HERITAGE IMPACT ASSESSMENT

In terms of Section 38(8) of the NHRA for the

PROPOSED DEVELOPMENT OF GRID CONNECTION INFRASTRUCTURE FOR PARADYS POWERLINE 1 NEAR VILJOENSKROON

Prepared by CTS Heritage

CTS HERITAGE

Jenna Lavin

For

Solis Environmental

August 2023

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EXECUTIVE SUMMARY

1. Site Name:

Paradys Solar PL 1 near Viljoenskroon, Free State Province

2. Location:

The project area is located between Orkney and Viljoenskroon in the Free State Province.

3. Locality Plan:

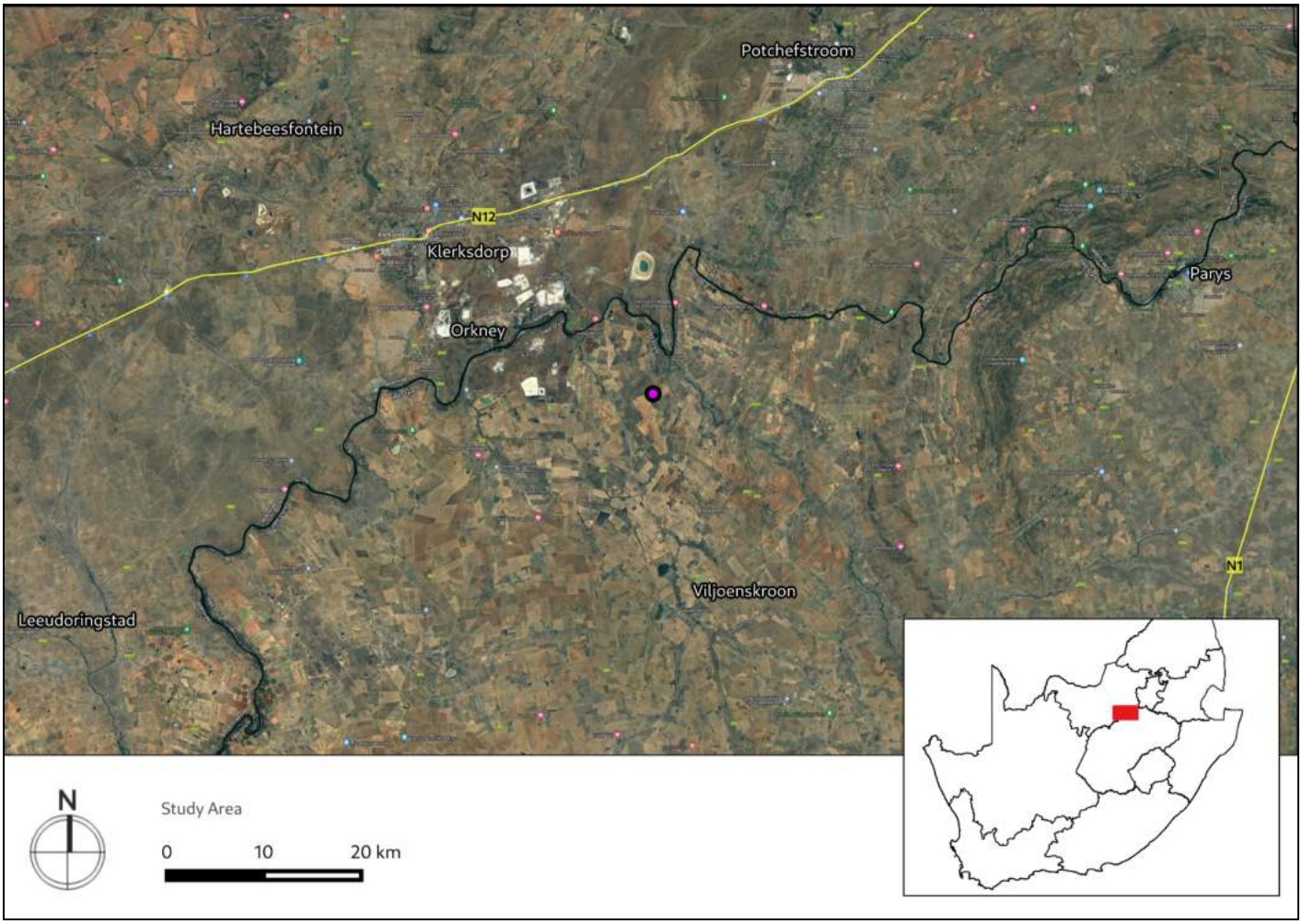

Figure A: Location of the proposed development area

4. Description of Proposed Development:

This application is for the proposed development of the electrical grid connection infrastructure associated with the proposed Paradys Solar PV 1 facility. For the authorised Paradys Solar PV 1 to connect to the electrical grid, requires transformation of the voltage from 480V to 33kV to 132kV. The normal components and dimensions of a distribution rated electrical substation (i.e., collector substation) will be required. Output voltage from the inverter

is 480V and this is fed into step up transformers to 132kV.Asubstationhas been authorised to step the voltage up to 132kV, after which the power will be evacuated into the national grid via the Zaaiplaats collector substation and the power line.

5. Anticipated Impacts on Heritage Resources:

The survey proceeded with no major constraints and limitations, and the project area was comprehensively surveyed for heritage resources, and a number of significant archaeological material remains were documented. The significant heritage resources identified within the development area relate to the agricultural past and burial grounds and graves. No significant resources were identified within the grid corridor or its alternative.

As is expected in this area, significant Iron Age resources were identified on top of the Paradys Koppie. Similar Iron Age sites are known from the nearby Harmony Gold Mining area. In general, sites such as these provide a significant amount of scientific information about the past when subject to appropriate analysis and as such, these sites have been determined to have high levels of scientific significance, and are graded IIIA. No impact to these significant resources is anticipated from this proposed development.

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the overlying soils and sands of the Quaternary. There is a very small chance that fossils may occur below ground in the quartzites but this is very unlikely. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations for foundations and infrastructure have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. The impact on the palaeontological heritage would be low, so as far as the palaeontology is concerned, the project should be authorised.

6. Recommendations:

Based on the outcomes of this report, it is not anticipated that the proposed development of the grid connection infrastructure will negatively impact on significant heritage resources on condition that:

- The attached Chance Fossil Finds procedure must be implemented for the duration of construction activities
- Although all possible care has been taken to identify sites of cultural importance during the investigation of the study area, it is always possible that hidden or subsurface sites could be overlooked during the assessment. If any evidence of archaeological sites or remains (e.g. remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, charcoal and ash concentrations), fossils, burials or other categories of heritage resources are found during the proposed

development, work must cease in the vicinity of the find and SAHRA must be alerted immediately to determine an appropriate way forward.

8. Author/s and Date:

Jenna Lavin

August 2023

Details of Specialist who prepared the HIA

Jenna Lavin, an archaeologist with an MSc in Archaeology and Palaeoenvironments, heads up the heritage division of the organisation since 2016, and has a wealth of experience in the heritage management sector. Jenna's previous position as the Assistant Director for Policy, Research and Planning at Heritage Western Cape has provided her with an in-depth understanding of national and international heritage legislation. Her previous 8 years of experience at various heritage authorities in South Africa means that she has dealt extensively with permitting, policy formulation, compliance and heritage management at national and provincial level and has also been heavily involved in rolling out training on SAHRIS to the Provincial Heritage Resources Authorities and local authorities.

Jenna is on the Executive Committee of the Association of Professional Heritage Practitioners (APHP), and is also an active member of the International Committee on Monuments and Sites (ICOMOS) as well as the International Committee on Archaeological Heritage Management (ICAHM). In addition, Jenna has been a member of the Association of Southern African Professional Archaeologists (ASAPA) since 2009.

Since 2016, Jenna has drafted over 250 Screening and Heritage Impact Assessments throughout South Africa.

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APPENDICES

1. INTRODUCTION

1.1 Background Information on Project

This application is for the proposed development of the electrical grid connection infrastructure associated with the proposed Paradys Solar PV 1 facility. For the authorised Paradys Solar PV 1 to connect to the electrical grid, requires transformation of the voltage from 480V to 33kV to 132kV. The normal components and dimensions of a distribution rated electrical substation (i.e., collector substation) will be required. Output voltage from the inverter is 480V and this is fed into step up transformers to 132kV.Asubstationhas been authorised to step the voltage up to 132kV, after which the power will be evacuated into the national grid via the Zaaiplaats collector substation and the power line. The existing Eskom lines with capacity and Eskom Switching stations of other Mulilo projects currently under development is considered as the feasible connection point:

- Construction Phase:

  The proposed 132kV overhead power line will be approximately 9.2km long and will be constructed within the identified grid connection corridor. The minimum vertical clearance to buildings, poles and structures not forming part of the power line must be 3.8m, while the minimum vertical clearance between the conductors and the ground is 6.7m. The minimum distance between trees and shrubs and any bare phase conductor of a 132kV power line must be 4m, allowing for the possible sideways movement and swing of both the power line conductor and the tree or shrub. The structure to be utilised for the power line towers will be informed by the local geotechnical and topographical conditions as well as by specific requirements from Eskom. The construction of the proposed overhead power line and collector substation(s)will take approximately 12 months to complete. Following the Commercial Operation Date (COD) of the authorised Paradys Solar PV the applicant will hand over the powerline and the associated infrastructure (i.e. substation and service road) to Eskom Holdings SOC Ltd (Eskom) to operate and maintain. This is in line with Eskom's well-established Self Build Grid Connection Strategy for Renewable Energy Projects developed under the REIPPP Procurement Programme.
- Operation Phase:

  The proposed power line and associated servitude will require routine maintenance throughout
- Decommissioning Phase:

  The photovoltaic solar power plant has a lifespan of between 20 and 25 years from where the facility and its associated infrastructure will be decommissioned or upgraded. If the solar plant is not decommissioned the power line is expected to have a lifespan of more than 40 years (with maintenance) and the infrastructure will only be decommissioned once it has reached the end of life, or if no longer required. Upon decommissioning, the power line would be disassembled, and the components removed from site, and recycled where possible, in line with the Environmental Management Programme EMP.

