PROPOSED PHAKWE RICHARDS BAY GAS POWER 3 2000MW COMBINED CYCLE GAS TO POWER PLANT, KWAZULU-NATAL PROVINCE

VISUAL ASSESSMENT – INPUT FOR SCOPING REPORT

Produced for:

Phakwe Richards Bay Gas Power 3 (Pty) Ltd

On behalf of:

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Lourens du Plessis (t/a LOGIS) is a *Professional Geographical Information Sciences (GISc) Practitioner* registered with The South African Geomatics Council (SAGC), and specialises in Environmental GIS and Visual Impact Assessments (VIA).

Lourens has been involved in the application of GIS in Environmental Planning and Management since 1990. He has extensive practical knowledge in spatial analysis, environmental modeling and digital mapping, and applies this knowledge in various scientific fields and disciplines. His expertise is often utilised in Environmental Impact Assessments, State of the Environment Reports and Environmental Management Plans.

He is familiar with the "Guidelines for Involving Visual and Aesthetic Specialists in EIA Processes" (Provincial Government of the Western Cape: Department of Environmental Affairs and Development Planning) and utilises the principles and recommendations stated therein to successfully undertake visual impact assessments. Although the guidelines have been developed with specific reference to the Western Cape province of South Africa, the core elements are more widely applicable (i.e. within the KwaZulu-Natal Province).

Savannah Environmental (Pty) Ltd appointed Lourens du Plessis as an independent specialist consultant to undertake the visual impact assessment for the proposed Phakwe Richards Bay Gas Power 3 2,000 MW Combined Cycle Gas to Power Plant (PRBGP3). He will not benefit from the outcome of the project decision-making.

1. INTRODUCTION

Phakwe Richards Bay Gas Power 3 (Pty) Ltd intends developing a 2,000MW Combined Cycle Gas to Power Plant (PRBGP3) located on various erven within the Richards Bay (RB) Industrial Development Zone (IDZ) Phase 1F, Richards Bay, KwaZulu-Natal Province.

The power plant will operate at mid-merit to baseload duty and will include the following main infrastructure:

- A number of gas turbines for the generation of electricity through the use of natural gas (liquid or gas forms), or a mixture of Natural gas and Hydrogen (in a proportion scaling up from 20% H2) as fuel source, operating all turbines at mid-merit or baseload (estimated 16 to 24 hours daily operation).
- Exhaust stacks associated with each gas turbine (up to 45m high).
- A number of Heat Recovery Steam Generator (HRSG to generate steam by capturing the heat from the turbine exhaust.
- A number of steam turbines to generate additional electricity by means of the steam generated by the HRSG.
- The water treatment plant will demineralise incoming water from municipal or similar supply, to the gas turbine and steam cycle requirements. The water treatment plant will produce two parts demineralised water and reject one-part brine, which will be discharged to the RB IDZ storm water system.
- Steam turbine water system will be a closed cycle with air cooled condensers. Make-up water will be required to replace blow down.
- Air cooled condensers to condensate used steam from the steam turbine.
- Compressed air station to supply service and process air.
- Water pipelines and water tanks for storage and distributing of process water. (Potential sourcing of alternative water outside RB IDZ supply (Municipality)).

- Water retention pond
- Closed Fin-fan coolers to cool lubrication oil for the gas turbines
- Gas generator Lubrication Oil System.
- Gas pipeline supply conditioning process facility. Please note, gas supply will be via dedicated pipeline from the proposed Transnet supply pipeline network of Richards Bay (the location of this network has not yet been confirmed) or, alternatively directly from the Regasification facilities at RB Harbour. The gas pipeline will be separately authorized.
- Site water facilities including potable water, storm water, waste water
- Fire water (FW) storage and FW system
- Diesel emergency generator for start-up operation.
- Onsite fuel conditioning including heating system.
- All underground services: This includes storm water and waste water.
- Ancillary infrastructure including:
- Roads (access and internal);
- Warehousing and buildings;
- Workshop building;
- Fire water pump building;
- Administration and Control Building;
- Ablution facilities;
- Storage facilities;
- Guard House;
- Fencing;
- Maintenance and cleaning area;
- Operational and maintenance control centre;
- Electrical facilities including:
- Power evacuation including GCBs, GSU transformers, MV busbar, HV cabling and 1x275kV or 400kV GIS Power Plant substation.
- Generators and auxiliaries;
- Eskom 275 or 400kV GIS interface Substation, Underground 275 or 400kV power cabling connecting Power Plant GIS substation and Eskom GIS Interface substation and an overhead 275kV or 400kV power line connecting the Eskom interface substation to the selected Eskom grid connection point (all subject to a separate environmental authorisation application):
- Service infrastructure including:
- Storm water channels;
- Water pipelines
- Temporary work areas during the construction phase (laydown areas)

A dedicated pipeline to connect into an on-site gas receiving and conditioning station will provide the natural gas or the mixture of natural gas and Hydrogen. The pipeline will be connected to the proposed Transnet supply pipeline network of Richards Bay (the location of this network has not yet been confirmed), or it will extend directly to the Regasification facilities in the RB Harbour. A separate EIA process will be undertaken for the dedicated fuel-supply pipeline.

