher at Thyspunt than at Duynefontein because the proposed NPS project would introduce unprecedented economic development opportunities whereas the same cannot be said of Duynefontein. Many stakeholders would argue that they do not want such economic development in the area and that it would actually further spoil the area but the reality is that many other stakeholders in the area live in

poverty or at least very low levels of income with few if any prospects for changing their lot. The proposed NPS will introduce not just direct economic benefits but large-scale knock on benefits as well. It would be hard to see that the proposed project would not result in a general level of improvement in human well-being for a large percentage of potentially affected stakeholders pretty much all in lower income brackets. Again this effect would be relatively more pronounced at Thyspunt than it would at Duynefontein given the generally better developed economy in the area of the latter.

The impact nature of electricity generation is one where the impacts are felt at the source of generation and along the transmission lines whereas the real benefits manifest at the end of the lines. This obviously excludes the local economic benefits that will derive from the construction activities and to a lesser extent the economic benefits associated with power station operations in the form of spending on local goods and services and the impact of salaried employees living and requiring goods and services of their own in the area. Therefore it must be recognized that the economic value of the electricity generated is significant but that is a value that will not accrue at a local level (viz. in the immediate vicinity of the power station) but rather nationally through use by industrial or other commercial users. The value of electricity is obviously significant too for domestic users.

Other cumulative effects would typically derive from atmospheric emissions, noise, wastewater discharge and resource consumption. At both Duynefontein and Thyspunt background air quality is generally good in the absence of significant other sources and the impact of the proposed NPS will not change that situation materially. Certainly mechanically generated dust will need to be effectively managed during the construction phase and there will be small scale emissions from backup power supply system's episodically but the proposed NPS will not result in material change in air quality at either of the sites. The same is true of noise although high noise pressure levels will be generated during the construction phase. The distance from the sites to the nearest sensitive receptors serves to ensure that there will not be material changes in background noise brought about by the combination of activities associated with the proposed NPS and other activities in the respective areas.

Public sentiment is one of deep concern regarding potential adverse health effects of the proposed NPS both at the level of a large scale accidental release with immediate possible fatalities or serious injuries or a long term serious illness risk. Were either or both to manifest the consequences would be highly severe and any risk of public mortality or morbidity has to be recognized as very significant and has been presented as such in the assessment. What makes the risk tolerable is the very low likelihood of it ever occurring due to the defence in depth principles that underpin the design and operation of a modern NPS. These defence in depth principles see high levels of redundancy in control and cooling systems supplemented by multiple levels of containment. The defence in depth principles serve to ensure that radioactivity releases from the power station are kept well below background levels of radioactivity under all circumstances and as such mortality or morbidity as a result of radioactive exposure is highly unlikely.

Non-radiological exposure risks of mortality and morbidly on the NPS would derive from motor vehicle accidents, potential increases in HIV/AIDS due to the presence of a large labour force and increased opportunities crime that could be violent. These various effects are inevitably associated with large-scale construction projects and the extent of the effects similarly constrained to the broader project area. Despite the various mitigation that has been proposed to minimize these mortality/morbidity risks, they are likely to occur albeit at a limited scale. The mitigation would only serve to limit the extent and not prevent them entirely. For decision-making purposes if the decision is to authorize the proposed NPS then it should be recognized that these non-radiological risks are likely to occur. Mechanically generated dust from the construction activities also poses a potential risk of human morbidity but dispersion modelling of the likely ambient concentrations of dust show that it will be well below the national ambient air quality standards that serve to protect human health.

Prevailing human health could also be improved by the additional infrastructure that would be established that would see additional medical facilities and improved water supply and sanitation being brought about by the project. To some extent this additional infrastructure would simply offset the additional pressure on such services brought about by an increased number of people but there would be definite carry over benefits for people who have always lived in the area. Again it should be noted that this benefit is likely to be more pronounced at Thyspunt than it would be at Duynefontein because Duynefontein already has better developed services and infrastructure than Thyspunt.

Concerns have also been raised about the marine environment at both possible sites as a result of interaction of the project with the marine environment through water abstraction for cooling and drinking water purposes and discharge of heated cooling water and brine. Construction activities also pose the risk of contaminated stormwater being discharged from the site into the marine environment and excess spoil is also planned to be disposed in the sea. In all cases there will be controls that limit the risk of significant change to the marine environment. These controls include very specific operational parameters for the disposal of the spoil at sea, dilution of the brine form the desalination plants using cooling water and the use of a diffuser to limit the impact of heated water pulses into the marine environment. A reduction in the quality of the marine environment is deemed to be a low residual risk.