1.2 Description of Property and Affected Environment

The Paradys PV EGI development forms part of the Paradys PV Cluster. The Paradys PV Cluster lies just over 15km north of Viljoenskroon on the Free State Province side of the Vaal River. Orkney, which lies on the northern bank of the Vaal River and in the North West Province, is roughly 25km northwest of the study area and is accessed from the R76 tarred road before breaking off onto one of several gravel farm roads that service the various maize and cattle farms in the area.

The area is well-known for its intensive maize and cattle production. Grain silos storing maize for the export market dot the horizon and the roads were full of grain trucks hauling the latest harvest at the time of the survey. A number of mines are located near the development such as the Moab Khotsong gold mine immediately adjacent to the western end of the grid connection near the Mercury substation and these mines are collectively served by several very large overhead powerlines (mainly 400kV) that run along the Vaal Reefs goldfields.

Some eco-tourism farms and hunting lodges have also cropped up over the last 30 years in the area, particularly along the Vaal River. Areas that have not been cultivated are either on the slightly elevated ground formed by the ridge at Paradys where the soil is too shallow to plant maize, or in the wetlands that form near the Vaal floodplain and the Renosterrivier tributary that adjoins the Vaal River. These areas have instead been used extensively for the grazing of cattle and sheep.

The farm werfs typically have an older, late 19th century component in the form of stone walled kraals and very basic structures, and formalised development of the farms appears to have gathered speed in the 20th century along with the mining industry. Werfs in the area normally have several modern buildings and heavily altered buildings due to the strong commercial businesses that have expanded in the area. A few abandoned werfs and ruined farmworkers cottages are also becoming more common on the landscape as large farming corporates buy out the arable land due to the increasing tendency to scale up the agribusinesses.

