PROPOSED HENDRINA ASH DAM EXTENSION

VISUAL ASSESSMENT - INPUT FOR SCOPING REPORT

Produced for:

ESKOM

Produced by:

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On behalf of:

- May 2011-

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MAPS

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MetroGIS (Pty) Ltd, specialising in visual assessment and Geographic Information Systems, undertook this visual assessment in collaboration with V&L Landscape Architects CC.

Lourens du Plessis, the lead practitioner undertaking the assessment, has been involved in the application of Geographical Information Systems (GIS) in Environmental Planning and Management since 1990.

The team undertaking the visual assessment has extensive practical knowledge in spatial analysis, environmental modeling and digital mapping, and applies this knowledge in various scientific fields and disciplines. The expertise of these practitioners is often utilised in Environmental Impact Assessments, State of the Environment Reports and Environmental Management Plans.

The visual assessment team 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.

Lidwala Specialist Engineers appointed MetroGIS (Pty) Ltd as an independent specialist consultant to undertake the visual impact assessment for the proposed Hendrina Ash Dam development. Neither the author, MetroGIS or V&L Landscape Architects will benefit from the outcome of the project decision-making.

1. INTRODUCTION

Hendrina Power Station is located approximately 40km south of Middelburg, on the south-western border of Pullenshope. The site lies approximately 5 km west of the N11. It is one of Eskom's oldest Coal-fired power stations, commissioned between 1970 and 1976. In 2001 the power station had a total capacity of 1900 MW.

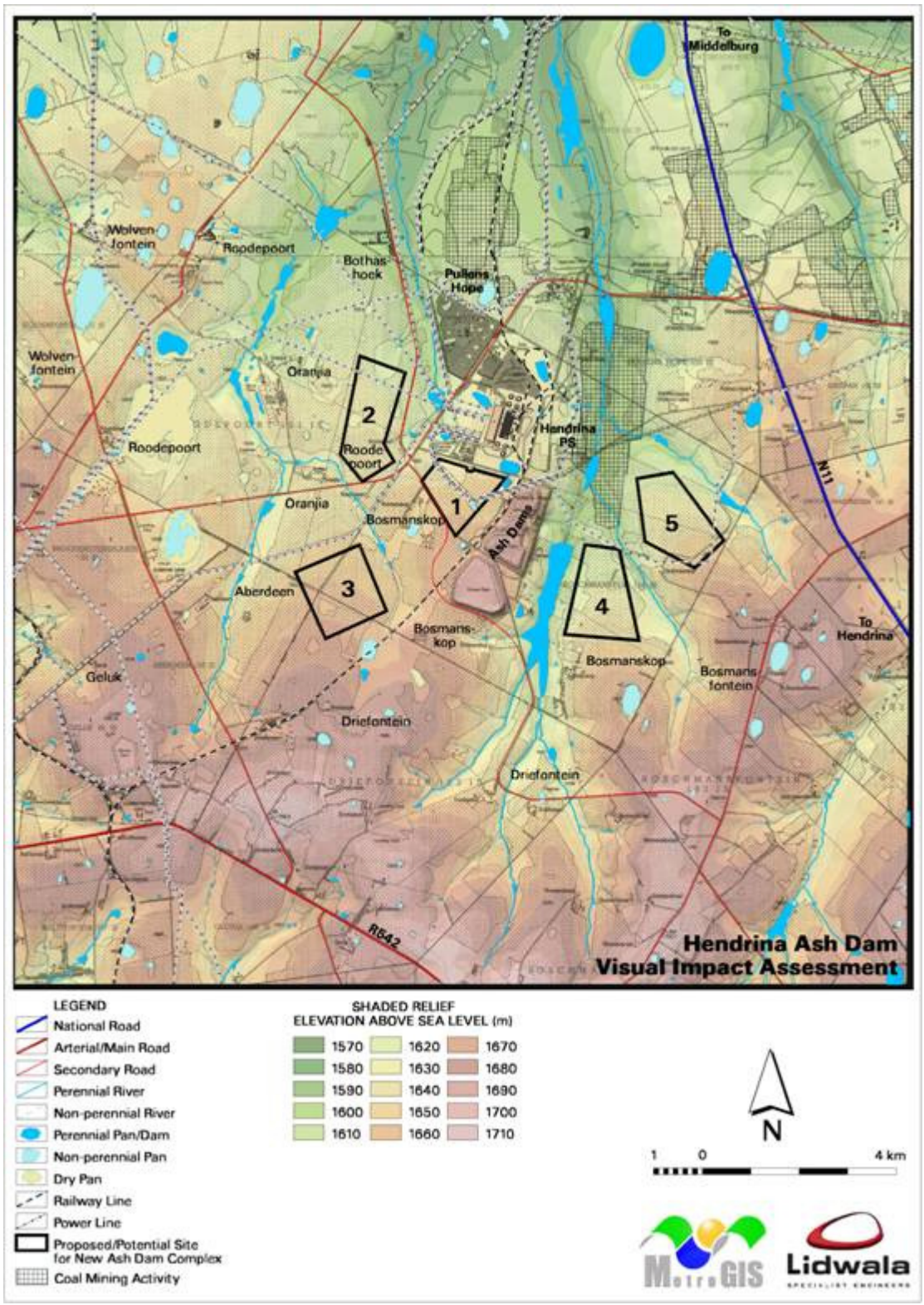
Wet Ashing technology is utilised for the disposal of ash. Currently, two ash dams are in operation, and three are not in use. The operational dams are expected to reach full capacity within five years, which means that from June 2018, a new ash dam will be required.

In this respect, Eskom proposes to extend the ashing capacity of the Hendrina Power Station through the development of a new ash dam. The proposed dam will have a design capacity of 43.4 million m^3 and will cover a ground footprint of 135 ha.

The construction of this new ash dam will cater for the ashing requirements of the power station until 2035 (i.e. the anticipated lifespan of the power station).

The new ash dam will be constructed to an ultimate height of 44m, and the rate of rise is expected to be between 3 and 3,5m per year. Ancillary infrastructure is expected to include conveyors, access roads, fencing and security lighting.

ECsoft Pty Ltd have identified 5 sites adjacent to and / or near to the power station for the potential location of the new ash dam. These have been indicated on **Map 1**.