Figure 1: Regional locality of the proposed project area.

Figure 2: Proposed (preliminary) infrastructure layout.

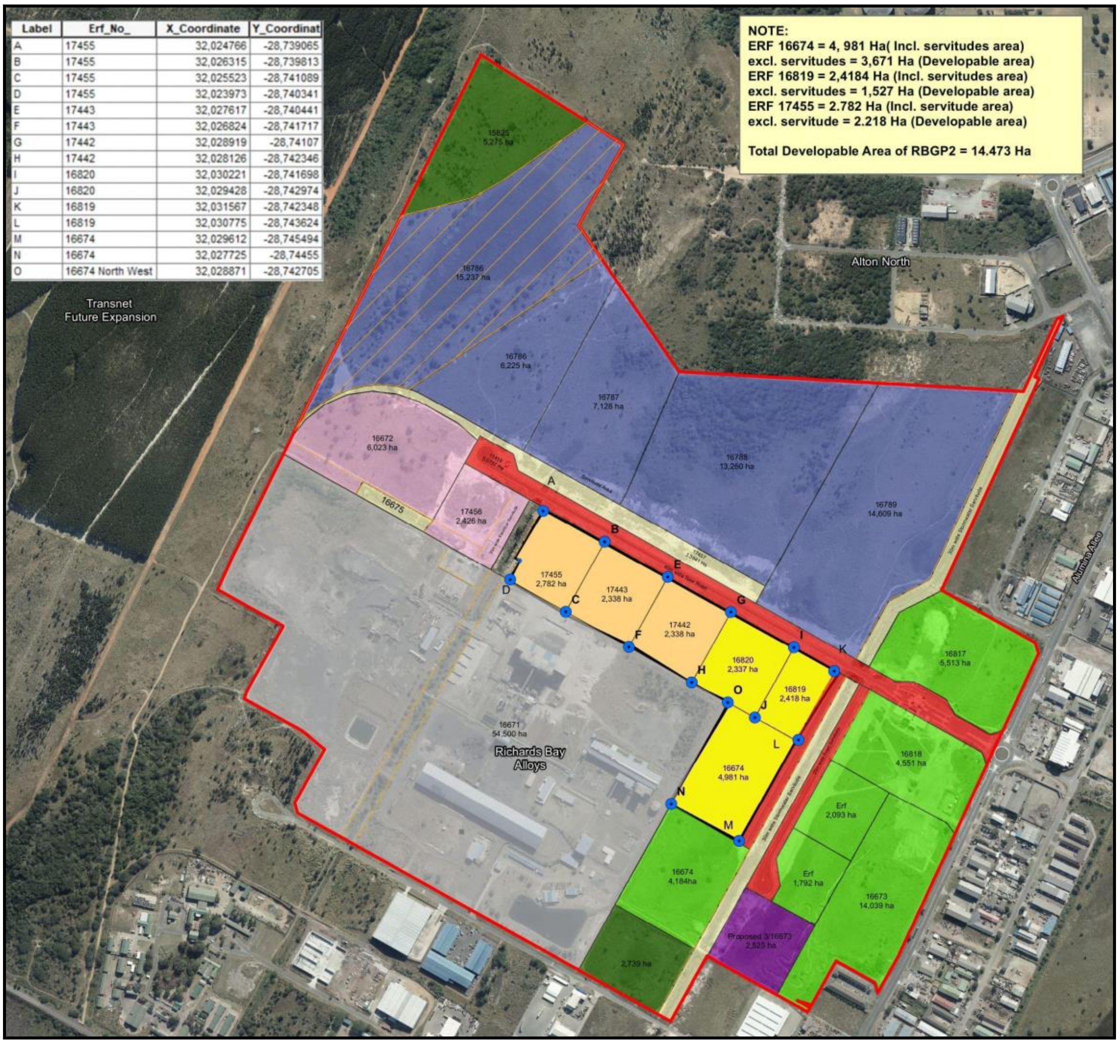

Figure 3: Location of the PRBGP3 (yellow) within the RB IDZ Phase 1F (red outline).

2. SCOPE OF WORK

The scope of the work includes a scoping level visual assessment of the issues related to the visual impact.

The study area for the visual assessment encompasses a geographical area of 171km² (the extent of the full page maps displayed in this report) and includes a minimum 6km buffer zone (area of potential visual influence) from the development footprint. The study area includes the Alton industrial area, a section of the Richards Bay harbour, the central business district (CBD) and a number of residential areas.

