HERITAGE IMPACT ASSESSMENT

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

Proposed development of the 30MW Harmony Target Solar PV, Allanridge, Free State Province

SAHRIS Ref:

Prepared by CTS Heritage

CTS HERITAGE

For

Savannah Environmental

January 2023

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EXECUTIVE SUMMARY

1. Site Name:

30MW Harmony Target Solar PV, Allanridge, Free State Province

2. Location:

Farm Name	Portion Number
Kromdraai 386	0

3. Locality Plan:

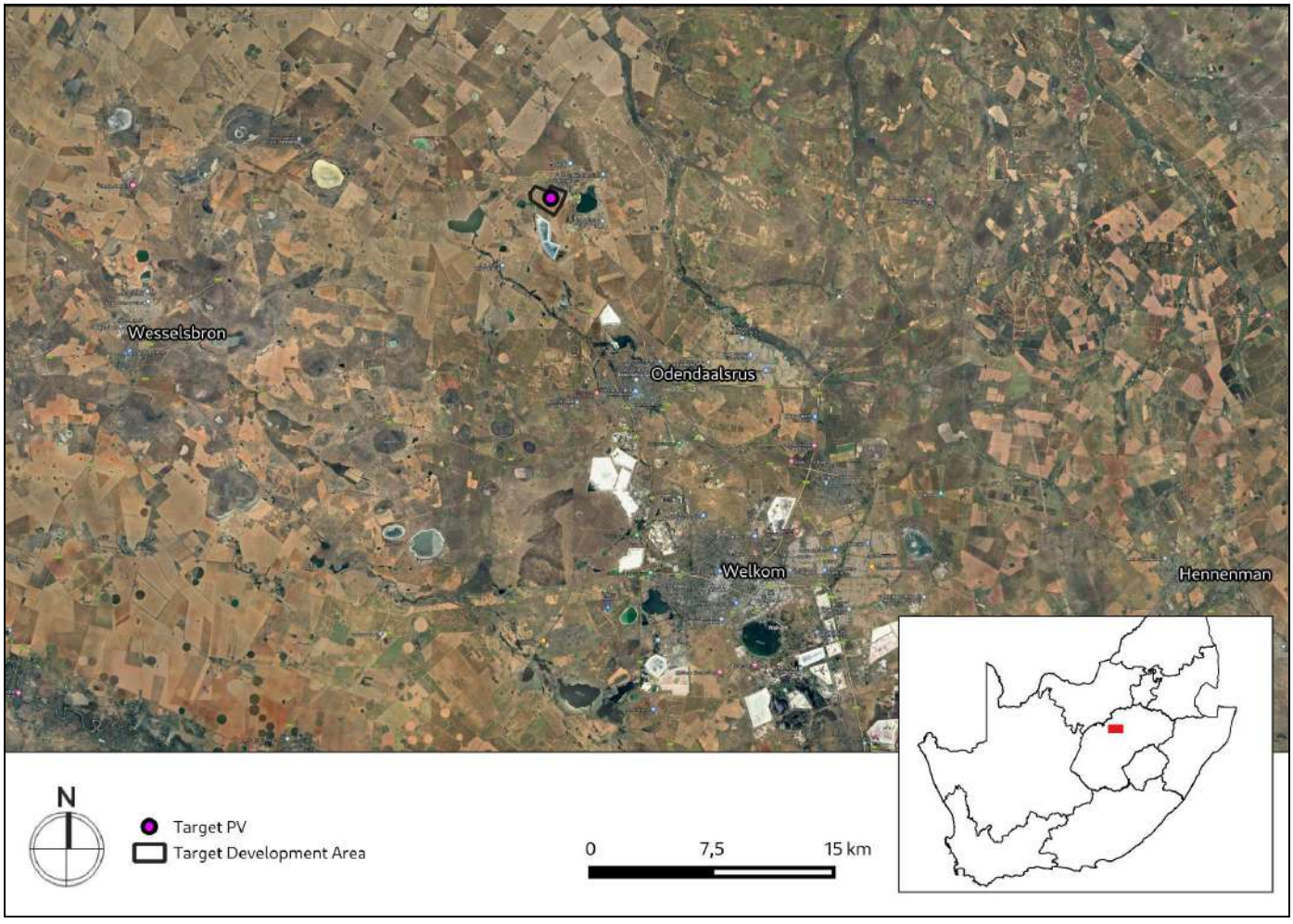

Figure 1: Location of the proposed study area

4. Description of Proposed Development:

Avgold (Pty) Ltd (a subsidiary of Harmony Gold Mining Company Ltd) is looking to supplement its energy supply by implementing Photovoltaic (PV) generation, aiding their transition to a more sustainable and environmentally friendly energy mix.

The development of a solar photovoltaic (PV) facility with a generating capacity of up to 30MW is proposed 550m south of the Harmony Target operations, approximately ~14km south of the town of Allanridge within the Matjhabeng Local Municipality and within the Lejweleputswa District Municipality, Free State Province. The PV facility is located on Portion 0 of the Farm Kromdraai 386 and Portion 0 of the Farm Aandenk 227. The solar PV development will be known as Harmony Target Solar PV Facility.

5. Heritage Resources Identified in and near the study area:

Site No.	Site Name	Description	Period	Co-ordinates		Grading	Mitigation
TG1	Target 1	Isolated artefacts: two miniature cores associated with microlithic flake production	LSA	-27.76088904	26.63345299	NCW	NA

6. Anticipated Impacts on Heritage Resources:

All of the areas surveyed as part of this assessment have been transformed through agricultural interventions and/or mining activity. No archaeological resources of scientific cultural value were identified within the area proposed for the Target PV Facility and its grid connection and as such, no impact to significant archaeological heritage resources is anticipated.

Furthermore, no impacts to significant palaeontological heritage is anticipated on condition that the attached Chance Fossil Finds Process is implemented and no impacts to the cultural landscape are anticipated.

7. Recommendations:

There is no objection to the proposed development in terms of impacts to heritage resources on condition that:

- The attached Chance Fossil Finds Procedure is implemented for the duration of construction activities
- Should any buried archaeological resources or human remains or burials be uncovered during the course of development activities, work must cease in the vicinity of these finds. The South African Heritage Resources Agency (SAHRA) must be contacted immediately in order to determine an appropriate way forward.

Details of Specialist who prepared the HIA

Jenna Lavin, an archaeologist with an MSc in Archaeology and Palaeoenvironments, and currently completing an MPhil in Conservation Management , heads up the heritage division of the organisation, 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 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 a member 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. Recently, Jenna has been responsible for conducting training in how to write Wikipedia articles for the Africa Centre's WikiAfrica project.

Since 2016, Jenna has drafted over 100 Heritage Impact Assessments throughout South Africa.

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CONTENTS

1. INTRODUCTION

1.1 Background Information on Project

Avgold (Pty) Ltd (a subsidiary of Harmony Gold Mining Company Ltd) is looking to supplement its energy supply by implementing Photovoltaic (PV) generation, aiding their transition to a more sustainable and environmentally friendly energy mix.

The development of a solar photovoltaic (PV) facility with a generating capacity of up to 30MW is proposed 550m south of the Harmony Target operations, approximately ~14km south of the town of Allanridge within the Matjhabeng Local Municipality and within the Lejweleputswa District Municipality, Free State Province. The PV facility is located on Portion 0 of the Farm Kromdraai 386 and Portion 0 of the Farm Aandenk 227. The solar PV development will be known as Harmony Target Solar PV Facility.

The preferred site for the project is on properties which are privately owned by the Mine and are available for the proposed project, and is therefore deemed technically feasible by the project developer for such development to take place.

A project site[1] considered to be technically suitable for the development of the solar PV facility, with an extent of approximately 500ha, was identified. A development area[2] of ~245ha was demarcated within this project site and allows an adequate footprint (~105ha)[3] for the installation of a solar PV facility with a contracted capacity of up to 30MW, while allowing for the avoidance of environmental site sensitivities.

The infrastructure associated with the 30MW solar PV facility will include:

- PV modules and mounting structures
- Inverters and transformers a SCADA room, and maintenance room
- Cabling between the project components, to be laid underground where practical
- Access roads, internal roads and fencing around the development area.
- Temporary and permanent laydown areas and O&M buildings.
- Grid connection solution including an on-site facility substation, switching station, to be connected to the Avgold Substation via an overhead power line (located ~400m north east of the site).

[1] The project site comprises the affected properties for that identified area within which the development area and development footprint are located. It is the broader geographic area assessed as part of the BA process, within which direct effects of the proposed project may occur. The project site is ~500ha in extent.
[2] The development area is that identified area where the 30MW PV facility is planned to be located. This area has been selected as a practicable option for the facility, considering technical preference and constraints. The development area is ~245ha in extent.
[3] The development footprint is the defined area (105ha) located within the development area) where the PV panel array and other associated infrastructure for the Harmony Target Solar PV facility is planned to be constructed. This includes the actual footprint of the facility, and the area which would be disturbed.

Three alternative grid corridors (300m in width) have been assessed. These are described as follows:

Alternative 1: A 300m wide corridor between the switching substation located on the Harmony Target Solar PV Facility and the Avgold Substation via an overhead power line (~750m in length). The corridor exits the facility from the north east corner of the development footprint, and follows existing Eskom power lines to the east of the development area as well as an unnamed mine access road. The route skirts around the Loraine One Substation to access the south side of the Avgold Substation (located directly south west of the Loraine One Substation).

Alternative 2: A 300m wide corridor between the switching substation located on the Harmony Target Solar PV Facility and the Avgold Substation via an overhead power line (~440m in length). The corridor exits the facility from the north east corner of the development footprint, and follows a secondary mine access road to access the south side of the Avgold Substation (located 400m north east of the site).

Alternative 3: A 300m wide corridor between the switching substation located on the Harmony Target Solar PV Facility and the Avgold Substation via an overhead power line (~1.5km in length). The corridor exits the facility from the north west corner of the development footprint, and follows the farm boundary for approximately 200m west before turning north and then east to follow an unnamed mine access road for approximately 570m. at the junction with the secondary road, the route turns south to access the south side of the Avgold Substation.

The site is accessible via the R30 and an unnamed secondary road/mine access road.

As of 2019, the Industrial sector was the leading electricity consumer in South Africa, with up to 56 percent of the total consumption (Ratshomo 2019). Mining and quarrying accounted for 10% of the industrial consumption while non-ferrous metals and non-metallic both accounted for 8% and 5%, respectively (*Chamber of Mines of South Africa, 2017*).

The successful development of the renewable energy projects will enable Harmony Gold to make a valuable and meaningful contribution towards growing the green economy within the province and South Africa. This will assist the Free State in creating green jobs and reducing Green House Gas emissions, whilst reducing the energy demand on the National Grid.

1.2 Description of Property and Affected Environment

The potentially affected area associated with the proposed PV facility is located in the Target mining area, approximately 12 km north-east of the town of Odendaalsrus in the goldfields region of the Lejweleputswa district of the Free State province of South Africa. The footprint for potential development is largely flat, and characterised - over substantial portions - by ploughed agricultural camps in the western most two-thirds. The upper sediments in the agriculturally affected regions (western portion) have thus been extensively disturbed through agricultural processes, and the original quaternary deposits have been reworked or removed to depths in excess of ~0.5m in several places, as a consequence of agriculture and/or mining related clearing (CTG1 - CTG6).

Local bedrock outcrops ephemerally at several points east of the affected area. This bedrock is comprised largely of shales and indurated siltstones (Ecca Group), whereas the upper sediments covering these host rocks, and the footprint itself, likely derive from the in-situ weathering of local parent formations. The upper sediments were fluvially deposited across much of the area (as evidenced by sub-angular edges and rounding of lithic inclusions), and potentially relate in depositional origin to summer flooding of the drainages to the south and west.

In the eastern portion of the affected property, where natural landscape is primarily retained (i.e. unaffected by modern activity), grassland and semi-arid shrubland is evident with shale and some evidence for sub-volcanic rock in the form of small secondary colluvial nodules (<5cm in maximum diameter) in several locations.

The western portion of the affected property is interspersed with vehicle tracks where grass has been trampled and/or removed, probably to facilitate vehicle manoeuvrability between agricultural infrastructure and to facilitate movement associated with prospecting. Indigenous fowl including francolin and guineafowl were observed on the affected property, in addition to abundant traces of burrowing rodents (predominantly hares), which may well affect any potential sub-surface archaeology (though no sub-surface remains were documented).

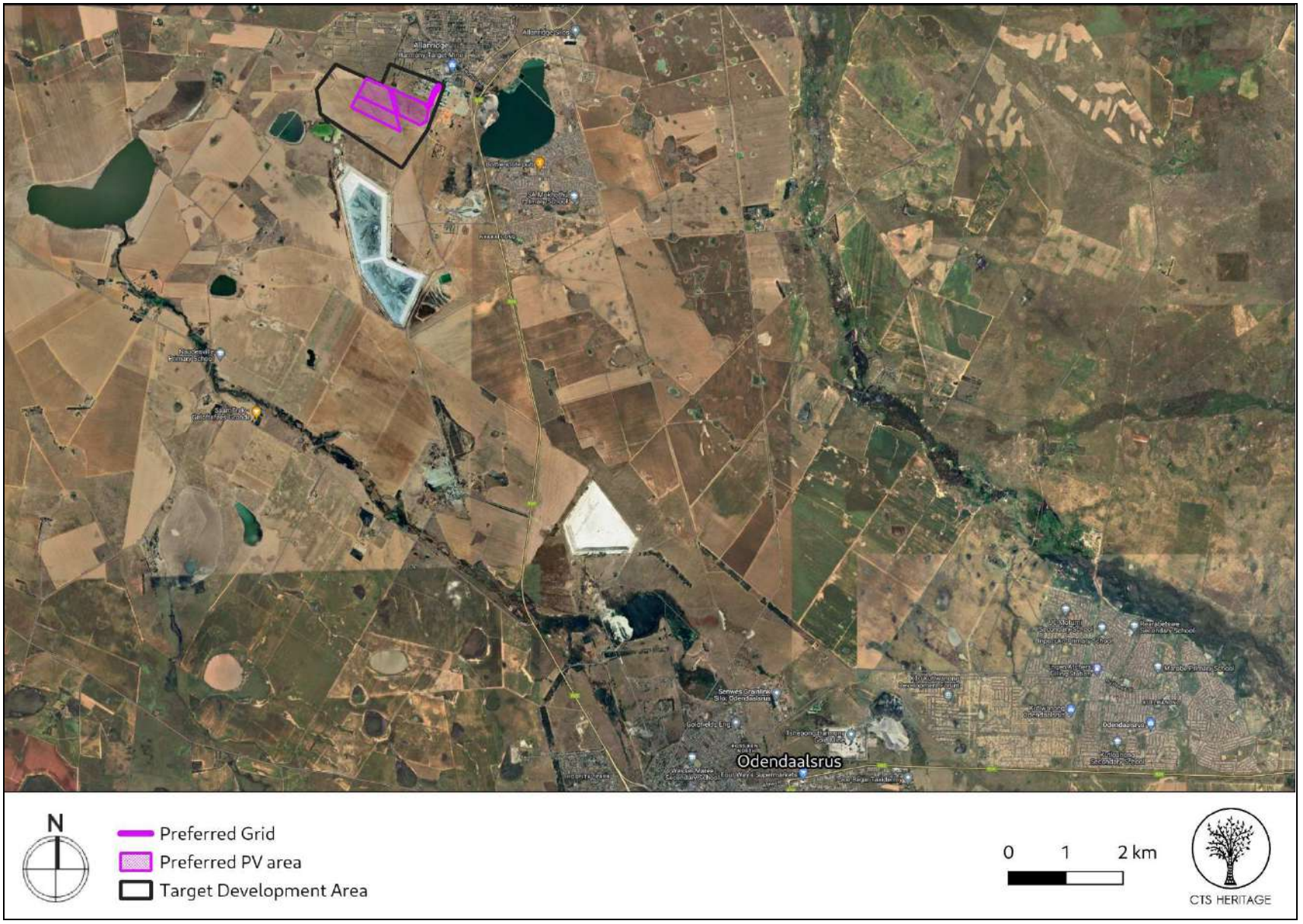

Figure 1.1: The proposed development area

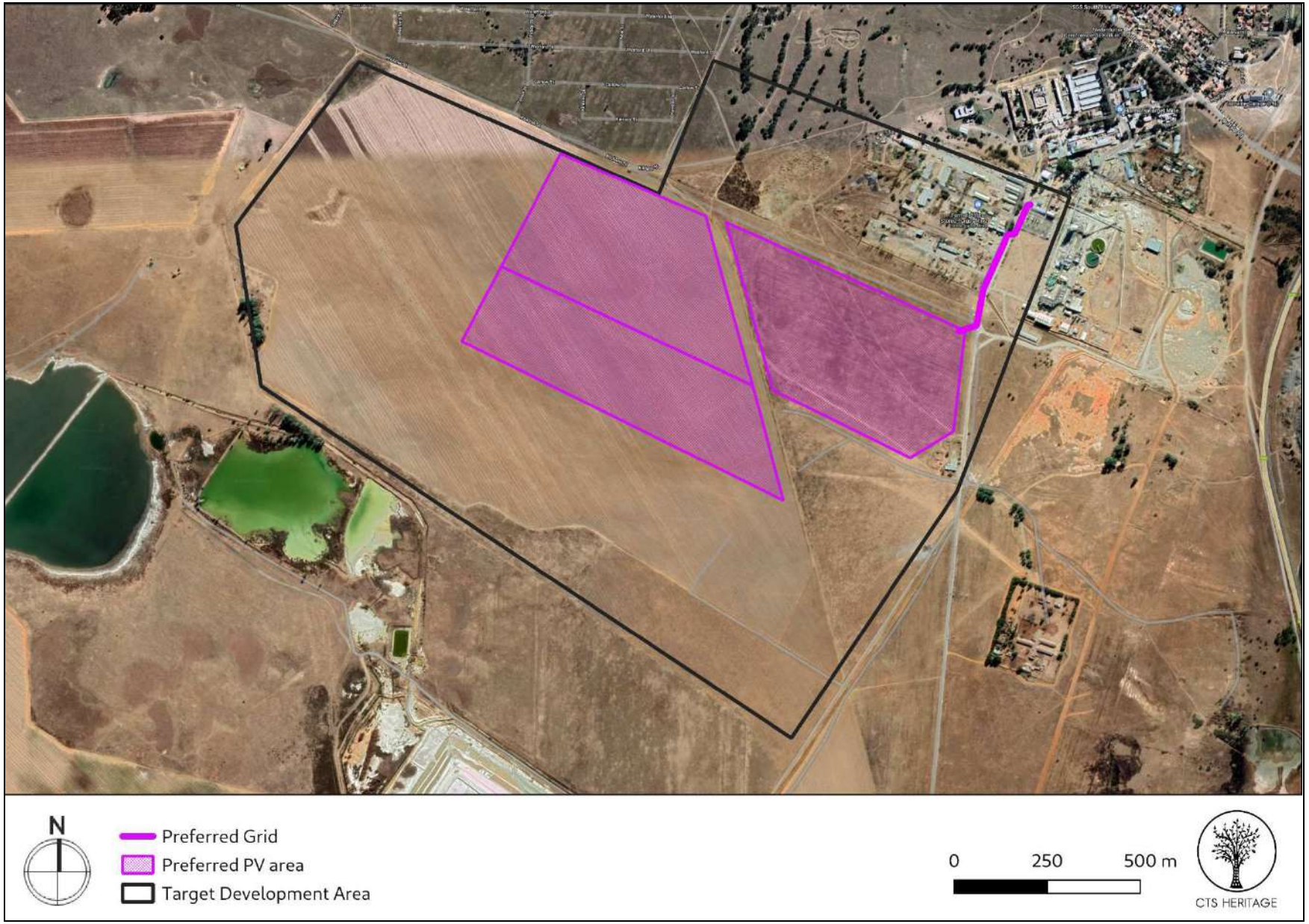

Figure 1.2: The proposed development area

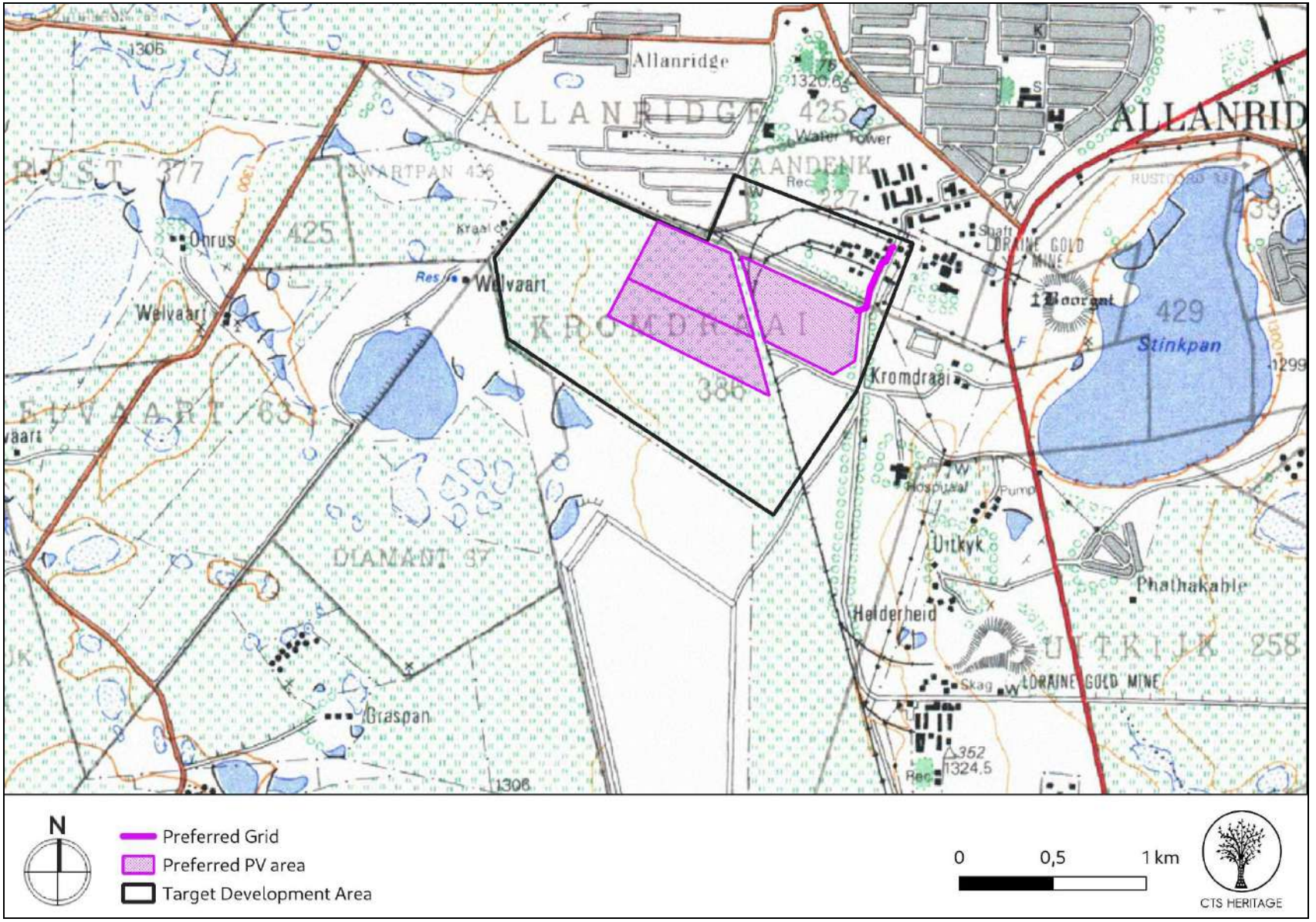

Figure 1.3: Study Area reflected on the 1:50 000 Topo Map

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) (Appendix 1)
- An archaeologist conducted an assessment of the broader study area in order to determine the archaeological resources likely to be disturbed by the proposed development. The archaeologist conducted her site visit on 30 June 2022 (Appendix 2)
- A Desktop Palaeontology Assessment was completed 6 July 2022, Appendix 3)
- The identified resources were assessed to evaluate their heritage significance and potential impacts to these resources were interrogated
- 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

Ploughed agricultural camps encompass the western most two-thirds of the affected area. Consequently, the upper sediments are substantially disturbed where crops are actively growing and cattle grazing and resulting trampling is evident.

Dense grasses and occasional shrubland cover portions of the project area. This coverage significantly inhibited the visibility of surface archaeology. However, this is not regarded as a substantial problem in relation to the Stone Age archaeological remains, which in most cases look to have generally limited scientific importance due to the disturbed and deflated contexts they occur in. Additionally, even in the places that had optimal visibility, evidence of archaeology was extremely sparse. It is clear that the Stone Age sensitivity and scientific potential of the project area has been comprehensively assessed.

The inability to assess some of the footprint area at ground surface level in some portions (due to modern vegetation cover), should be regarded as a constraint to the documentation of potential graves.

Previous vegetation clearing activities through prospection, and by farmers, may have affected evidence of surface archaeology including the possible above-surface presence of material evidence of graves (i.e. the removal of surface stone structures).