Finally but importantly there are multiple construction activities that could impact surface and ground water quality and groundwater yields. Such activities relate to the presence of hydrocarbons and other hazardous chemicals that could be spilled during construction activities. Although there are no perennial watercourses on either site such spillages could result in contamination of stormwater runoff, which could result in further potential impacts on wetlands, groundwater quality through percolation / recharge or marine discharge. Strict controls will be required not just to reduce the risk of spills but to ensure that there is rapid clean-up of the spill should it occur so as to prevent downstream risks of contamination. Large-scale spillages should be prevented by the proposed mitigation but smaller scale spills are an unfortunate reality of large construction sites. The initial use of groundwater required for both sites before the desalination plant is established is modelled not to result in a reduction in groundwater yields and the use of hydrological walls to cut off the areas affected by dewatering will limit the extent of the drawdown thereby also not impacting in any material ways on groundwater flows or quantity.

It is concluded that both sites are environmentally acceptable for a nuclear power station. The Thyspunt site is considered the preferred site and it is recommended that it be authorised by the DEA (with conditions) for Nuclear-1. Eskom must ensure that the required mitigation measures are effectively implemented. It is important to remember that none of the specialist assessments identified fatal flaws at any of the remaining sites, and both the proposed sites remain viable sites for nuclear power station development, either for Nuclear 1, which is now proposed, or for some future power station. As such, the site selected is the one that provides the greatest immediate return from an electricity supply point of view. Thyspunt will strengthen the eastern grid and help create a generation centre along the east coast.

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 generation in coastal areas in South Africa 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 a reliable base load (as per chapter 4) 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; and
- Hydro-electric power is not considered a feasible alternative due to the scarcity of water in South Africa and the limited potential energy of our water resources. South Africa and Eskom are committed to work with Southern African countries for supply options that could potentially be derived from hydro-power. Realising such opportunities will take time and there is too much uncertainty currently to be able to plan effectively for such realisation.

Policy dictates that South Africa must make increasing use of nuclear power generation to reduce greenhouse gas emissions to comply with commitments made at the Copenhagen Climate Change Summit in December 2009. These commitments require South Africa to reduce CO_2 by 34 % by 2020. Over the full lifecycle greenhouse gas emissions from nuclear power generation is a fraction of those generated using coal. The Integrated Resource Plan (IRP) presents these arguments and accordingly includes 9 600 MW of Nuclear in the power generation mix. The continued use and further development of renewable energy technologies is in no way precluded by the choice of nuclear. As pointed out earlier in this EIR, nuclear generation is not seen as an alternative to renewable technologies in the IRP. Indeed the IRP presents that both technologies need to be developed in parallel. In addition to all existing and committed power plants (Medupi, Kusile and Ingula), the IRP presents that projected electricity demand in South Africa will be supplied using the following technology mix:

- 9.6 GW (9 600 MW) nuclear;
- 6.3 GW of coal;
- 11.4 GW of renewable energy; and,
- 11.0 GW of other generation sources.

Nuclear plant types
Pressurised Water Reactors are internationally the most commonly used nuclear reactors. The KNPS uses Pressurised Water Reactor technology and it is therefore a tested form of power generation that has been operating safely for the past 30 years. Eskom is familiar with the technology from a health and safety, as well as from an operational perspective.

Modes of transport
Road transport is accepted as the only solution for the transport of heavy loads from the harbours for Duynefontein and Thyspunt.

Positions 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 both 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 Exclusion Zone (EZ) of the Emergency Planning Zone (EPZ), which is expected to be at least 800 m from the proposed nuclear power station.

From an environmental perspective the specialists collectively recommended that the following areas not be considered as suitable for the construction of a nuclear power station:

- 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
- The area within 100 m from the high water's edge of any wetland.

Figures for the combined overlaid sensitivity maps for all the sites are contained in Chapter 9 and Appendix A.

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.

The transverse dune system at Duynefontein is endemic, with this system being poorly represented on the Cape West Coast. However based on further studies and additional field work subsequently conducted at the Duynefontein site (2015 Botanical Dune Report – **Appendix E11**), suggested a reappraisal situation, due to the stabilisation of the mobile dunes in close proximity to the existing KNPS. Two factors are paramount to this reappraisal: (i) the substantial loss in dune mobility due to development in the south, coupled with increases in vegetal cover have meant the dune can no longer function in its pristine state and (ii) development would be localised to vegetated parts of the dune system, permitting the remaining small mobile system in the north to function in the long term, albeit artificially restricted. Therefore it is possible to encroach onto the southern portion of the dune system (closer to Nuclear-1 site), with certain provisos in place. However, to maximise the land use and to also be in line with the EIR approach to keep out of the mobile dunes habitat as much as possible, the mobile dune system will not be affected.