3. METHODOLOGY

The study was undertaken using Geographical Information Systems (GIS) software as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed facility. A detailed Digital Terrain Model (DTM) for the study area was created from topographical data provided by NASA in the form of a 30m resolution SRTM (Shuttle Radar Topography Mission) elevation model.

The methodology utilised to identify issues related to the visual impact included the following activities:

- The creation of a detailed digital terrain model of the potentially affected environment.
- The sourcing of relevant spatial data. This included cadastral features, vegetation types, land use activities, topographical features, site placement, etc.
- The identification of sensitive environments upon which the proposed facility could have a potential impact.
- The creation of viewshed analyses from the proposed project site in order to determine the visual exposure and the topography's potential to absorb the potential visual impact. The viewshed analyses take into account the dimensions of the proposed structures.

This report (scoping report) sets out to identify the possible visual impacts related to the proposed PRBGP3 from a desktop level.

4. THE AFFECTED ENVIRONMENT

The proposed project is located within the uMhlathuze Local Municipality, in the King Cetshwayo District Municipality of the KwaZulu-Natal Province. The project site falls within the Richards Bay city limits, approximately 2km north-west of the CBD and 5km north of the harbour. It is located within the Alton industrial area, and more specifically centrally within the RB IDZ Phase 1F, a proclaimed special economic zone aimed at attracting investment to the region.

Even though Alton is a predominantly light industrial area, there are a large number of major industries within the larger area, namely; the Hillside and Bayside aluminium smelters, the Mondi paper plant, the Foskor plant and a large number of industrial structures related to coal storage and transportation at the Port of Richards Bay.

Topography, vegetation and hydrology

The proposed project site is located at approximately 45m above sea level. The topography of the study area is described as *plains* of the eastern coastal foreland. The region has an even slope with elevation ranging from sea level at the Indian Ocean to approximately 130m above sea level to the north-west.

The flat topography is dominated by wetlands and water bodies (e.g. the Nsezi and Mzingazi lakes, the harbour bay and its numerous channels) while the Mhlatuze River meanders to the south of the study area. The project site falls within the Mhlatuze River quaternary catchment and the Nseleni River floodplain (a tributary of the Mhlatuze) is prominent to the west of the study area.

The larger part of the study area falls within the *Indian Ocean Coastal Belt* bioregion comprising of *Maputaland Wooded Grassland*, interspersed with *Subtropical Alluvial Vegetation, Swamp Forests, Subtropical Freshwater Wetlands* and *Freshwater Lakes*. It must be noted though, that large parts of the study area, especially to the north, have been transformed by forestry (exotic plantations) and sugar cane cultivation, and industrial development. The dominant land cover types, where intact, are described as *Thicket* and *Dense Bushland* and *Grassland*.

Refer to **Maps 1** and **2** for the topography and land cover maps of the study area.

Land use and settlement patterns

The industrial activities, the RB IDZ and the transportation infrastructure related to the port, as mentioned earlier, are the primary land use activities within the study area. This and the intensive forestry and sugar cane production to the north (and further south) account for the largest economical drivers within the region. There is a well-established railway network and a large number of electricity distribution and transmission power lines traversing the study area.

The N2 national road, the R34 arterial road (John Ross Parkway) and the R619 main road provide motorised access to the region. The John Ross Parkway traverses south of the Alton industrial area and the R619 north-east of the proposed development site.

The majority of residential areas within Richards Bay are located north of the city and east of the R619 main road. Residential neighbourhoods include Aquadene, Brackenham, Arboretum, Birdswood, Veld-en-Vlei and Wilde-en-Weide. The Brackenham and Wilde-en-Weide residential areas are located at distances of respectively 1.2km and 1.4km (at the closest) from the proposed development site.

There are only two proclaimed terrestrial protected areas within the region, namely; the Enseleni Nature Reserve to the north-west and the Richards Bay Game Reserve south of the study area. Other than these protected areas, and potentially along the Indian seaboard, there are no identified tourist attractions or destinations in closer proximity to the development site.[1]