Access was not possible in areas actively mined; however, any archaeology occurring in these areas would be *ex situ* in any case, and of limited scientific importance.

The team is confident that, despite these challenges, the work completed has provided a sufficient assessment of the heritage sensitivity of the area proposed for development.

2.5 Savannah Impact Assessment Methodology

Direct, indirect and cumulative impacts of the issues identified through the Basic Assessment process were assessed in terms of the following criteria:

- The nature, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The extent, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high).
- The duration, wherein it will be indicated whether:
    - The lifetime of the impact will be of a very short duration (0 – 1 years) – assigned a score of 1.
    - The lifetime of the impact will be of a short duration (2 – 5 years) – assigned a score of 2.
    - Medium-term (5 – 15 years) – assigned a score of 3.
    - Long term (> 15 years) – assigned a score of 4.
    - Permanent – assigned a score of 5.
- The consequences (magnitude), quantified on a scale from 0 – 10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight

impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

- The probability of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1 – 5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- The significance, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high.
- The status, which will be described as either positive, negative or neutral.
- The degree to which the impact can be reversed.
- The degree to which the impact may cause irreplaceable loss of resources.
- The degree to which the impact can be mitigated.

The significance is calculated by combining the criteria in the following formula:

S = (E + D + M) x P

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

The significance weightings for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area).
- 30 – 60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated).
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

3. HISTORY AND EVOLUTION OF THE SITE AND CONTEXT

3.1 Desktop Assessment

Background

This application is for the proposed development of a PV facility and associated grid infrastructure located immediately adjacent to the town of Allanridge and approximately 15km from the town of Odendaalsrus in the Free State Province. Odendallsrus started out in 1912 as a ramshackle collection of farms and a central church that became a town. In April 1946 gold was struck on the farm *Geduld* near the town. Allanridge is the main centre of the Loraine Gold Mining Company and is dominated by the tall headgear and complex reduction works that processes thousands of tons of gold-bearing ore every month. Allanridge was established as a settlement in the Free State goldfields in 1947 and was named after Allan Roberts whose borehole's proximity to the gold bearing reef was the precursor to the mining in the area. The town layout was designed by town planner William Backhouse, who also planned Welkom. It became a municipality on 21 December 1956.

The study area falls within the bioregion described by Mucina et al (2006) as the Dry Highveld Grassland Bioregion with the vegetation described as Vaal-Vet Sandy Grassland within a Grassland Biome. Land use in the general area is characterised by mining and agriculture, dominated by crops and cattle farming. The study area is characterised by deep sandy to loamy soils based on the extensive agricultural activities." According to Fourie (2021), "Existing surrounding land uses associated with the project area include a combination of mining related infrastructure and developments, powerlines, refuse dumps and dirt roads." As the area proposed for development is located within an existing mining area, it is very unlikely that significant built environment heritage will be impacted by the proposed development.

The proposed development area is located immediately adjacent to an old National Monument declared in 1960. This site has the shape of a keyhole and marks the place where the first gold prospecting borehole in this area of vast plains was drilled. Although the first payable gold deposits to be discovered in the Orange Free State were not found in this borehole, it was the first prospecting borehole in the area and the results obtained from it undoubtedly gave rise to other prospecting and the discovery of the Orange Free State goldfields. The monument erected round the borehole through the generosity of Lorraine Gold Mines Limited, is fittingly designed in the form of a keyhole to symbolise the unlocking of the goldfields of the Orange Free State. A detailed history of this monument is recorded on SAHRIS. The history of Allanridge is intimately linked with the gold mining industry and as such, it is unlikely that the proposed PV development will negatively impact on this unique cultural landscape as it is proposed to support the gold mining industry.

Archaeology

According to Fourie (2021), "The Free State has a rich archaeological and historical history going back millions of

years and includes significant aspects such as Later Stone Age rock art, Battlefields and Iron Age stonewalled enclosures. The general surroundings of the study area became a melting pot of contact and conflict as it represents one of many frontiers where San hunter-gatherers, Nguni and Sotho-Tswana agro-pastoralists, Dutch Voortrekkers and British Colonists all came together. The ravages of war also swept across these plains, and in particular the South African War (1899-1902) as well as the Boer Rebellion (1914-1915)." No heritage resources of significance were identified by Van der Walt (2013) in his assessment of a nearby farm. Van der Walt (2013) notes that "some MSA finds might be possible around pans on the farm. It is important to note that the lack of sites can be attributed to a lack of sustainable water sources (no pans exist in the development footprint) in the development area as well as the lack of raw material for the manufacturing of stone tools. No Sites dating to the Early or Middle Iron Age have been recorded or are expected for the study area. The same goes for the Later Iron Age period where the study area is situated outside the western periphery of the distribution of Late Iron Age settlements in the Free State. However to the north of the study area, ceramics from the Thabeng facies belonging to the Moloko branch of the Urewe tradition were recorded at Oxf 1 and Platberg 32/71 (Maggs 1976, Mason 1986)".

In his field assessment conducted close to the area proposed for development, Rossouw (2012) noted that "The Stone Age archaeological footprint in the region is largely represented by the occurrence of open-site, Middle Stone Age (MSA) and Later Stone Age (LSA) assemblages that are mainly located near river drainages. Interestingly, a large number of MSA artifacts were found 2m below the surface at the Allanridge railway siding in 1953. The material is stored at the National Museum in Bloemfontein. Unfortunately, the context of the assemblage is unknown. MSA as well as LSA artefacts, in association with mammal fossil remains, are also found in a series of erosional gullies along the Sand and Doring Rivers between Virginia and Theunisen. There are no records of rock engravings known from the area. The ruins of a large complex of Late Iron Age settlements (OXF 1, Maggs 1976) are found at Strydfontein between Hennenman and Ventersburg. However, it is noted that the affected area is situated outside the western periphery of distribution of Late Iron Age settlements below the Vals River in the Free State (Maggs 1976)." In Rossouw's assessment, he found no evidence of *in situ* Stone Age or Iron Age archaeological material. He noted no indications of prehistoric structures or rock engravings, historical buildings or structures older than 60 years. Two small graveyards were also recorded during the survey.

Figure 2.1: Spatialisation of heritage assessments conducted in proximity to the broader study area

Figure 2.2: Spatialisation of heritage resources known in proximity to the broader study area

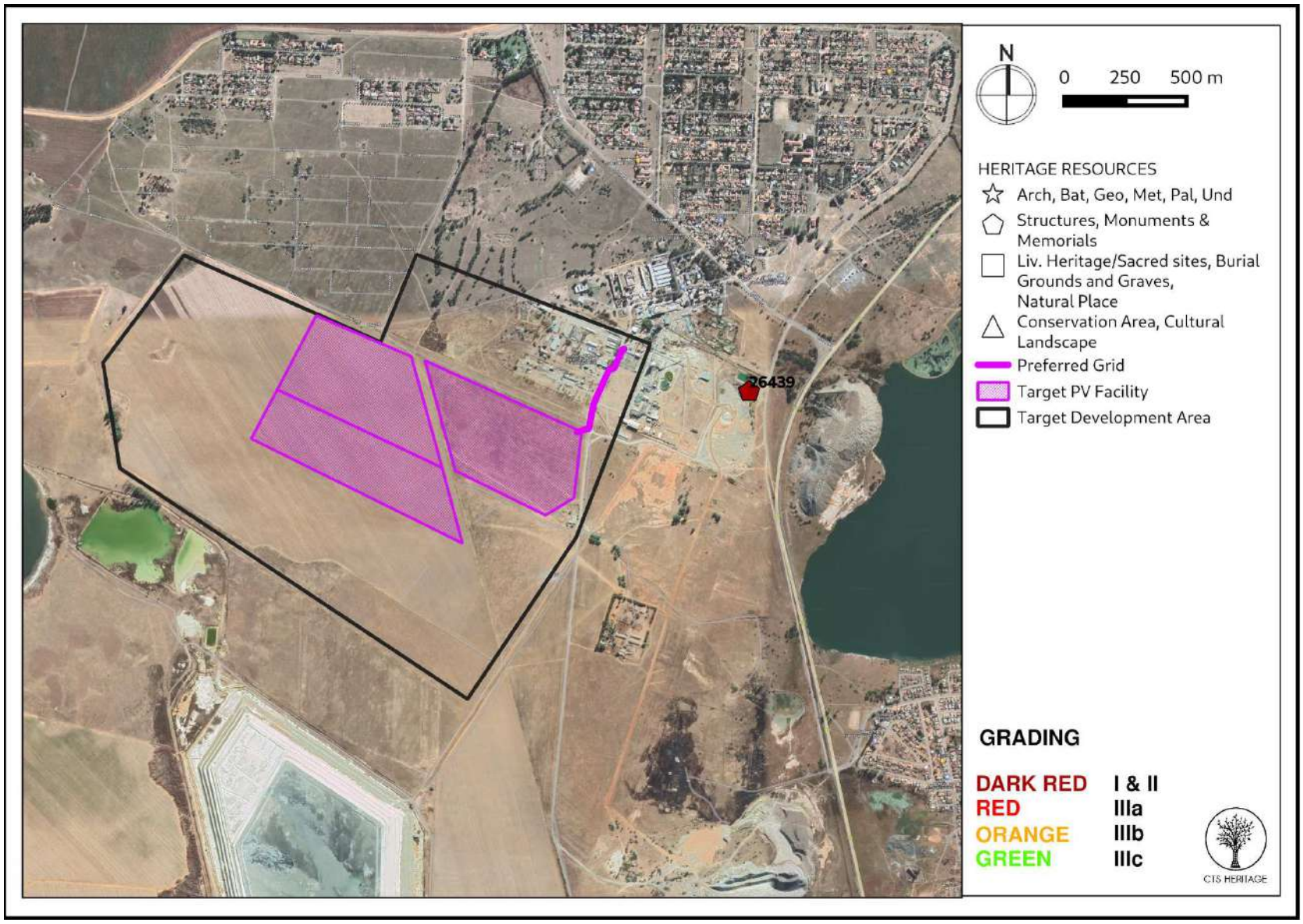

Figure 2.3: Spatialisation of heritage resources known in proximity to the broader study area

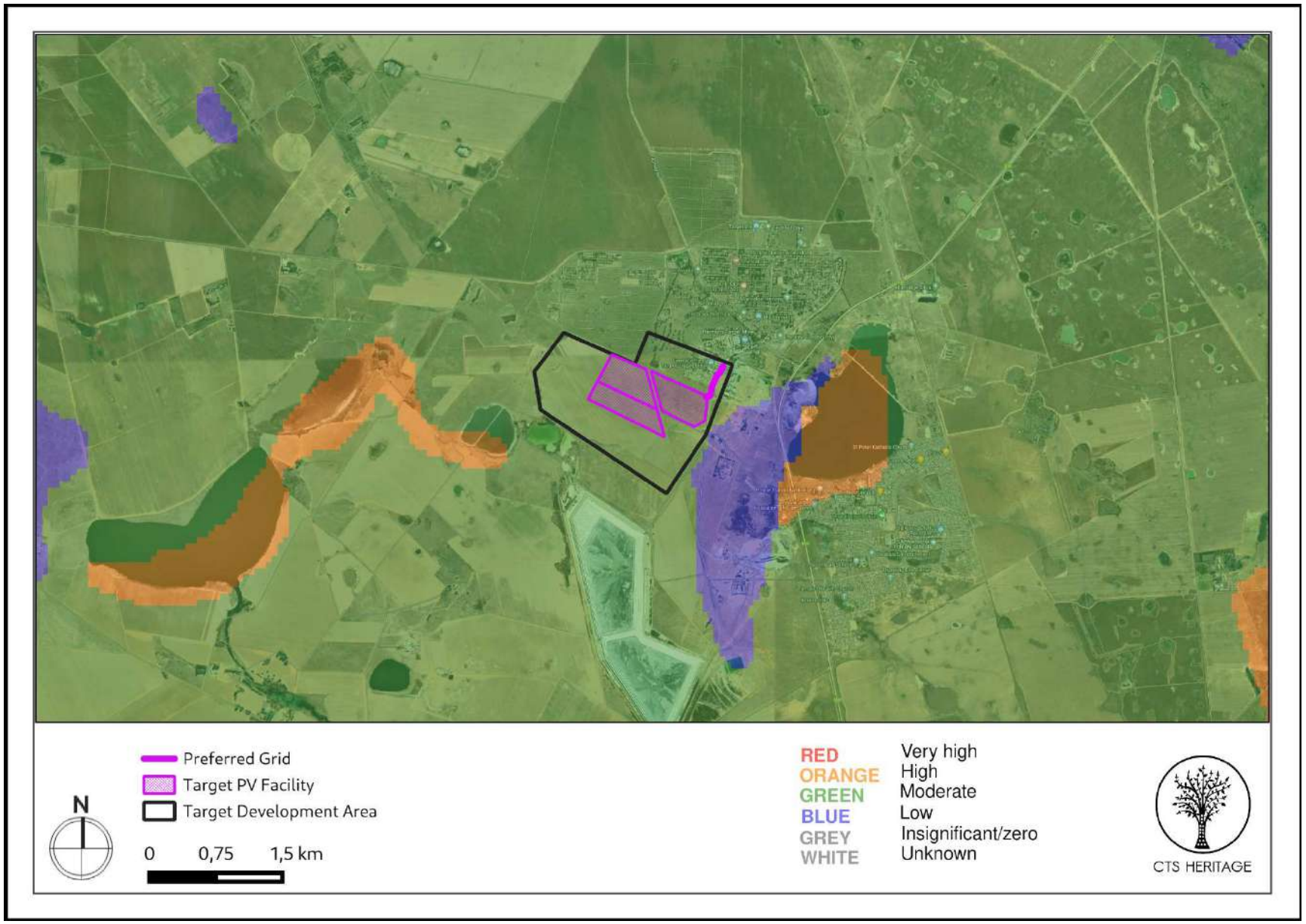

Figure 3.1: Palaeontological sensitivity of the area surrounding the broader study area

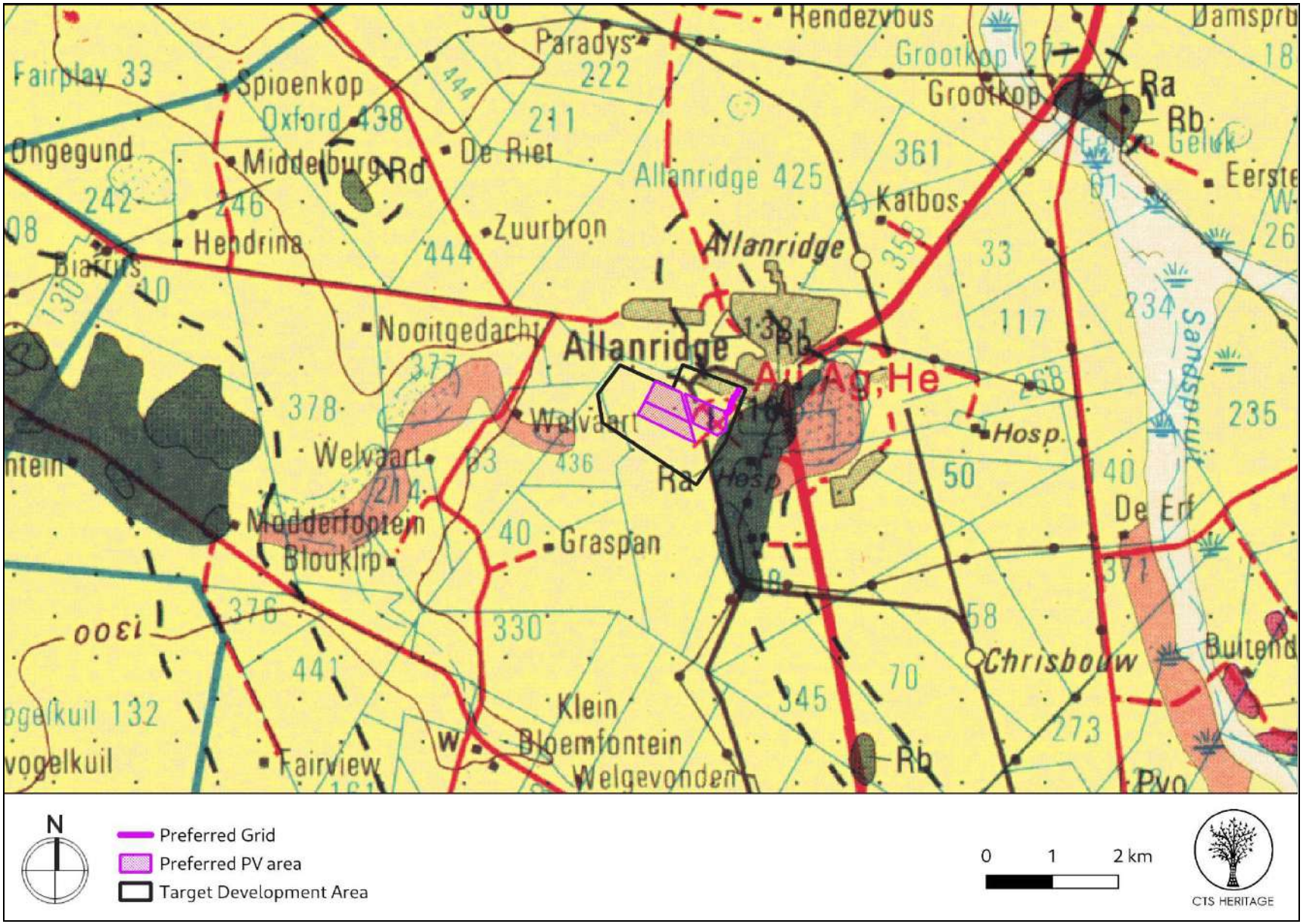

Figure 3.2: Geology Map. Extract from the CGS 2726 Kroonstad Geology Map indicating that the development area is underlain by Quaternary Sands (Qs) d

3.2 Palaeontology

According to the SAHRIS Palaeosensitivity Map the development sites are underlain by sediments of moderate fossil sensitivity (Figure 4) consisting of caenozoic regolith according to the extract from the CGS 2726 Kroonstad Geology Map (Figure 4b). According to a Palaeontological assessment completed by Groenewald (2013) for a development located nearby in similar sediments, "No fossils have been described from the quaternary aeolian deposits in the study area, although fossil finds have been recorded from similar aged sediments, for example: the Cornelia Formation in the north-eastern Free State (Johnson et al, 2006)." It is possible that sensitive sediments of the Adelaide Subgroup underly the Quaternary Sands. According to Groenewald (2013), "The Permian Adelaide Subgroup is interpreted as a meandering river deposit grading upwards into a lacustrine environment and is well known for containing fossils (Johnson et al, 2006). Although difficult to correlate the study area directly with more well-known outcrops of the lower part of the Adelaide Subgroup to the east, the subgroup is known to contain very good examples of Glossopteris flora as well as numerous remains of vertebrate fossils associated with the Dicynodon Assemblage Zone in the north-eastern part of the Karoo Basin (Groenewald, 1989 and 1996)." Groenewald (2013) concludes that "There is a possibility that fossils could be encountered during excavation into both the quaternary sand deposits and the Adelaide Subgroup sediments within the development footprint. The study area has been extensively modified through agricultural development and it is unlikely that fossils will be exposed in these developed areas."

4. IDENTIFICATION OF HERITAGE RESOURCES

4.1 Summary of findings of Specialist Reports

4.1.1 Archaeology

The survey was conducted primarily on foot but also involved driving between key targeted areas, and sought to assess the presence and significance of archaeological occurrences within the project area. Overall field assessment documented a sparse number of isolated stone artefacts in secondary and surface contexts, suggesting the area may have been traversed intermittently by Stone Age groups through periods in both the Middle Stone Age (MSA – ~300ka:~40ka), the Later Stone Age (LSA: ~40ka: ~2ka) in addition to individual bifacial tools potentially associated with the later ESA (~400-~200ka), although artefacts that could be clearly linked with chrono-cultural periods were scarce.

The presence of small nodules of artefact-quality chert rocks, homogenous quartzites as well as high-quality riverine Hornfels and Quartz in the project areas in addition to relatively abundant standing water, were likely the resources that attracted groups to the broader region, and resulted in them leaving behavioural traces in the form of stone artefacts. Indeed the majority of the stone artefacts identified look to be the result of expedient 'testing' of rocks for quality, although several cores and tools associated with more extensive investment in production were identified. In this sense no evidence of substantial densities of finds or occupational debris were identified, and the stone artefacts present look to have been produced by mobile forager groups moving through the area.

No primary or secondary sources of artefact quality stone were documented on the affected property, and only two stone artefacts (on exotic fine-grained quartzite) were documented in the vicinity of the affected property. The isolated archaeological finds were documented in the eastern portion, in broad association with the original quaternary upper sediments. However these archaeological finds occurred in secondary contexts on a deflated land surface, so therefore have limited potential for modern scientific analyses (due to the *ex situ* spatial contexts of the finds and limited possibility of radiometric dating or directly associating them with dateable sediments).

Apart from the ephemeral Stone Age remains documented, evidence for archaeology was minimal. No graves were identified within the survey and visibility was reasonably good for stone structures, so the latter finding could be considered comprehensive. However, the substantial grass cover and soil formation across the eastern part of the footprint was a relevant constraint to documenting stone artefacts and other smaller potential surface remains such as pottery etc.

4.1.2 Palaeontology

The site for development is on Quaternary sands. Six formations are recognised in the Kalahari Group but they are not often indicated on the geological maps. A more recent review by Botha (2021) attempts to correlate the Quaternary sediments but they are difficult to date or to determine their source. In this part of the Free State the

Hoopstad Aeolian sands are present. According to Harmse (1963, in Botha, 2021) this extensive red and grey sandy soil cover is associated with three generations of aeolian sand sheets. Moreover, these generations of aeolian sand form the soil substrate in the heart of the nation's maize cultivation region, yet their geological origin and age remains understudied (Botha, 2021, p. 825).

Quaternary sands and alluvium do not preserve fossils because they are transported and porous. For preservation of fossils, a low energy deposit with sedimentation of fine grained silts or muds that exclude decomposing organisms such as bacteria, fungi and invertebrates is required to maintain a highly reducing environment (Cowan, 1995). Only if there are traps such as palaeo-pans or palaeo-springs that provide traps for water and fine sediments, would plants or bones be preserved and fossilised. No such features are visible in the satellite imagery in the project footprint.

Figure 4.1: . Dense grasses cover portions of the project area inhibiting the visibility of surface archaeology at Target: CTG9.

Figure 4.2: Areas of Target affected by mining activities

Figure 4.3: Areas of Target affected by mining activities

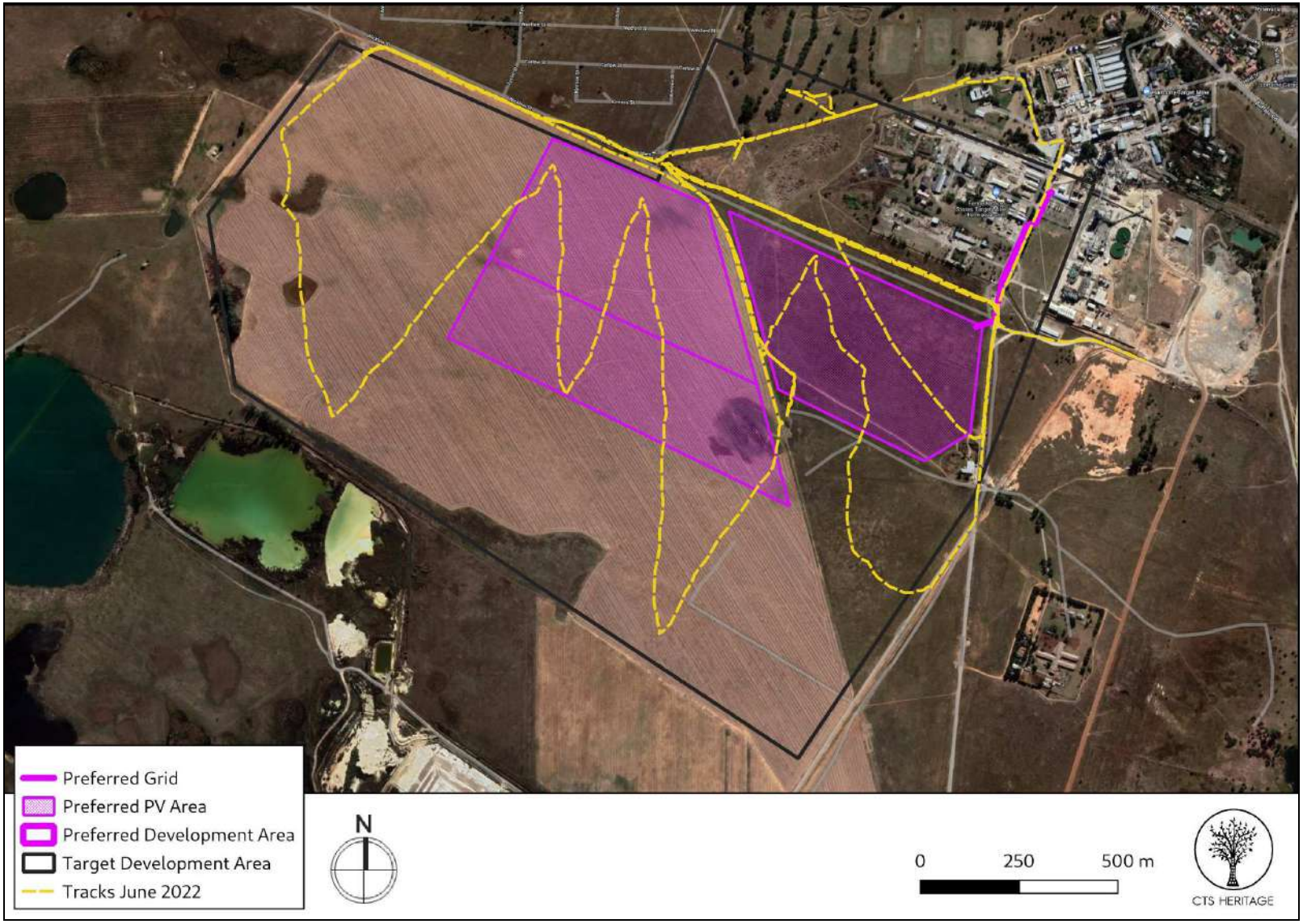

Figure 5: Overall track paths of foot survey - Target PV Facility

4.2 Heritage Resources identified

No significant archaeology was documented within the footprint at Target. The only isolated finds were two small probably Later Stone age cores (TG1). These cores were documented in the area of the footprint that is not currently earmarked for development.