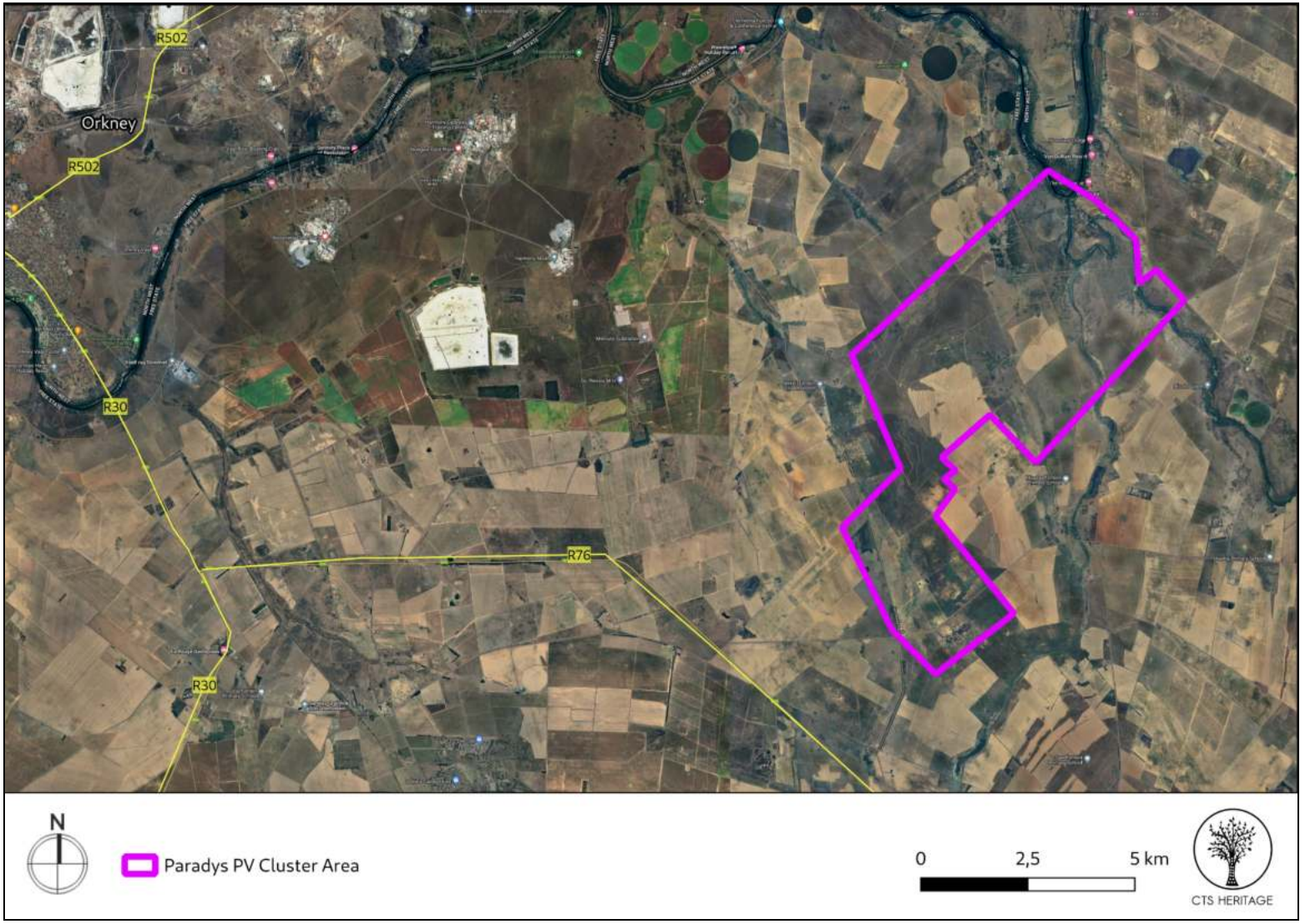

Figure 1.1: Proposed development area relative to Orkney

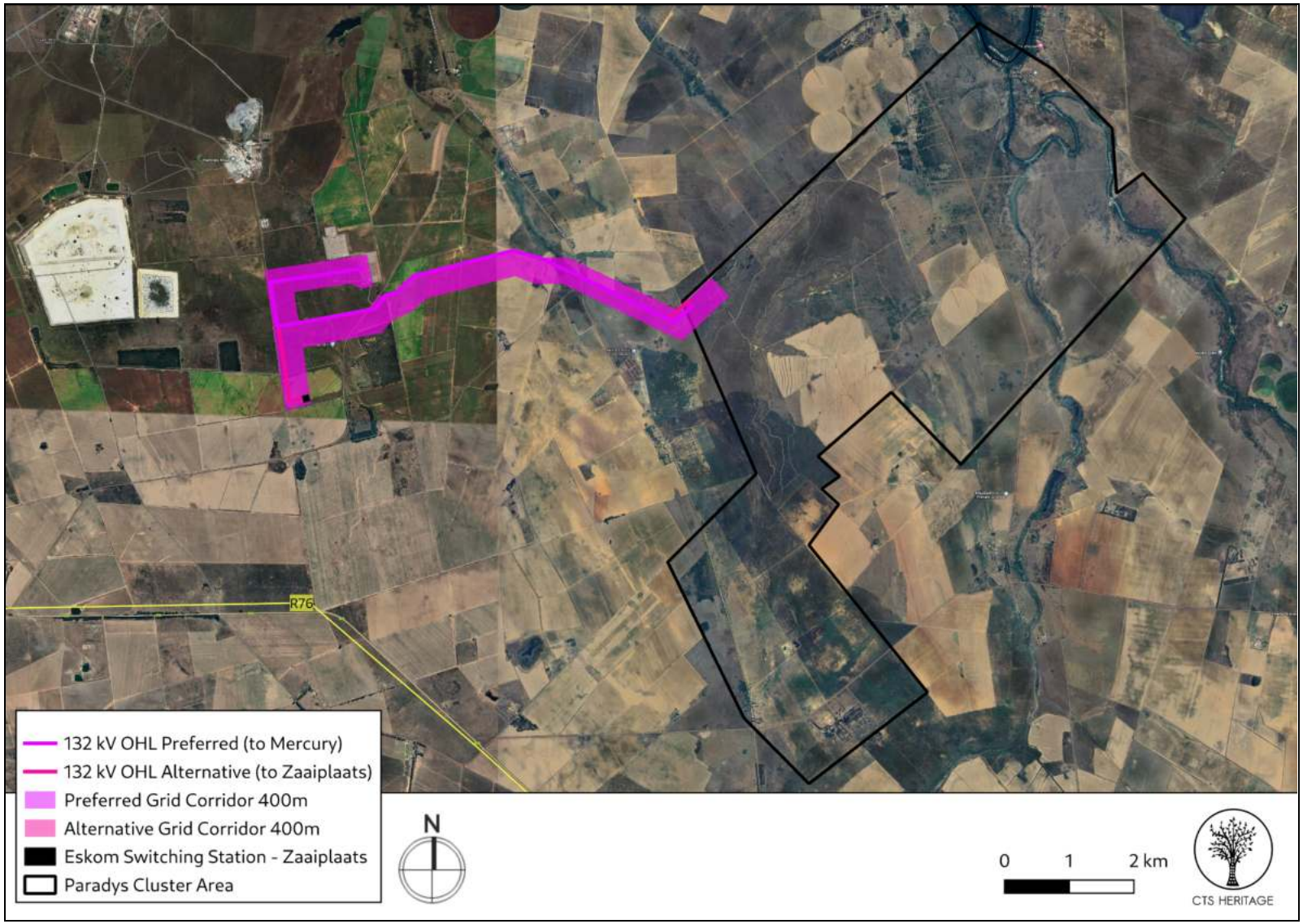

Figure 1.2: The proposed development layout

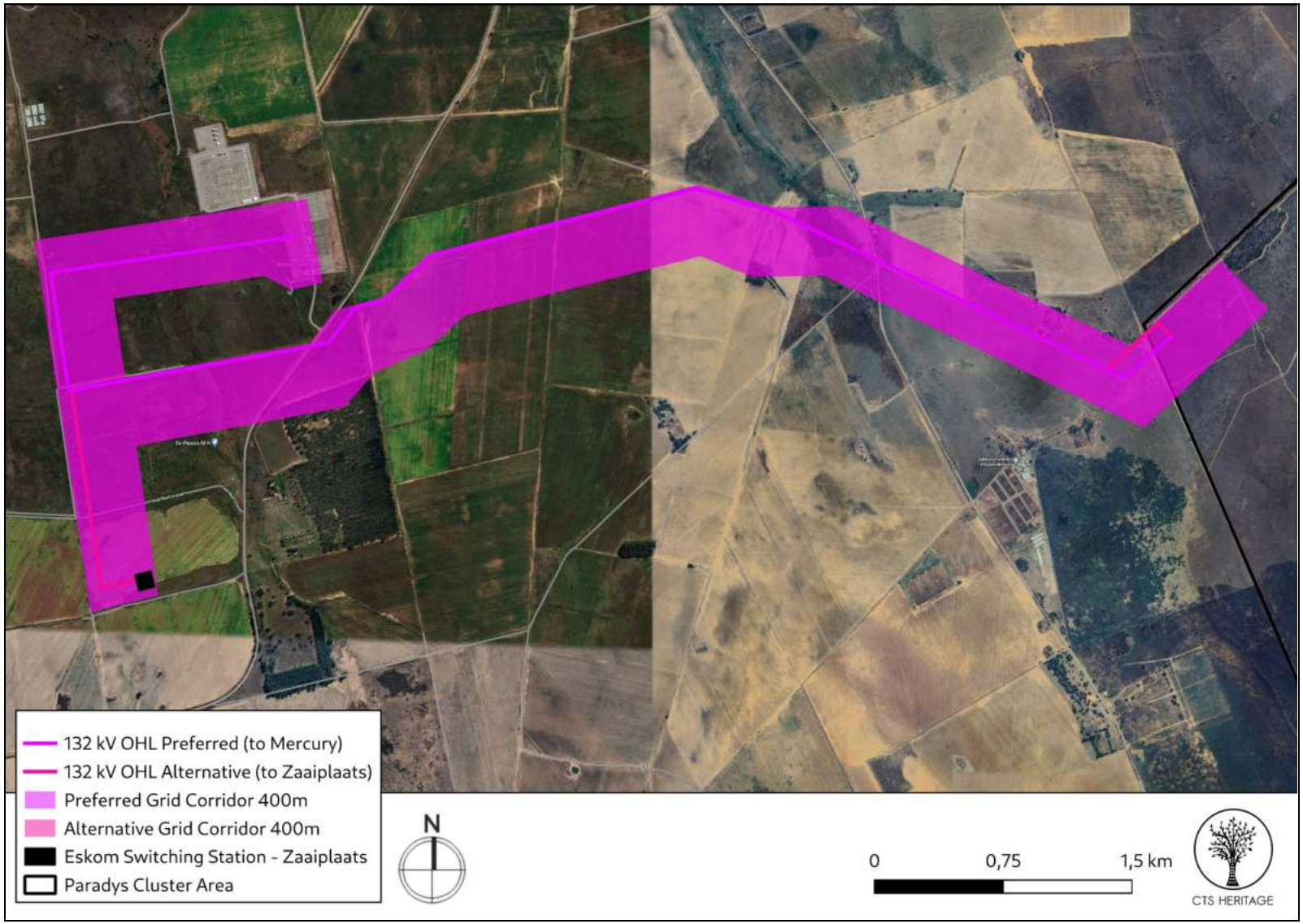

Figure 1.3: The proposed development layout of the Paradys Solar PV EGI

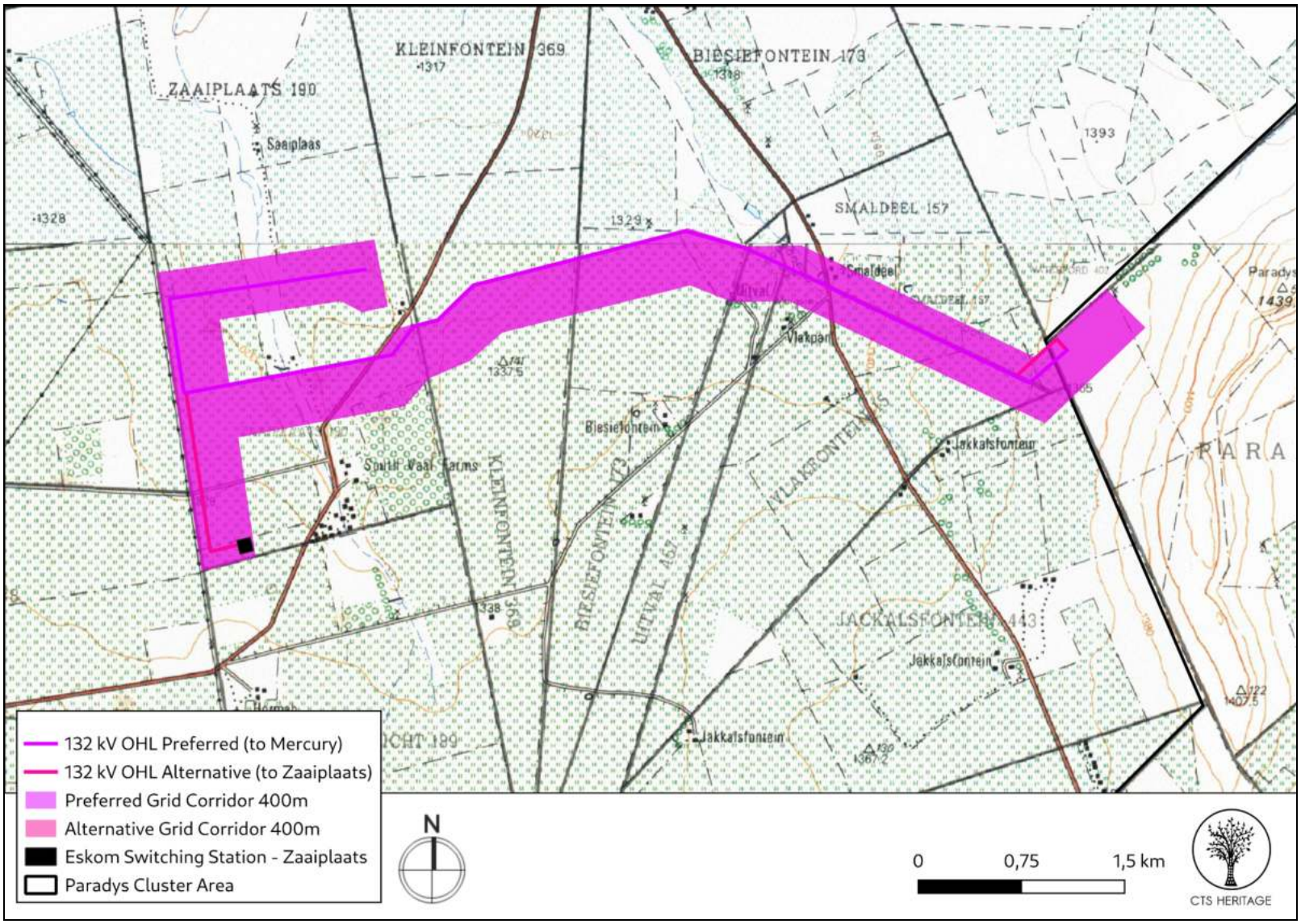

Figure 1.4: The proposed development layout on an extract of the 1:50 000 Topo Map

2. METHODOLOGY

2.1 Purpose of HIA

The purpose of this Heritage Impact Assessment (HIA) is to satisfy the requirements of section 38(8), and therefore section 38(3) of the National Heritage Resources Act (Act 25 of 1999).

2.2 Summary of steps followed

- A Desktop Study was conducted of relevant reports previously written (please see the reference list for the age and nature of the reports used)
- An archaeologist conducted an assessment of archaeological resources likely to be disturbed by the proposed development. The archaeologist conducted his site visit on 3 to 7 July 2023
- A palaeontologist conducted a desktop assessment of palaeontological resources likely to be disturbed by the proposed development.
- The identified resources were assessed to evaluate their heritage significance and impacts to these resources were assessed.
- Alternatives and mitigation options were discussed with the Environmental Assessment Practitioner

2.3 Assumptions and uncertainties

- The *significance* of the sites and artefacts is determined by means of their historical, social, aesthetic, technological and scientific value in relation to their uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

- It should be noted that archaeological and palaeontological deposits often occur below ground level. Should artefacts or skeletal material be revealed at the site during construction, such activities should be halted, and it would be required that the heritage consultants are notified for an investigation and evaluation of the find(s) to take place.

However, despite this, sufficient time and expertise was allocated to provide an accurate assessment of the heritage sensitivity of the area.

2.4 Constraints & Limitations

The development covers a large area and many of the fields that lie in between the planned PV laydown areas were in the final days of the maize harvest during the survey. Visibility on the curved ridgeline at Paradys improved somewhat and Iron Age kraals and Later Stone Age tools could be found with relative ease in these

areas despite the high stands of grass cover. Lower down the dormant patches of veld become entirely overgrown and visibility was reduced to the jeep tracks and exposed rocky ground where cattle had not reduced the cover sufficiently.

2.5 Solis Impact Assessment Methodology

The environmental assessment aims to identify the various possible environmental impacts that could results from the proposed activity. Different impacts need to be evaluated in terms of its significance and in doing so highlight the most critical issues to be addressed.

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in the Table below.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System

Impact assessment must take account of the nature, scale and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the project phases:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact the following criteria is used:

Table 2: The rating system

NATURE
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.

GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.

2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects

SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity. The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact significance rating**	**Description**
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive effects.

3. HISTORY AND EVOLUTION OF THE SITE AND CONTEXT

3.1 Desktop Assessment

Background

This application is for the proposed development of one of 5x PV facilities and their respective grid connections located outside of Orkney along the R76 regional route connecting Orkney to Viljoenskroon. This regional route runs approximately 3km south of the development area.

Built Environment & Cultural Landscapes

The development areas are located in peri-urban farms just outside the towns of Orkney (North West) and Viljoenskroon (Free State). The town of Orkney was established in 1940 at the junction of the various railway lines. It was name after the old gold mine opened by Thomas Leask, who came from the Orkney Islands, in 1880 (SESA 1973 in Van Schalkwyk 2021). Viljoenskroon is a maize and cattle farming town located in the Free State province of South Africa. It was named after the original farm owner J. J. Viljoen and his horse Kroon. The town was laid out in 1921 on the farm "Mahemskuil" and became a municipality in 1925. A number of large gold and diamond mines are also located inbetween the three solar PV sites, namely Taulekoa Mine next to Goedgenoeg 433, Kopanong Gold Mine next to Pretorius Kraal 53 and Great Noligwa Mine next to Groot Vaders Bosch 592. Ruins of or intact avenues of trees, historical farmsteads and farm labourer's cottages may potentially be found within the proposed development areas. The cultural landscape is characterised by a agriculture with abrupt transitions into extremely heavy industrial areas in and around the mining compounds. The installation of solar PV plants will therefore not have any impacts on the landscape character of the area but a foot survey identifying potentially conservation-worthy built environment structures is recommended.