At the Thyspunt site the area 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). None of the specialists have indicated that the recommended footprint area for the power station is environmentally sensitive. The findings of the extensive surveys conducted, including a trial excavation program (2011) indicated that it is possible to position the proposed nuclear-1 power station in such a way that physical impacts to heritage sites of an archaeological nature are minimised.

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:

- 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.
- Appointment of the vendor and results of any further detailed geological conditions.

Utilisation of abstracted groundwater

Groundwater will have to be abstracted from deep excavations at both sites in order to allow for the construction of a Nuclear Island. The preferred alternative with regards to abstraction of groundwater is the storage and utilisation of the water on site. However, due to the volume of water likely to be abstracted, particularly at Thyspunt, some water may also have to be discharged into the sea. Transfer to the municipal water supply system is not regarded as feasible at any of the alternative sites, due to distance from the nearest serviced urban area. Based on the amount of available space of low environmental sensitivity on the sites it may be possible to allow for some storage of groundwater. 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, which is then deemed the most judicious alternative.

Fresh water supply

At all sites desalination provides a guaranteed source of fresh water supply for the lifespan of the proposed nuclear power station without jeopardising the availability of fresh water to other users. A desalinisation plant is therefore the preferred alternative for the provision of fresh water at all alternative sites.

Management of brine

Either the disposal of brine into the sea or the co-disposal of brine and cooling water into the sea 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. Although disposal of brine during the construction phase directly into the surf zone is environmentally acceptable for short periods of time it is thje recommendation of the EAP that the construction phase brine is piped and disposed beyond the surf zone.

Intake of sea water
The installation of intake and outlet tunnels which entails the installation of undersea pipelines, that obtain water from the ocean and feed cooling water into a storage area (intake basin) located adjacent to the cooling water pump houses is the only feasible alternative for both alternative sites.

Outlet of water and chemical effluent
Outlet structures for cooling water and chemical effluent must be offshore. All releases need to occur at the appropriate distances as described by the relevant specialists. Provided that the specific mitigation measures identified in the marine biology report are adhered to, offshore effluent release is therefore the recommended alternative.

Management of spoil material
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 used for activities like levelling of the HV Yard to the greatest extent possible, to avoid the need to dispose of spoil in discard dumps on land (applicable to Thyspunt only).

Access to the sites:
Existing off-site access routes will be used and upgraded for the Duynefontein site, but the Thyspunt site will require significant upgrading of existing public roads. Three alternative on-site routes are under consideration at Thyspunt: an eastern, western and northern access route. The northern access road was rejected for environmental reasons. The environmental impacts associated with the route identification for Thyspunt's new access route formed part of this EIA process. Four options for the Western Access Road were initially considered, namely W1, W2, W3 and W4. W1 to W3 all originate to the west of Umzamuwethu (between Umzamuwethu and Oyster Bay), whilst W4 originates from the Humansdorp-Oyster Bay road to the east of Umzamuwethu. W4 was initially rejected by the biophysical specialists on the basis of its potential impact on the western portion of the Oyster Bay Mobile Dunefield and associated sensitive ecosystems, its crossing of a drainage line and its length. Of W1, W2 and W3, W1 was preferred by the majority of the specialists.

In recognition of I&AP concerns about the western access road received during the 2011 round of public comments on the Revised Draft EIR (Version 1), new alternative alignments for the Western Access Road were investigated. These alternatives focused on aligning the Western Access Road to the east of Umzamuwethu to prevent the road creating a divide between Umzamuwethu and Oyster Bay. A number of alternative alignments to this road were investigated in late 2012 and the inland alternative furthest from Oyster Bay (IR2) has been subsequently recommended. This alignment has some biophysical impacts but not of such significance that they constitute fatal flaws.

As stated earlier the Thyspunt site requires transport route upgrades with regard to public roads, access and emergency evacuation during the construction phase. The R330 is now proposed to be used only for passenger vehicle traffic and abnormal load transport, and sections will require upgrading for this purpose. The Oyster Bay Road is now proposed to be upgraded to a surfaced road to be used during the construction and operations phases for staff access and heavy vehicle traffic and as an emergency evacuation route for areas such as Oyster Bay. The DR1762, which links the R330 and Oyster Bay Road is now proposed to be surfaced to provide improved east-west connectivity. Bypass roads to the east and west of Humansdorp are also now proposed to be constructed to reduce the traffic impact on central Humansdorp. Consequently heavy construction vehicles accessing the Thyspunt site will not have to travel through the centre of Humansdorp

Management of radioactive waste
The only feasible and reasonable alternative for the disposal of Low-Level and Intermediate Level radioactive waste is disposal at the Vaalputs Nuclear Waste Disposal Site. It is the only authorised facility for this form of waste in South Africa and it has sufficient capacity for the waste that will be generated by Nuclear-1.