Table 1: Heritage resources identified from fieldwork 2022

Site No.	Site Name	Description	Period	Co-ordinates		Grading	Mitigation
TG1	Target 1	Isolated artefacts: two miniature cores associated with microlithic flake production	LSA	-27.76088904	26.63345299	NCW	NA

Figure 6: Ex situ archaeological remains from Target: TG1: two miniature cores associated with microlithic flake production

4.3 Mapping and spatialisation of heritage resources

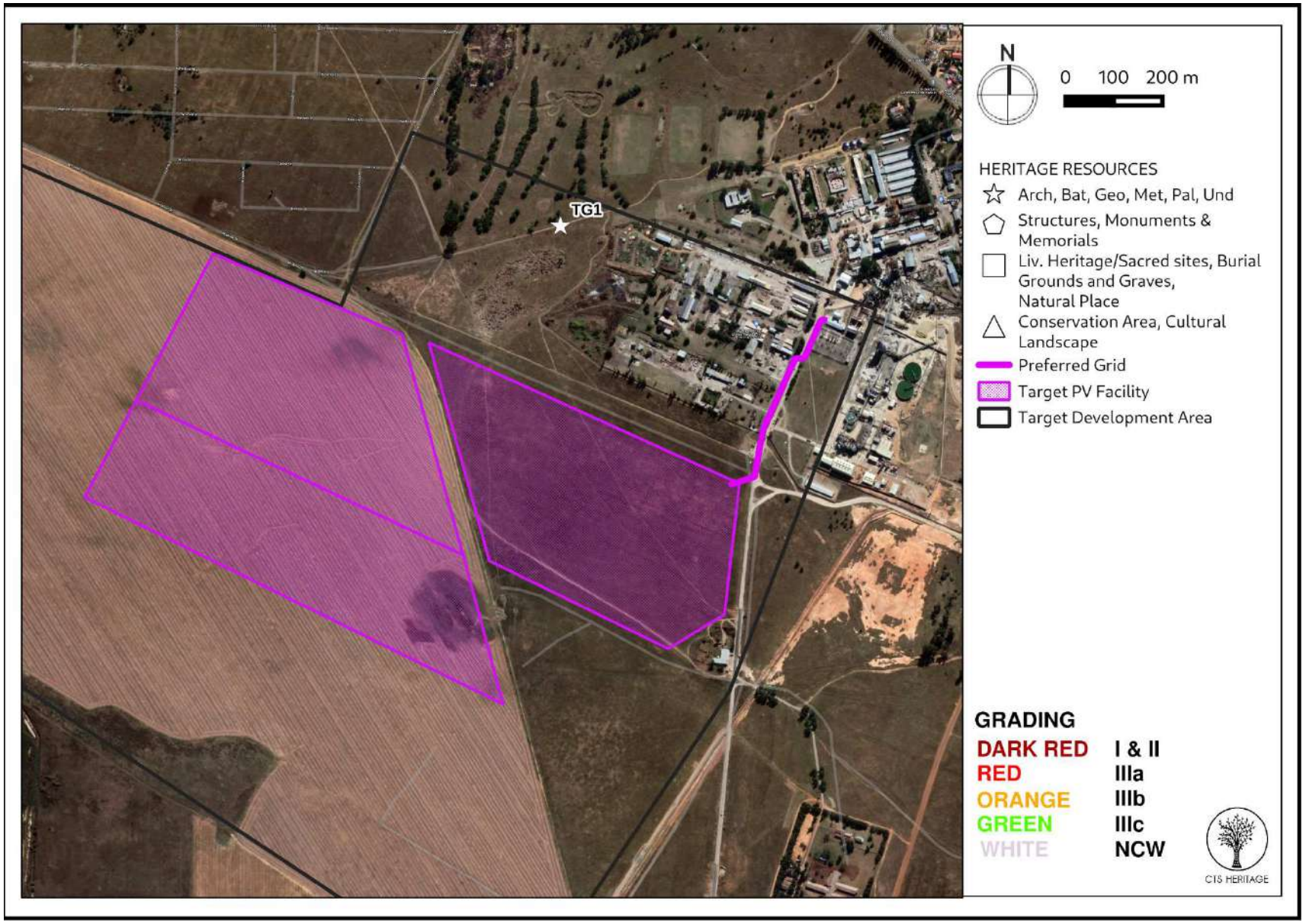

Figure 7: Map of significant heritage resources identified during the field assessment, relative to the proposed development.

5. ASSESSMENT OF THE IMPACT OF THE DEVELOPMENT

5.1 Assessment of impact to Heritage Resources

5.1.1 Archaeology

The potential for finding a dateable *in-situ* archaeological horizon at Target based on current surface observations outlined above appears to be low. The documented archaeology at Target is therefore classified as scientifically LOW SIGNIFICANCE.

Concerning the archaeology observed during the survey of the potentially affected area at Target, there are no objections to the authorization of the proposed development, provided that if any evidence of buried human remains are exposed during excavation, that development activities cease in the area of the identified remains.

No impacts to significant heritage resources are anticipated.

Table 4.1: Impacts of the proposed development on archaeological resources

NATURE: It is possible that buried archaeological resources may be impacted by the proposed development in the preferred location				
		Without Mitigation		**With Mitigation**
MAGNITUDE	**L (2)**	No archaeological resources of significance were identified within the development area	**L (2)**	No archaeological resources of significance were identified within the development area however
DURATION	**H (5)**	Where manifest, the impact will be permanent.	**H (5)**	Where manifest, the impact will be permanent.
EXTENT	**L (1)**	Limited to the development footprint	**L (1)**	Limited to the development footprint
PROBABILITY	**L (2)**	It is unlikely that significant heritage will be impacted	**L (1)**	It is unlikely that significant heritage will be impacted
SIGNIFICANCE	**L**	(2+5+1)x2 = 16	**L**	(2+5+1)x1 = 8
STATUS		Negative		Negative
REVERSIBILITY	**L**	Any impacts to heritage resources that do occur are irreversible	**L**	Any impacts to heritage resources that do occur are irreversible
IRREPLACEABLE LOSS OF RESOURCES?	**L**	Not Likely	**L**	Not Likely
CAN IMPACTS BE MITIGATED		NA		
MITIGATION: • Should any previously unrecorded archaeological resources or possible burials be identified during the course of construction activities, work must cease in the immediate vicinity of the find, and SAHRA must be contacted regarding an appropriate way forward.				
RESIDUAL RISK: None				

5.1.2 Palaeontology

According to the Desktop Palaeontology Assessment, "Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the sandstones, shales and sands are typical for the country and might contain trapped fossils. The sands of the Quaternary period would not preserve fossils. The area has been disturbed from farming and mining so no fossils would be present on the surface."

"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 the right age to contain fossils but are covered by soils. Furthermore, the material to be excavated are soils and this does not preserve fossils. Since there is a small chance that fossils were trapped in pans that might occur below the soils and 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 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 sands and soils of the Quaternary. There is a very small chance that fossils may occur in pans or springs but no such feature is visible in the satellite imagery. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr."

Table 4.2: Impacts of the proposed development to palaeontological resources

NATURE: It is possible that buried palaeontological resources may be impacted by the proposed development in the preferred location				
		Without Mitigation		**With Mitigation**
MAGNITUDE	**M (5)**	According to the SAHRIS Palaeosensitivity Map (Figure 3.1), the area proposed for development of the PV facilities is underlain by sediments that have moderate palaeontological sensitivity.	**M (5)**	According to the SAHRIS Palaeosensitivity Map (Figure 3.1), the area proposed for development of the PV facilities is underlain by sediments that have moderate palaeontological sensitivity.
DURATION	**H (5)**	Where manifest, the impact will be permanent.	**H (5)**	Where manifest, the impact will be permanent.
EXTENT	**L (1)**	Limited to the development footprint	**L (1)**	Limited to the development footprint
PROBABILITY	**L (1)**	It is unlikely that significant fossils will be impacted	**L (1)**	It is unlikely that significant fossils will be impacted
SIGNIFICANCE	**L**	(5+5+1)x1=11	**L**	(5+5+1)x1=11
STATUS		Negative		Negative
REVERSIBILITY	**L**	Any impacts to heritage resources that do occur are irreversible	**L**	Any impacts to heritage resources that do occur are irreversible
IRREPLACEABLE LOSS OF RESOURCES?	**L**	Unlikely	**L**	Not Likely
CAN IMPACTS BE MITIGATED		Yes		
MITIGATION: The attached Chance Fossil Finds Procedure must be implemented for the duration of construction activities Should any previously unrecorded palaeontological resources be identified during the course of construction activities, work must cease in the immediate vicinity of the find, and SAHRA must be contacted regarding an appropriate way forward.				
RESIDUAL RISK: None				

5.2 Sustainable Social and Economic Benefit

According to the Social Impact Assessment completed for this project, Harmony Gold currently has social labour plans in place which meet the requirements of employment in terms of local employment and skills development. As per the SLP, the Harmony Target Plant Human Resources Development (HRD) Strategy supports the company's business strategy and objectives, as well as the South African legislative and regulatory framework that seeks to address the general skills shortage within the country, as well as ensuring equitable representation in the workplace. Part of these strategies include:

- Adult Basic Education Training
- Portable Skills Training plans
- Trainee Programmes and Learnerships for Employees
- Management Development Programs
- Talent Pool Development
- Community Human Resource Development Programme
- Learnerships for the Community

It is the mine's intention to incorporate the development of the Harmony One Plant Solar PV facility under the same principles as followed in the SLP, albeit on a smaller scale, relative to the size of the development of a 30MW solar PV facility.

The establishment of the facility will be a game-changing event for the community and local municipality. It'll result in the following impacts, in varying degrees:

- People
    - Skills development
    - Employment
    - Renewed sense of hope
    - Improved social outcomes owing to SED investments: Health, Education
- Economic participation
- Increased sense of prestige for the community and town
- Planet: Increased power supply for the country, with less damage to the planet as a consequence.
- Profit
    - Increased revenue for local municipality
    - Increased economic activity in local community and broader municipality
    - Investment in social and commercial infrastructure to increase economic activity.

Based on the findings of the SIA, the anticipated socio-economic benefits to be derived from this project outweigh the potential negative impacts to heritage resources, especially if the Final Layout (Figure 8) is implemented.

5.3 Proposed development alternatives

Based on the outcomes of this analysis, and other environmental constraints, a Final Layout has been developed that fits within the various environmental constraints identified. This Final Layout is mapped in Figure 8 relative to the identified heritage resources and is the preferred development layout from a heritage perspective.

Three alternative grid corridors (300m in width) have been assessed. These are described as follows:

Alternative 1: A 300m wide corridor between the switching substation located on the Harmony Target Solar PV Facility and the Avgold Substation via an overhead power line (~750m in length). The corridor exits the facility from the north east corner of the development footprint, and follows existing Eskom power lines to the east of the development area as well as an unnamed mine access road. The route skirts around the Loraine One Substation to access the south side of the Avgold Substation (located directly south west of the Loraine One Substation).

Alternative 2: A 300m wide corridor between the switching substation located on the Harmony Target Solar PV Facility and the Avgold Substation via an overhead power line (~440m in length). The corridor exits the facility from the north east corner of the development footprint, and follows a secondary mine access road to access the south side of the Avgold Substation (located 400m north east of the site).

Alternative 3: A 300m wide corridor between the switching substation located on the Harmony Target Solar PV Facility and the Avgold Substation via an overhead power line (~1.5km in length). The corridor exits the facility from the north west corner of the development footprint, and follows the farm boundary for approximately 200m west before turning north and then east to follow an unnamed mine access road for approximately 570m. at the junction with the secondary road, the route turns south to access the south side of the Avgold Substation.

Observation TG1 falls within the proposed grid alignment alternative 3, however this observation is determined to be Not Conservation-Worthy and as such, no impact to heritage resources is anticipated from this final layout.

5.4 Cumulative Impacts

This application is for the proposed development of a solar energy facility and associated grid connection to facilitate activities at the Target Harmony Mine. The location of the proposed PV facility within an area with existing mining activities may lend itself to cumulative impacts. However, in terms of cumulative impacts to heritage resources, it is preferable that industrial-type infrastructure is clustered within an area in order to prevent the sprawl of industrial development across otherwise sensitive cultural landscapes.

As such, it is not anticipated that the proposed development will have a negative cumulative impact on significant heritage resources.

6. RESULTS OF PUBLIC CONSULTATION

The public consultation process will be undertaken by the EAP during the EIA. No heritage-related comments have been received to-date. SAHRA is required to comment on this HIA and make recommendations prior to the granting of the Environmental Authorisation.

7. CONCLUSION

The areas surveyed as part of this assessment have been transformed through agricultural interventions and/or mining activity. No archaeological resources of scientific cultural value were identified within the area proposed for the Target PV Facility and its grid connection and as such, no impact to significant archaeological heritage resources is anticipated.

Furthermore, no impacts to significant palaeontological heritage is anticipated on condition that the attached Chance Fossil Finds Process is implemented and no impacts to the cultural landscape are anticipated.

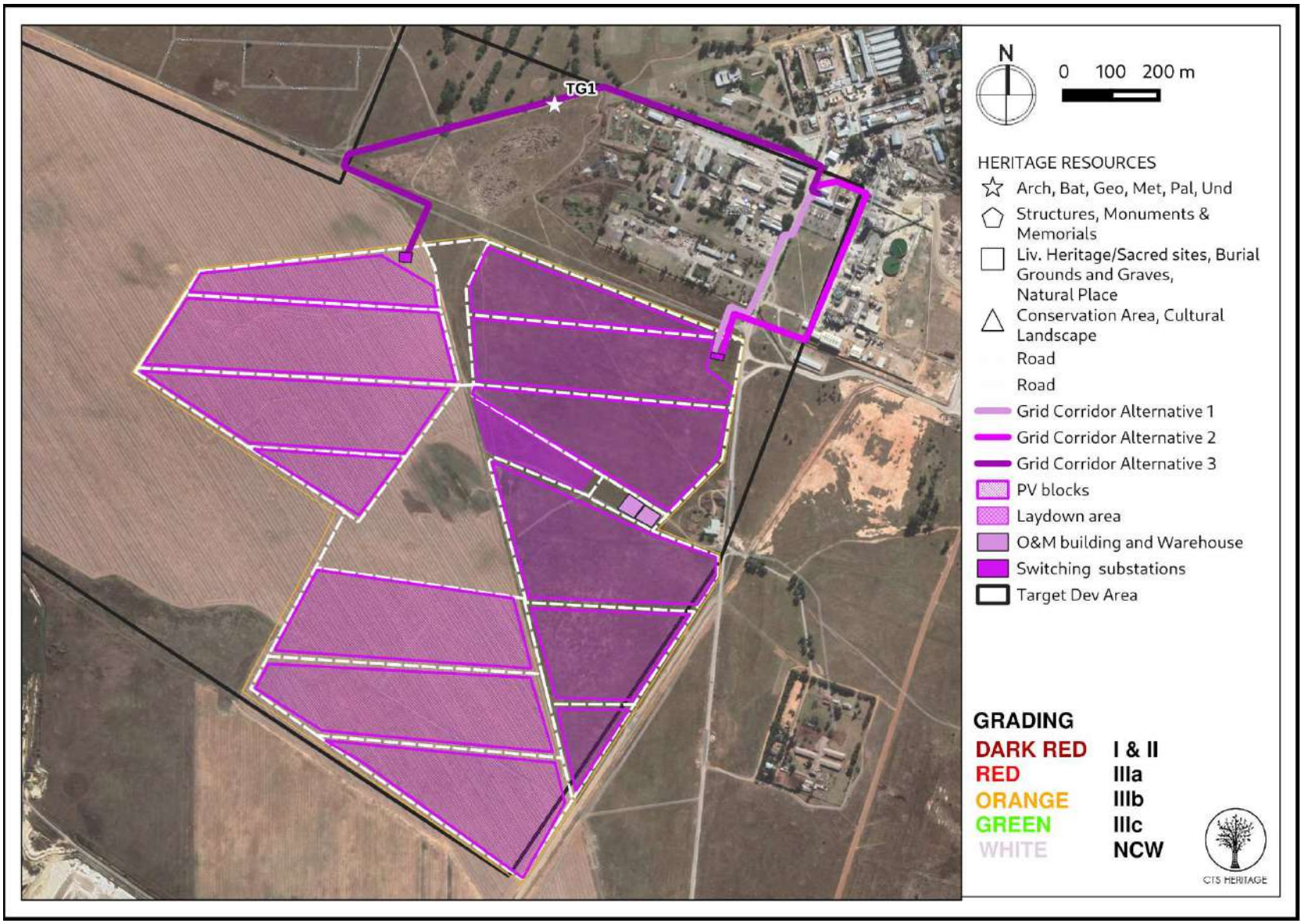

Figure 8: Map of significant heritage resources identified during the field assessment, relative to the proposed Final Layout

8. RECOMMENDATIONS

There is no objection to the proposed development in terms of impacts to heritage resources on condition that:

- The attached Chance Fossil Finds Procedure is implemented for the duration of construction activities
- Should any buried archaeological resources or human remains or burials be uncovered during the course of development activities, work must cease in the vicinity of these finds. The South African Heritage Resources Agency (SAHRA) must be contacted immediately in order to determine an appropriate way forward.

9. REFERENCES

Heritage Impact Assessments				
NID	**Author(s)**	**Date**	**Type**	**Title**
109887	HIA Phase 1	Lloyd Rossouw	10/09/2012	Phase 1 Heritage Impact Assessment of a Proposed New Solar Facility at Grootspruit 252 near Allanridge, FS
120509	Archaeological Specialist Reports	Jaco van der Walt	06/05/2013	Archaeological Scoping Report for the Proposed Grootkop Solar Energy Facility
120510	PIA Desktop	Barry Millsteed		Desktop Palaeontology Heritage Impact Assessment Report for the Grootkop Solar Energy Facility
164270	AIA Phase 1	Jaco van der Walt	30/08/2013	Archaeological Impact Assessment for the proposed Grootkop Solar Energy Facility, Free State Province

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APPENDICES

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APPENDIX 1: Heritage Screening Assessment (2022)

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HERITAGE SCREENER

CTS Reference Number:	**CTS22_101**
SAHRIS Reference:	
Client:	**Savannah Environmental (Pty) Ltd**
Date:	**May 2022**
Title:	**Proposed development of the Target PV Facility near Welkom**

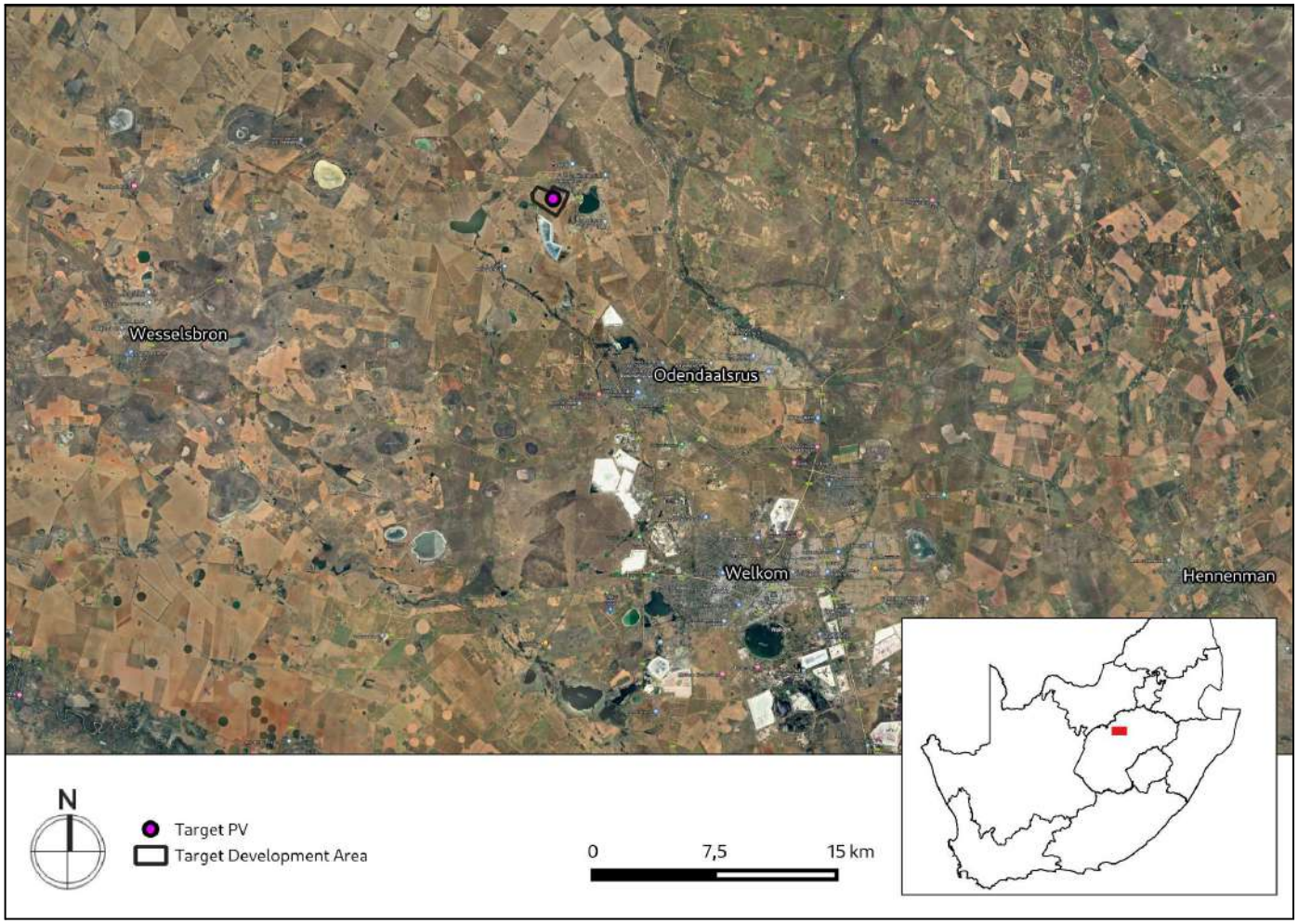

Figure 1a. Satellite map indicating the location of the proposed development in the Free State

RECOMMENDATION

As it is possible that significant heritage resources will be impacted by the proposed development, it is recommended that a Heritage Impact Assessment is completed that satisfies section 38(3) of the NHRA and assesses likely impacts to archaeological and palaeontological heritage.

CTS Heritage
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1. Proposed Development Summary

The development of a renewable energy facility, overhead powerline and associated infrastructure proposed by AVGOLD LTD. The project entails the development of an 30MW solar PV over 72 ha of land and will be known as Harmony Target Solar PV Facility, the facility will include a grid connection solution and other associated infrastructure.

The Solar PV facility is based approximately 500m south of the Harmony Target mining operations, located ~1km south of the town of Allanridge within the Matjhabeng Local Municipality, and within the Lejweleputswa District Municipality, Free State Province.