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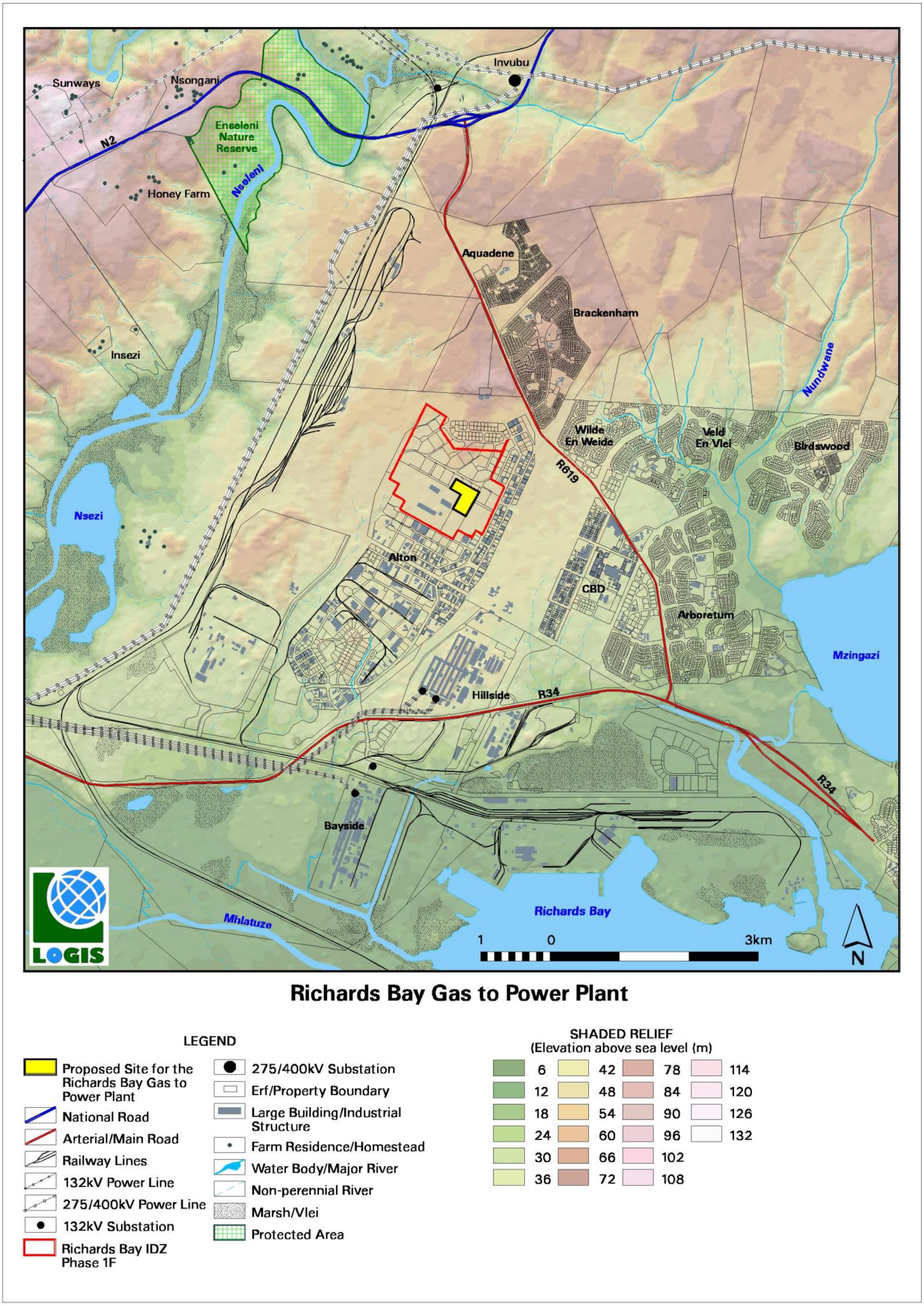
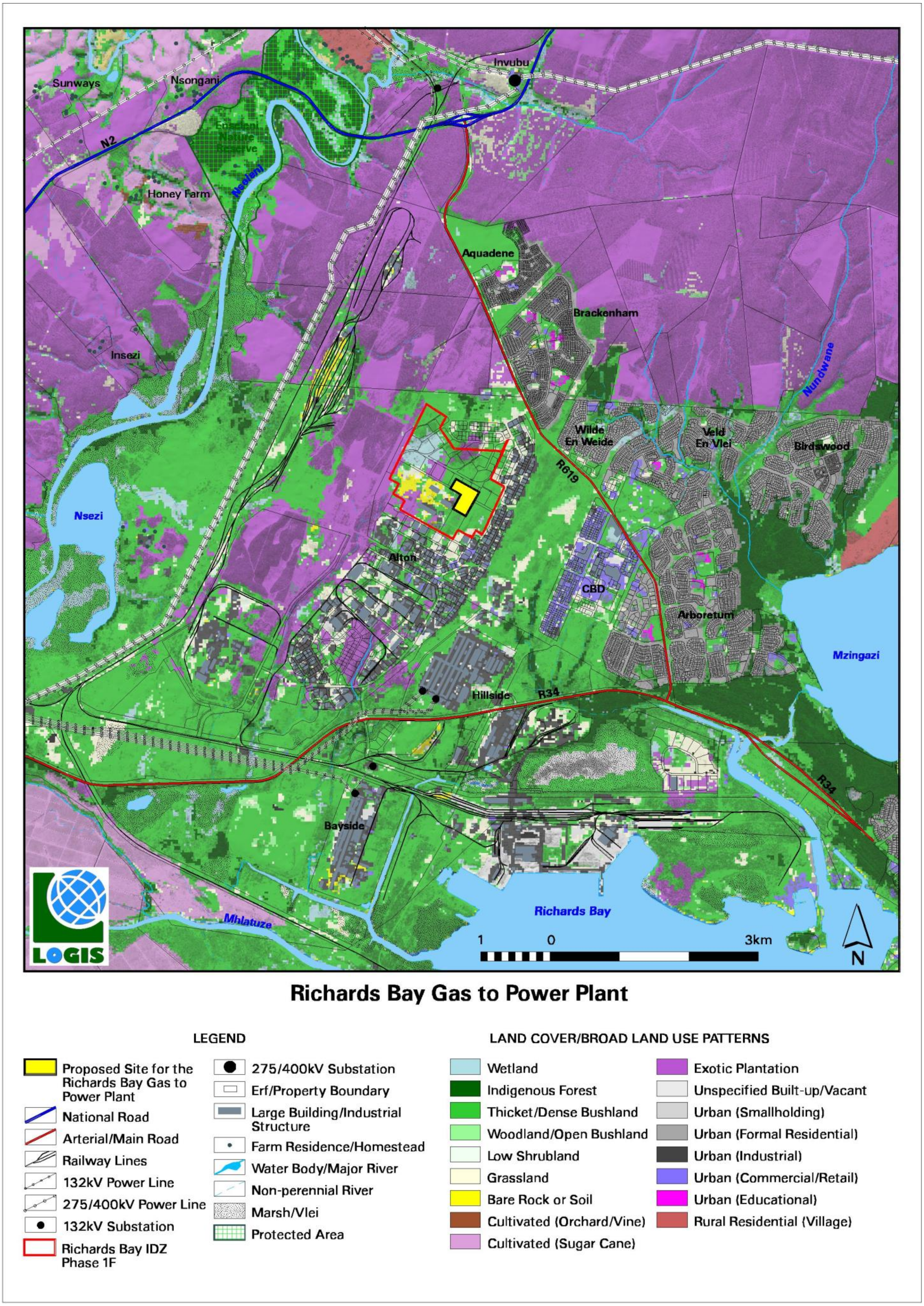
[1] Sources: DEAT (ENPAT KwaZulu-Natal), NBI (Vegetation Map of South Africa, Lesotho and Swaziland), NLC2018 (ARC/CSIR) and SAPAD201_Q1 (DFFE).