Map 1: Shaded relief map (indicating the location options of the proposed infrastructure and the topography and elevation above sea level) of the study area.

2. SCOPE OF WORK

The scope of work for the proposed infrastructure includes a scoping level visual assessment of the issues related to the visual impact. The scoping phase is the process of determining the spatial and temporal boundaries (i.e. extent) and key issues to be addressed in an impact assessment.

The main purpose is to focus the impact assessment on a manageable number of important questions on which decision-making is expected to focus and to ensure that only key issues and reasonable alternatives are examined.

The study area for the visual assessment encompasses a geographical area of approximately 420 km² (i.e. the extent of the maps) and includes a minimum 5km buffer zone from each of the alternatives sites under consideration.

3. METHODOLOGY

The study has been undertaken using Geographic Information Systems (GIS) software as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed facility.

This report (scoping report) sets out to do the following:

- To identify the possible visual impacts related to the proposed facility;
- To compare the results of the visibility analysis for each site and
- To rate the sites in terms of preference, in light of the potential visual exposure for each.

The procedure for identifying potential visual impact is as follows:

- The creation of a detailed digital terrain model (DTM) of the potentially affected environment. This has been created from 20m interval contours supplied by the Surveyor General.
- The sourcing of relevant spatial data. This includes cadastral features, vegetation types, land use activities, topographical features, site placement, etc.
- The identification of sensitive environments upon which the proposed infrastructure could have a potential impact.
- The creation of viewshed analyses from each of the alternative sites in order to determine the visual exposure of each, and the topography's potential to absorb the potential visual impact.

The results of the visibility analyses for the 5 alternative sites are compared according to the following criteria:

- **Proximity to the existing power station.** The location of the proposed ash dam should ideally be in close proximity to the power station. This allows for the consolidation and concentration of visual impact of the existing and proposed infrastructure.

  It also negates the potential secondary visual impacts brought about by the construction of lengthy conveyor belts to transport the wet ash from the power station to the ash dam.

  This is considered to be the most important criterion from a visual perspective, and as such is allocated an appropriate weighting.

- **Extent of potential visual exposure**. Sites of limited visual exposure are preferable to those with large areas of potential visual exposure.

- **Presence of high viewer incidence.** Areas of high viewer incidence include the National, arterial and secondary roads in the study area. The higher the number of visual receptors, the greater the potential visual impact of the proposed development, by virtue of the higher frequency of sightings. Such areas of high viewer incidence should ideally be avoided from a visual impact point of view.

- **Presence of sensitive visual receptors.** The inhabitants of homesteads and residences represent visual receptors that should ideally not be exposed to visual impacts.

A value is allocated to each site in terms of the above criteria. The table below illustrates the rating method is used in this regard.

Table 1: Site Preference Rating Criteria

Site Preference Rating	**Criteria**			
	Proximity to power station	*Extent of visual exposure*	*Presence of high viewer incidence*	*Sensitive visual receptors*
Preferred	Close (8)	Small (4)	Few (4)	Few (4)
Acceptable	Med close (6)	Med small (3)	Mod (3)	Mod (3)
Not Preferred	Med far (2)	Med large (2)	Significant (2)	Significant (2)
No-Go	Far (1)	Large (1)	Most (1)	Most (1)

The above exercise allows for the determination of a total score for each site, and the subsequent identification of a Preferred, Acceptable, Not Preferred or No-Go site in terms of potential visual impact.

4. ANTICIPATED ISSUES RELATED TO VISUAL IMPACT

Anticipated issues related to the potential visual impact of the proposed ash dam include the following:

- The visibility of the infrastructure to, and potential visual impact on observers travelling along national and arterial roads (i.e. the *N11 and R542)* as well as secondary roads within the study area.
- The visibility of the facility to, and visual impact on farms and homesteads within the study area.
- The visibility of the infrastructure from and potential visual impact on tourist access routes (i.e. the *N11 and R542)* within the study area.
- The potential visual impact of the infrastructure on the visual character and sense of place of the study area, with specific reference to the rural and agricultural nature of the greater region.
- The potential visual impact of ancillary infrastructure (i.e. conveyors, access roads, fencing and security lighting etc.).
- The potential visual impact of lighting of the infrastructure in terms of light glare, light trespass and sky glow.
- The potential cumulative visual impact of the proposed infrastructure, which will contribute to the existing industrial visual character of the power station and immediate surrounds. This is relevant in context of the largely rural and agricultural nature of the greater region.
- Potential visual impacts associated with the construction phase.
- The potential to mitigate visual impacts and inform the design process.

It is envisaged that the issues listed above may constitute a visual impact at a local and/or regional scale.

These anticipated visual impacts should be assessed in greater detail during the EIA phase of the project as this report is only focussed on defining the potential visual exposure of the proposed development and identifying the potential issues associated with the visibility of the proposed ash dam.

5. REGIONAL OVERVIEW

The study area for the visual assessment is located close to Hendrina in the Steve Tshwete Municipality of the Mpumalanga Province.

There are no major towns in the immediate area. Middelburg lies 40 km to the north west, and Hendrina some 16km to the south east. A number of farms and homesteads occur throughout the study area, and in close proximity to the power station. Refer to **Map 1**.

The N11 bypasses the site in the east and the R542 traverses a section of the study area in the south west. In addition, a number of secondary roads interconnect with the national and arterial roads, as well as with one another.

Mining and related activity is a prolific land use in the study area, which in combination with the existing power station results in a decidedly industrial visual character within an otherwise rural and agricultural regional setting. Power lines which extend to the north, west and east of the power station contribute further to this existing visual intrusion. Refer to **Map 2**.

The topography of the area is typical of the Mpumalanga Highveld, mainly a gently undulating plateau, varying between 1680m and 1600m amsl along the

Woes-Alleen Spruit. The north of the study area appears lower lying and undulating, while the south is characterised by low hills.

In addition to the above mentioned spruit, a large number of dams and pans are present in the study area, although many of these have been disturbed to some extent by mining activity. The drainage lines which traverse the study area all flow north towards the Olifants River. Refer to **Map 1**.