2. Application References

Name of relevant heritage authority(s)	SAHRA
Name of decision making authority(s)	DFFE

3. Property Information

Latitude / Longitude	27°45'58.46"S 26°38'2.42"E	
Erf number / Farm number	Kromdraai 386	0
Local Municipality	Matjhabeng	
District Municipality	Lejweleputswa	
Province	Free State	
Current Use	Mining	
Current Zoning	Agriculture	

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4. Nature of the Proposed Development

Total Area	72ha
Depth of excavation (m)	<2m
Height of development (m)	Max 20m pylons

5. Category of Development

x	**Triggers: Section 38(8) of the National Heritage Resources Act**
	Triggers: Section 38(1) of the National Heritage Resources Act
x	1. Construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier over 300m in length.
	2. Construction of a bridge or similar structure exceeding 50m in length.
	3. Any development or activity that will change the character of a site-
x	a) exceeding 5 000m^2 in extent
	b) involving three or more existing erven or subdivisions thereof
	c) involving three or more erven or divisions thereof which have been consolidated within the past five years
	4. Rezoning of a site exceeding 10 000m^2
	5. Other (state):

6. Additional Infrastructure Required for this Development

NA

7. Mapping (please see Appendix 3 and 4 for a full description of our methodology and map legends)

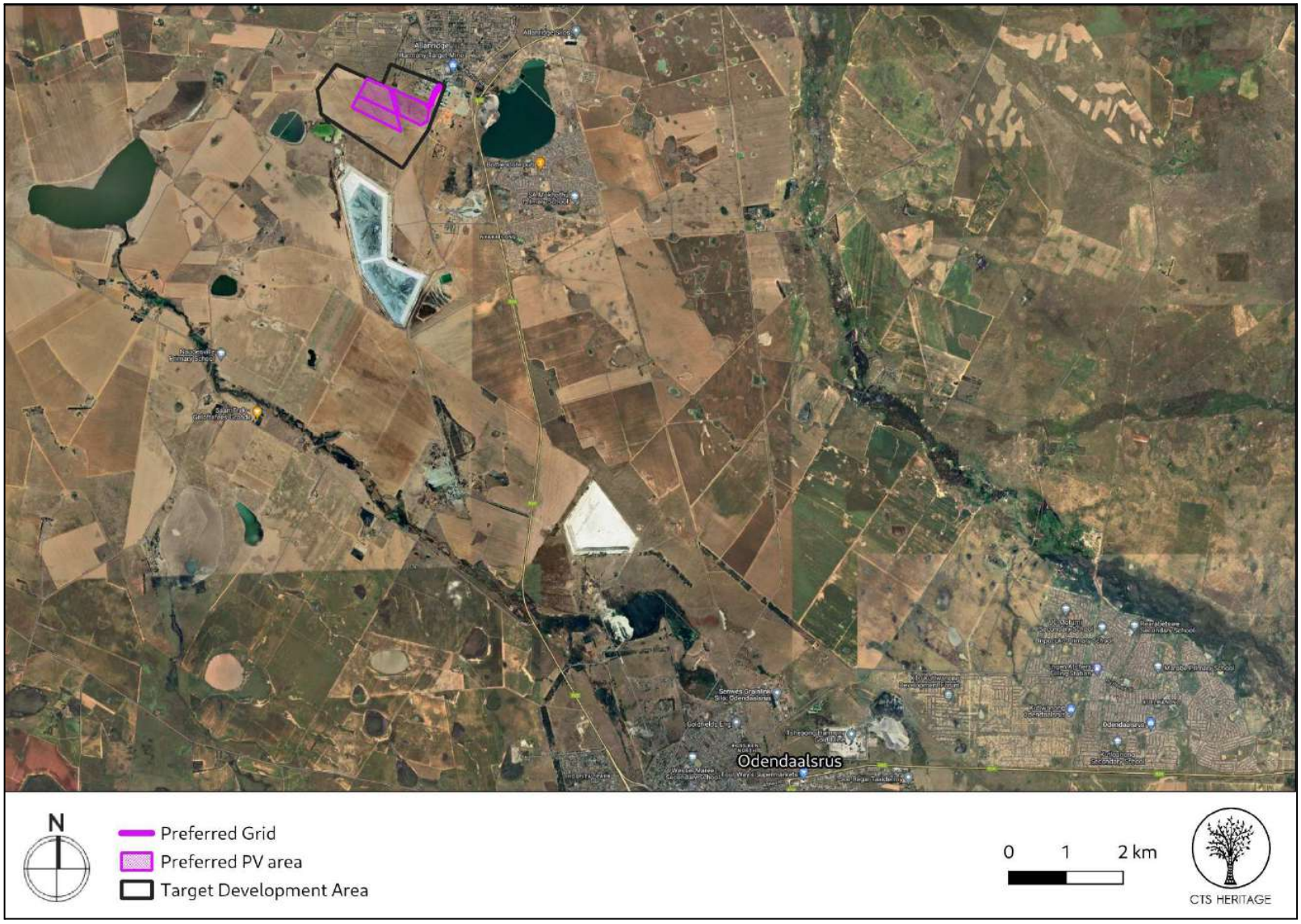

Figure 1b. Overview Map. Satellite image (2022) indicating the proposed development area

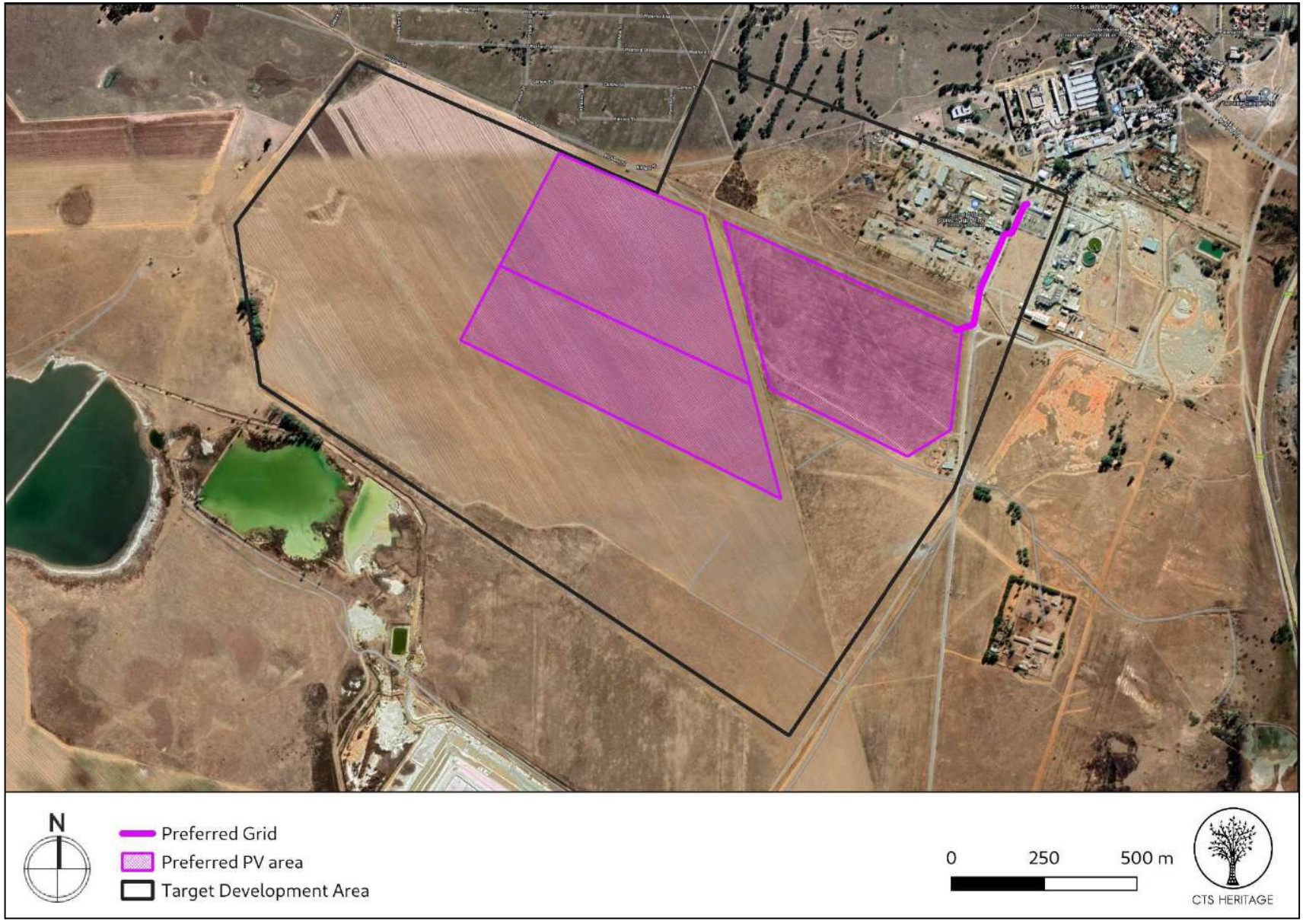

Figure 1c. Overview Map. Satellite image (2022) indicating the proposed development area

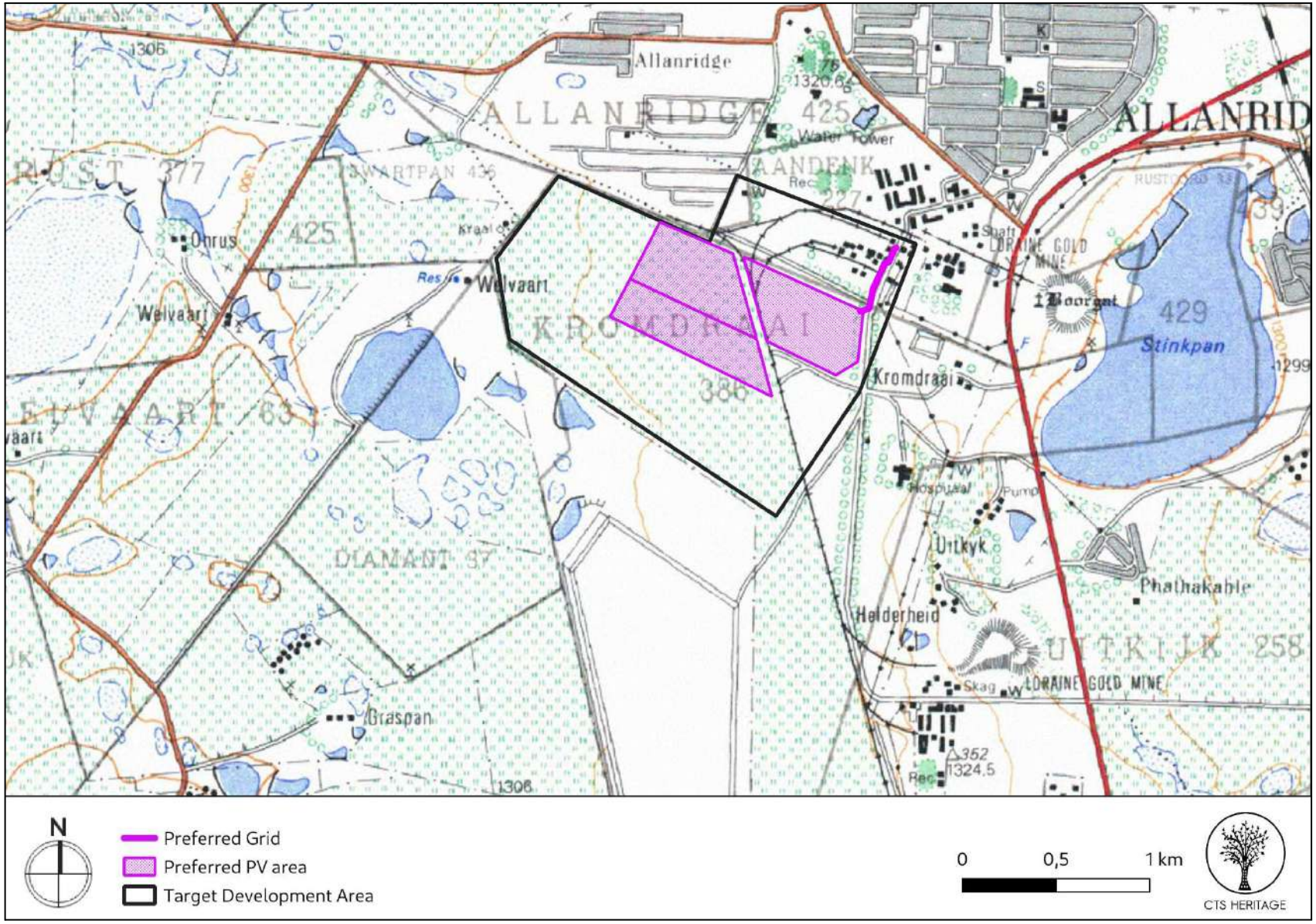

Figure 1d. Overview Map. Extract from 1:50 000 Topo

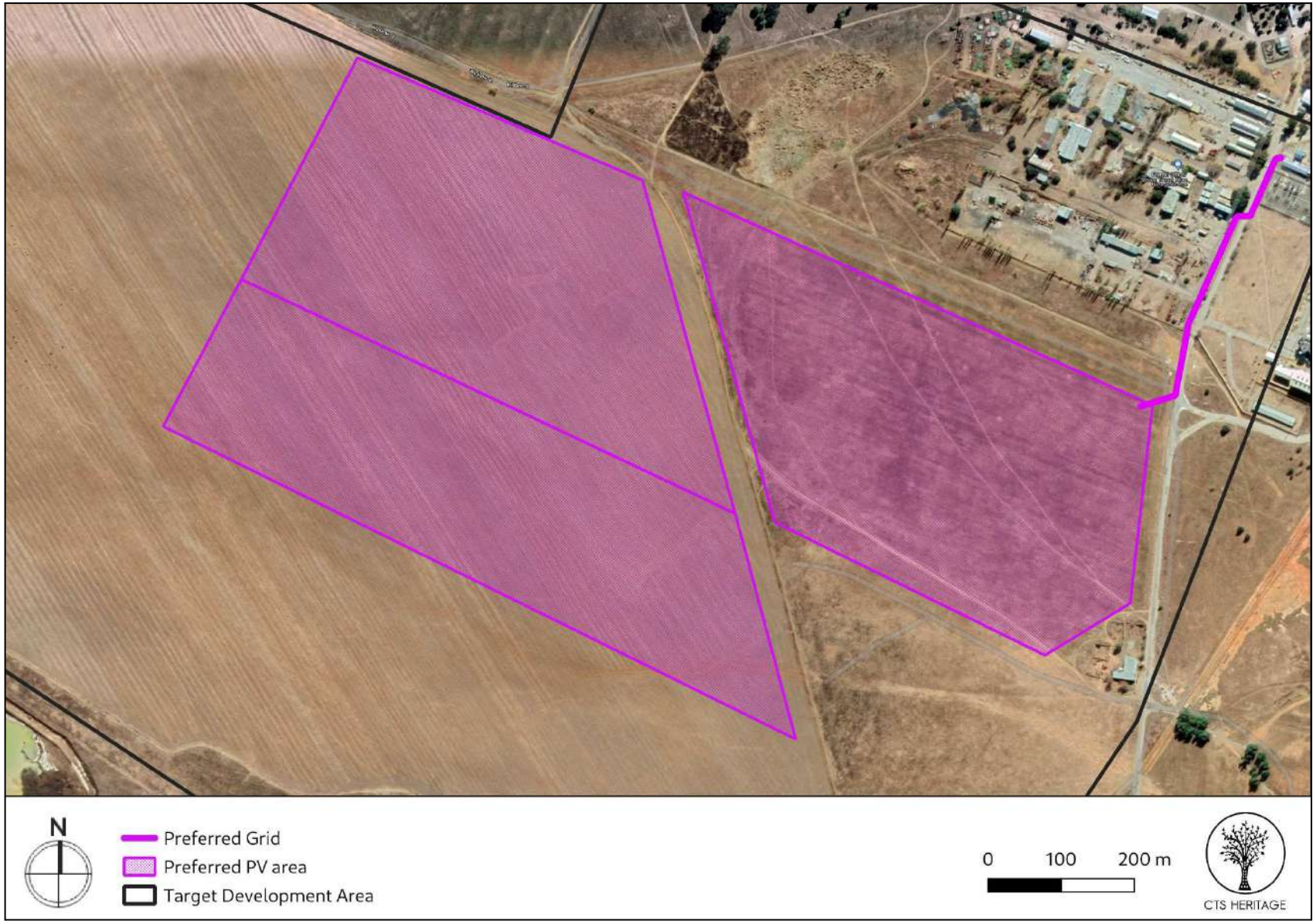

Figure 1e. Overview Map. Preferred

Figure 2. Previous HIAs Map. Previous Heritage Impact Assessments covering the proposed development area with SAHRIS NIDS indicated. Please see Appendix 2 for a full reference list.

Figure 3. Heritage Resources Map. Heritage Resources previously identified within the study area, with SAHRIS Site IDs indicated in the insets below. Please See Appendix 4 for full description of heritage resource types.

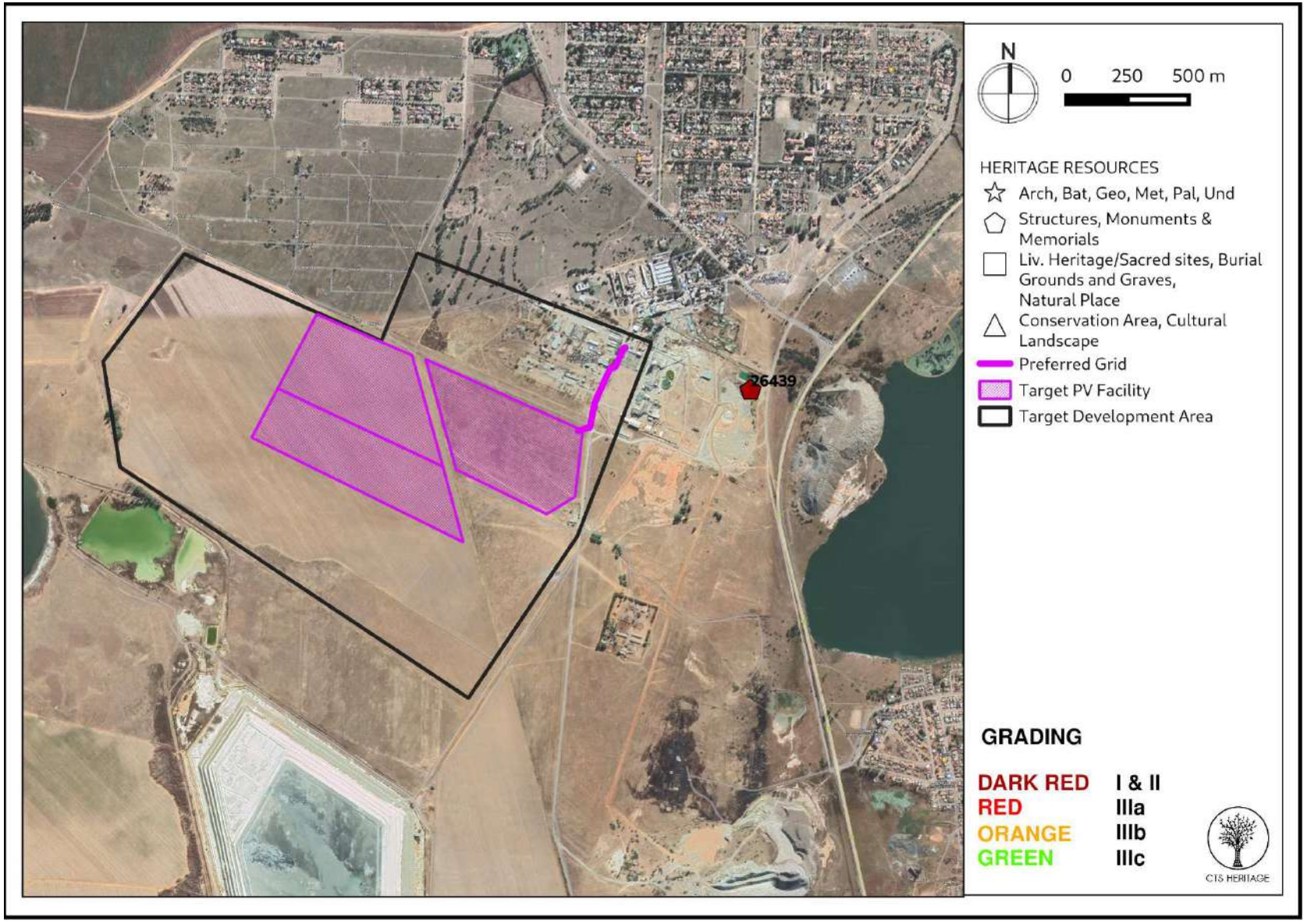

Figure 3a. Heritage Resources Map. Heritage Resources close to the development area

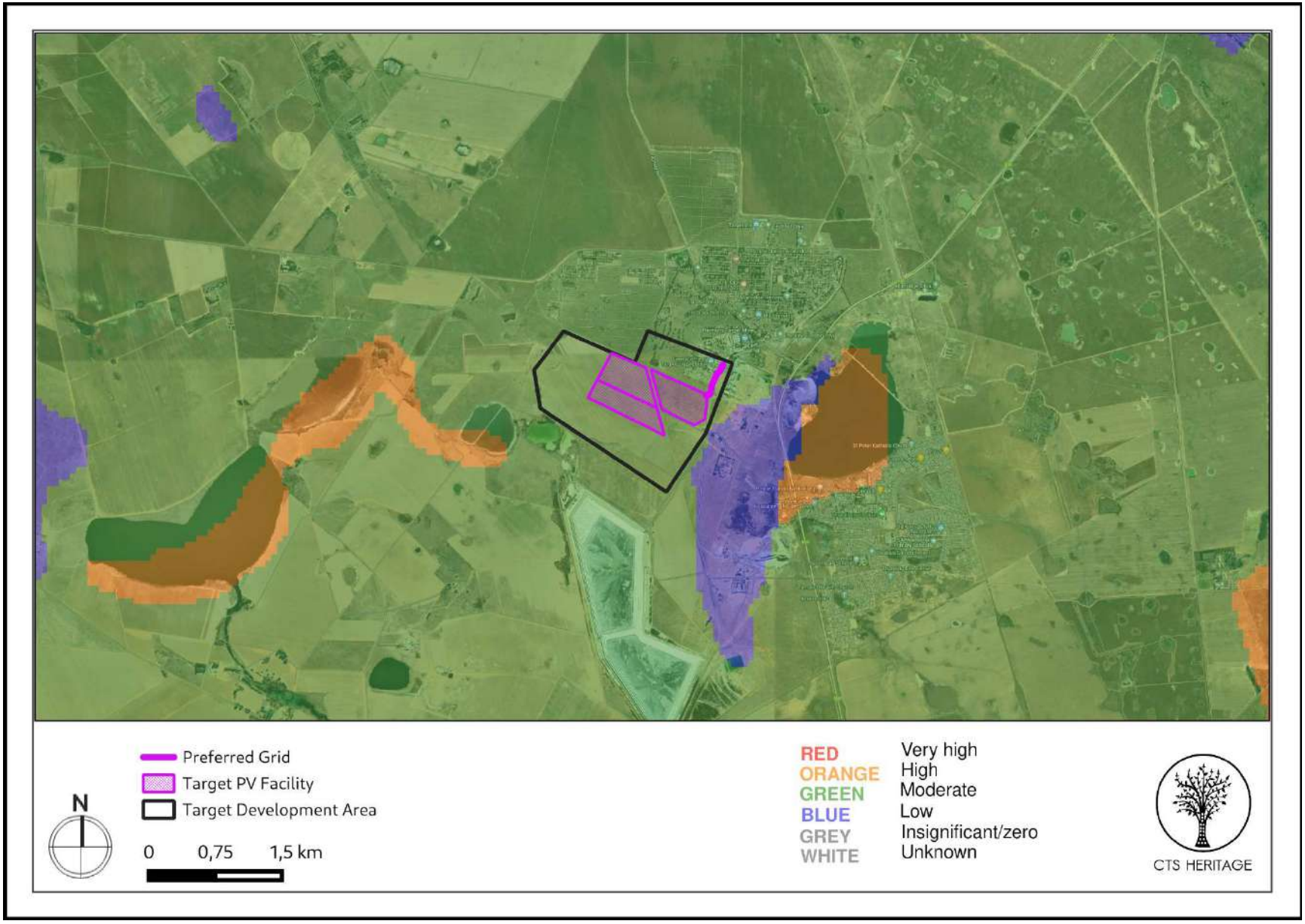

Figure 4a. Palaeosensitivity Map. Indicating fossil sensitivity underlying the study area. Please See Appendix 3 for a full guide to the legend.