In his assessment of a PV Facility located less than 5km from this development area, Van der Walt (2016 SAHRIS ID 385181) noted that no scenic significant cultural landscapes or viewscapes were noted during the fieldwork within the area. The VIA for this nearby PV project also noted that there are no significant visual issues in the area. In 2022, CTS Heritage completed an HIA for an adjacent project known as the Mercury PV Cluster. The HIA noted that The broader cultural landscape of the development area has been assessed for cultural heritage significance, and found to have the following elements that contribute to the cultural value of the area:

- Dispersed farm werfs often associated with clusters of trees, with a consistent relationship between werfs, trees and roads
- Remnant areas of tree plantation
- Avenues of trees along roads, farm boundaries and access routes

This pattern seems to be repeated within this development area, and it is further noted that Paradyskop koppie falls within the broader development footprint.

Archaeology

Archaeological sites spanning the Earlier, Middle and Later Stone Age have been found in the region despite the extensive agricultural transformation of the area. In Dreyer (2005) and Van der Walt's (2007) heritage impact assessments of Pretorius Kraal 53 located in Orkney, various modern buildings were recorded that are located near the banks of the Vaal River that were deemed as not conservation worthy. Van der Walt identified some Middle to Later Stone Age artefacts scattered across the farm but did not map them. In Van Schalkwyk's (2021) impact assessment of the Siyanda Solar farm on Grootdraai 468 (which lies on the western border of Pretorius Kraal 53 in Orkney) is of relevant here due to the proximity of the study to this assessment area (SAHRIS ID 578029). Van Schalkwyk (2021) noted that visibility issues were a major problem, *"Due to the very dense vegetation cover that occur in the project area, natural as well as agricultural fields, it was impossible to obtain any ground visibility. The strategy was therefore to examine natural and man-made features that are usually associated with human habitation and activities such as clumps of trees and rock outcrops. The proposed power line corridor connecting the Solar Power Plant to the the existing Vaal Reef Substation was not surveyed as access to the relevant properties (Pretoriuskraal 53) was not possible. It is proposed that once the power line route has been confirmed within the 100m corridor a heritage walk-though needs to be undertaken."* Two burial sites were recorded during this survey despite the lack of Stone Age sites with the help of a local informant who had been working on the property for a number of years.

In his assessment, Huffman (2005, SAHRIS ID 7367) identified no sites of archaeological interest. In their assessment conducted in close proximity to this proposed development, Henderson and Koortzen (2007, SAHRIS ID 7340) noted that while no sites were found in the area surveyed, a number of previously excavated inspection pits yielded archaeological material in the form of stone artefacts. Henderson and Koortzen (2007, SAHRIS ID 7340) note that "These artefacts had been brought up from an unknown depth (probably no more than a metre or two), and were mostly undiagnostic flakes with one blade-like flake which could be Middle Stone Age. Raw material included cryptocrystalline, chert and quartz." Van der Walt (2016) conducted an archaeological field assessment for the Orkney PV Facility which will connect to this grid connection (2016, SAHRIS ID 385181). He made no archaeological observations but did identify two cemeteries. It is therefore highly likely that further burials may be located on the proposed solar PV areas as well as Stone Age material similar to the artefacts recorded but not mapped by Van der Walt. An archaeological field survey is therefore recommended.

In 2022, CTS Heritage completed an HIA for an adjacent PV project known as the Mercury PV Cluster. The archaeology assessment found a single archaeological site and very few isolated individual artefacts were documented. Cumulatively these findings indicate cultural evidence for MSA and LSA occupations of the area. The majority of finds were identified in disturbed surface contexts, and could not be tied chrono-culturally to a particular prehistoric period, however one site was relatively less affected by post-depositional processes, and

may have been exposed relatively recently. One isolated historic burial and an historic burial ground were identified within the vicinity of the Zaaiplaats farm werf. These resources have high levels of social and intrinsic cultural value and are graded IIIA. The presence of these burials highlights the possibility of further hidden or unmarked burials located throughout the development area. It is likely that similar archaeological resources will be present within this development area.

Palaeontology

According to the SAHRIS Palaeosensitivity Map the development sites are underlain by sediments of Low to Moderate fossil sensitivity (Figure 4). According to the extract from the Council of GeoScience Map 2726 Kroonstad, the area proposed for development is underlain by the Allanridge and Rietgat Formations of the Ventersdorp Subgroup. Butler (2016, SAHRIS ID 368565) completed a palaeontological assessment for the now approved Orkney PV facility to which this OHL is connected. Butler (2016) notes that the Ventersdorp Subgroup characterises a major occurrence of igneous extrusion that is associated with the fracturing of the Kaapvaal Craton approximately 2.7 Billion years ago.

An assessment completed by Almond (2021) for the nearby Siyanda Solar Power Plant is of relevance here due to its proximity to the development area. Almond (2021) noted that the broader area is "underlain near-surface or at depth by shallow marine carbonate bedrocks of the Malmani Subgroup (Chuniespoort Group, Transvaal Supergroup) of Precambrian age that are known to contain fossil stromatolites (laminated microbial bio-sedimentary structures) of various shapes and sizes (domes, columns etc). Indeed, stromatolite occurrences on Farm Grootdraai 468 are specifically mentioned in the Kroonstad 1: 250 000 geological sheet explanation by Schutte (1993). A combined desktop study and palaeontological site visit indicated that exposure levels of Precambrian bedrocks within the solar facility and grid connection project areas are generally very low due to low topographic relief and karstic weathering across an ancient land surface, widespread sandy soil cover and dense grassy vegetation. Well-preserved occurrences of stromatolites worthy of scientific interest are apparently rare, while the stromatolite varieties recorded here are likely to be of widespread occurrence within the bedrock units concerned (viz. the Oaktree and Monte Christo Formations). The thin to thick, Late Caenozoic (Pleistocene to Recent) unconsolidated sandy deposits mantling the carbonate bedrocks, especially in the south, are generally unfossiliferous and so far no fossil material has been found within them."

In the PIA completed for the adjacent Mercury PV Cluster by Bamford (2022), it is noted that "in terms of impacts to palaeontology, based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the overlying deep soils and sands of the Quaternary. In the northernmost section (Kleinfontein PV1, only north of the grid connection) there is a very small chance that fossils may occur in the shales below ground of the early Permian Vryheid Formation so a Fossil Chance Find

Protocol should be added to the EMPr. The proposed PV projects are located entirely on moderately sensitive Quaternary sands." As such, neither the Allanridge Formation nor the Rietgat Formation are known to be fossiliferous. It is therefore very unlikely that the proposed development will impact on significant palaeontological heritage and no further assessment is recommended in this regard.

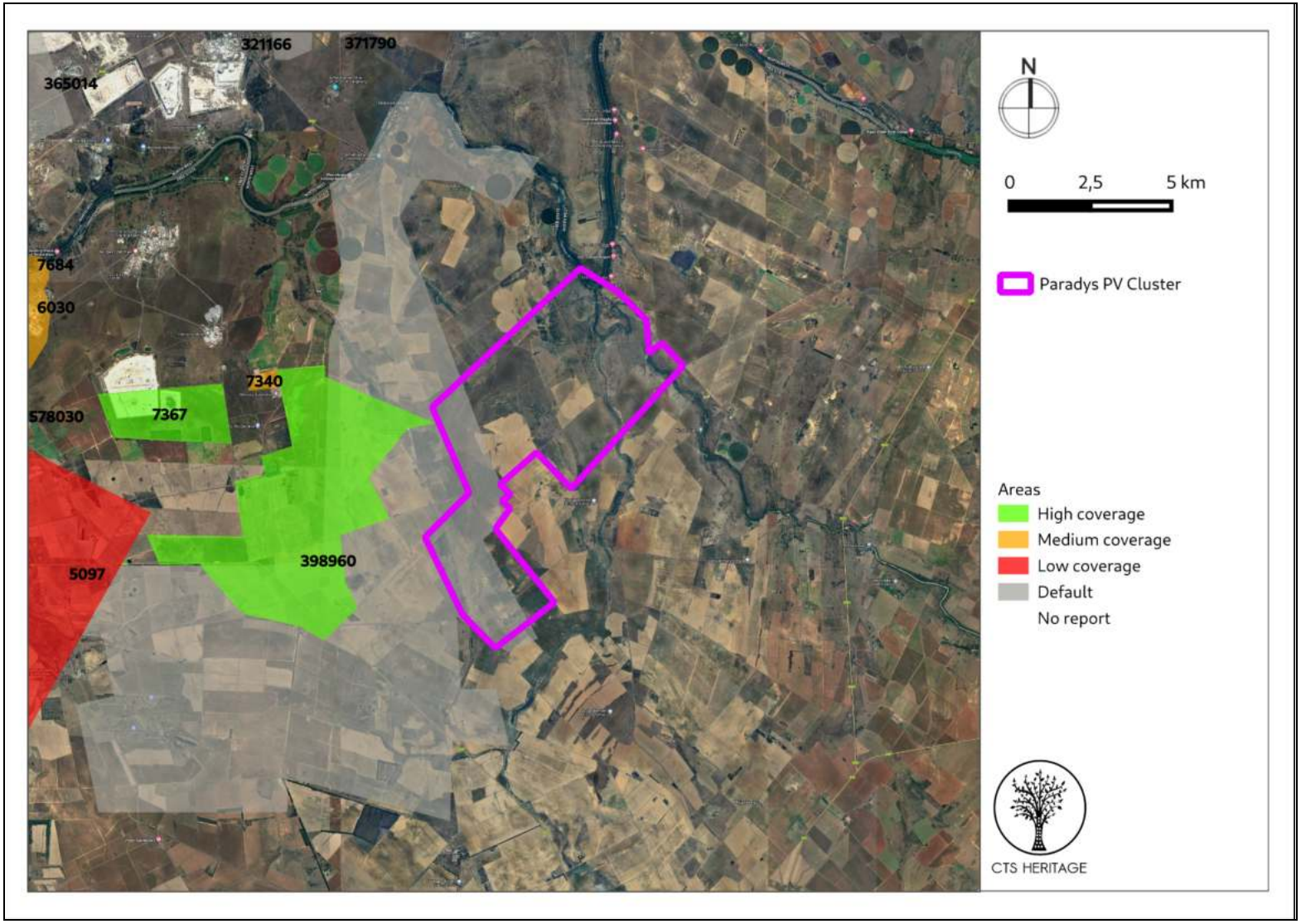

Figure 2: Spatialisation of heritage assessments conducted in proximity to the proposed development