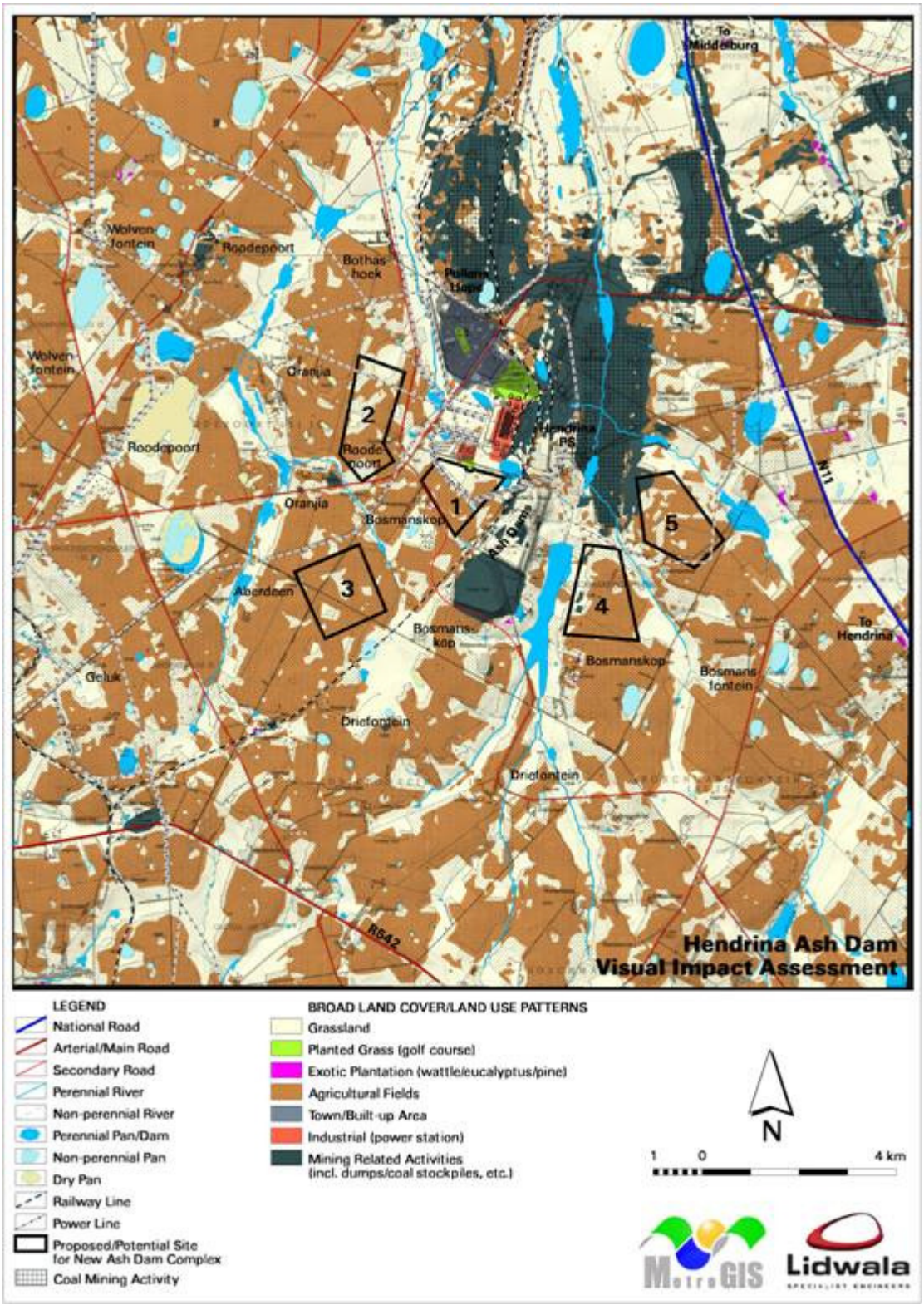
The ENPAT describes the terrain as *moderately undulating plains and pans* and the natural vegetation type as *Bankenveld.*

With its moderately dry subtropical climate, the study area receives between 621 and 752 mm of rainfall per annum.

No formally protected areas or conservation areas are located in close proximity to the proposed site, or within the identified study area.

The study area falls within the Mpumalanga Province, which is a particularly popular and well frequented tourist destination in South Africa. There are no known tourist facilities or destinations within the study area, but tourists en route to other parts of Mpumalanga may utilise the main regional access routes such as the N11 and the R542.

Source: Department of Environmental Affairs and Tourism, 2001. *Environmental Potential Atlas for Mpumalanga Province (ENPAT Mpumalanga).*



Map 2: Land cover / land use patterns of the study area.

6. SITE SPECIFIC RESULTS

6.1 Potential Visual Exposure

The viewshed analyses for the 5 alternative sites take into account the scale of the proposed infrastructure, calculated at 44m above ground level, and cover the entire footprint area of each site.

This was done to determine the general visual exposure of the area under investigation, simulating the anticipated ash dam at its full height. It must be noted that the viewshed analyses do not include the effect of vegetation cover or existing structures on the exposure of the proposed ash dam, therefore signifying a worst-case scenario.

The result of the preliminary viewshed analysis for the proposed ash dam, should this be located on **Site 1**, is shown on **Map 3**. The following is evident from the viewshed analysis:

- The proposed ash dam will have a large core area of potential visual exposure on the site itself, and within a 2,5km offset. Almost the entire area within 2,5km is likely to be visually exposed. The exception is the south east, beyond the existing ash dams.

  This core area includes a number of homesteads and farms (i.e. Bosmanskop, Oranjia and Roodepoort) and a few dams and pans. In general, the drainage lines are not exposed, due to their incised topography.

  The secondary roads giving access to the north, west and south will also be exposed to potential visual impact.

- Potential visual exposure is somewhat reduced in the medium distance (i.e. between 2,5 and 5km). Areas in the west and east, along the drainage lines, will be visually screened.