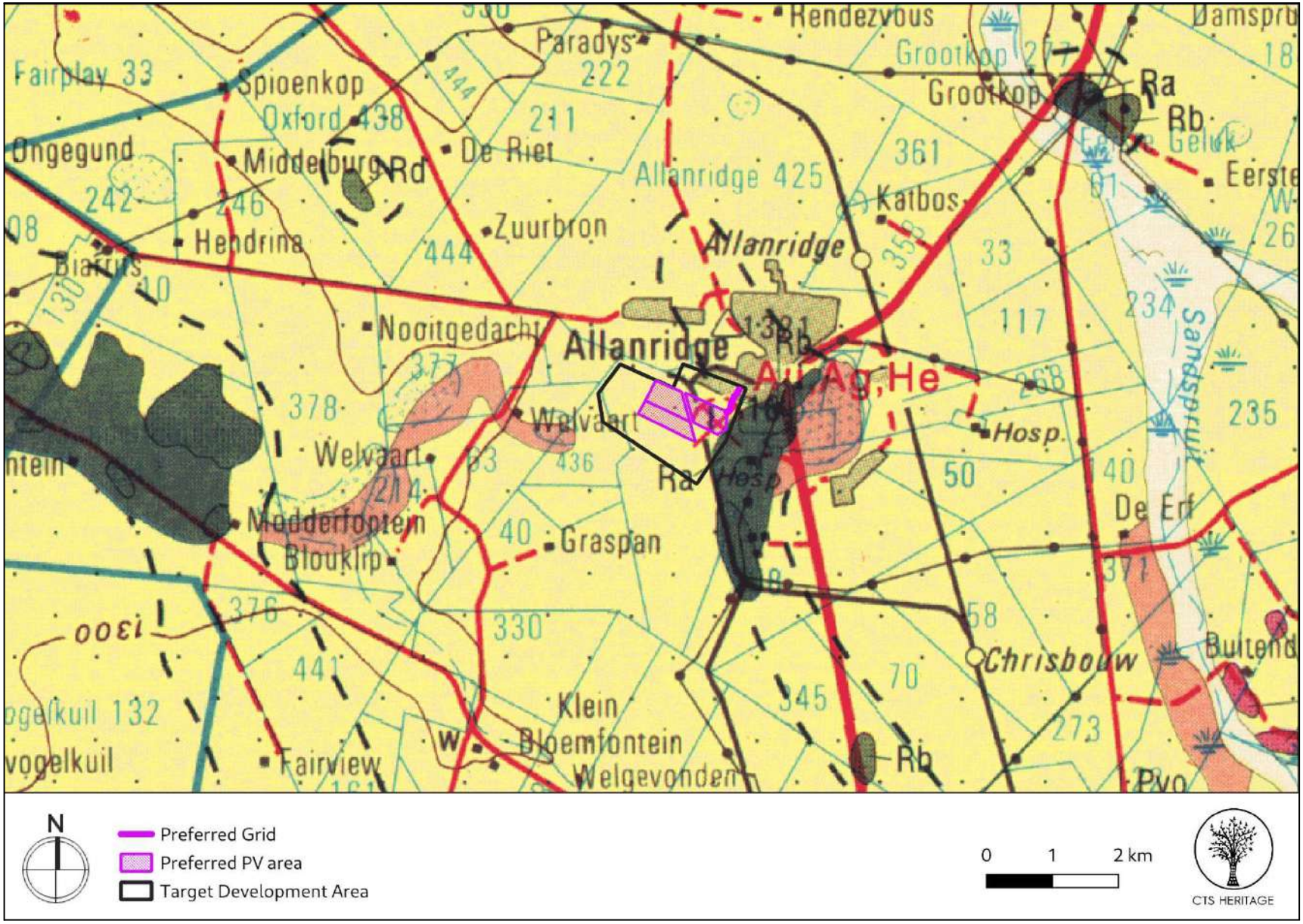

Figure 4b. Geology Map. Extract from the CGS 2726 Kroonstad Geology Map indicating that the development area is underlain by Quaternary Sands (Qs)

8. Heritage Assessment

Background

This application is for the proposed development of a PV facility and associated grid infrastructure located immediately adjacent to the town of Allanridge and approximately 15km from the town of Odendaalsrus in the Free State Province. Odendallsrus started out in 1912 as a ramshackle collection of farms and a central church that became a town. In April 1946 gold was struck on the farm *Geduld* near the town. Allanridge is the main centre of the Loraine Gold Mining Company and is dominated by the tall headgear and complex reduction works that processes thousands of tons of gold-bearing ore every month. Allanridge was established as a settlement in the Free State goldfields in 1947 and was named after Allan Roberts whose borehole's proximity to the gold bearing reef was the precursor to the mining in the area. The town layout was designed by town planner William Backhouse, who also planned Welkom. It became a municipality on 21 December 1956.

The study area falls within the bioregion described by Mucina et al (2006) as the Dry Highveld Grassland Bioregion with the vegetation described as Vaal-Vet Sandy Grassland within a Grassland Biome. Land use in the general area is characterised by mining and agriculture, dominated by crops and cattle farming. The study area is characterised by deep sandy to loamy soils based on the extensive agricultural activities." According to Fourie (2021), "Existing surrounding land uses associated with the project area include a combination of mining related infrastructure and developments, powerlines, refuse dumps and dirt roads." As the area proposed for development is located within an existing mining area, it is very unlikely that significant built environment heritage will be impacted by the proposed development.

The proposed development area is located immediately adjacent to an old National Monument declared in 1960. This site has the shape of a keyhole and marks the place where the first gold prospecting borehole in this area of vast plains was drilled. Although the first payable gold deposits to be discovered in the Orange Free State were not found in this borehole, it was the first prospecting borehole in the area and the results obtained from it undoubtedly gave rise to other prospecting and the discovery of the Orange Free State goldfields. The monument erected round the borehole through the generosity of Lorraine Gold Mines Limited, is fittingly designed in the form of a keyhole to symbolise the unlocking of the goldfields of the Orange Free State. A detailed history of this monument is recorded on SAHRIS. The history of Allanridge is intimately linked with the gold mining industry and as such, it is unlikely that the proposed PV development will negatively impact on this unique cultural landscape as it is proposed to support the gold mining industry.

Archaeology

According to Fourie (2021), "The Free State has a rich archaeological and historical history going back millions of years and includes significant aspects such as Later Stone Age rock art, Battlefields and Iron Age stonewalled enclosures. The general surroundings of the study area became a melting pot of contact and conflict as it represents one of many frontiers where San hunter-gatherers, Nguni and Sotho-Tswana agro-pastoralists, Dutch Voortrekkers and British Colonists all came together. The ravages of war also swept across these plains, and in particular the South African War (1899-1902) as well as the Boer Rebellion (1914-1915)." No heritage resources of significance were identified by Van der Walt (2013) in his assessment of a nearby farm. Van der Walt (2013) notes that "some MSA finds might be possible around pans on the farm. It is important to note that the lack of sites can be attributed to a lack of sustainable water sources (no pans exist in the development footprint) in the development area as well as the lack of raw material for the manufacturing of stone tools. No Sites dating to the Early or Middle Iron Age have been recorded or are expected for the study area. The same goes for the Later Iron Age period where the study area is situated outside the western periphery of the distribution of Late Iron Age settlements in the Free State. However to the north of the study area, ceramics from the Thabeng facies belonging to the Moloko branch of the Urewe tradition were recorded at Oxf 1 and Platberg 32/71 (Maggs 1976, Mason 1986)".

In his field assessment conducted close to the area proposed for development, Rossouw (2012) noted that "The Stone Age archaeological footprint in the region is largely represented by the occurrence of open-site, Middle Stone Age (MSA) and Later Stone Age (LSA) assemblages that are mainly located near river drainages. Interestingly, a large number of MSA artifacts were found 2m below the surface at the Allanridge railway siding in 1953. The material is stored at the National Museum in Bloemfontein. Unfortunately, the context of the assemblage is unknown. MSA as well as LSA artefacts, in association with mammal fossil remains, are also found in a series of erosional gullies along the Sand and Doring Rivers between Virginia and Theunisen. There are no records of rock engravings known from the area. The ruins of a large complex of Late Iron Age settlements (OXF 1, Maggs 1976) are

found at Strydfontein between Hennenman and Ventersburg. However, it is noted that the affected area is situated outside the western periphery of distribution of Late Iron Age settlements below the Vals River in the Free State (Maggs 1976)." In Rossouw's assessment, he found no evidence of *in situ* Stone Age or Iron Age archaeological material. He noted no indications of prehistoric structures or rock engravings, historical buildings or structures older than 60 years. Two small graveyards were also recorded during the survey.

It is possible that the proposed development will impact on significant archaeological heritage and a field assessment to determine this is recommended.

Palaeontology

According to the SAHRIS Palaeosensitivity Map the development sites are underlain by sediments of moderate fossil sensitivity (Figure 4) consisting of caenozoic regolith according to the extract from the CGS 2726 Kroonstad Geology Map (Figure 4b). According to a Palaeontological assessment completed by Groenewald (2013) for a development located nearby in similar sediments, "No fossils have been described from the quaternary aeolian deposits in the study area, although fossil finds have been recorded from similar aged sediments, for example: the Cornelia Formation in the north-eastern Free State (Johnson et al, 2006)." It is possible that sensitive sediments of the Adelaide Subgroup underly the Quaternary Sands. According to Groenewald (2013), "The Permian Adelaide Subgroup is interpreted as a meandering river deposit grading upwards into a lacustrine environment and is well known for containing fossils (Johnson et al, 2006). Although difficult to correlate the study area directly with more well-known outcrops of the lower part of the Adelaide Subgroup to the east, the subgroup is known to contain very good examples of Glossopteris flora as well as numerous remains of vertebrate fossils associated with the Dicynodon Assemblage Zone in the north-eastern part of the Karoo Basin (Groenewald, 1989 and 1996)." Groenewald (2013) concludes that "There is a possibility that fossils could be encountered during excavation into both the quaternary sand deposits and the Adelaide Subgroup sediments within the development footprint. The study area has been extensively modified through agricultural development and it is unlikely that fossils will be exposed in these developed areas."

Since there is a very small chance that fossils from the Adelaide Subgroup below the ground surface may be disturbed, it is recommended that a Fossil Chance Find Protocol be implemented during development.

RECOMMENDATION

As it is possible that significant heritage resources will be impacted by the proposed development, it is recommended that a Heritage Impact Assessment is completed that satisfies section 38(3) of the NHRA and assesses likely impacts to archaeological and palaeontological heritage.

9. Scoping Assessment Impact Table

Impact

- Impact to archaeological and built environment resources
- Impact to palaeontological resources
- Impact to Cultural Landscape
- Cumulative Impact

Desktop Sensitivity Analysis of the Site

- Impact to significant archaeological resources such as Stone Age artefact scatters, remnants of Iron Age settlements, burial grounds and graves, historical artefacts, historical structures and rock art engravings through destruction during the development phase and disturbance during the operational phase is possible.
- Impacts to palaeontological resources are unlikely.
- There is the potential for the cumulative impact of proposed solar energy facilities to negatively impact the cultural landscape due to a change in the landscape character from rural and mining to semi-industrial, however, due to the density of mining activities in the area, the impact on the experience of the cultural landscape is not foreseen to be significant.

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Impact to significant heritage resources through destruction during the development phase and disturbance during the operational phase.	Destruction of significant heritage resources	Local scale with broader impacts to scientific knowledge	None known at present

Gaps in knowledge & recommendations for further study

The heritage resources in the area proposed for development are not yet sufficiently recorded

Based on the available information, including the scale and nature of the proposed development, it is likely that significant heritage resources will be impacted by the proposed development and as such it is recommended that further heritage studies are required in terms of section 38 of the NHRA with specific focus on impacts to archaeological heritage.

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APPENDIX 1

List of heritage resources within the development area

Site ID	Site no	Full Site Name	Site Type	Grading
46556	GRTS001	Grootspruit Solar 001	Burial Grounds & Graves	Grade IIIa
46557	GRTS002	Grootspruit Solar 002	Burial Grounds & Graves	Grade IIIa
84405	DERMA001	Demarcation of Agricultural 001	Structures	Grade IIIc
84407	DERMA002	Demarcation of Agricultural 002	Structures	Grade IIIc
29865	Grootspruit 252/0	Grootspruit 252/0, Odendaalsrus RD	Archaeological	
35623	HIL001	Hilton 001	Burial Grounds & Graves	Grade IIIa
105603	Grave of Sipho Mutsi	Grave of Sipho Mutsi, Kutlwanong Cemetery, Odendaalsrus	Burial Grounds & Graves	Grade II
26439	**9/2/328/0001**	**Prospecting bore-hole, Aandenk, Odendaalsrus District**	**Monuments & Memorials, Structures**	**Grade II**

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APPENDIX 2

Reference List with relevant AIAs and PIAs

Heritage Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
109887	HIA Phase 1	Lloyd Rossouw	10/09/2012	Phase 1 Heritage Impact Assessment of a Proposed New Solar Facility at Grootspruit 252 near Allanridge, FS
120509	Archaeological Specialist Reports	Jaco van der Walt	06/05/2013	Archaeological Scoping Report for the Proposed Grootkop Solar Energy Facility
120510	PIA Desktop	Barry Millsteed		Desktop Palaeontology Heritage Impact Assessment Report for the Grootkop Solar Energy Facility
164270	AIA Phase 1	Jaco van der Walt	30/08/2013	Archaeological Impact Assessment for the proposed Grootkop Solar Energy Facility, Free State Province

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APPENDIX 3 - Keys/Guides

Key/Guide to Acronyms

AIA	Archaeological Impact Assessment
DARD	Department of Agriculture and Rural Development (KwaZulu-Natal)
DEA	Department of Environmental Affairs (National)
DEADP	Department of Environmental Affairs and Development Planning (Western Cape)
DEDEAT	Department of Economic Development, Environmental Affairs and Tourism (Eastern Cape)
DEDECT	Department of Economic Development, Environment, Conservation and Tourism (North West)
DEDT	Department of Economic Development and Tourism (Mpumalanga)
DEDTEA	Department of economic Development, Tourism and Environmental Affairs (Free State)
DENC	Department of Environment and Nature Conservation (Northern Cape)
DMR	Department of Mineral Resources (National)
GDARD	Gauteng Department of Agriculture and Rural Development (Gauteng)
HIA	Heritage Impact Assessment
LEDET	Department of Economic Development, Environment and Tourism (Limpopo)
MPRDA	Mineral and Petroleum Resources Development Act, no 28 of 2002
NEMA	National Environmental Management Act, no 107 of 1998
NHRA	National Heritage Resources Act, no 25 of 1999
PIA	Palaeontological Impact Assessment
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
VIA	Visual Impact Assessment

Full guide to Palaeosensitivity Map legend

	RED:	VERY HIGH - field assessment and protocol for finds is required
	ORANGE/YELLOW:	HIGH - desktop study is required and based on the outcome of the desktop study, a field assessment is likely
	GREEN:	MODERATE - desktop study is required
	BLUE/PURPLE:	LOW - no palaeontological studies are required however a protocol for chance finds is required
	GREY:	INSIGNIFICANT/ZERO - no palaeontological studies are required
	WHITE/CLEAR:	UNKNOWN - these areas will require a minimum of a desktop study.

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APPENDIX 4 - Methodology

The Heritage Screener summarises the heritage impact assessments and studies previously undertaken within the area of the proposed development and its surroundings. Heritage resources identified in these reports are assessed by our team during the screening process.

The heritage resources will be described both in terms of **type**:

- Group 1: Archaeological, Underwater, Palaeontological and Geological sites, Meteorites, and Battlefields
- Group 2: Structures, Monuments and Memorials
- Group 3: Burial Grounds and Graves, Living Heritage, Sacred and Natural sites
- Group 4: Cultural Landscapes, Conservation Areas and Scenic routes

and **significance** (Grade I, II, IIIa, b or c, ungraded), as determined by the author of the original heritage impact assessment report or by formal grading and/or protection by the heritage authorities.

Sites identified and mapped during research projects will also be considered.

DETERMINATION OF THE EXTENT OF THE INCLUSION ZONE TO BE TAKEN INTO CONSIDERATION

The extent of the inclusion zone to be considered for the Heritage Screener will be determined by CTS based on:

- the size of the development,
- the number and outcome of previous surveys existing in the area
- the potential cumulative impact of the application.

The inclusion zone will be considered as the region within a maximum distance of 50 km from the boundary of the proposed development.

DETERMINATION OF THE PALAEONTOLOGICAL SENSITIVITY

The possible impact of the proposed development on palaeontological resources is gauged by:

- reviewing the fossil sensitivity maps available on the South African Heritage Resources Information System (SAHRIS)
- considering the nature of the proposed development
- when available, taking information provided by the applicant related to the geological background of the area into account

DETERMINATION OF THE COVERAGE RATING ASCRIBED TO A REPORT POLYGON

Each report assessed for the compilation of the Heritage Screener is colour-coded according to the level of coverage accomplished. The extent of the surveyed coverage is labeled in three categories, namely low, medium and high. In most instances the extent of the map corresponds to the extent of the development for which the specific report was undertaken.

Low coverage will be used for:

- desktop studies where no field assessment of the area was undertaken;
- reports where the sites are listed and described but no GPS coordinates were provided.
- older reports with GPS coordinates with low accuracy ratings;
- reports where the entire property was mapped, but only a small/limited area was surveyed.
- uploads on the National Inventory which are not properly mapped.

Medium coverage will be used for

- reports for which a field survey was undertaken but the area was not extensively covered. This may apply to instances where some impediments did not allow for full coverage such as thick vegetation, etc.
- reports for which the entire property was mapped, but only a specific area was surveyed thoroughly. This is differentiated from low ratings listed above when these surveys cover up to around 50% of the property.

High coverage will be used for

- reports where the area highlighted in the map was extensively surveyed as shown by the GPS track coordinates. This category will also apply to permit reports.

RECOMMENDATION GUIDE

The Heritage Screener includes a set of recommendations to the applicant based on whether an impact on heritage resources is anticipated. One of three possible recommendations is formulated:

(1) The heritage resources in the area proposed for development are sufficiently recorded - The surveys undertaken in the area adequately captured the heritage resources. There are no known sites which require mitigation or management plans. No further heritage work is recommended for the proposed development.

This recommendation is made when:

- enough work has been undertaken in the area
- it is the professional opinion of CTS that the area has already been assessed adequately from a heritage perspective for the type of development proposed

(2) The heritage resources and the area proposed for development are only partially recorded - The surveys undertaken in the area have not adequately captured the heritage resources and/or there are sites which require mitigation or management plans. Further specific heritage work is recommended for the proposed development.

This recommendation is made in instances in which there are already some studies undertaken in the area and/or in the adjacent area for the proposed development. Further studies in a limited HIA may include:

- improvement on some components of the heritage assessments already undertaken, for instance with a renewed field survey and/or with a specific specialist for the type of heritage resources expected in the area
- compilation of a report for a component of a heritage impact assessment not already undertaken in the area

- undertaking mitigation measures requested in previous assessments/records of decision.

(3) The heritage resources within the area proposed for the development have not been adequately surveyed yet - Few or no surveys have been undertaken in the area proposed for development. A full Heritage Impact Assessment with a detailed field component is recommended for the proposed development.

Note:
The responsibility for generating a response detailing the requirements for the development lies with the heritage authority. However, since the methodology utilised for the compilation of the Heritage Screeners is thorough and consistent, contradictory outcomes to the recommendations made by CTS should rarely occur. Should a discrepancy arise, CTS will immediately take up the matter with the heritage authority to clarify the dispute.

APPENDIX 5 -Summary of Specialist Expertise

Jenna Lavin, an archaeologist with an MSc in Archaeology and Palaeoenvironments, and currently completing an MPhil in Conservation Management , heads up the heritage division of the organisation, 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 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 a member 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. Recently, Jenna has been responsible for conducting training in how to write Wikipedia articles for the Africa Centre's WikiAfrica project.

Since 2016, Jenna has drafted over 50 Heritage Impact Assessments throughout South Africa.

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APPENDIX 2: Archaeological Assessment (2022)

ARCHAEOLOGICAL SPECIALIST STUDY

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

The development of various PV Facilities and their associated grid connections associated with Harmony Gold Mining activities throughout the Free State Province and in the North West Province

Prepared by

CTS HERITAGE

Jenna Lavin
Dr. D. Presnyakova

In Association with

Savannah Environmental

June 2022

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EXECUTIVE SUMMARY

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CONTENTS

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1. INTRODUCTION

1.1 Background Information on Project

TBA

1.2 Description of Property and Affected Environment

1.2.1 *Harmony*

The potentially affected footprint related to the proposed PV facility is located across the Harmony 1 mining area, approximately 2.5km south of the town of Welkom. The potentially affected area is largely flat. Yet an isolated elevated mound of disturbed quaternary sediments of fluvial origin is present on the landscape (CHM5). This elevated mound appears to have been exposed through past agricultural activities, and includes associated archaeological materials of Pleistocene age, as well as abundant unworked riverine raw-materials in certain localities.

Indeed, much of the northern and central portions of the affected area are significantly modified by recent and historical agricultural activities. In this regard, there are structural remnants of a farm (HM5) that would have encompassed substantial portions of the affected area when active, which is evident by the lateral spatial morphology of the now dense grasses and delineated fields associated with the agriculturally affected portions. Where retained and unaffected by agriculture, the natural vegetation comprises grassland and shrubland typical of the Free State Grassland Biome, interspersed with denser indigenous foliage along several drainage and paleo-drainage channels traversing the area. Predictably, local wildlife is more abundant in the areas that retain more extensive coverage of indigenous vegetation, with evidence of smaller antelope (such as Duiker and Steenbok), indigenous fowl including francolin, spurfowl and guineafowl , as well as some traces of burrowing rodents (molerats, hares and meerkats) evident in the project footprint.

The south-western portion of the potentially affected area has a higher frequency of active non-perennial drainages than the north-eastern portion. These drainages are associated with substantial fluvial deposits of riverine quartzite rocks (evident from the rock cortex), and other secondary deposits of sedimentary rocks that derive from the parent formations of the broader goldfields region. These cobbles would have been sources of raw-material for Stone Age occupants of the area. Other rock types incorporated in the cobble deposits include quartz and indurated shales (Hornfels), many of which are artefact manufacturing quality in terms of homogeneity and lithic fracture properties.

The historical use of the landscape for agricultural purposes, and relatively abundant remnants of recently abandoned structures in one area (HM5-HM8) raise the potential for graves and isolated burials. Importantly though, no graves were identified within this particular survey, and there would not be evidence of graves within the extensive ploughed areas of the footprint. However, the dense grass cover related to late summer heavy rainfall was a pertinent constraint to documenting potential graves in the areas that were not ploughed. Grass cover made potential grave locations impossible to exhaustively assess across the project area (particularly in cases where above surface material indicators may have been removed through crop related activities or through trampling related to stock farming).

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1.2.2 *Central*

The potentially affected footprint related to the proposed PV facility and associated infrastructure is located across several previously ploughed agricultural camps, approximately 9.5km to the south-east of the town of Welkom. Overall the area is flat, and is heavily modified by modern land-use activities such as historical agriculture and prospecting. As a result of such disturbance, little of the original natural landscape - in terms of vegetation, geology and probably also archaeology - is visible today.

The northern portion (Central Plant PV Facility (Alternative 1)) of the affected area is characterised by ploughed agricultural camps. Agricultural activities have disturbed the upper ~0.5-1m of original quaternary sediments associated with this area. At several localities, exposures of agriculturally reworked quaternary surface deposits are visible (CCT63), which include sparsely distributed Pleistocene stone artefacts in some places. These artefacts have been rolled, as evidenced by rounding and frequencies of edge-damage on all specimens, and are in heavily disturbed depositional contexts. Structural remains of past agricultural activities are also evident in close proximity to the ploughed areas. Ephemeral remnants of one modern Kraal were visible, however, this Kraal is likely not older than 60 years, thus offering little in terms of scientific or heritage value (CCT14).

An active high energy non-perennial braiding river with associated minor drainages is located in the south-eastern portion, and there are extensively ploughed fields in the south-western portion of Alternative 1. Several associated drainage channels expose fluvial deposits that are likely Pleistocene in origin. However, the spatial extent and life-history of the drainages are affected by the extensive modern disturbance related to mining activity and prospection in the area (CCT1). Substantial fluvial deposits of riverine quartzite rocks, and other secondary deposits of sedimentary rocks that are characteristic of the parent formations of the broader goldfields region, are associated with these channels. A diversity of rocks is incorporated in the cobble deposits including quartz and indurated shales (Hornfels), many of which are artefact quality in terms of homogeneity and fracture characteristics. Sparse Pleistocene artefacts are associated with these cobble deposits, and mostly comprise products from early on in core reduction, with one weathered bifacial tool indicative of an earlier Late Pleistocene or Middle-Pleistocene occupation of the region. This bifacial tool may be indicative of a broad minimum age for the original fluvial deposition of the cobbles and artefacts in this area. That said, the artefacts themselves could have been fluvially transported over substantial distances. The artefacts identified were all *ex-situ*, meaning that they cannot be dated or geochronologically associated with an encompassing deposit, so are limited in scientific value. All artefacts occur as isolated finds rather than scatters of associated archaeological materials.

The potentially affected area also has sporadic invasive vegetation including eucalyptus, occasional black Wattle and several Pine trees. Where the indigenous vegetation is evident, it comprises grassland and semi-arid shrubland typical of the southern African Grassland Biome in the summer-rainfall region, although indigenous vegetation has been removed across >70% of the affected area. In terms of fauna, only evidence for burrowing rodents (predominantly hares) was observed. Bioturbation relating to burrowing rodents may well affect any potential sub-surface archaeology (though no sub-surface remains were documented apart from the reworked isolated Pleistocene artefacts).