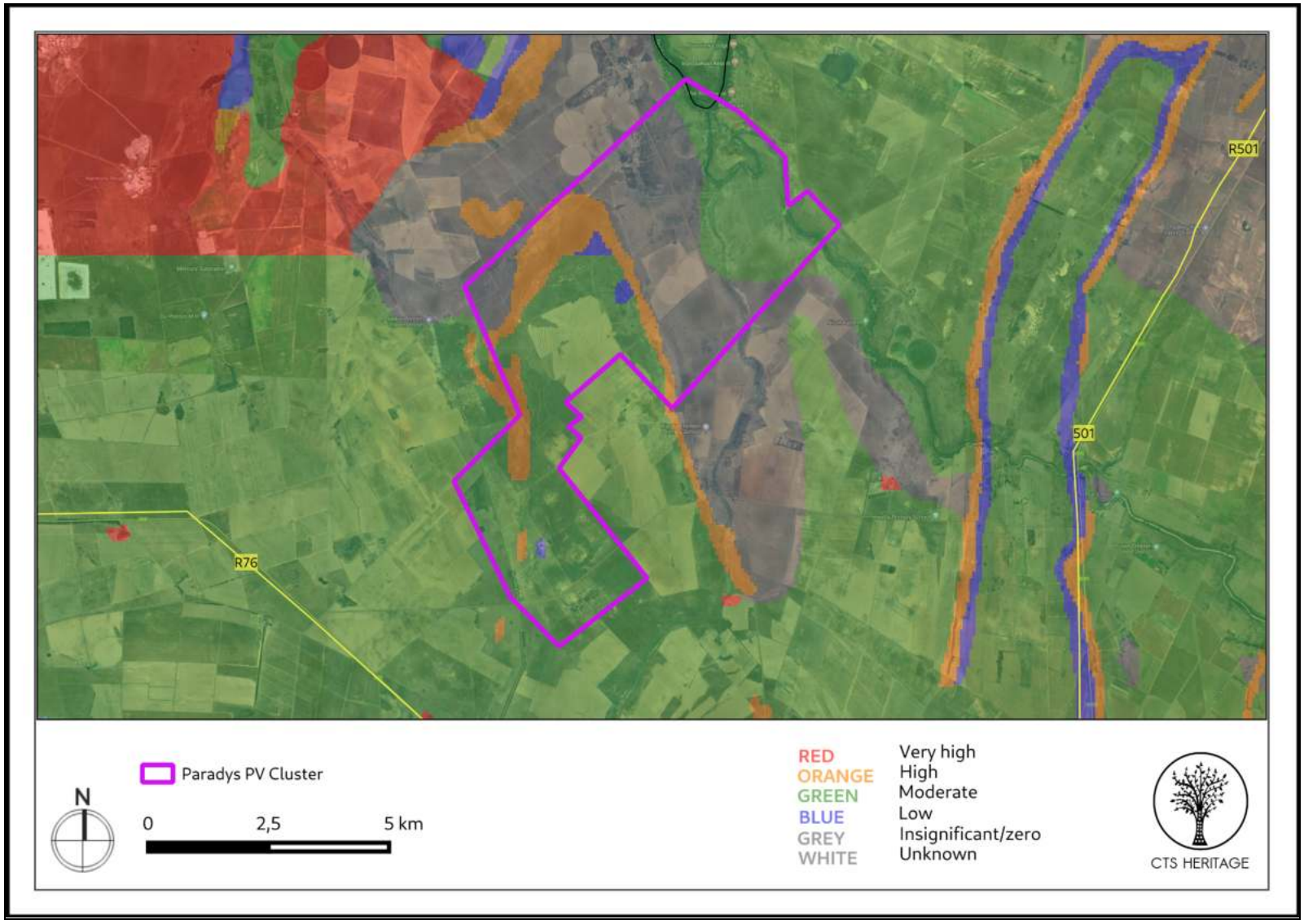

Figure 3.1: Palaeontological sensitivity of the proposed development area

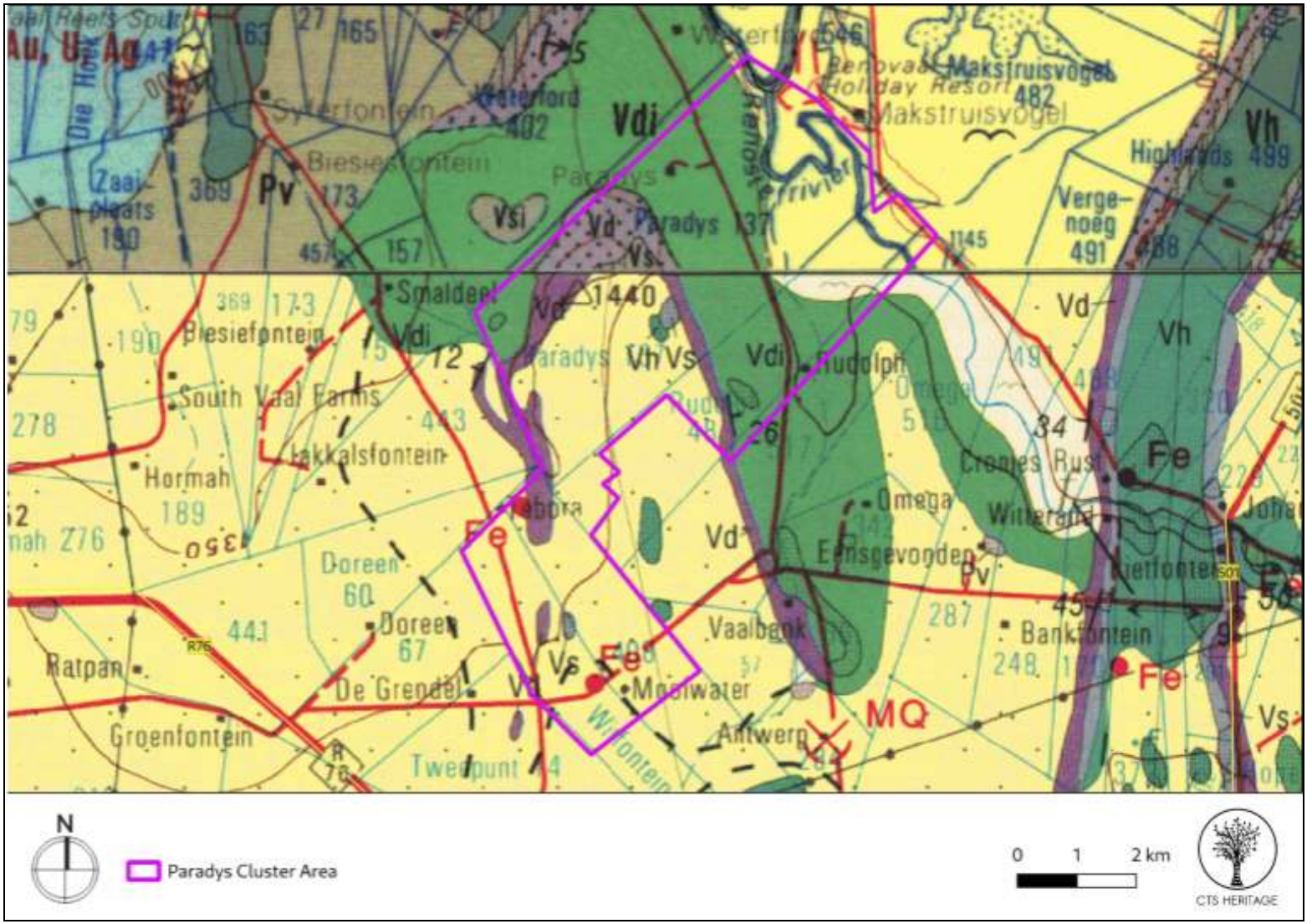

Figure 3.2. Geology Map. Extract from the CGS 2626 West Rand Geology Map indicating that the two Free State solar PV sites are underlain by sediments of the Malmani subgroup (Vmd) while the North West site is underlain by sediments of the Allanridge Formation (Va).

4. IDENTIFICATION OF HERITAGE RESOURCES

4.1 Summary of findings of Specialist Reports

Archaeology (Appendix 1)

The archaeology field assessment was completed for the whole of the Paradys PV Cluster Facility and the results of the assessment are relevant to determine the overall archaeological context and sensitivity of the development area.

Nearly 50 observations were made during the survey that consisted mainly of buildings and graves at the various werfs included in the study area. At Paradys, the older, likely original settlement footprint was obscured by dense bush and a number of informal 20th century graveyards are located here. Iron Age stone walled kraals and Later Stone Age artefacts in hornfels, chert and quartz were found on and close to the ridge which arcs from the northeast around to the southwest. The kraal enclosures appear to be late, possibly 19th century and historical walling features are also present. Most of the ruins recorded on the various farms (eg Witfontein, Smaldeel, De Grendel, Deborah) were built from the 1940s onwards and typically consist of a row of staff cottages that have since been abandoned as the farms have changed hands and ownership has become more and more aggregated amongst the larger corporate agribusinesses.

In areas bordering the maize fields, isolated and disturbed finds of MSA material was also found and it is more than likely that these continued in the cultivated areas. Early MSA and Early Stone Age material is also buried beneath the topsoil but the proposed development is unlikely to require very deep excavations that will reveal material at these depths.

Palaeontology (Appendix 2)

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site for development is in the moderately fossiliferous Kalahari sands (green) and moderately fossiliferous Daspoort Formation (orange) and non-fossiliferous Hekpoort Formation (grey).

Volcanic rocks such as diabase and andesitic lavas (Hekpoort Formation) do not preserve fossils as they have originated from below the earth's surface. No fossils have been reported from the Daspoort Formation quartzites but this formation is lumped together in the Palaeotechnical Report for the Free State (Groenewald et al., 2014) with the Magaliesberg, Timeball Hill and Silverton Formations, only some of which have recorded stromatolites. In addition, the area is covered with sols and has been cultivated for decades so any rocks have been removed.