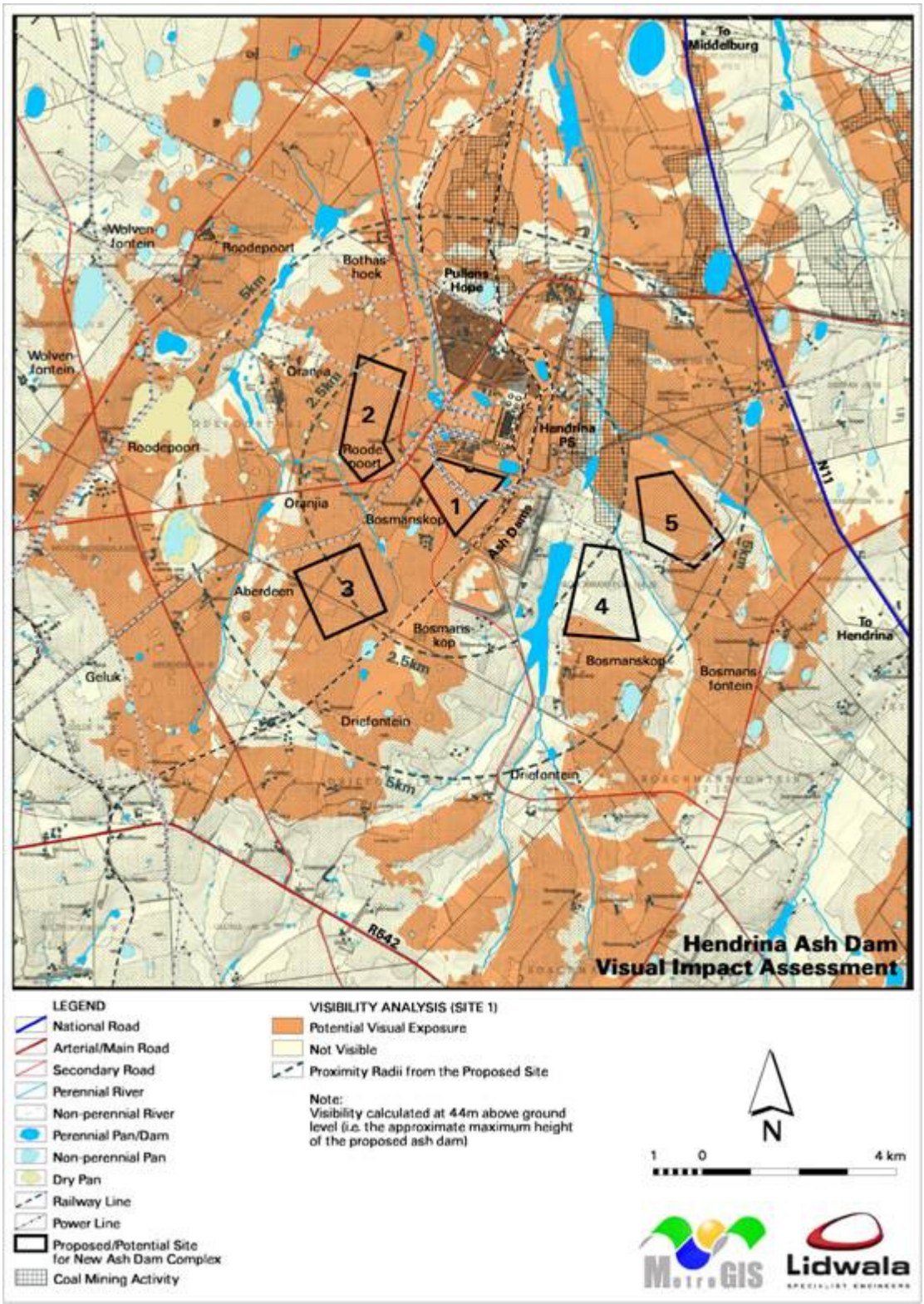
  The main receptors that are likely to be exposed to potential visual impact include users of secondary roads to the north, north east and west and a number of homesteads and farms. These include Bothashoek, Oranjia, Aberdeen, Driefontein and Bosmanskop.

  A few non-perennial pans also fall within the zone of potential visual exposure.

- In the longer distance (i.e. beyond 5km), visual exposure is further reduced, interrupted in the far north west and north east and by the hills in the south of the study area.

  Receptors exposed to potential visual exposure include the farms and homesteads of Roodepoort and Bosmansfontein. Relatively long stretches of the N11 fall within the zone of potential visual exposure, as do relatively continuous lengths of secondary roads in the west, north west and south east.

The total area of potential visual exposure for this site alternative is 188,4km².



Map 3: Potential visual exposure for Site Option 1.

The result of the preliminary viewshed analysis for the proposed ash dam, should this be located on **Site 2**, is shown on **Map 4**. The following is evident from the viewshed analysis:

- The proposed ash dam will have a large core area of potential visual exposure on the site itself, and within a 2,5km offset. Almost the entire area within 2,5km is likely to be visually exposed. The exception is the east, beyond the power station, and west beyond Oranjia.

  This core area includes a number of homesteads and farms (i.e. Bothashoek, Bosmanskop, Oranjia and Roodepoort) and a few dams and pans. In general, the actual drainage lines are not exposed, due to their incised topography.

  The secondary roads giving access to the north, west and south east will also be exposed to potential visual impact.

- Potential visual exposure is somewhat reduced in the medium distance (i.e. between 2,5 and 5km). A large area in the east as well as smaller patches in the west will be visually screened.