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Apart from the isolated Stone Age remains mentioned, there was no evidence of Iron Age archaeology within the footprint. No graves were identified within the survey and visibility was reasonably good for stone structures, although much of the surface sediments were only visible in disturbed contexts. Relevantly, the dense grass cover was a pertinent constraint to documenting potential graves in the areas that were not disturbed. Agricultural and prospection activities may have removed surficial indicators of sub-surface archaeology such as burials, which needs to be considered in future development implicating excavation.

1.2.3 *Target*

The potentially affected area associated with the proposed PV facility is located in the Target mining area, approximately 12 km north-east of the town of Odendaalsrus in the goldfields region of the Lejweleputswa district of the Free State province of South Africa. The footprint for potential development is largely flat, and characterised - over substantial portions - by ploughed agricultural camps in the western most two-thirds. The upper sediments in the agriculturally affected regions (western portion) have thus been extensively disturbed through agricultural processes, and the original quaternary deposits have been reworked or removed to depths in excess of ~0.5m in several places, as a consequence of agriculture and/or mining related clearing (CTG1 - CTG6).

Local bedrock outcrops ephemerally at several points east of the affected area. This bedrock is comprised largely of shales and indurated siltstones (Ecca Group), whereas the upper sediments covering these host rocks, and the footprint itself, likely derive from the in-situ weathering of local parent formations. The upper sediments were fluvially deposited across much of the area (as evidenced by sub-angular edges and rounding of lithic inclusions), and potentially relate in depositional origin to summer flooding of the drainages to the south and west.

In the eastern portion of the affected property, where natural landscape is primarily retained (i.e. unaffected by modern activity), grassland and semi-arid shrubland is evident with shale and some evidence for sub-volcanic rock in the form of small secondary colluvial nodules (<5cm in maximum diameter) in several locations. No primary or secondary sources of artefact quality stone were documented on the affected property, and only two stone artefacts (on exotic fine-grained quartzite) were documented in the vicinity of the affected property. The isolated archaeological finds were documented in the eastern portion, in broad association with the original quaternary upper sediments. However these archaeological finds occurred in secondary contexts on a deflated land surface, so therefore have limited potential for modern scientific analyses (due to the *ex situ* spatial contexts of the finds and limited possibility of radiometric dating or directly associating them with dateable sediments).

The western portion of the affected property is interspersed with vehicle tracks where grass has been trampled and/or removed, probably to facilitate vehicle manoeuvrability between agricultural infrastructure and to facilitate movement associated with prospecting. Indigenous fowl including francolin and guineafowl were observed on the affected property, in addition to abundant traces of burrowing rodents (predominantly hares), which may well affect any potential sub-surface archaeology (though no sub-surface remains were documented).

Apart from the ephemeral Stone Age remains documented, evidence for archaeology was minimal. No graves were identified within the survey and visibility was reasonably good for stone structures, so the latter finding could be

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considered comprehensive. However, the substantial grass cover and soil formation across the eastern part of the footprint was a relevant constraint to documenting stone artefacts and other smaller potential surface remains such as pottery etc.

1.2.4 *Joel*

The potentially affected footprint related to the proposed PV facility is located across the Joel mining area, approximately 12 km north-east of the town of Odendaalsrus in the goldfields region of the Lejweleputswa district of the Free State province of South Africa. Relative to the 4 other affected areas discussed in the report, the Joel area is substantially less affected by modern activities and significant portions of the original landscape are retained that have thick shrubs and grasses, although portions of the property owned by the mine look currently to be leased out for cattle grazing, and one small central area has been affected by historical mining (evidenced by an abandoned shaft CJL13).

The footprint is located in the vicinity of the Free State Doring meandering river system. Portions of the affected property are located on the terraces of this drainage system, with evidence of banded chert nodules (4-11cm in maximum diameter – a high quality raw-material for artefact manufacture) (CJL2), and thick fluvially deposited sands (CJL11). Importantly, only marginal topsoil formation was evident in the area, which may be a further indicator of the erosional effects of a past active high-energy river system. Several remnants of dam structures were recorded, implicating the historical anthropogenic capture of naturally available water in the summer rainfall season (CJL3 and CHL6). Although the affected area is relatively flat, there are more resistant raised areas that are richer in archaeological materials relative to the deflated areas between(CJL11). There is also more evidence for soil formation in the raised portions, indicating that parts of the landscape have been differentially eroded by natural (flooding) and/or anthropogenic processes (agriculture) over time.

The natural vegetation comprises Savanna Grassland typical of the southern African summer-rainfall region interspersed with abundant acacia, and dense grasses among the shrubs, with small open patches of sand dispersed between the thicker vegetation (which were extensively examined, although archaeological visibility was poor) (CJL1, CJL2, CJL4, CJL10, CJL12, and JL1 and 2) . Chert artefacts were exposed in several patches indicating that the vegetation cover may be inhibiting visibility of more extensively distributed archaeological materials. There is abundant evidence of indigenous and invasive fauna including smaller to medium sized buck (Bushbuck, Duiker and Steenbok), Suids including various bushpig species (and modern traps set for their capture), abundant Vervet monkeys, indigenous and feral fowl including herds of Ostrich, francolin, spurfowl and guineafowl, as well as traces of burrowing rodents (molerats, hares and meerkats).

Importantly, no graves were identified within the survey, and there would not be evidence of graves within the areas of the footprint extensively affected by flooding. In addition, there was no evidence for historical dwelling structures that would make potential burials more likely. The dense grass and acacia cover, however, was a pertinent constraint to documenting potential graves in the areas that were not disturbed. Extensive grass cover made potential grave locations impossible to exhaustively assess across the project area although their presence seems unlikely given the

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paucity of archaeological evidence for historical domestic activities such as dwellings.

1.2.5 Moab

The potentially affected area related to the proposed PV facility is located across the Moab mining area and some privately owned agricultural camps in the east, approximately 12 km south-east of the town of Orkney. Although Orkney is located in the North-West province, the PV footprint is located across the southern bank of the Vaal River, on the northern border of the Free State province of South Africa.

Much of the footprint has been affected by sporadic surface disturbance and modern excavation likely associated with historical agricultural activities (and modern ploughed fields to the east of the Moab boundary included in the affected footprint) (CMB3), with mining prospection and the development of mining related infrastructure (CMB26). Where the natural vegetation is retained, it comprises grassland typical of the southern African Grassland Biome in the summer-rainfall region interspersed with acacia, and in some areas, such as the south-west, dense invasive forest comprising eucalyptus plantation and occasional black Wattle (CMB10). Chert bedrock outcrops in multiple locations (CMB4) in the north-west and in the south-east (some with clear prehistoric exploitation traces) (CM2). Where indigenous grassland is retained, evidence of smaller antelope (such as Duiker and Steenbok), abundant Vervet monkeys, indigenous fowl including francolin, spurfowl and guineafowl, as well as traces of burrowing rodents (molerats, hares and meerkats) were observed within the affected area.

The topography of the project area is generally flat. It declines, however, gradually in the south-east where a drainage channel is located associated with Middle and Later Stone Age materials. There is extensive disturbance in the form of recent and historical clearing associated with probable mining-related activities. Bioturbation in the form of rodent activity is evident in the upper ~0.4-1m of sandy topsoil, as well as evidence for past stock rotation farming in the southern portion (probably prior to the land being owned by the mining company), and modern stock farming and bean plantation in the most easterly portion (on what looks to be privately owned/leased land).

The sandy upper sediments look to be fluvially deposited across much of the area, with very few lithic inclusions (some marginally rounded), indicating low-energy deposition in the north-western portions probably related to the Vaal river system, and with primary nodules of chert (5-10cm in maximum diameter) deriving from the local bedrock. Artefact quality raw-material in the form of primary local cherts is available within the footprint, with several outcrops associated with sparse archaeological evidence. Some ephemeral Stone Age exploitation evidence in the form of simple cortical flakes, flake removal traces on outcrops and cores were identified as well as some systematic Levallois and bladelet production in the eastern portion. No identified sites represent archaeological remains in dateable contexts that need to be avoided (see sensitivity ranking), and all are of low scientific significance.

Importantly, no graves were identified within the survey, and there would not be evidence of graves within the extensively disturbed areas of the footprint. In addition, there was no evidence for historical dwelling structures apart from the non-domestic dilapidated Vaal Reef Shooting Club. Relevantly though, the dense grass cover was a pertinent constraint to documenting potential graves in the areas that were not disturbed. Extensive grass cover made potential grave locations impossible to exhaustively assess across the project area (particularly in cases where above surface

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material indicators may have been removed through modern disturbance or through trampling related to historical stock farming activities.

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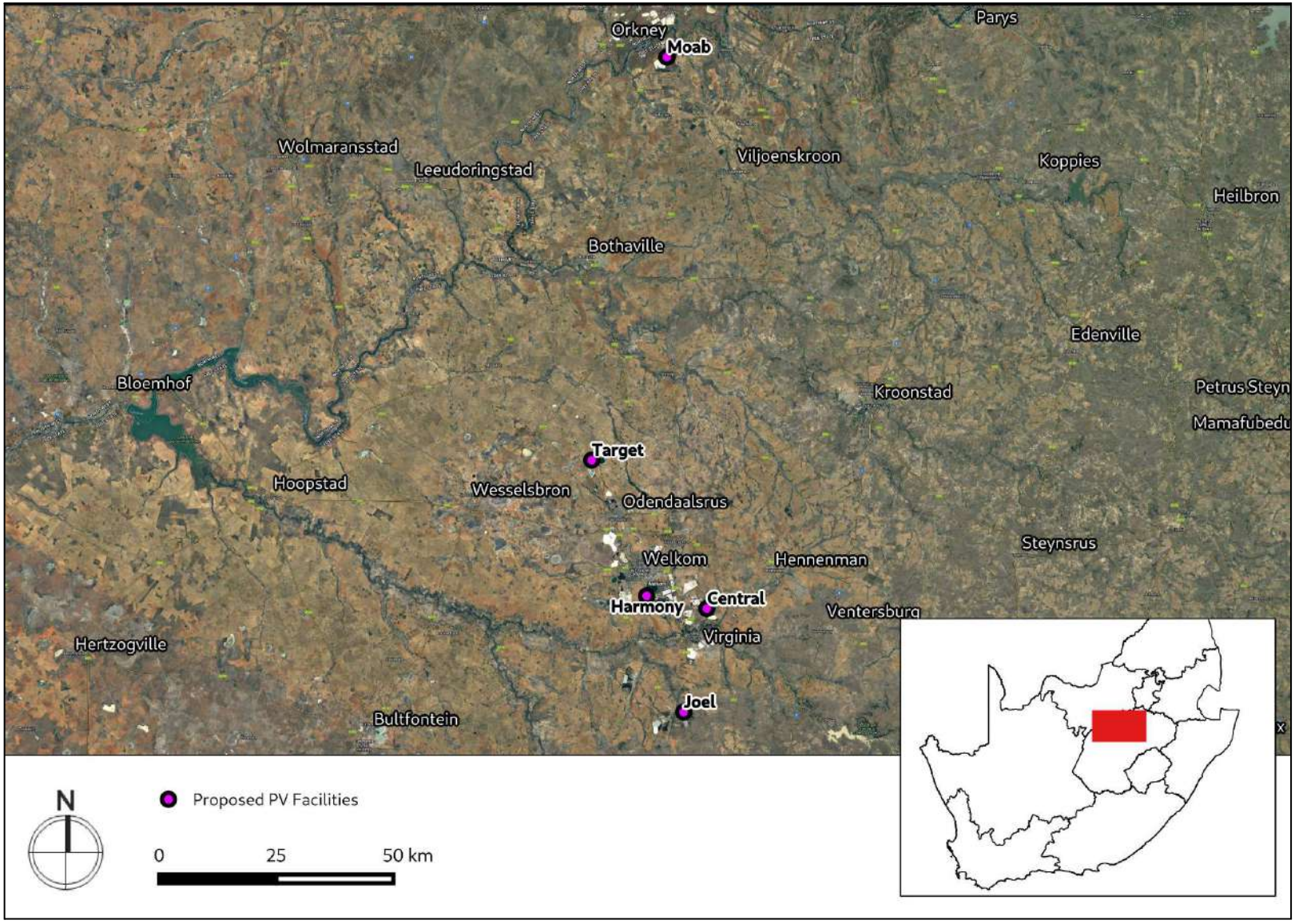

Figure 1.1: Close up satellite image indicating proposed location of study area

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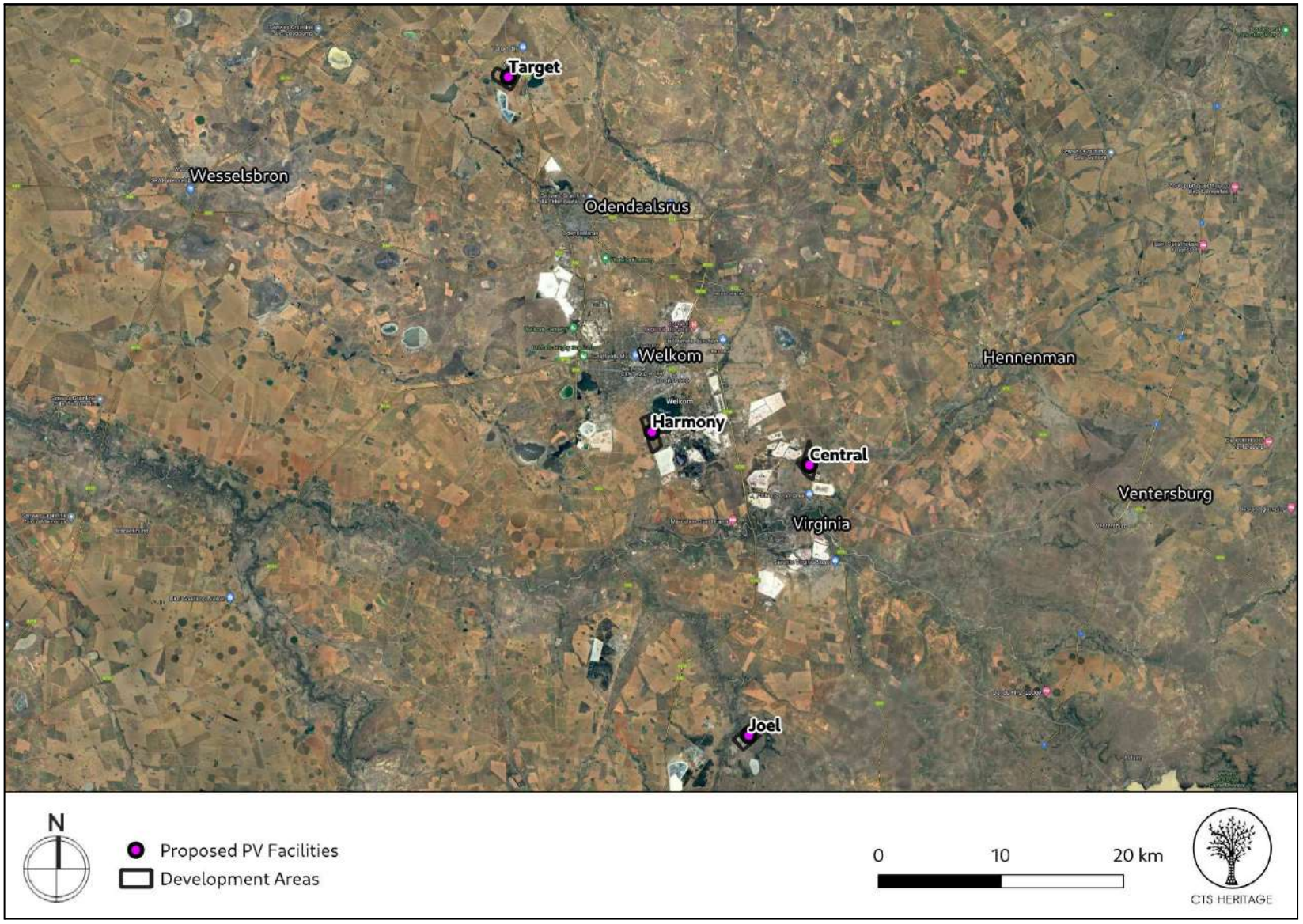

Figure 1.2: Study Area

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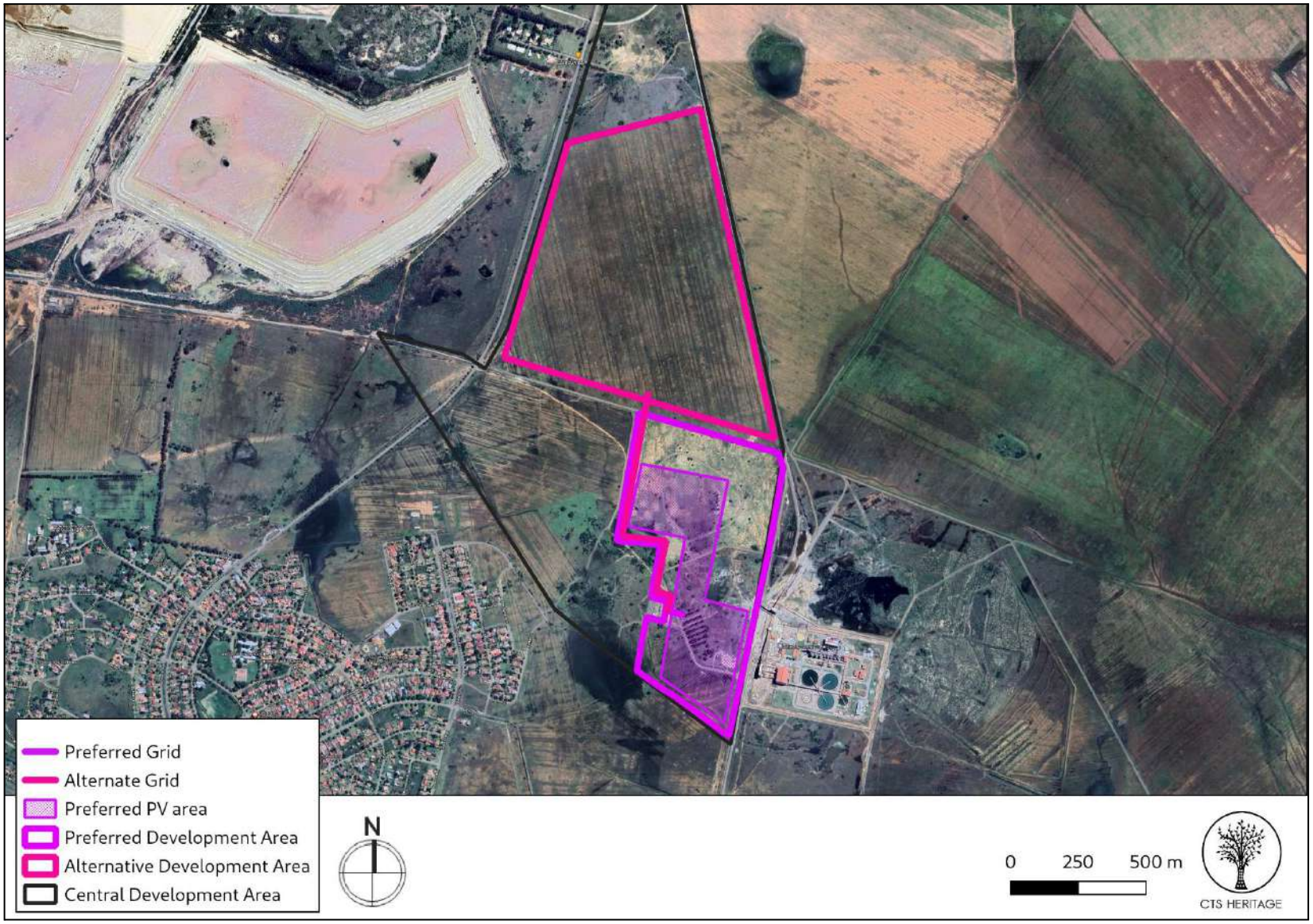

Figure 1.3: Study Area for Central PV

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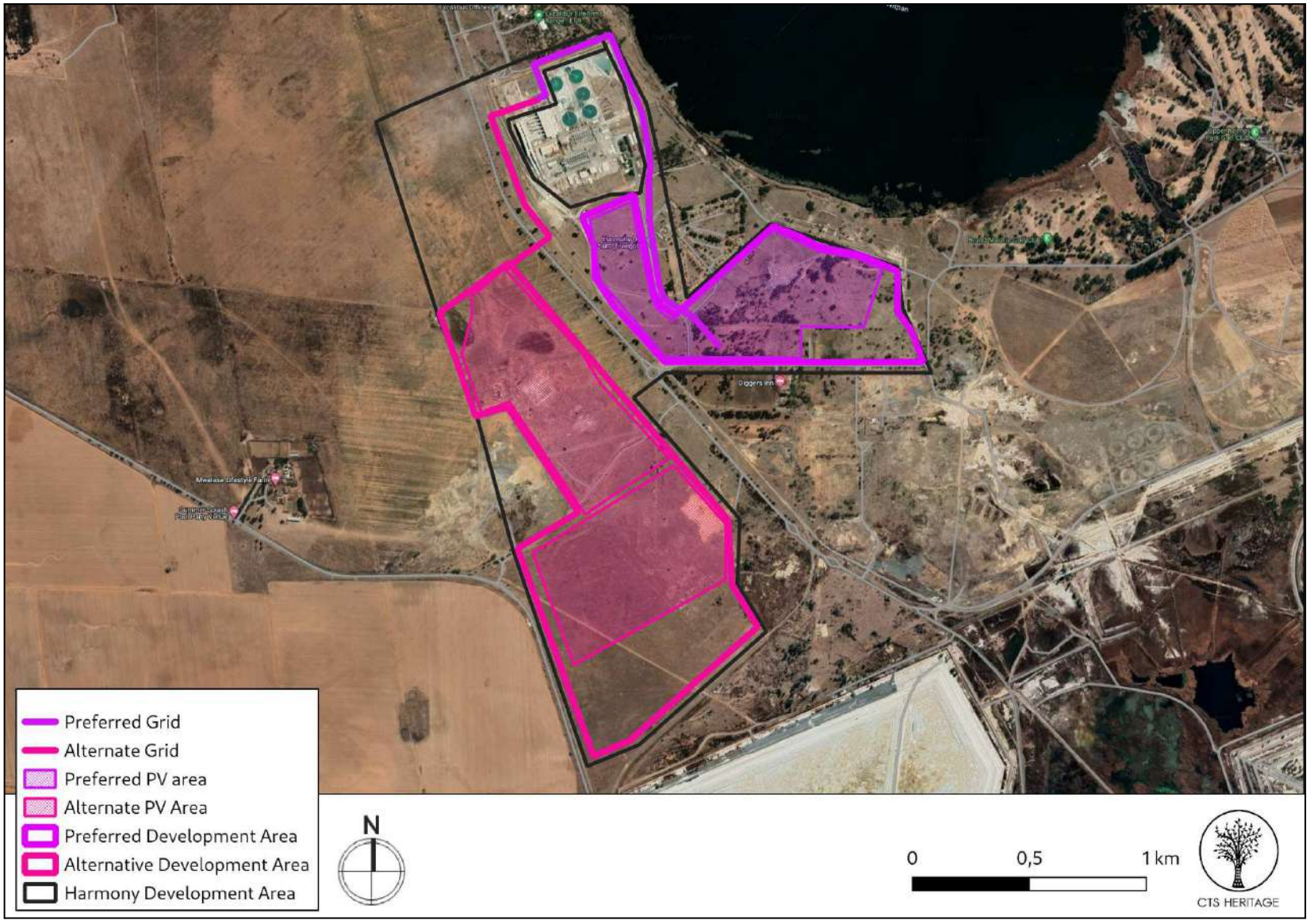