Map 1: Shaded relief map of the study area.



Map 2: Land cover and broad land use patterns.

5. VISUAL EXPOSURE/VISIBILITY

The result of the preliminary viewshed analysis for the proposed facility is shown on the map below (**Map 3**). The initial viewshed analysis was undertaken from a representative number of vantage points within the proposed development area at an offset of 45m above ground level. This was done in order to determine the general visual exposure (visibility) of the area under investigation, simulating the proposed maximum structure-height (e.g. exhaust stacks) associated with the power plant.

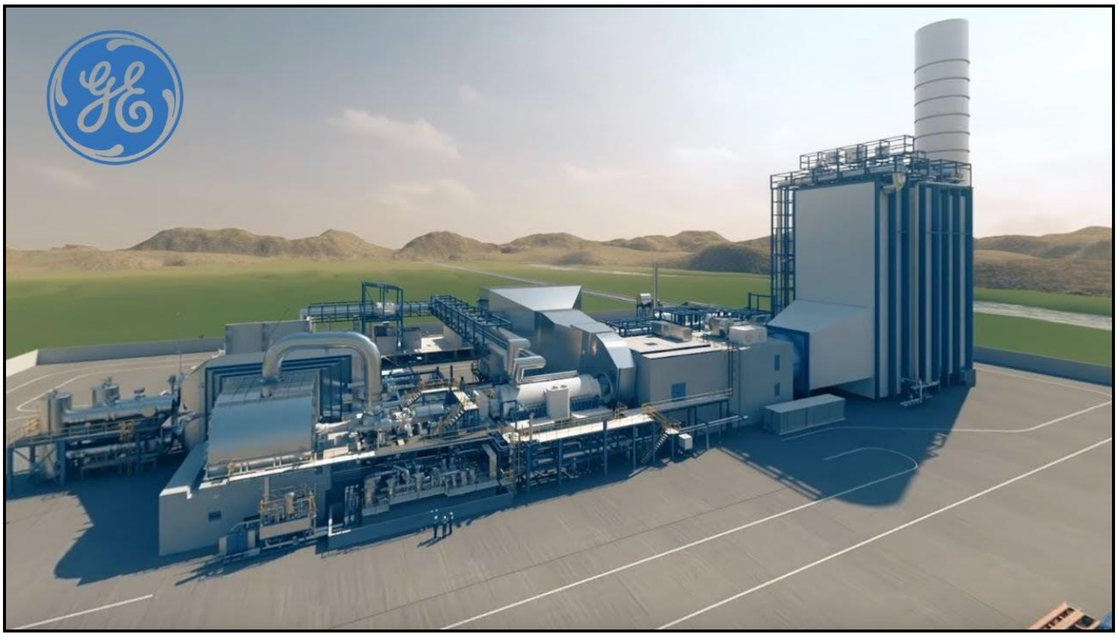


Figure 4: Example of a CCGT Power Plant.