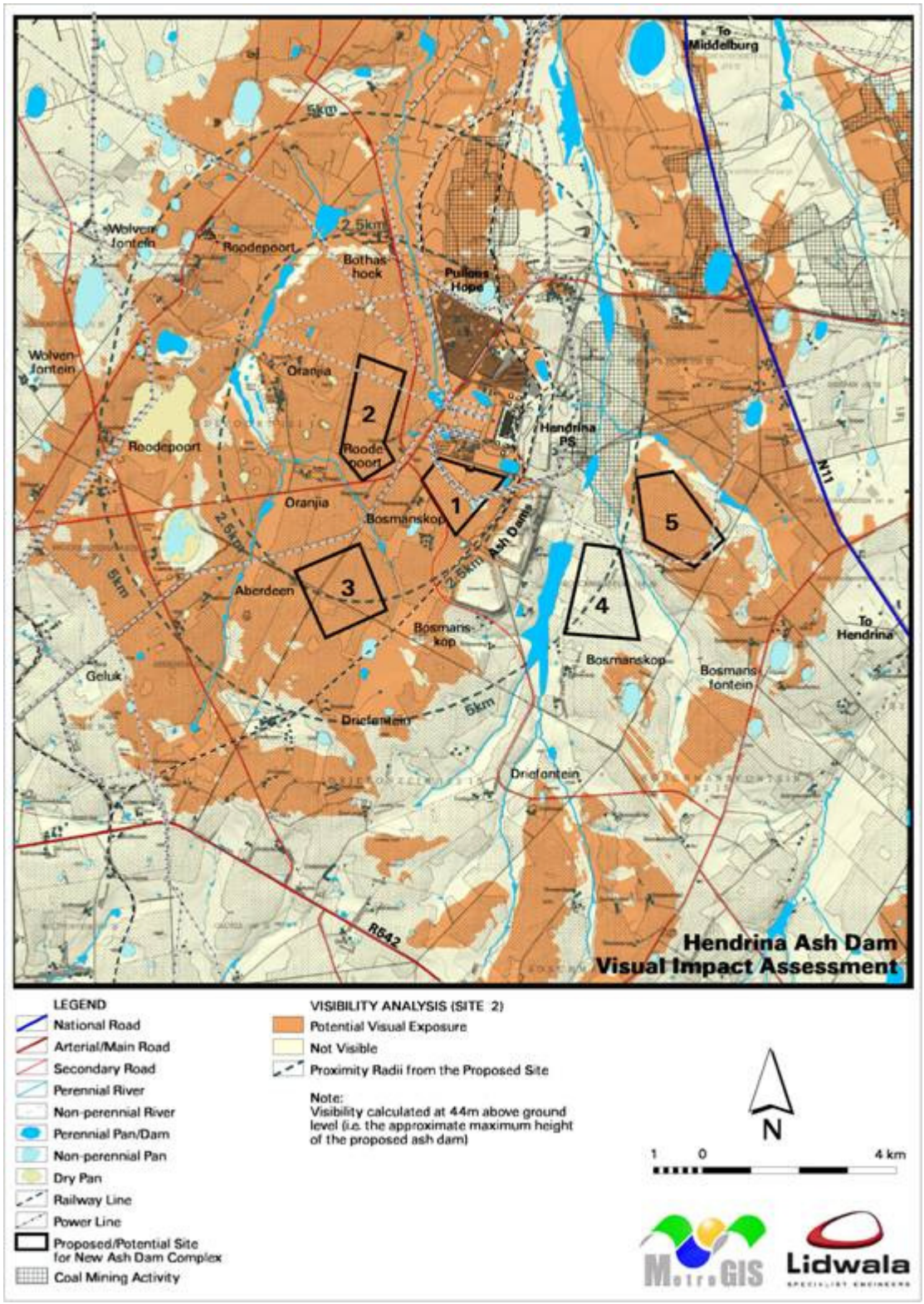
  The main receptors that are likely to be exposed to potential visual impact include users of secondary roads to the north, north west and west and a number of homesteads and farms. These include Roodepoort, Aberdeen and Driefontein.

  A few drainage lines, dams and non-perennial pans also fall within the zone of potential visual exposure.

- In the longer distance (i.e. beyond 5km), visual exposure is further reduced, interrupted in the far north west, north east and east, and by the hills in the south of the study area.

  No farms or homesteads are expected to be exposed to potential visual impact, but relatively long stretches of the N11 fall within the zone of potential visual exposure. Short stretches of secondary roads in the west, north and south will be similarly exposed.

The total area of potential visual exposure for this site alternative is 167,2km².



Map 4: Potential visual exposure for Site Option 2.

The result of the preliminary viewshed analysis for the proposed ash dam, should this be located on **Site 3**, is shown on **Map 5**. The following is evident from the viewshed analysis:

- The proposed ash dam will have a large core area of potential visual exposure on the site itself, and within a 2,5km offset. Almost the entire area within 2,5km is likely to be visually exposed. The exception is a small area to the east, south west and west of the site.

  This core area includes a number of homesteads and farms (i.e. Bosmanskop, Oranjia, Driefontein, Aberdeen and Roodepoort) and a few dams and pans. In general, the actual drainage lines are not exposed, due to their incised topography.

  The secondary roads in the north and east will also be exposed to potential visual impact.

- Potential visual exposure is somewhat reduced in the medium distance (i.e. between 2,5 and 5km). Large areas in the east, along the drainage line, will be visually screened. As will smaller patches in the north west.