Aeolian sands and alluvium are fairly mobile and very porous so they do not provide suitable conditions for preservation of organic matter (Cowan, 1995). Only in places where the sands have been waterlogged, such as palaeo-pans or palaeo-springs, is there any chance of fossilisation. For example, roots can be encased in

calcium-rich or silica-rich sands and crusts, known as rhizoliths or rhizocretions, can form around the roots, invertebrates or bones around the margin of a pond, pan or spring (Klappa, 1980; Cramer and Hawkins, 2009; Peters et al., 2022).

Note: in the southern part of the map in figure 3, there is a disjunction between the Vryheid Formation rocks ending abruptly along the line that joins the maps. The southern map shows the surface rocks, Quaternary sands and alluvium in this case, while the northern map shows the rocks from borehole core information, i.e. the underlying rocks. Since this project will be on the surface only, it is advisable to use the surface strata – the moderately fossiliferous Quaternary sands.

4.2 Heritage Resources identified

No significant heritage resources have been identified within or in close proximity to the area proposed for development.

4.3 Mapping and spatialisation of heritage resources

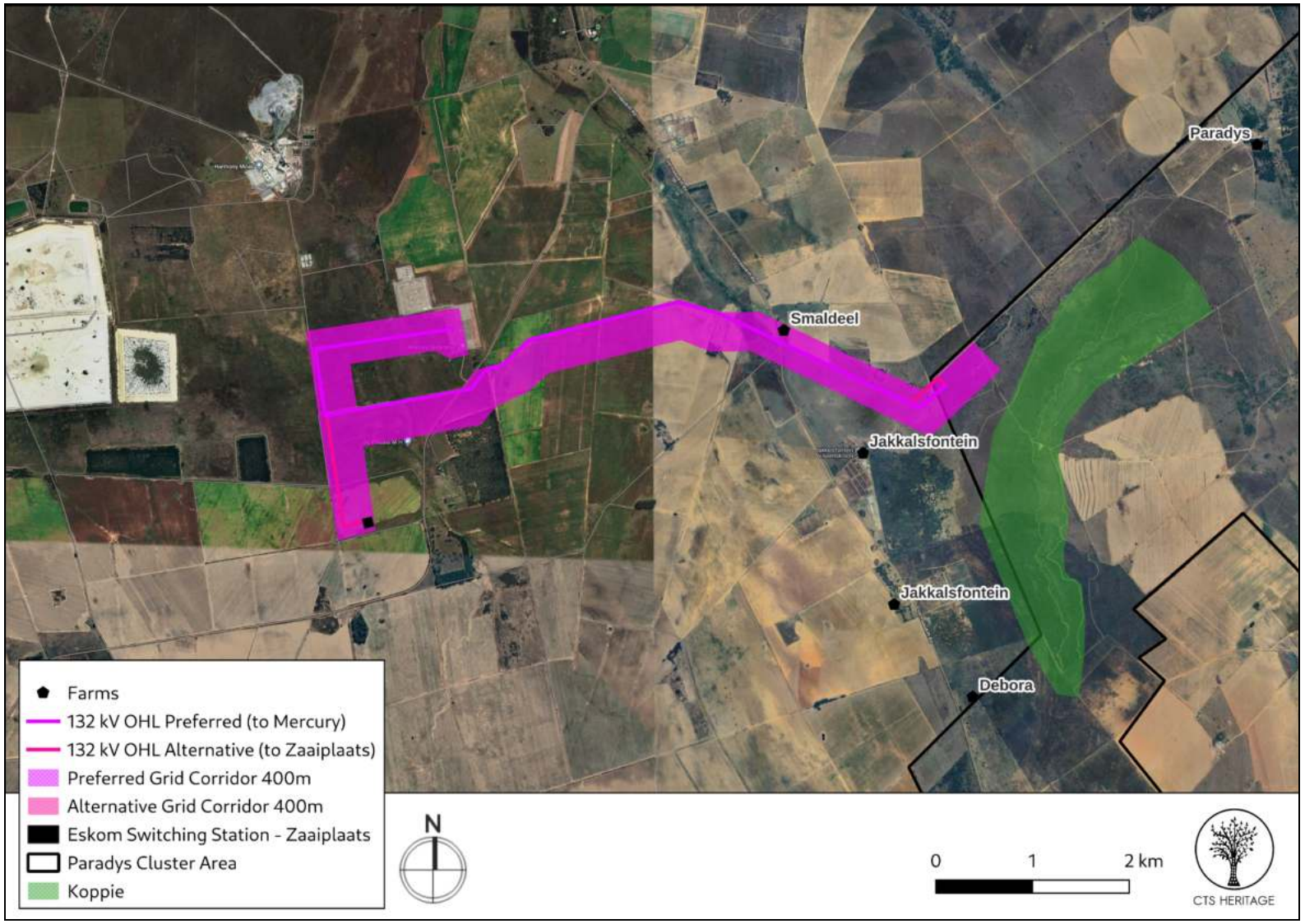

Figure 6.1: Map of potential heritage resources relative to the proposed development area extracted from the 1:50 000 Topo Map

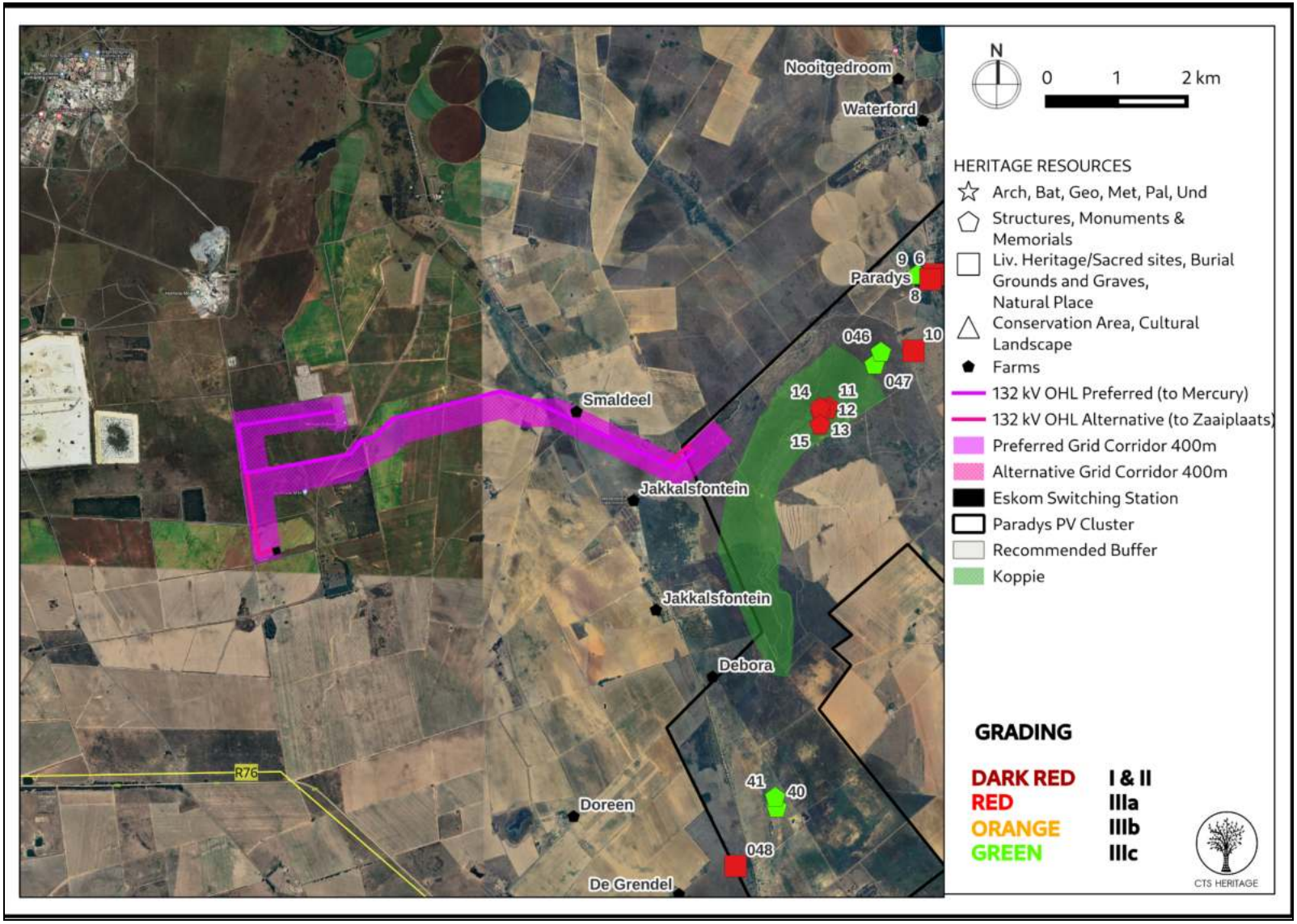

Figure 6.2: Map of all sites and observations noted within the development area with recommended mitigation measures

5. ASSESSMENT OF THE IMPACT OF THE DEVELOPMENT

5.1 Assessment of impact to Heritage Resources

Due to the nature of heritage resources, impacts to archaeological and palaeontological heritage resources are unlikely to occur during the PLANNING, OPERATIONAL and DECOMMISSIONING phases of the project. Potential impacts to the cultural landscape throughout the OPERATIONAL phase are discussed in the section below that deals with Cumulative Impacts. The impacts discussed here pertain to the CONSTRUCTION phase of the project.

No significant archaeological resources were identified within the proposed grid corridor or its alternative. No impact to significant archaeological heritage is anticipated here.

Palaeontology

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are either much too old to contain body fossils or too young and friable to preserve fossils. Furthermore, the material to be excavated are soils and sands and they do not preserve fossils. Since there is an extremely small chance that fossils from below ground may be disturbed, a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is extremely low.

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the overlying soils and sands of the Quaternary. There is a very small chance that fossils may occur below ground in the quartzites but this is very unlikely. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations for foundations and infrastructure have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. The impact on the palaeontological heritage would be low, so as far as the palaeontology is concerned, the project should be authorised.