The viewshed analysis will be further refined once a preliminary and/or final layout of the power plant is completed and will be regenerated for the actual position of the infrastructure on the site and actual proposed technology during the EIA phase of the project.

Map 3 also indicates proximity radii from the footprint of the proposed structures/activities in order to show the viewing distance (scale of observation) of the power plant and ancillary infrastructure in relation to their surrounds.

The viewshed analysis does not include the effect of vegetation cover or existing structures on the exposure of the proposed power plant, therefore signifying a worst-case scenario. It is however expected that the built structures and industrial buildings, and even the vegetation within the region, may influence the viewshed analysis and ultimately mitigate the visual impact to some degree. It is recommended that these structures and vegetation that make up the visual absorption capacity (VAC) be built into the digital terrain model, in order to accurately determine the visual exposure during the IEA phase of the project.

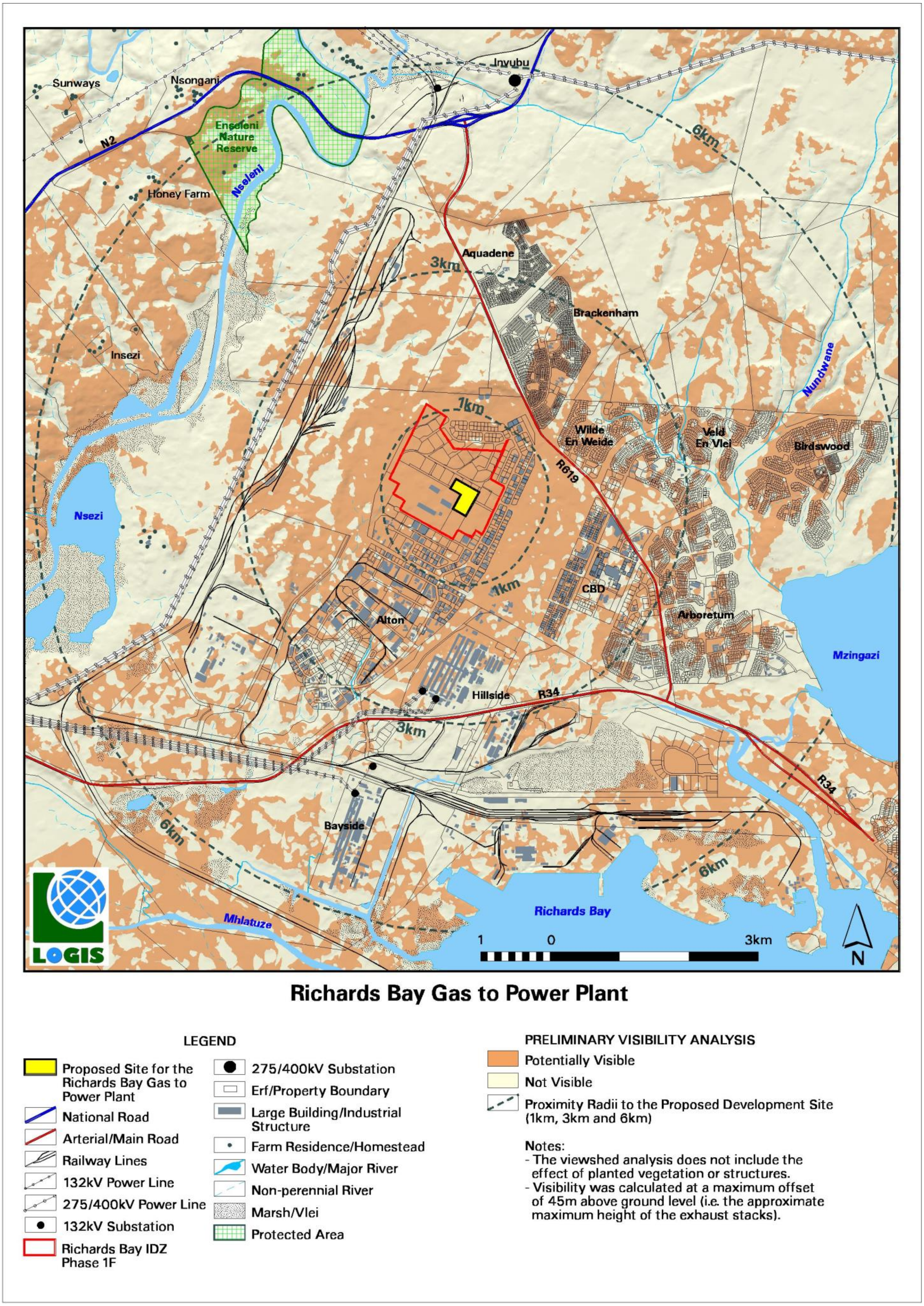
Results

It is clear that the power plant may have a fairly large area of potential visual exposure, not considering the VAC of built structures and vegetation. The power plant buildings and exhaust stacks would theoretically be visible from large parts of the study area, especially within a 1 - 3km radius of the structures. These exposed areas include sections of the R619 main road and the south-western outlying areas of the Brachenham and Wilde-en-Weide residential areas.

The visual exposure will however not be in isolation, but rather in the context of the existing structures and buildings present at this location and within the region. The visual exposure, and ultimately the visual impact, would therefore be combined or cumulative, rather than an individual visual impact. It should therefore be determined if the cumulative visual impact is expected to be excessively high, or whether the existing structures absorb the potential visual impact i.e. consolidate the existing visual impact.

Conclusion

Even if the existing structures successfully absorb the visual impact, or if the VAC of the site visually conceals the structures, the power plant and substation (where visible within shorter distances e.g. within a 1 – 3km radius), may constitute a high visual prominence, potentially resulting in a visual impact. This may become evident should potential sensitive visual receptors be identified within this zone during the EIA phase of the project. Alternatively, if there are no sensitive visual receptors, or if it is determined that the perception of the placement of the infrastructure within an existing industrial area (and proclaimed IDZ) is acceptable to all, the visual impact may be low.



Map 3: Map indicating the potential (preliminary) visual exposure of the proposed facility.

6. ANTICIPATED ISSUES RELATED TO THE VISUAL IMPACT

Anticipated issues related to the potential visual impact of the proposed power plant and ancillary infrastructure includes the following:

- The visibility of the facility from, and potential visual impact on observers travelling along the R619 main road or residing within a 1 – 3km radius of the plant (e.g. residents of Brachenham and Wilde-en-Weide).