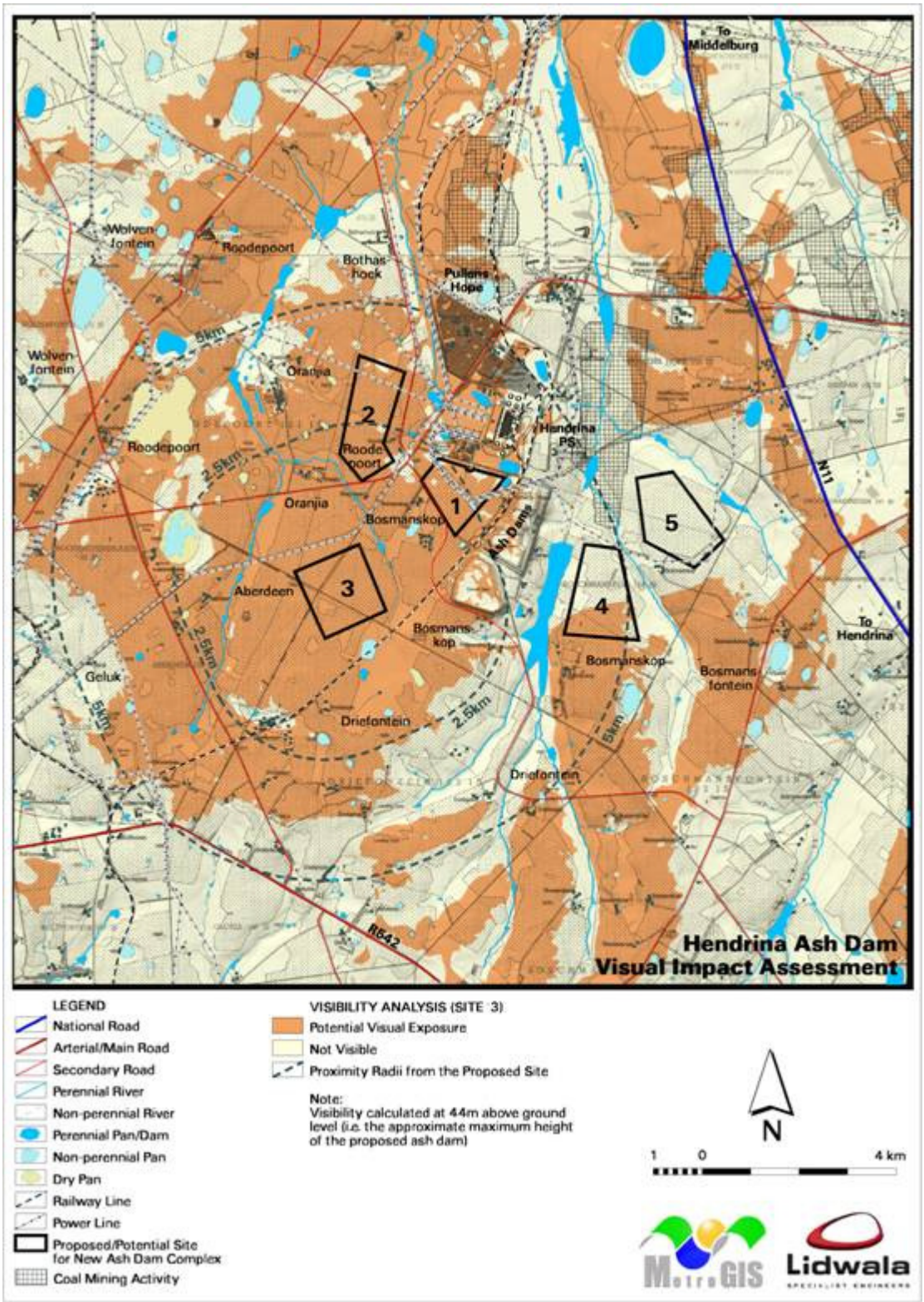
  The main receptors that are likely to be exposed to potential visual impact include users of secondary roads to the north east and north west and a number of homesteads and farms. These include Roodepoort, Oranjia, Driefontein and Bosmanskop.

  A few dams and non-perennial pans also fall within the zone of potential visual exposure.

- In the longer distance (i.e. beyond 5km), visual exposure is further reduced, with significant visually screened areas in all directions.

  Receptors exposed to potential visual exposure include the farms and homesteads of Roodepoort and Bosmansfontein. Relatively long stretches of the N11 fall within the zone of potential visual exposure, as do interrupted stretches of secondary roads in the north, north west and east of the study area.

The total area of potential visual exposure for this site alternative is 168,8km².



Map 5: Potential visual exposure for Site Option 3.

The result of the preliminary viewshed analysis for the proposed ash dam, should this be located on **Site 4**, is shown on **Map 6**. The following is evident from the viewshed analysis:

- The proposed ash dam will have a large core area of potential visual exposure on the site itself, and within a 2,5km offset. Almost the entire area within 2,5km is likely to be visually exposed. The exception is the west, beyond the existing ash dams and the east.

  This core area includes a number of homesteads and farms (i.e. Bosmanskop and Bosmansfontein) and a few pans and dams. In general, the actual drainage lines are not exposed, due to their incised topography.

  The secondary road in the south west will also be exposed to potential visual impact.

- Potential visual exposure is somewhat reduced in the medium distance (i.e. between 2,5 and 5km). Areas in the west and south east will be visually screened by existing topography (i.e. ash dams and low hills).

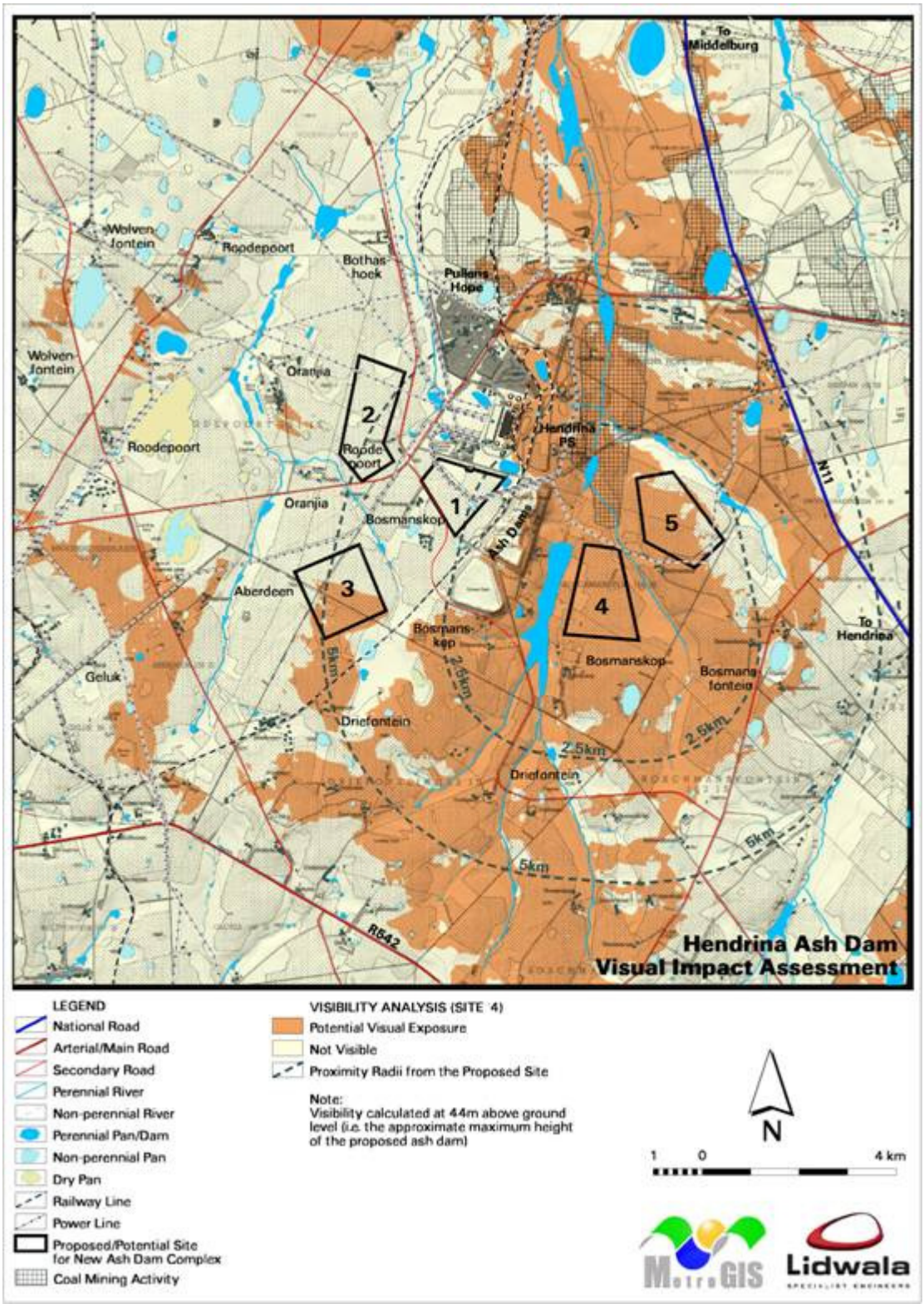
  The main receptors that are likely to be exposed to potential visual impact include users of the N11 and of the secondary road in the south. Driefontein is the only homestead or farm which is expected to be visually exposed.