Table 4: Assessment of impacts

NATURE		
Destruction of significant archaeological and palaeontological heritage during the construction phase of development.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
4	Complete loss of resources	The impact results in a complete loss of all resources.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
SIGNIFICANCE		

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.
The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	**Impact significance rating**	**Description**
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.

5.2 Sustainable Social and Economic Benefit

According to information received from the client, the operational phase will have a direct positive impact through the creation of employment opportunities and skills development, development of non-polluting, renewable energy infrastructure, contribution to Local Economic Development (LED) and social upliftment and increase in household earnings.

The proposed project will contribute to local economic growth by supporting industry development in line with provincial and regional goals and ensuring advanced skills are drawn to the Free State Province. The project will likely encounter widespread support from government, civil society and businesses, all of whom see potential opportunities for revenues, employment and business opportunities locally. The development of the solar PV facility will in turn lead to growth in tax revenues for local municipalities and sales of carbon credits, resulting in increased foreign direct investment.

The increase in the demand for services such as accommodation, transportation, security, general maintenance and catering will generate additional indirect socio-economic benefits for the local community members.

The main benefit of the proposed development operating in the area is that local companies or contractors will be hired for the duration of the construction period. The operational phase will provide permanent job opportunities to the local communities from the surrounding area since security guards and general labourers will be required on a full-time basis.

As such, the anticipated socio-economic benefits to be derived from the project outweigh any negative impacts to heritage resources on condition that the recommendations made below are implemented.

5.3 Proposed development alternatives

The DEAT 2006 guidelines on 'assessment of alternatives and impacts' proposes the consideration of four types of alternatives namely, the no-go, location, activity, and design alternatives. It is, however, important to note that the regulation and guidelines specifically state that only 'feasible' and 'reasonable' alternatives should be explored. It also recognizes that the consideration of alternatives is an iterative process of feedback between the developer and EAP, which in some instances culminates in a single preferred project proposal. An initial site screening was conducted by the developer the affected properties and the farm portions were found favorable due to its proximity to grid connections, solar radiation, ecology and relative flat terrain. These factors were then taken into consideration and avoided as far as possible.

The following alternatives were considered in relation to the proposed activity and all specialists should also make mention of these:

No-go alternative

This alternative considers the option of 'do nothing' and maintaining the status quo. The site is currently zoned for agricultural land uses. Should the proposed activity not proceed, the site will remain unchanged and will continue to be used for agricultural purposes. The potential opportunity costs in terms of alternative land use income through rental for energy facility and the supporting social and economic development in the area would be lost if the status quo persist.

Location alternatives

This alternative asks the question, if there is not, from an environmental perspective, a more suitable location for the power line. Only one route alternative is being considered since this is considered a the most feasible and shortest route to connect the Solar PV to the National Grid. The proposed powerline is approximately 9.2km long, and the proposed route of the power line is the shortest route from the authorised on-site substation(s)to the National Grid.

Design and layout alternatives

1. Collector Substation Alternative Locations:

Within the grid connection corridor, two collector substation location options are being considered for development. These are all located within the northern section of the grid connection, and each has a capacity of 132kV and will be ~2.5ha in extent. Refer to the Figure

The choice of pylon structure to be used for the power line will be determined in consultation with Eskom and does not significantly affect the environmental impacts of the proposed development as provision has already been made for the visual, avifauna, ecological and heritage impacts of erecting a power line. No defined structure has been confirmed at this stage and will depend on Eskom's technical requirements. The proposed 132kV line must be constructed according to the authorised standards for a power line approved by Eskom Holdings SoC Ltd. The structure to be utilised for the power line towers will also be informed by the local geotechnical and topographical conditions. The following alternatives are considered with regards to the proposed structures:

2.Steel lattice towers:

The steel lattice towers provide the following advantages over the other tower types available:

- Enables multipath earthing which enhances the overall electrical performance of the powerline.
- Is visually less obtrusive than the mono-pole option

- Is more practicable that other options i.e. more cost effective and more practical to construct and maintain.
- Is safer to work on than the monopole and wood pole structures.
- Is more durable than the wood pole structures.

3.Steel monopoles:

The steel monopole is considered less suitable than the steel lattice towers for the following reasons:

- Is visually more intrusive than the lattice towers.
- Is more expensive than the lattice towers.
- Requires more steel than the lattice towers.
- Is more difficult to erect.
- Is not as safe to work on as the lattice towers.

4.Wood poles:

Wood pole structures are only used in extreme circumstances where a visual impact needs to be avoided. Wood pole structures may be cheaper to produce and to construct, but they have one tenth of the lifespan of the metal counterparts and are far more susceptible to weather conditions which makes them less efficient and practicable. The wood pole structure is also more susceptible to having the cross arms burnt off by electrical faults as well as being susceptible to deformation with height.

Technology alternatives

The powerline will be constructed within the identified grid connection corridor towards the existing Eskom Mercury Substation. The 132kV overhead powerline is the only preferred alternative for the evacuation of the generated electricity due to the following reasons:

1.Overhead Transmission Lines-Overhead lines are less costly to construct than underground lines. Therefore, the preference with overhead lines is mainly on the grounds of cost. Overhead lines allow high voltage operations and the surrounding air provides the necessary electrical insulation to earth. Further, the surrounding air cools the conductors that produce heat due to lost energy (Swingler et al, 2006).

The overall weather conditions in the Free State Province are less likely to cause damage and faults on the proposed overhead transmission power line. Nonetheless, if a fault occurs, it can be found quickly by visual means using a manual line patrol. Repair to overhead lines is relatively simple in most cases and the line can usually be

put back into service within a few days. In terms of potential impacts caused by overhead transmission lines include visual intrusion and threats to sensitive habitat (where applicable).

The choice of structure to be used for the power line will be determined in consultation with Eskom once the Engineers have assessed the geotechnical and topographical conditions and decided on a suitable structure which meets the prescribed technical requirements. The choice of structures to be used will not have any adverse impacts on the environment. The line will be constructed according to the authorised standards for a power line approved by Eskom Holdings SoC Ltd.

2.Underground Transmission Lines-Underground cables have generally been used where it is impossible to use overhead lines for example because of space constraints. Underground cabling of high voltage power lines over long distances is not considered a feasible or environmentally practicable alternative for the following reasons:

- Underground cabling will incur significantly higher installation and maintenance costs.
- It is more difficult and takes longer to isolate and repair faults on underground cables.
- There is increased potential for faulting at the transition point from underground cable to overhead power line.
- Underground cables require a larger area to be disturbed during construction and maintenance operations and hence have a bigger environmental disturbance footprint.
- Underground cabling requires the disturbance of a greater area when it comes to agriculture and other compatible land uses as the entire servitude becomes available for use as opposed to just the area around the towers.

The use of an underground power line is not feasible for the proposed project due to the length of the line, which is ~9.2km long.

The following alternatives may be considered for **the overhead power line.**

1.Single Circuit Overhead Power Line

The use of single circuit overhead power lines to distribute electricity is considered the most appropriate technology and has been designed over many years for the existing environmental conditions and terrain as specified by Eskom Specifications and best international practice. Based on all current technologies available, single circuit overhead power lines are considered the most environmentally practicable technology available for the distribution of power. This option is considered appropriate for the following reasons:

- More cost-effective installation costs
- Less environmental damage during installation

- More effective and cheaper maintenance costs over the lifetime of the power line.

The use of a single-circuit power line is considered for the proposed project as it will meet the requirements to evacuate the generated solar electricity from the one Solar PV to the national grid.

2.Double Circuit Overhead Power Line

Where sensitive environmental features are identified, and there is sufficient justification, Eskom will consider the use of double circuit (placing 2 power lines on either side of the same tower structure) to minimize impacts. However, the use of double-circuiting has a number of technical disadvantage Faults or problems on one power line may mean that the other power line is also disabled during maintenance, and this will affect the quality of supply to an area. Larger and taller towers as well as more towers are required for double-circuit power lines. The double-circuit overhead power line proves more feasible since the single circuit may not have the capacity to transmit the large amount of electricity generated from the plant and during maintenance the entire plant would not have to be off-line as one of the double circuit lines would still be able to supply electricity. The double circuit would also be able to accommodate more than one Solar PV.

5.4 Cumulative Impacts

The cumulative impact of a development is the impact that development will have when its impact is added to the incremental impacts of other past, present or reasonably foreseeable future activities that will affect the same environment. It is important to note that the cumulative impact assessment for a particular project, like what is being done here, is not the same as an assessment of the impact of all surrounding projects. The cumulative assessment for this project is an assessment only of the impacts associated with this project, but seen in the context of all surrounding impacts. It is concerned with this project's contribution to the overall impact, within the context of the overall impact. But it is not simply the overall impact itself.

The most important concept related to a cumulative impact is that of an acceptable level of change to an environment. A cumulative impact only becomes relevant when the impact of the proposed development will lead directly to the sum of impacts of all developments causing an acceptable level of change to be exceeded in the surrounding area. If the impact of the development being assessed does not cause that level to be exceeded, then the cumulative impact associated with that development is not significant.

In terms of cumulative impacts to heritage resources, impacts to archaeological and palaeontological resources are sufficiently dealt with on a case by case basis. The primary concern from a cumulative impact perspective would be to the cultural landscape. The cultural landscape is defined as the interaction between people and the places that they have occupied and impacted. In some places in South Africa, the cultural landscape can be more

than 1 million years old where we find evidence of Early Stone Age archaeology (up to 2 million years old), Middle Stone Age archaeology (up to 200 000 years old), Later Stone Age archaeology (up to 20 000 years old), evidence of indigenous herder populations (up to 2000 years old) as well as evidence of colonial frontier settlement (up to 300 years old) and more recent agricultural layers.

Modern interventions into such landscapes, such as renewable energy development, constitute an additional layer onto the cultural landscape which must be acceptable in REDZ areas. The primary risk in terms of negative impact to the cultural landscape resulting from renewable energy development lies in the eradication of older layers that make up the cultural landscape. There are various ways that such impact can be mitigated.

In terms of impacts to heritage resources, it is preferred that this kind of infrastructure development is concentrated in one location and is not sprawled across an otherwise agricultural landscape. The proposed development may therefore result in unacceptable risk or loss, as the proposed development may result in a change to the sense of place of the area as this development is located outside of a REDZ area.