- The visibility of the facility to, and potential visual impact on residents of farm residences located within close proximity of the site (if present).

- Potential cumulative visual impacts (or alternatively, consolidation of visual impacts) with specific reference to the location of the proposed power plant within an existing industrial area.

- The potential visual impact of operational, safety and security lighting of the facility at night on observers residing in close proximity to the facility.

- The visual absorption capacity of existing structures, buildings and natural or planted vegetation (if applicable) within the study area.

- The potential to mitigate visual impacts.

It is envisaged that the issues listed above may constitute a significant visual impact at a local and/or regional scale. These need to be assessed in greater detail during the EIA phase of the project. A detailed Visual Impact Assessment is required to be undertaken to confirm the presence of sensitive receptors and assess the significance of the potential visual impact.

Table 1: Impact table summarising the potential primary visual impacts associated with the 2,000MW CCGT Power Plant.

<table>
<tr><td colspan="4">Impact

Visual impact of the power plant on observers in close proximity to the proposed infrastructure and activities. Potential sensitive visual receptors may include:

• Observers travelling along the R619 main road
• Residents of homesteads and farm dwellings (if present in close proximity to the facility)</td></tr>
<tr><td>Issue</td><td>Nature of Impact</td><td>Extent of Impact</td><td>No-Go Areas</td></tr>
<tr><td>The viewing of the power plant and ancillary infrastructure and activities</td><td>The potential negative experience of viewing the power plant and ancillary infrastructure and activities</td><td>Primarily observers situated within a 1-3km radius of the power plant</td><td>N.A.</td></tr>
<tr><td colspan="4">Description of expected significance of impact

Extent: Local
Duration: Long term
Magnitude: Moderate
Probability: Probable
Significance: Moderate
Status (positive, neutral or negative): Negative</td></tr>
</table>

Reversibility: Recoverable Irreplaceable loss of resources: No Can impacts be mitigated: Yes
Gaps in knowledge & recommendations for further study A finalised layout of the power plant and ancillary infrastructure are required for further analysis. This includes the provision of the dimensions of structures and equipment. Additional spatial analyses are required in order to create a visual impact index that will include the following criteria: • Visual exposure (including the effect of existing structures and vegetation) • Visual distance/observer proximity to the structures/activities • Viewer incidence/viewer perception (sensitive visual receptors) • Visual absorption capacity of the environment surrounding the power plant infrastructure and activities Additional activities: • Identify potential cumulative visual impacts (or consolidation of visual impacts) • Undertake a site visit • Recommend mitigation measures and/or infrastructure placement alternatives Refer to the Plan of Study for the EIA phase of the project below.