  A few non-perennial pans also fall within the zone of potential visual exposure.

- In the longer distance (i.e. beyond 5km), visual exposure is significantly reduced, with only limited areas in the north and south potentially exposed to visual impact.

  Receptors within this viewshed are limited to short stretches of the N11 and secondary roads in the north and south. No farms or homesteads are expected to be exposed to visual impact.

The total area of potential visual exposure for this site alternative is 114,2km².



Map 6: Potential visual exposure for Site Option 4.

The result of the preliminary viewshed analysis for the proposed ash dam, should this be located on **Site 5**, is shown on **Map 7**. The following is evident from the viewshed analysis:

- The proposed ash dam will have a large core area of potential visual exposure on the site itself, and within a 2,5km offset. Almost the entire area within 2,5km is likely to be visually exposed. Exceptions are small patches in the north, west and south.

  This core area includes a number of homesteads and farms (i.e. Bosmanskop and Bosmansfontein) and a few pans and dams. In general, the actual drainage lines are not exposed, due to their incised topography.

  A short stretch of the N11 falls within this zone, as does part of the secondary road to the south east of the site.

- Potential visual exposure is somewhat reduced in the medium distance (i.e. between 2,5 and 5km). Areas in the west, beyond the existing ash dam, as well as to the east and south west will be visually screened.

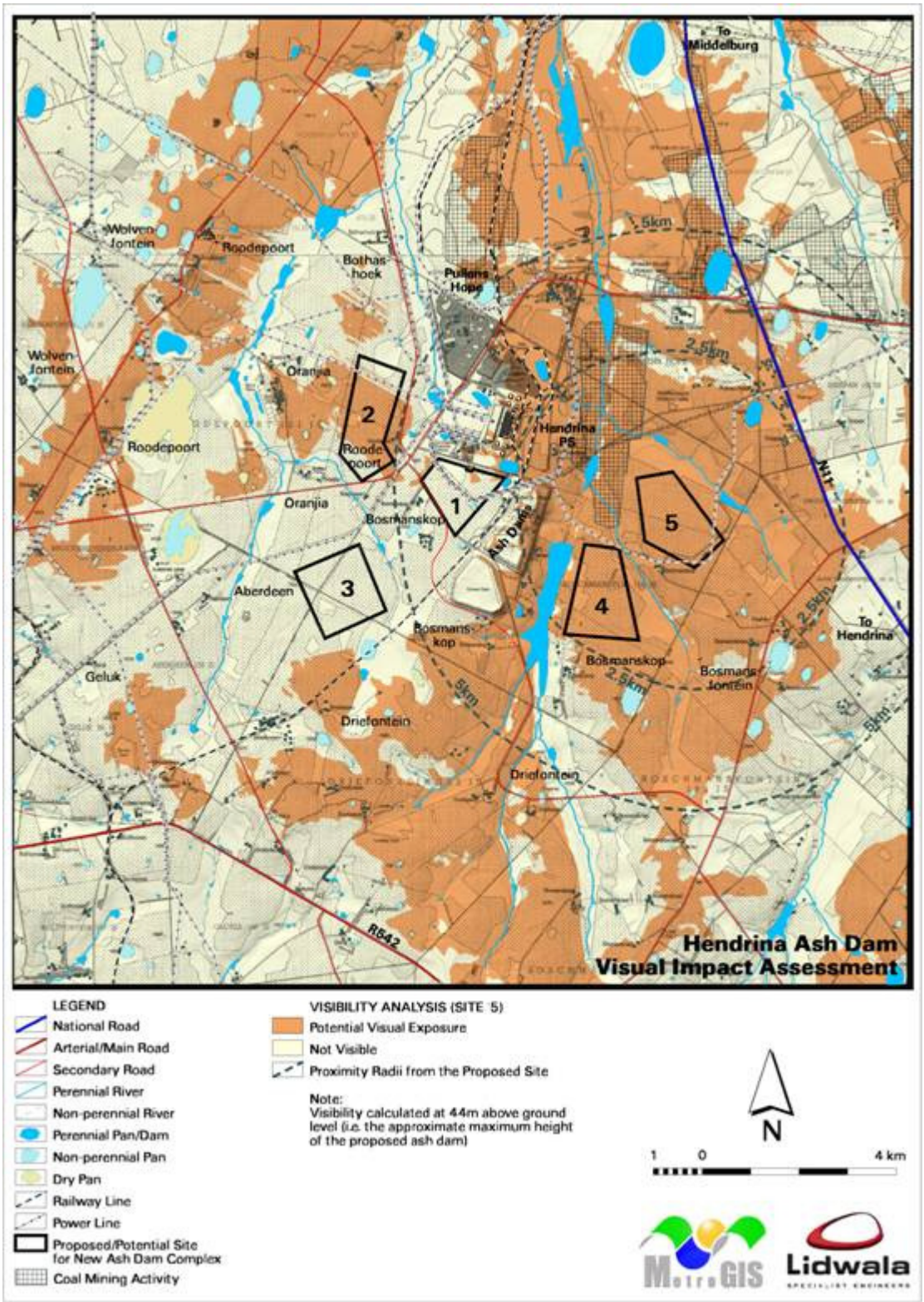
  The main receptors that are likely to be exposed to potential visual impact include users of the N11 to the north of the site and secondary roads to the north, south west, east and south. The farms and homestead of Bosmanskop falls within the viewshed and will be exposed to potential visual impact.