With regards to High-Level Waste (spent fuel), the only alternative currently available in South Africa is long-term storage of the spent fuel in the nuclear power station. Vaalputs is being considered as a disposal site for High-Level Waste, but the required authorisation processes for this will take several years, so currently the disposal of spent fuel at this facility is not a feasible option.

No-Go 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 (Chapter 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. Until the KNPS is decommissioned, the no-go alternative is also not a realistic alternative at Duynefontein.

Key mitigation measures and conditions of authorisation
The findings of the specialist studies undertaken within this EIA provide an assessment of both the benefits and potential negative impacts anticipated as a result of the proposed project. The findings conclude that there are no environmental fatal flaws that should prevent the proposed project from proceeding at any of the alternative sites, provided that the recommended mitigation and management measures are implemented.

It is imperative that the recommendations for mitigation contained in this EIR, the Environmental Management Plan (EMP) and in the specialist studies be strictly implemented. The mitigation measures for botanical impacts, vertebrate fauna, wetlands, dune geomorphology and heritage resources are particularly important. Mitigation of heritage impacts particularly may require the work of a site-specific team dedicated to excavations over a period of six months to a year prior to the onset of construction for areas which fall within the 200m coastal setback line.

In order to achieve appropriate environmental management standards and ensure that the findings of the environmental studies are implemented through practical measures, the recommendations (including the technical specialist's recommendations) from this EIA have been included within an EMP (in compliance with the NEMA Regulation 34) which has been included in Appendix F. This EMP should form part of the contract with the contractors appointed to construct the proposed nuclear power station and ancillary infrastructure. The EMP should be used to ensure compliance with environmental specifications and management measures during all phases of the project. The implementation of this EMP for all life cycle phases (i.e. construction, operation and decommissioning) is essential.

The EMP is a dynamic document and as new information becomes available over time, or as lessons are learnt in the implementation of the EMP's recommendations, the EMP must be updated over time.

WAY FORWARD

The NNR is mandated by the NNRA to provide for the protection of persons, property and the environment against nuclear damage through the establishment of safety standards and regulatory practices. In accordance with Section 21 of the NNRA, Eskom is required to submit a formal application to the NNR for a nuclear installation license for the siting, construction, operation, decontamination and decommissioning of a nuclear power station. The Act makes provision for the NNR Board to arrange for public hearings pertaining to health, safety and environmental issues related to the specific application.

In terms of the Constitution of the Republic of South Africa (Act No. 108 of 1996) and the National Environmental Management Act, the DEA is responsible for assessing the impacts of the power station on the environment. In recognition of the dual but distinct responsibility with respect to the assessment of radiation hazards, the NNR and the DEA have signed a co-operative agreement in which it is agreed that the DEA, the lead authority on environmental matters, and NNR will work in close collaboration on the assessment of nuclear-related matters. With respect to this EIA, specialist studies relating to radiological issues have been included for information which will support the DEA decision making.

This Revised Draft EIR (Version 2) has been distributed for comment to all registered I&APs. A number of public interactions will be held during the comment period on this Revised Draft EIR (Version 2). All comments on the document will be considered by GIBB and a response thereto will be provided in a revised Issues and Response Report (IRR), prior to submission of the Final EIR to the DEA for decision-making.

It is anticipated that Eastern Cape DEAET and the Western Cape DEA&DP, as well as the NNR (amongst other Government Departments), would provide comment to the DEA on the adequacy of the Final EIR. The DEA will consider these comments prior to making a decision on the acceptability of the proposed Nuclear-1 project. All I&APs will be notified of the availability of the Final EIR for information purposes, as well as of the DEA's decision.

Should the DEA authorise the proposed nuclear power station, it must be authorised strictly according to the conditions indicated in the Final EIR. Should some of the required mitigation measures not be implemented prior to the start of construction, as recommended (e.g. the conditions with respect to excavation of archaeological and palaeontological sites), then construction should not be allowed to commence.

Should there be any substantive changes to the design of the proposed power station after submission of the Final EIR to the DEA for decision-making, a re-assessment of the environmental impacts may be required. The assumptions with respect to technical details of the power station (as detailed in the Consistent Dataset – Appendix C) are **key** in this respect. Once a nuclear power station vendor has been identified, it must be confirmed that the specifications of the power station continue to conform to the Consistent Dataset, which acted as the basis for this EIA process. It is recommended Eskom must provide such confirmation to the DEA well prior to construction of the power station.