7. CONCLUSION AND RECOMMENDATIONS

The fact that some components (e.g. the exhaust stacks) of the proposed power plant may be visible does not necessarily imply a high visual impact. Sensitive visual receptors within (but not restricted to) a 1-3km buffer zone from the power plant need to be identified and the severity of the visual impact assessed within the EIA phase of the project.

It is recommended that additional spatial analyses be undertaken in order to create a visual impact index that will further aid in determining potential areas of visual impact. This exercise should be undertaken for the power plant as well as for the ancillary infrastructure, as these structures (e.g. the substation) may have varying levels of visual impact at a more localised scale. The site-specific issues (as mentioned earlier in the report) and potential sensitive visual receptors should be measured against this visual impact index and be addressed individually in terms of nature, extent, duration, probability, severity and significance of visual impact.

This recommended work must be undertaken during the Environmental Impact Assessment (EIA) Phase of reporting for this proposed project. In this respect, the Plan of Study for the EIA is as follows:

- **Determine potential visual exposure**

The visibility or visual exposure of any structure or activity is the point of departure for the visual impact assessment. It stands to reason that if the proposed power plant and associated infrastructure were not visible, no impact would occur.

The viewshed analyses of the proposed facility and the related infrastructure are based on a 30m resolution SRTM digital terrain model of the study area.

The first step in determining the visual impact of the proposed facility is to identify the areas from which the structures would be visible. The type of structures, the dimensions, the extent of operations and their support infrastructure are taken into account.

Features such as vegetation, man-made topographical features and other existing structures (that make up the visual absorption capacity of the environment surrounding the proposed development) that might shield the facility are built into the model to ensure that the result of the visibility analysis is as accurate as possible.

- **Determine visual distance/observer proximity to the facility**

In order to refine the visual exposure of the facility on surrounding areas/receptors, the principle of reduced impact over distance is applied in order to determine the core area of visual influence for each type of structure.

Proximity radii for the proposed power plant are created in order to indicate the scale and viewing distance of the facility and to determine the prominence of the structures in relation to their environment.

The visual distance theory and the observer's proximity to the facility are closely related, and especially relevant, when considered from areas with a high viewer incidence and a predominantly negative visual perception of the proposed facility.

- **Determine viewer incidence/viewer perception (sensitive visual receptors)**

The next layer of information is the identification of areas of high viewer incidence (i.e. main roads, residential areas, settlements, etc.) that would be exposed to the project infrastructure.

This is done in order to focus attention on areas were the perceived visual impact of the facility will be the highest and where the perception of affected observers will be negative.

Related to this data set, is a land use character map, that further aids in identifying sensitive areas and possible critical features (i.e. tourist facilities, national parks, residential areas, etc.), that should be addressed.

- **Determine the visual absorption capacity of the landscape**

This is the capacity of the receiving environment to absorb the potential visual impact of the proposed facility. The VAC is primarily a function of the vegetation, and will be high if the vegetation is tall, dense and continuous. Conversely, low growing sparse and patchy vegetation will have a low VAC.

The VAC would also be high where the environment can readily absorb the structure in terms of texture, colour, form and light / shade characteristics of the structure. On the other hand, the VAC for a structure contrasting markedly with one or more of the characteristics of the environment would be low.

The VAC also generally increases with distance, where discernable detail in visual characteristics of both environment and structure decreases.

- **Calculate the visual impact index**

The results of the above analyses are merged in order to determine the areas of likely visual impact and where the viewer perception would be negative. An area with short distance visual exposure to the proposed infrastructure, a high viewer incidence and a predominantly negative perception would therefore have a higher value (greater impact) on the index. This focusses the attention to the critical areas of potential impact and determines the potential **magnitude** of the visual impact.

Geographical Information Systems (GIS) software will be used to perform the analyses and to overlay relevant geographical data sets in order to generate a visual impact index.

- **Determine impact significance**

The potential visual impacts are quantified in their respective geographical locations in order to determine the significance of the anticipated impact on identified receptors. Significance is determined as a function of extent, duration, magnitude (derived from the visual impact index) and probability. Potential cumulative and residual visual impacts are also addressed. The results of this section is displayed in impact tables and summarised in an impact statement.

- **Propose mitigation measures**

The preferred layout alternative (or a possible permutation of the alternatives) will be based on its potential to reduce the visual impact. Additional general mitigation measures will be proposed in terms of the planning, construction, operation and decommissioning phases of the project.

- **Reporting and map display**

All the data categories, used to calculate the visual impact index, and the results of the analyses will be displayed as maps in the accompanying report. The methodology of the analyses, the results of the visual impact assessment and the conclusion of the assessment will be addressed in the VIA report.

- **Site visit**

Undertake a site visit in order to verify the results of the spatial analyses and to identify any additional site specific issues that may need to be addressed in the VIA report.

8. REFERENCES/DATA SOURCES

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