The landscape within which the proposed project areas are located, is not worthy of formal protection as a heritage resource and has the capacity to accommodate such development from a heritage perspective. The proposed development is located sufficiently far from significant roads and features that impact is unlikely. Additional mitigation measures to limit the negative impact to the cultural landscape are included below.

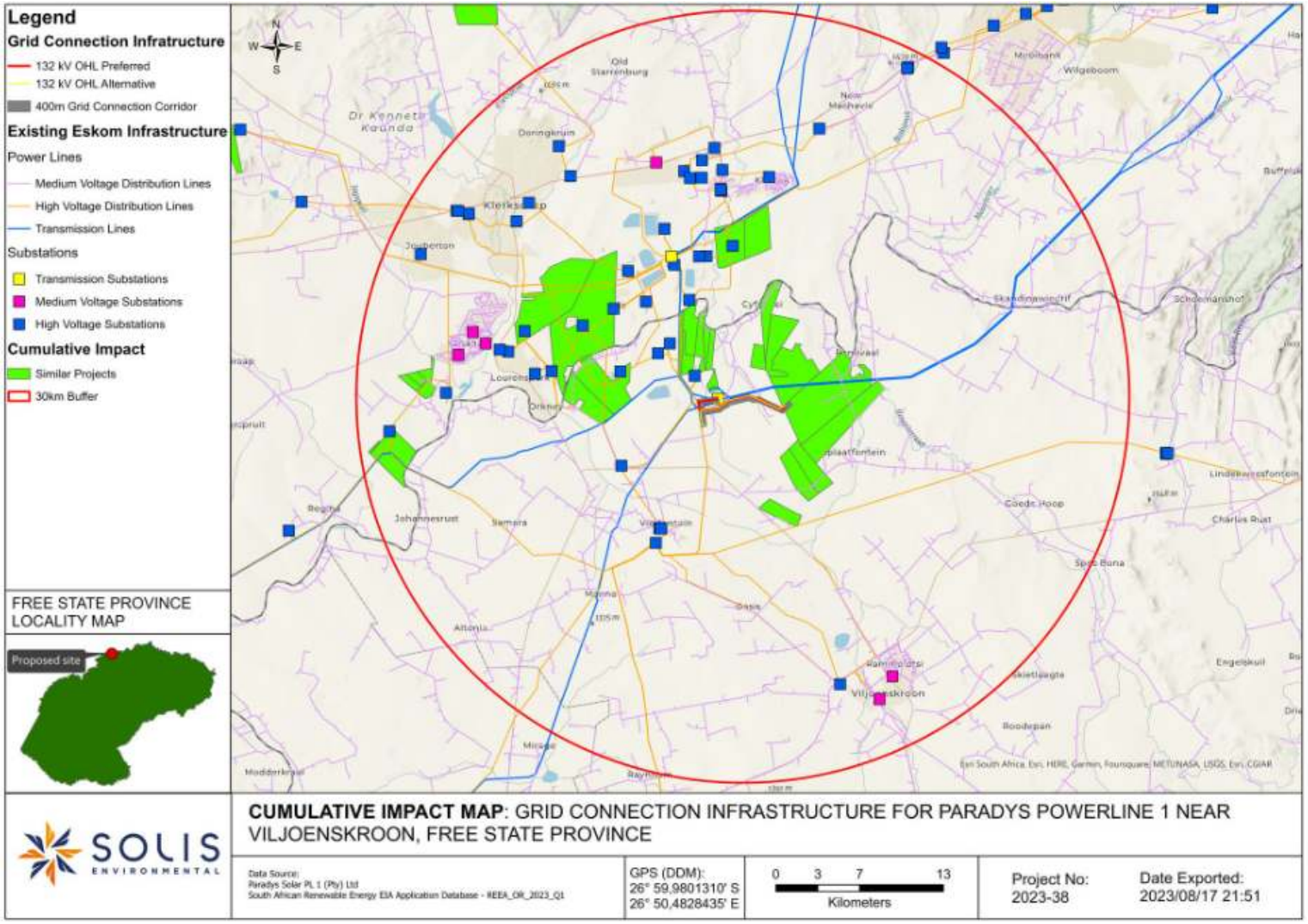

Figure 7: Cumulative Impact Map

5.5 Site Verification

According to the DFFE Screening Tool analysis, the development area has VERY HIGH levels of sensitivity for impacts to palaeontological heritage and LOW levels of sensitivity for impacts to archaeological and cultural heritage resources. The results of this assessment in terms of site sensitivity are summarised below:

- The cultural value of the broader area is moderate (MEDIUM)
- No significant archaeological resources were identified within the development area (LOW)
- No highly significant palaeontological resources were identified within the development area, and the geology underlying the development area is not very sensitive for impacts to significant fossils (LOW)

As per the findings of this assessment, and its supporting documentation, the outcome of the sensitivity verification disputes the results of the DFFE Screening Tool for Palaeontology - this should be LOW - and disputes the results of the screening tool for archaeology and cultural heritage - this should be considered to be MEDIUM. This evidence is provided in the body of this report and in the appendices (Appendix 1, 2 and 3).

6. RESULTS OF PUBLIC CONSULTATION

As this application is made in terms of NEMA, the public consultation on the HIA will take place with the broader public consultation process required for the Environmental Impact Assessment process and will be managed by the lead environmental consultants on the project.

7. CONCLUSION

The survey proceeded with no major constraints and limitations, and the project area was comprehensively surveyed for heritage resources, and a number of significant archaeological material remains were documented. The significant heritage resources identified within the development area relate to the agricultural past and burial grounds and graves. No significant resources were identified within the grid corridor or its alternative.

As is expected in this area, significant Iron Age resources were identified on top of the Paradys Koppie. Similar Iron Age sites are known from the nearby Harmony Gold Mining area. In general, sites such as these provide a significant amount of scientific information about the past when subject to appropriate analysis and as such, these sites have been determined to have high levels of scientific significance, and are graded IIIA. No impact to these significant resources is anticipated from this proposed development.

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the overlying soils and sands of the Quaternary. There is a very small chance that fossils may occur below ground in the quartzites but this is very unlikely. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations for foundations and infrastructure have commenced then they should be rescued and a

palaeontologist called to assess and collect a representative sample. The impact on the palaeontological heritage would be low, so as far as the palaeontology is concerned, the project should be authorised.

8. RECOMMENDATIONS

Based on the outcomes of this report, it is not anticipated that the proposed development of the grid connection infrastructure will negatively impact on significant heritage resources on condition that:

- The attached Chance Fossil Finds procedure must be implemented for the duration of construction activities
- Although all possible care has been taken to identify sites of cultural importance during the investigation of the study area, it is always possible that hidden or subsurface sites could be overlooked during the assessment. If any evidence of archaeological sites or remains (e.g. remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, charcoal and ash concentrations), fossils, burials or other categories of heritage resources are found during the proposed development, work must cease in the vicinity of the find and SAHRA must be alerted immediately to determine an appropriate way forward.

9. REFERENCES

Heritage Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
345	Marion Bamford	18/05/2012	PIA Phase 1	Palaeontological Impact Assessment for Kabi Vaalkop Solar PV Facility
4974	Udo Kusel	02/04/2008	HIA Phase 1	Cultural Heritage Resources Impact Assessment of Portion 523 of the Farm Townlands of Klerksdorp 424 IP Matlosana Local Municipality Southern District Municipality, North West Province
5097	Johnny Van Schalkwyk	07/03/2003	AIA Phase 1	Mercury-Perseus 400 kV Transmission Line, Cultural Heritage Resources
6030	Cobus Dreyer	20/06/2005	AIA Phase 1	Archaeological and Historical Investigation of the Proposed Residential Developments on Subdivision 13 of the Farm Pretoriuskraal 53, Viljoenskroon, Free State
7684	Jaco van der Walt	25/09/2007	AIA Phase 1	Archaeological Impact Assessment. Township Development and Sub Division of AH18, Pretoriuskraal, Orkney, North West Province
7685	Jaco van der Walt	25/09/2007	AIA Phase 1	Archaeological Impact Assessment. Township Development on Sub Division of AH19, Pretoriuskraal, Orkney, North West Province
9124	Francois P Coetzee	01/04/2012	Heritage Study	Cultural Heritage Survey of the Proposed Kabi Vaalkop PV Facility near Orkney, Dr Kenneth Kaunda District, North West Province
118491	Anton Pelser	01/11/2012	HIA Phase 1	Report on a Phase 1 HIA for the Alabama Extension 4 Township Development on the Remaining Extent of Portion 1of Town and Townlands of Klerksdorp 424-IP near KLerksdorp (Matlosana), North West Province
136737	Bruce Rubidge	19/10/2013	PIA Desktop	Palaeontological Scoping Report - Proposed Alabama Township Development
365014	Sidney Miller	02/03/2015	HIA Phase 1	Cultural Heritage Impact Assessment for Shafts #1 to #7, Orkney, Northwest Province, South Africa, for CAPM Gold.
368533	Jaco van der Walt	29/03/2016	Archaeological Specialist Reports	Archaeological Scoping Report for the Proposed Orkney Solar Farm And Associated Infrastructure Orkney, North West Province
368535	Elize Butler	01/12/2015		Palaeontological Impact Assessment Of The Proposed Orkney Solar Farm And Associated Infrastructure On The Remaining Extent Of Portions 7 And 21 Of The Farm Wolvehuis 114, Near Orkney, North West Province
368543	Udo Kusel	09/06/2016	HIA Phase 1	Phase 1 Cultural Heritage Resources Impact Assessment Phase 1 Cultural Heritage Resources Impact Assessment for the

				proposed town development Alabama Extension 6 and the rezoning of Park Erf 19613, Jouberton Extension 19. The proposed township establishment is situated on a poriton of the Remaining Extent of Portion 1 of the farm Townlands of Klerksdorp No. 424-IP North West Province
375984	Anton Pelser	01/11/2013	HIA Phase 1	Report on a Phase 1 HIA for the proposed Matlosana Estates & Uraniaville Ext 2 developments on various portions of Poriton 1 of the farm Town and Townlands of Klerksdorp 424-IP in Klerksdorp North West Province

CTS HERITAGE

APPENDICES

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APPENDIX 1: Archaeological Assessment (2023)

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APPENDIX 2: Palaeontological Assessment (2023)

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APPENDIX 3: Heritage Screening Assessments