Figure 1.4: Study Area for Harmony PV

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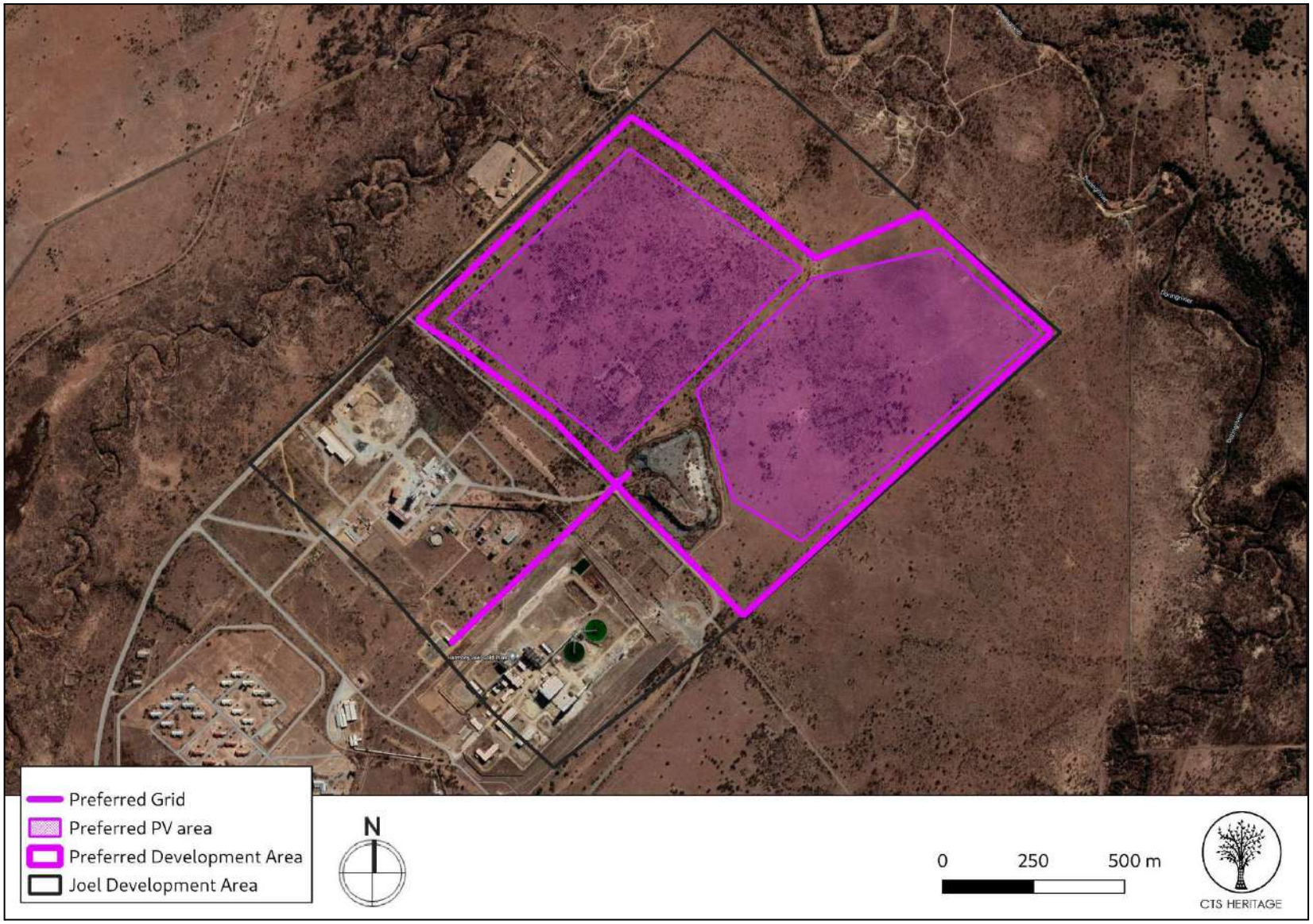

Figure 1.5: Study Area for Joel PV

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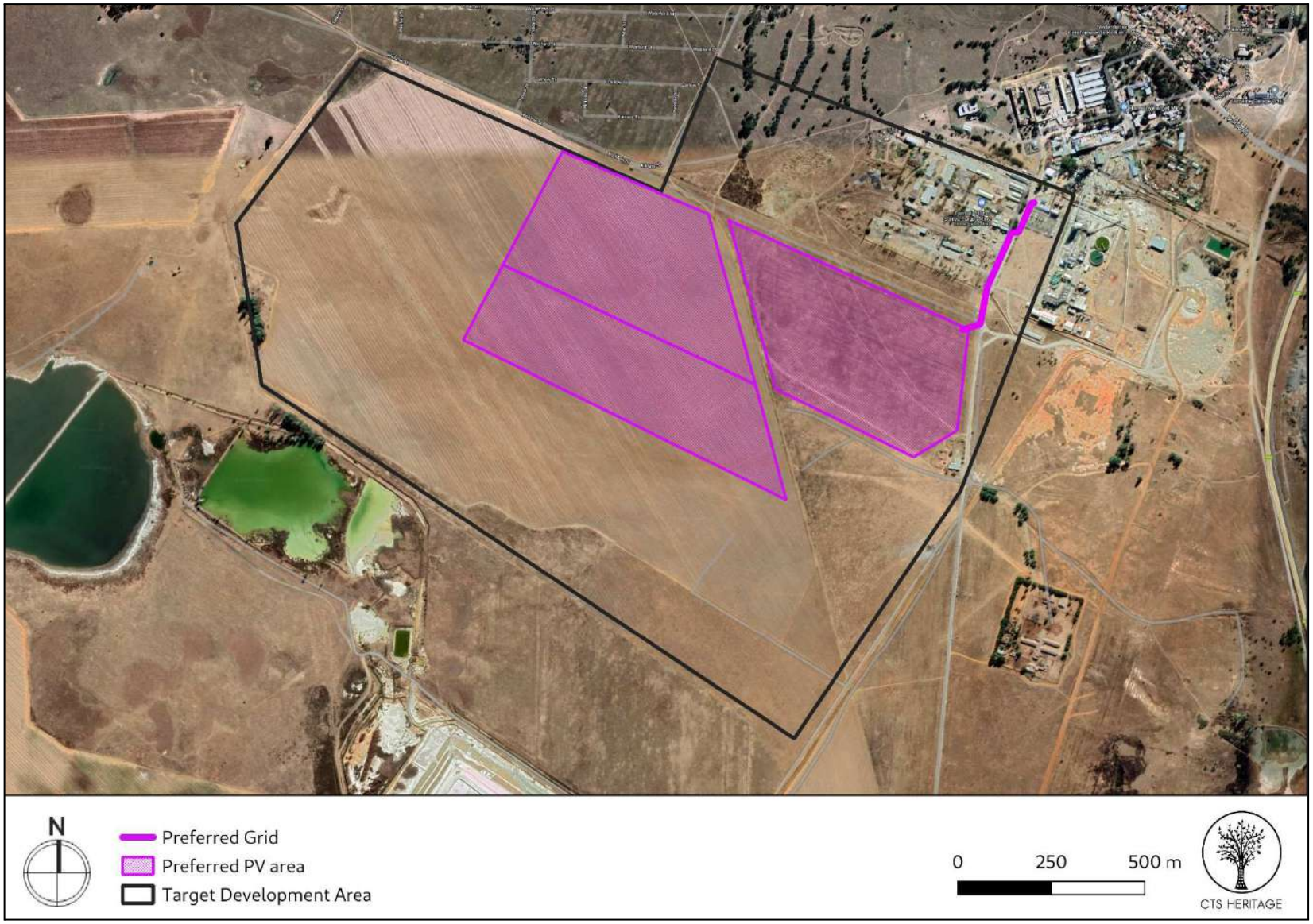

Figure 1.6: Study Area for Target PV

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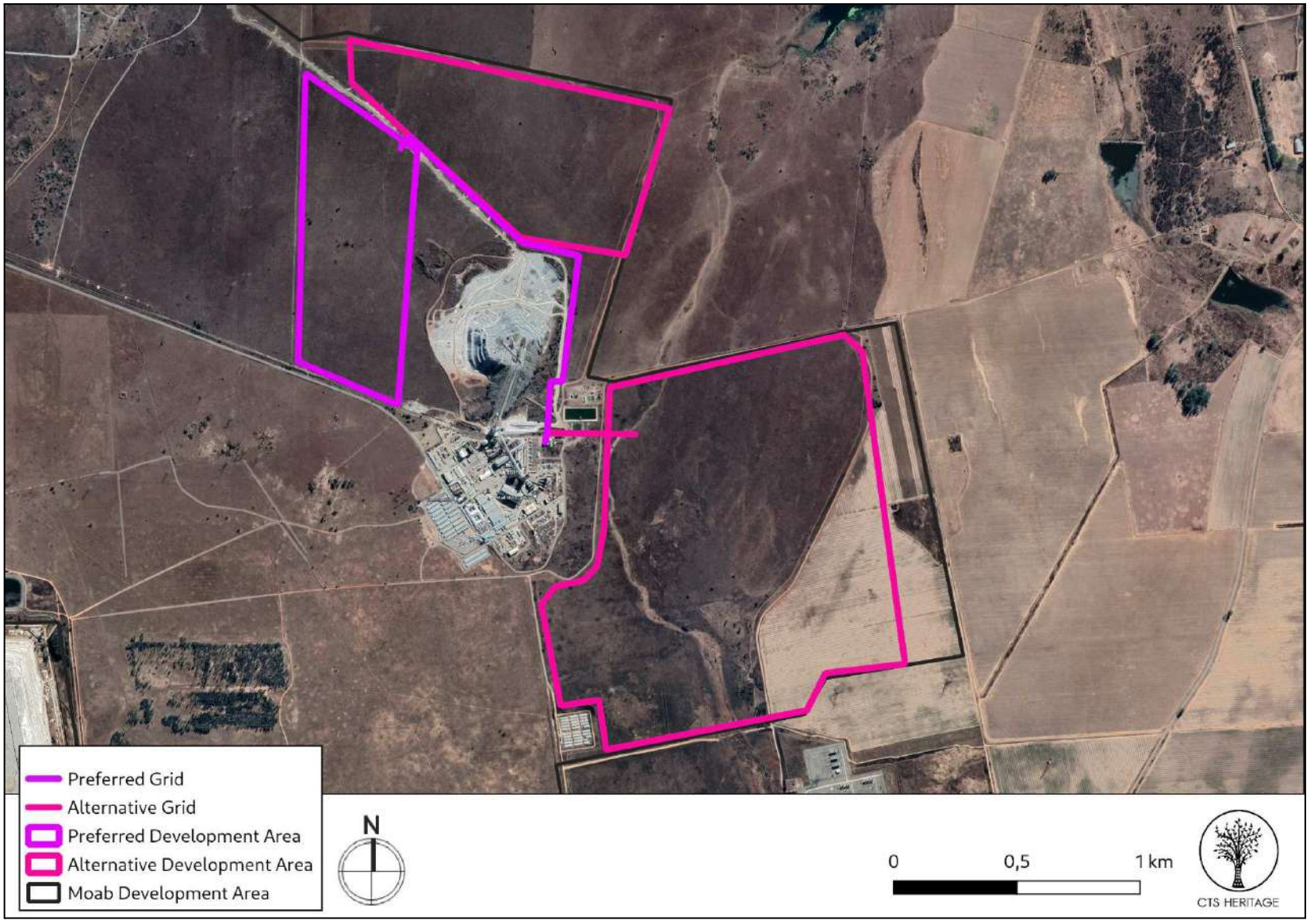

Figure 1.7: Study Area for Moab PV

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2. METHODOLOGY

2.1 Purpose of Archaeological Study

The purpose of this archaeological study is to satisfy the requirements of section 38(8), and therefore section 38(3) of the National Heritage Resources Act (Act 25 of 1999) in terms of impacts to archaeological resources.

2.2 Summary of steps followed

- An archaeologist conducted a survey of the sites and its environs from May to July 2022 to determine what archaeological resources are likely to be impacted by the proposed development.
- The study area was assessed on foot in transects, photographs of the context and finds were taken, and tracks were recorded using a GPS.
- The identified resources were assessed to evaluate their heritage significance in terms of the grading system outlined in section 3 of the NHRA (Act 25 of 1999).
- Alternatives and mitigation options were discussed with the Environmental Assessment Practitioner.

2.3 Constraints & Limitations

2.1 Harmony

(1) Dense grasses and occasional shrubs cover portions of the project area. This coverage significantly inhibited the visibility of surface archaeology. However, this is not regarded as a substantial problem in relation to the Stone Age archaeological remains, which in most cases look to have generally limited scientific importance due to the disturbed and deflated contexts they occur in. An exception is the context of the archaeology at JL2, which occurs in a potentially dateable context. Additionally, even in the places that had optimal visibility, evidence of archaeology was sparse. It is clear that the Stone Age sensitivity and scientific potential of the project area has been comprehensively assessed.

(2) The inability to assess some of the footprint area at ground surface level in some portions (due to modern vegetation cover), should be regarded as a constraint to the documentation of potential graves.

(3) Previous vegetation clearing activities through prospecting, and by farmers, may have affected evidence of surface archaeology including the possible above-surface presence of material evidence of graves (i.e. the removal of surface stone structures).

(4) Upper sediments are disturbed in the portions of the potentially affected area that have been historically farmed, inhibiting visibility.

(5) Access was not possible in areas that are being actively mined; however, any archaeology occurring in these areas would probably be *ex situ* in any case, and of limited scientific importance.

2.2 Central

(1) The area is heavily modified by modern land-use activities such as historical agriculture and prospecting. As a result of such disturbance, little of the original natural landscape - in terms of vegetation, geology and

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probably also archaeology - is visible today. Previous vegetation clearing activities through prospecting, and by farmers historically, may have affected evidence of surface archaeology including the possible above-surface presence of material evidence of graves (i.e. the removal of surface stone structures).

(2) Dense grasses and occasional shrubland cover portions of the project area. This coverage significantly inhibited the visibility of surface archaeology. However, this is not regarded as a substantial problem in relation to the Stone Age archaeological remains, which in most cases look to have generally limited scientific importance due to the disturbed and deflated contexts they occur in. Additionally, even in the places that had optimal visibility, evidence of archaeology was sparse. It is clear that the Stone Age sensitivity and scientific potential of the project area has been comprehensively assessed.

(3) The inability to assess some of the footprint area at ground surface level in some portions (due to modern vegetation cover), should be regarded as a constraint to the documentation of potential graves.

(4) Access was inhibited in areas actively prospected or mined; however, any archaeology occurring in these areas would be *ex situ* in any case, and of limited scientific importance.

2.3 *Target*

(1) Ploughed agricultural camps encompass the western most two-thirds of the affected area. Consequently, the upper sediments are substantially disturbed where crops are actively growing and cattle grazing and resulting trampling is evident.

(2) Dense grasses and occasional shrubland cover portions of the project area. This coverage significantly inhibited the visibility of surface archaeology. However, this is not regarded as a substantial problem in relation to the Stone Age archaeological remains, which in most cases look to have generally limited scientific importance due to the disturbed and deflated contexts they occur in. Additionally, even in the places that had optimal visibility, evidence of archaeology was extremely sparse. It is clear that the Stone Age sensitivity and scientific potential of the project area has been comprehensively assessed.

(3) The inability to assess some of the footprint area at ground surface level in some portions (due to modern vegetation cover), should be regarded as a constraint to the documentation of potential graves.

(4) Previous vegetation clearing activities through prospection, and by farmers, may have affected evidence of surface archaeology including the possible above-surface presence of material evidence of graves (i.e. the removal of surface stone structures).

(5) Access was not possible in areas actively mined; however, any archaeology occurring in these areas would be *ex situ* in any case, and of limited scientific importance.

2.4 Joel

(1) Substantial acacia and other shrubs cover portions of the project area, which are interspersed with dense

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grasses. This coverage significantly inhibited the visibility of surface archaeology. Given the presence of an archaeological site occurring in a dateable context, this vegetation coverage has to be considered a significant hindrance to assessing the Stone Age sensitivity of the project area.

(2) The inability to assess some of the footprint area at ground surface level in some portions (due to modern vegetation cover), should also be regarded as a constraint to the documentation of potential graves.

(3) High energy flooding may have affected evidence of surface archaeology including the possible above-surface presence of material evidence of graves (i.e. the removal of surface stone structures).

(4) Access was inhibited in areas that are actively mined; however, any archaeology occurring in these areas would be *ex situ* in any case, and of limited scientific importance.

2.5 Moab

(1) Dense grasses and occasional shrubland cover portions of the project area. This coverage significantly inhibited the visibility of surface archaeology. However, this is not regarded as a substantial problem in relation to the Stone Age archaeological remains, which in most cases look to have generally limited scientific importance due to the disturbed and deflated contexts they occur in. Additionally, even in the places that had optimal visibility, evidence of archaeology was extremely sparse. It is clear that the Stone Age sensitivity and scientific potential of the project area has been comprehensively assessed.

(2) The inability to assess some of the footprint area at ground surface level in some portions (due to modern vegetation cover), should be regarded as a constraint to the documentation of potential graves.

(3) Previous vegetation clearing activities through prospection may have affected evidence of surface archaeology including the possible above-surface presence of material evidence of graves (i.e. the removal of surface stone structures).

(4) Upper sediments are substantially disturbed in the eastern portion where crops are actively growing and cattle grazing is evident (in the area that appears to be private property).

(5) Access was inhibited in areas actively mined; however, any archaeology occurring in these areas would likely be *ex situ* in any case, and of limited scientific importance.

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3. HISTORY AND EVOLUTION OF THE SITE AND CONTEXT

This application is for the proposed development of a number of PV Facilities located throughout the Free State associated with various Harmony Mines. Four of these facilities are located in proximity to one another around the Welkom area, and the fifth is located further north near Orkney.

According to Fourie (2021), "The Free State has a rich archaeological and historical history going back millions of years and includes significant aspects such as Later Stone Age rock art, Battlefields and Iron Age stonewalled enclosures. The general surroundings of the study area became a melting pot of contact and conflict as it represents one of many frontiers where San hunter-gatherers, Nguni and Sotho-Tswana agro-pastoralists, Dutch Voortrekkers and British Colonists all came together. The ravages of war also swept across these plains, and in particular the South African War (1899-1902) as well as the Boer Rebellion (1914-1915)." No heritage resources of significance were identified by Van der Walt (2013) in his assessment of a nearby farm. Van der Walt (2013) notes that "some MSA finds might be possible around pans on the farm. It is important to note that the lack of sites can be attributed to a lack of sustainable water sources (no pans exist in the development footprint) in the development area as well as the lack of raw material for the manufacturing of stone tools. No Sites dating to the Early or Middle Iron Age have been recorded or are expected for the study area. The same goes for the Later Iron Age period where the study area is situated outside the western periphery of the distribution of Late Iron Age settlements in the Free State. However to the north of the study area, ceramics from the Thabeng facies belonging to the Moloko branch of the Urewe tradition were recorded at Oxf 1 and Platberg 32/71 (Maggs 1976, Mason 1986)".

Archaeology of the broader Welkom area

In his field assessment conducted within this broader area, Rossouw (2012) noted that "The Stone Age archaeological footprint in the region is largely represented by the occurrence of open-site, Middle Stone Age (MSA) and Later Stone Age (LSA) assemblages that are mainly located near river drainages. Interestingly, a large number of MSA artifacts were found 2m below the surface at the Allanridge railway siding in 1953. The material is stored at the National Museum in Bloemfontein. Unfortunately, the context of the assemblage is unknown. MSA as well as LSA artefacts, in association with mammal fossil remains, are also found in a series of erosional gullies along the Sand and Doring Rivers between Virginia and Theunisen. There are no records of rock engravings known from the area. The ruins of a large complex of Late Iron Age settlements (OXF 1, Maggs 1976) are found at Strydfontein between Hennenman and Ventersburg. However, it is noted that the affected area is situated outside the western periphery of the distribution of Late Iron Age settlements below the Vals River in the Free State (Maggs 1976)." In Rossouw's assessment, he found no evidence of *in situ* Stone Age or Iron Age archaeological material. He noted no indications of prehistoric structures or rock engravings, historical buildings or structures older than 60 years. Two small graveyards were also recorded during the survey.

In an assessment completed in this area, Van Ryneveld (2013) identified five historical structures on the property, but no archaeological heritage resources. Despite the high number of heritage impact assessments completed in the broader area, no archaeological sites of significance have been identified in close proximity to the proposed development area. This is likely due to the extreme transformation of the area as a result of historic and ongoing gold mining activities.

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Archaeology of the broader Orkney area

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 the nearby Pretorius Kraal 53, 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), 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 of an area immediately adjacent to the Moab PV project area, Huffman (2005, SAHRIS ID 7367) identified no sites of archaeological interest. In their assessment of an area located immediately adjacent to the areas proposed for 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."

In an assessment completed by CTS Heritage for a proposed PV facility located nearby, a single site and very few isolated individual artefacts were documented. Cumulatively these findings indicate cultural evidence for MSA and LSA occupations of the area. It was noted that 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 (VK4) was relatively less affected by post-depositional processes, and may have been exposed relatively recently. Apart from this one site, the potential for finding a dateable *in-situ* archaeological horizon based on current surface observations appears to be low. The documented archaeology is therefore classified as scientifically LOW-SIGNIFICANCE. 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.

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4. IDENTIFICATION OF HERITAGE RESOURCES

4.1 Field Assessment

The survey was conducted primarily on foot but also involved driving between key targeted areas, and sought to assess the presence and significance of archaeological occurrences within the project area. Across all 5 potentially affected areas, overall field assessment documented a sparse number of isolated stone artefacts in secondary and surface contexts and one denser occupational context in a potentially dateable context, suggesting the area may have been traversed intermittently by Stone Age groups through periods in both the Middle Stone Age (MSA – ~300ka:~40ka), the Later Stone Age (LSA: ~40ka: ~2ka) in addition to individual bifacial tools potentially associated with the later ESA (~400-~200ka), although artefacts that could be clearly linked with chrono-cultural periods were scarce. The presence of small nodules of artefact-quality chert rocks, homogenous quartzites as well as high-quality riverine Hornfels and Quartz in the project areas in addition to relatively abundant standing water, were likely the resources that attracted groups to the broader region, and resulted in them leaving behavioural traces in the form of stone artefacts and traces of lithic exploitation on primary sources of raw-material (the latter exclusively at Moab). Indeed the majority of the stone artefacts identified look to be the result of expedient 'testing' of rocks for quality, although several cores and tools associated with more extensive investment in production were identified. In this sense – apart from the single site at Joel (see below) - no evidence of substantial densities of finds or occupational debris were identified, and the stone artefacts present look to have been produced by mobile forager groups moving through the area.

4.1.1 Harmony

Field assessment at Harmony documented several stone artefact scatters in secondary contexts and one site (CHM4) in a close to primary context that optimally needs to be avoided. Cumulatively these finds suggest the area was occupied or traversed intermittently by Stone Age groups through periods in the Middle Stone Age (HM1-HM3), and perhaps the terminal ESA/early MSA (CHM4), as well as historical periods associated with more recent occupations of the region (HM5-8).

The sites of HM1, HM2 and HM3 have predominantly MSA artefacts that occur in ex-situ contexts, and the weathering of the edges suggests the artefacts have been exposed for substantial periods and have limited scientific value. HM4 is an MSA site associated with Pleistocene occupation of a paleo-drainage terrace. The artefacts at HM4 are eroding out of laminated – highly detailed – fluvial deposits that document both the depositional history of the meandering river system and the associated prehistoric occupation of the river terraces by MSA hominins. One bifacial tool was identified, which is certainly MSA, but may also document an older Middle-Pleistocene occupation of the terraces. Given the detailed depositional history of the river documented at HM4 and its association with anthropogenic activity, if this site could be avoided with the guidance of a 30m buffer zone for development that would be optimal.

The historical structures located at HM5-HM8 were documented, but are largely demolished and have limited scientific value. HM7 represents a historical walling structure associated with a drainage channel but has been affected by modern prospection to a degree that it no longer retains substantial heritage value.

4.1.2 Central

Field assessment at Central documented 4 Stone Age occurrences in secondary contexts (CT1-CT4). Cumulatively these

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finds suggest the area was occupied or traversed intermittently by Stone Age groups through periods in the Middle Stone Age, and perhaps the terminal ESA/early MSA.

CT1 was an isolated dolerite core that had been exposed in an intensively ploughed area. The bidirectional nature of removals suggest that the core is probably Middle Stone Age. CT2 was a quartz flake with a prepared platform, also occurring in an area affected substantially by modern agricultural activity. Such platform preparation (CT2) is typical of the products of MSA techniques of flake production. CT3 was a bifacial tool associated with a drainage channel within the footprint, although it was also isolated so has limited scientific value as a single find in an ex-situ, redeposited context. In addition, CT3 had substantial edge damage and weathering indicating that it may have been deposited by a river. As CT3 is a larger bifacial tool, it may be representative of terminal Acheulean technological activity within the area.

4.1.3 Target

No significant archaeology was documented within the footprint at Target. The only isolated finds were two small probably Later Stone age cores (TG1), however, these cores were documented in the area of the footprint that is not currently earmarked for development.

4.1.4 Joel

Field assessment at Joel documented several stone artefact scatters in secondary contexts and one site in a potentially dateable context that needs to be avoided. Cumulatively these finds suggest the area was occupied or traversed intermittently by Stone Age groups through periods in the Middle Stone Age (JL1, JL2, JL5), and the Later Stone Age (JL4, JL6), as well as potentially by groups in periods associated with herder and early historical occupations of the region. JL1 has a dolerite bi-directionally reduced core from initial nodule testing that is characteristic of the MSA. JL2 represents a site that accumulated because of the chert raw-material source nearby, so flakes are largely primary. JL2 also has a hammerstone with visible pitting associated with percussion activities – probably knapping. JL3 has heavily weathered quartzite artefacts including a single platform core (probably MSA given the degree of patination and probable Pleistocene age). JL4 has high-quality chert artefacts, which are also patinated, likely associated with bladelet production, thus indicative of a terminal Pleistocene or Holocene age. At JL6 there is a single platform bladelet core with evidence of crest production and unipolar bladelet production, certainly LSA, and probably indicative of Holocene technological activity.