  A few non-perennial pans also fall within the zone of potential visual exposure.

- In the longer distance (i.e. beyond 5km), visual exposure is further reduced, with the main areas of potential visual exposure lying to the north, south west and far north west of the study area.

  Receptors exposed to potential visual exposure include the farms and homesteads of Roodepoort, Oranjia and Driefontein. Short stretches of the N11 (north of the study area) fall within the zone of potential visual exposure, as do limited lengths of secondary roads in the south and north west of the study area.

The total area of potential visual exposure for this site alternative is 157,4km².



Map 5: Potential visual exposure for Site Option 7.

6.2 Site Preference Rating

With the viewshed analyses of the 5 site alternatives in hand, it is possible to rate these making use of visual sensitivity criteria. The purpose of this exercise is to determine a Preferred, Acceptable, Not Preferred or No-Go site in terms of potential visual impact.

The following rating method is used in this regard:

- Proximity to the existing power station:
  - Close: 8;
  - Med close: 6;
  - Med far: 4;
  - Far: 1.
- Extent of potential visual exposure:
  - Small: 4;
  - Med small: 3;
  - Med large: 2
  - Large: 1.
- Presence of affected areas of high viewer incidence:
  - Few: 4;
  - Moderate: 3;
  - Significant: 2;
  - Most: 1.
- Affected sensitive visual receptors:
  - Few: 4;
  - Moderate: 3;
  - Significant: 2;
  - Most: 1.

Table 2: Site Preference Ratings

Site Preference Rating	**Criteria**				**Specialist Specific Score**
	Proximity to power station	*Extent of visual exposure*	*Presence of high viewer incidence*	*Sensitive visual receptors*	
Site 1	8	1	2	2	**13 (Preferred)**
Site 2	6	2	1	1	**10 (Acceptable)**
Site 3	4	2	2	1	**9 (Not Preferred)**

Site 4	1	4	4	3	**12 (Acceptable)**
Site 5	1	3	3	4	**11 (Not Preferred)**

7. CONCLUSIONS AND RECOMMENDATIONS

The construction and operation of the proposed new ash dam for the Hendrina Power Station will in all likelihood have a visual impact on a number of potentially sensitive visual receptors, regardless of the alternative selected.

It is envisaged that the infrastructure would be largely visible to observers (i.e. people travelling along roads, residing on farms and at homesteads and tourists visiting the region), especially within a 0-5km radius of the site and would constitute a moderate to high visual prominence, potentially resulting in a visual impact.

It is noteworthy that the power station and immediate surrounds constitutes an existing visual impact. The visual impact of the ash dam may thus be somewhat ameliorated by the existing situation, but will also contribute to further, cumulative visual impact.

A comparative analysis of the results of the visibility analysis for each site and the subsequent rating of these in terms of visual sensitivity criteria revealed the following in terms of preference:

- Site 1: Preferred;
- Site 2: Acceptable;
- Site 3: Not Preferred;
- Site 4: Acceptable;
- Site 5: Not Preferred.

The above analysis clearly favours Site 1 for the location of the new ash dam. From a visual perspective, it is thus recommended that the significance of the potential visual impact of **Site 1** on sensitive receptors be assessed in further detail in the EIA.

Failing the selection of site 1 for the proposed new ash dam (possibly due to a fatal flaw not of a visual nature), sites 2 and 4 would also be considered acceptable, but not ideal, from a visual perspective.

The final site selected (i.e. site 1, 2 or 4) must be subjected to additional spatial analyses in order to create a visual impact index that will further aid in quantifying potential visual impact.

Specific spatial criteria need to be applied to the visual exposure of the proposed ash dam in order to successfully determine the issues related to the visual impact and ultimately the significance of the visual impact.

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

- **Determine Visual Distance/Observer Proximity:**

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

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

  MetroGIS determined the proximity radii based on the anticipated visual experience of the observer over varying distances. The distances are adjusted upwards for larger facilities and downwards for smaller facilities (i.e. depending on the size and nature of the proposed infrastructure).

  The proximity radii (calculated from the boundary lines of the site) are as follows:

  - 0 – 2,5km. Short distance view where the facility would dominate the frame of vision and constitute a very high visual prominence.
  - 2,5 - 5km. Medium distance view where the structures would be easily and comfortably visible and constitute a high visual prominence.
  - Greater than 5km. Medium to longer distance view where the facility would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a medium visual prominence.

- **Determine Viewer Incidence/Viewer Perception**

  The number of observers and their perception of a structure determine the concept of visual impact. If there are no observers, then there would be no visual impact. If the visual perception of the infrastructure is favourable to all the observers, then the visual impact would be positive.

  It is therefore necessary to identify areas of high viewer incidence and to classify certain areas according to the observer's visual sensitivity towards the proposed facility and its related infrastructure.

  It would be impossible not to generalise the viewer incidence and sensitivity to some degree, as there are many variables when trying to determine the perception of the observer; regularity of sighting, cultural background, state of mind, and purpose of sighting which would create a myriad of options.

- **Determine the Visual Absorption Capacity of the landscape**

  This is the capacity of the receiving environment to absorb or screen the potential visual impact of the proposed infrastructure. 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.

The digital terrain model utilised in the calculation of the visual exposure of the facility does not incorporate the potential visual absorption capacity (VAC) of the region. It is therefore necessary to determine the VAC by means of the interpretation of the natural visual characteristics, supplemented with field observations.

- **Determine the Visual Impact Index**

  The results of the above analyses are merged in order to determine where the areas of likely visual impact would occur. These areas are further analysed in terms of the previously mentioned issues (related to the visual impact) and in order to judge the severity of each impact.

The above exercise should be undertaken for the ash dam as well as the ancillary infrastructure, as these structures are envisaged to 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.

In addition, cumulative visual impact should be addressed, as well as suggested mitigation measures for all identified impacts (if any).

8. REFERENCES/DATA SOURCES

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