The relatively more scientifically significant sites/finds are associated with J5, which has later MSA lithics (prepared core technologies), a diversity of raw-materials, as well as a unifacially retouched point potentially indicative of the post-Howiesons Poort period (~55ka-35ka). At JL5, artefacts are eroding out of quaternary sediments, and have been brought to the current land surface through rodent borrowing and other forms of bioturbation. As this site appears to be in a potentially close to primary context (at least an *in situ* context that is potentially dateable), it should be avoided with at least a ~50m buffer zone for development.

4.5 Moab

The survey at Moab documented several isolated finds, and a sparse stone artefact scatter in a secondary context.

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The site at CM1 has a concentration of artefacts that look to be eroding from an encompassing sedimentary context, although the sediments in the close vicinity have been affected by recent land use activities. If this site could be avoided with the guidance of a 30m buffer zone for development that would be optimal. At CM3 several isolated chert artefacts were present on a deflated land surface. The small size of the flakes in addition to the platform morphology and dorsal removal patterns on one specimen may be indicative of bladelet production, thus indicating a likely terminal Pleistocene or Holocene age for these artefacts. Primary sources of chert were documented at several locations within the footprint (e.g. CM2), and several negative flake removals indicating Stone Age exploitation were identified on these outcrops.

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Figure 4.1: Dense grasses and occasional shrubs covering portions of the project area. Such vegetation inhibits the visibility of surface archaeology at Harmony: CHM1, CHM4, CHM8, CHM9, CHM15.

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Figure 4.2: Dense grasses cover portions of the project area inhibiting the visibility of surface archaeology at Central: CCT2; CCT8; CCT11; CT2.

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Figure 4.3: Dense grasses and occasional shrubs cover portions of the project area, inhibiting the visibility of surface archaeology at Moab: CMB1; CMB3; CMB5; CMB8; CMB9; CMB10; CMB16; CMB22; CMB25; CMB27.

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Figure 4.4: . Dense grasses cover portions of the project area inhibiting the visibility of surface archaeology at Target: CTG9.

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Figure 4.5:Acacia and other shrubs cover portions of the project area at Joel, which are interspersed with dense grasses: CJL1, CJL2, CJL10, CJL12.

Figure 4.6: Areas of Harmony affected by mining activities: CHM12

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Figure 4.7: Photos show an isolated elevated mound of quaternary sediments of fluvial origin at Harmony (CHM5). Coarse sands followed by laminated well-sorted coarse-medium sand succeeded by silts displayed in the photo is typical for a perennial meandering river.

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Figure 4.8: Active non-perennial drainages at Harmony (CHM4 and CHM13):

Figure 4.9: A depiction of raw material sources at Harmony: quartzite and shale (CHM3)..

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Figure 4.10: Areas of Central affected by mining activities: CCT1.

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Figure 4.11: Agricultural activities at Central have disturbed the upper ~0.5-1m of original quaternary sediments: CCT6

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Figure 4.12: An active high energy non-perennial braiding river (CCT11) with associated minor drainages is located in the south-eastern portion (CT3). Riverine quartzite rocks (CT3), and other secondary deposits of sedimentary rocks are associated with these fluvial channels. Many of these rocks are artefact quality in terms of homogeneity and fracture characteristics(CCT9).

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Figure 4.13: Areas of Moab affected by mining activities: CMB26.

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Figure 4.14: Areas of Moab affected by agricultural activities, fields: CMB3 and CMB20, as well as topsoil removed: CMB22.

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Figure 4.15: Artefact quality raw-material in the form of primary local cherts, available within the footprint (CMB4), with several outcrops associated with sparse archaeological evidence(CM1).

Figure 4.16: Areas of Target affected by mining activities

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Figure 4.17: Areas of Target affected by agricultural activities: CTG2, CTG4, CTG6

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Figure 4.18:Areas of Joel affected by mining activities CJL13

Figure 4.19: The natural Savanna Grassland vegetation at Joel: CJL4.

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Figure 4.20: small open patches of sand dispersed between the thicker vegetation: JL1 and JL2

Figure 4.21: Raised area of Joel that is richer in archaeological materials (site JL5) relative to the deflated areas surrounding (CJL11).

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Figure 4.22: Raw material availability at Joel: banded chert (CJL2) and hornfels outcrop with associated artefact (JL2).

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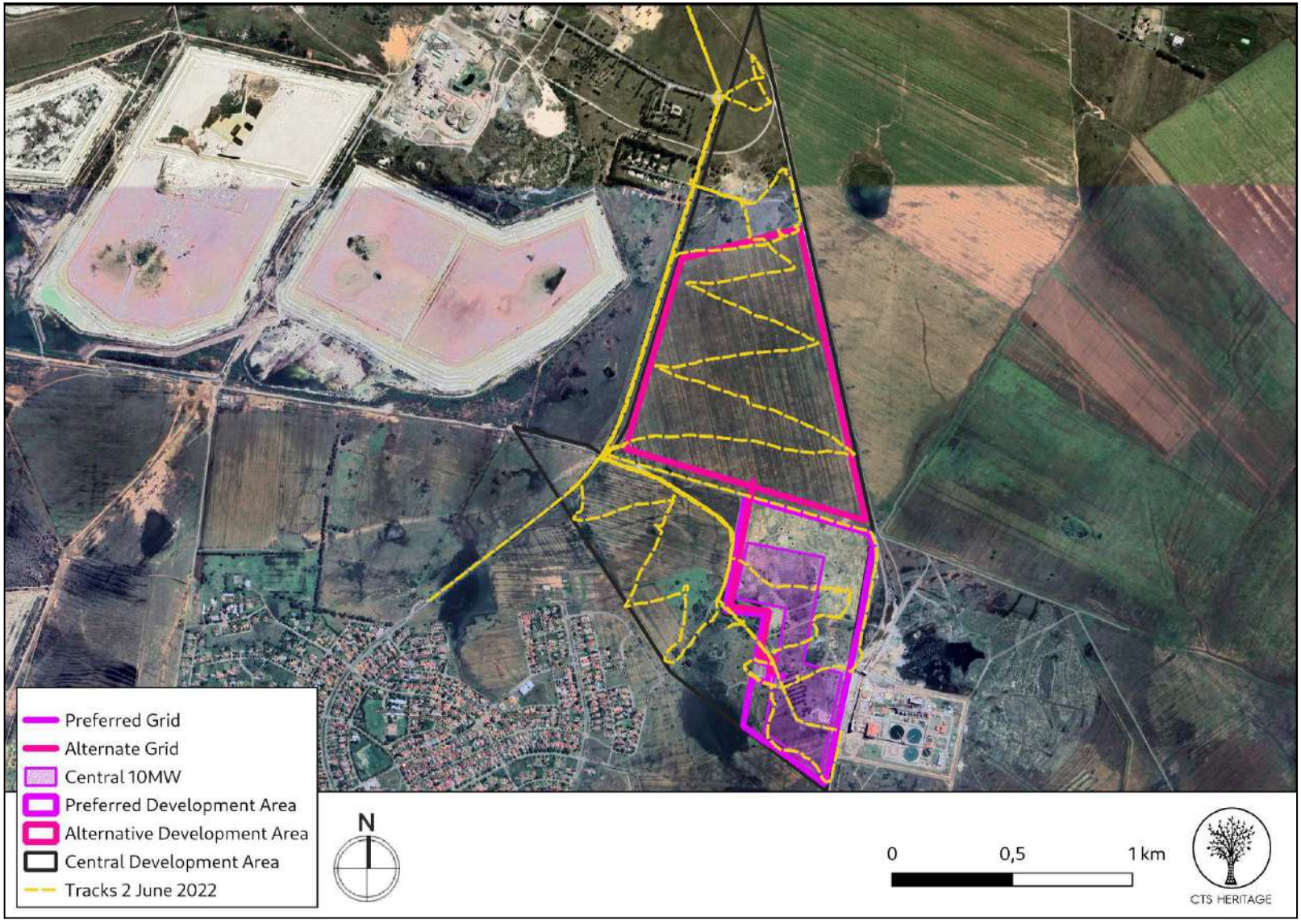

Figure 5.1: Overall track paths of foot survey - Central PV Facility

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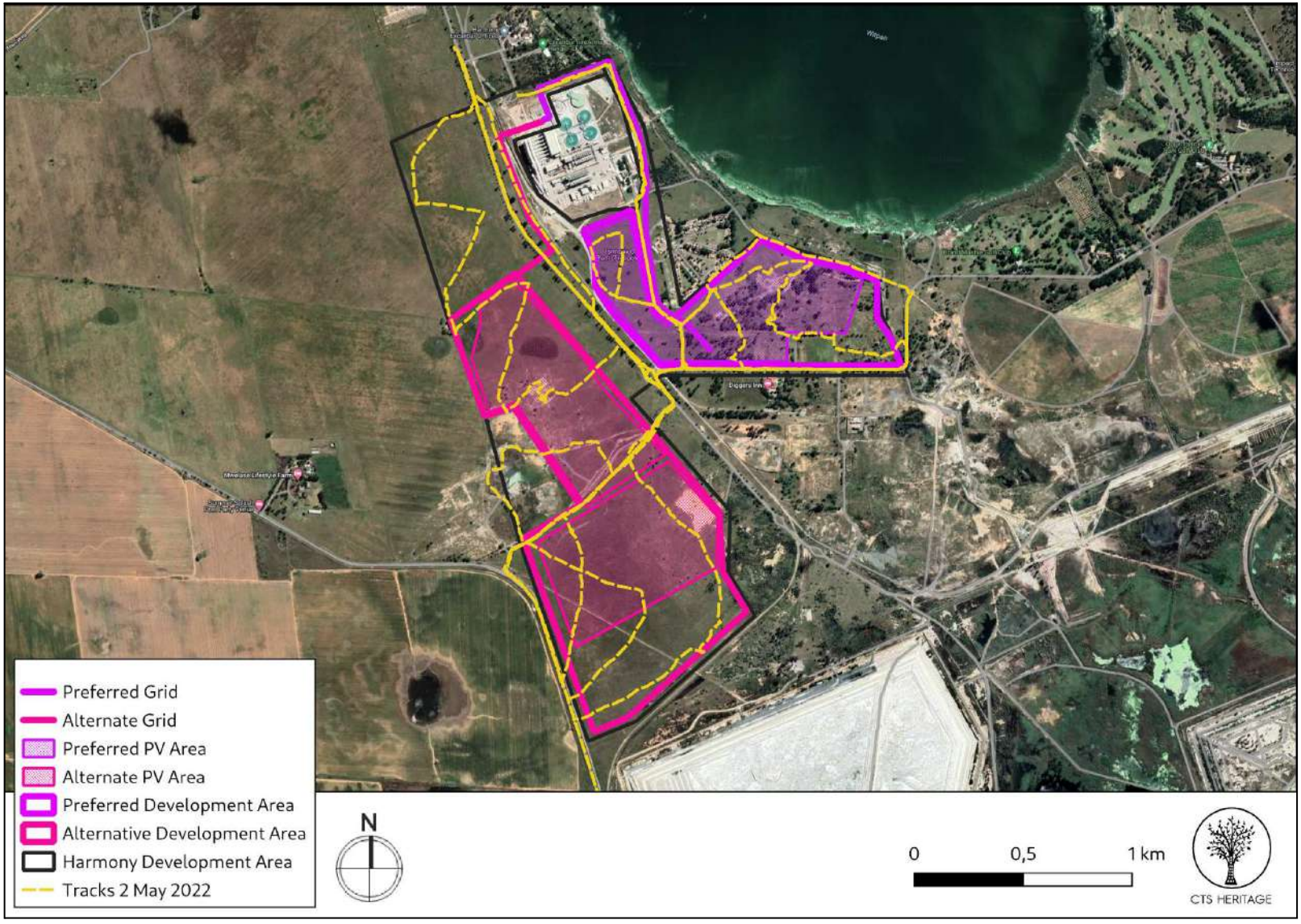

Figure 5.2: Overall track paths of foot survey - Harmony PV Facility

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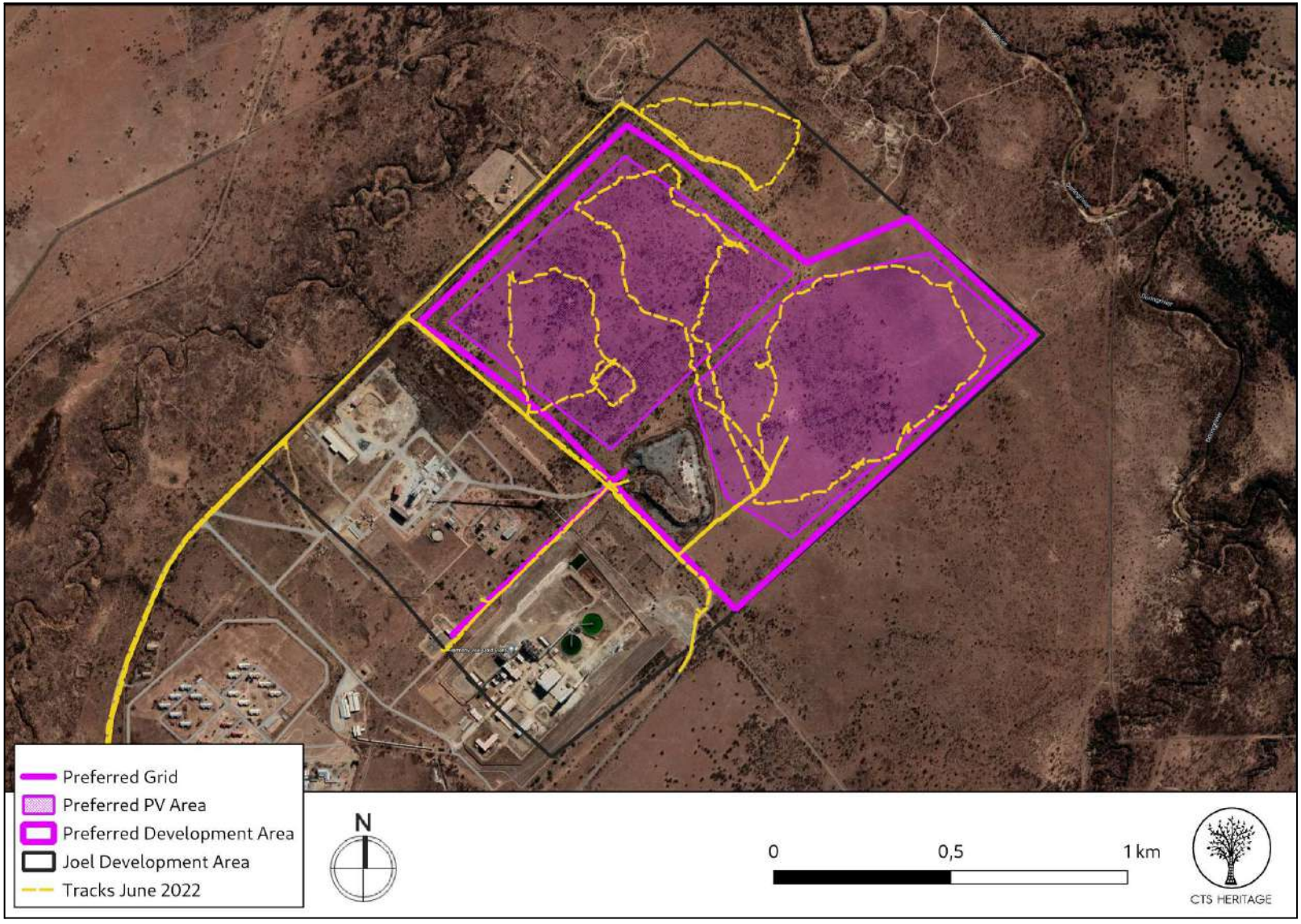

Figure 5.3: Overall track paths of foot survey - Joel PV Facility

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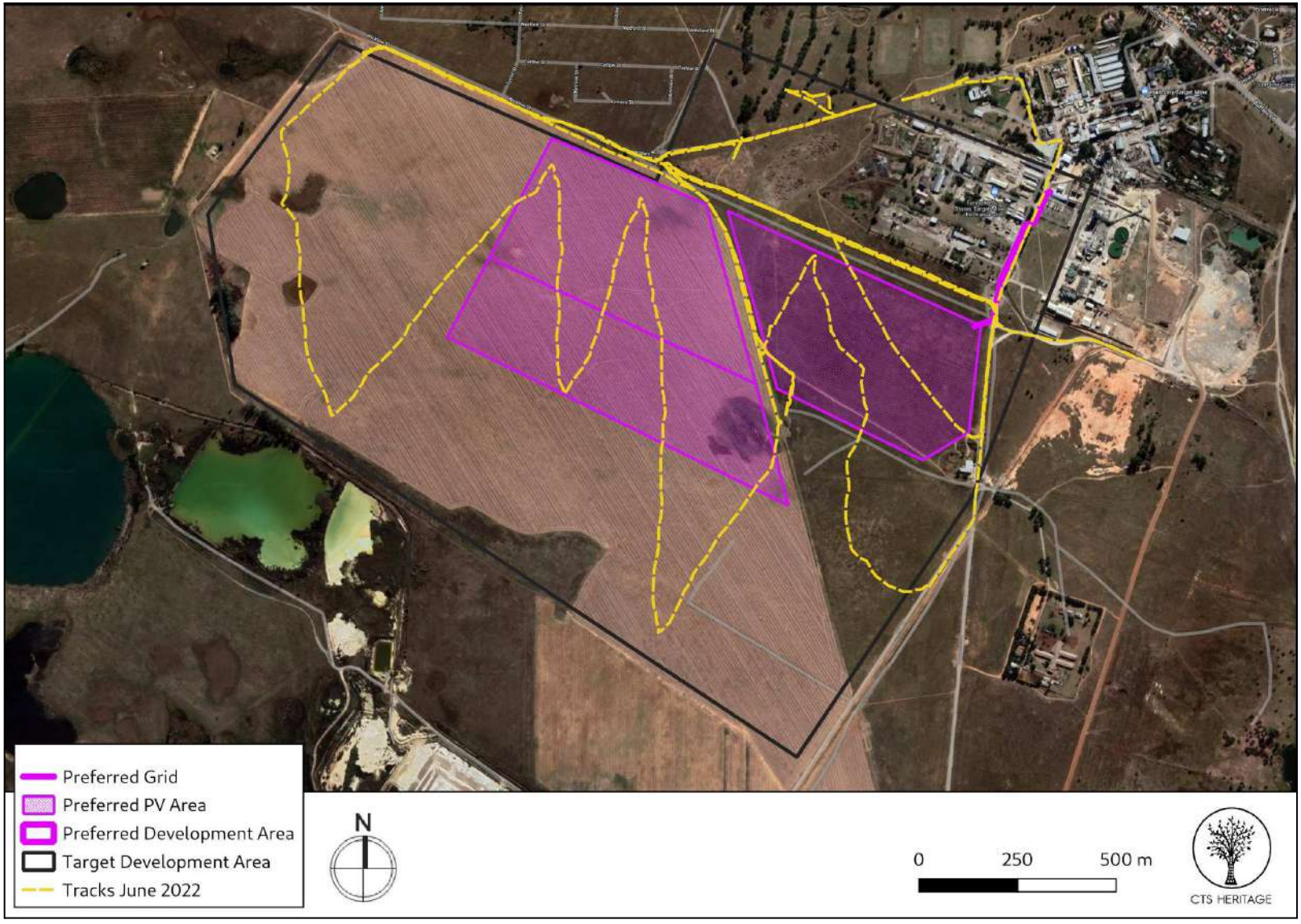

Figure 5.4: Overall track paths of foot survey - Target PV Facility

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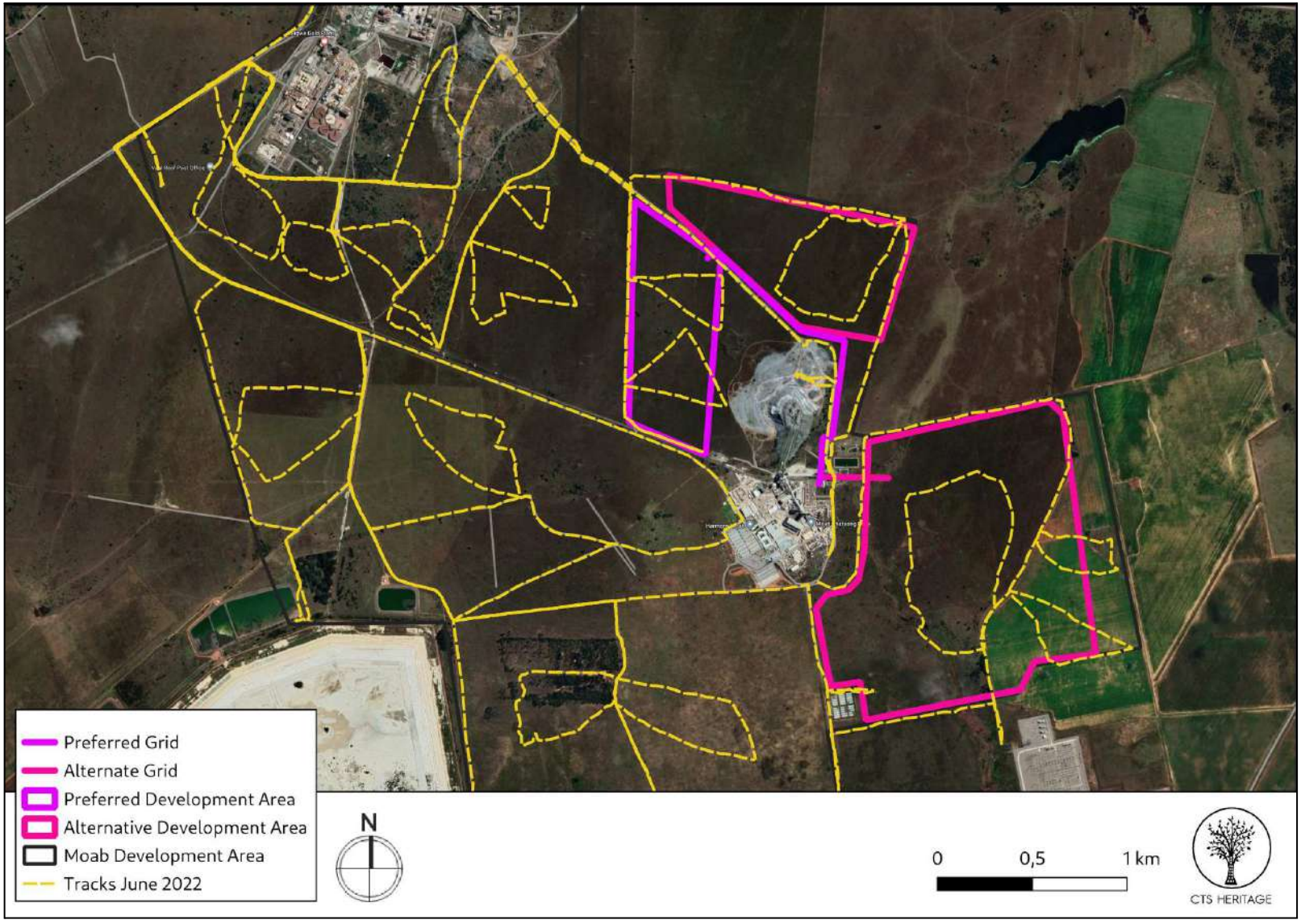

Figure 5.5: Overall track paths of foot survey - Moab PV Facility

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4.2 Archaeological Resources identified

Table 2: Observations noted during the field assessments conducted

Site No.	Site Name	Description	Period	Co-ordinates		Grading	Mitigation
CT1	Central PV	Isolated dolerite artefact: core with primary removals	ESA-MSA	-28,0423649 959266	26,8796689 622104	NCW	NA
CT2	Central PV	Isolated quartz artefact: prepared platform flake, heavily rolled and weathered	ESA-MSA	-28,0541419 889777	26,8806460 406631	NCW	NA
CT3	Central PV	Isolated quartzite artefact: bifacial tool with alternating retouch on both faces	MSA	-28,0561190 284788	26,8845039 792358	NCW	NA
CT4	Central PV	Isolated quartzite artefact: core with primary removals	ESA-MSA	-28,0617710 296064	26,88364198 43137	NCW	NA
HM1	Harmony PV	Isolated quartzite artefact: large side scraper	MSA	-28,0374500 155448	26,75613303 66879	NCW	NA
HM2	Harmony PV	Isolated quartzite artefact: single platform core with platform preparation removals	MSA	-28,0343310 255557	26,75568401 8135	NCW	NA
HM3	Harmony PV	Isolated quartzite artefact: marginally reduced core with primary removals	MSA	-28,0334970 261901	26,74948199 65213	NCW	NA
HM4	**Harmony PV**	**Concentration of artefacts: bifacial tool; complete flake and flake fragments**	**ESA-MSA**	**-28,027887 0183974**	**26,7480419 855564**	**IIIC**	**AVOID completely**
HM5	Harmony PV	Building structure likely older than 60 years: remnants of the farm house	Historical	-28,0253369 919955	26,7440390 400588	NCW	NA
HM6	Harmony PV	Foundation structure of a building older than 60 years	Historical	-28,0260460 171848	26,76196298 56199	NCW	NA
HM7	Harmony PV	Stone structure older than 60 years: walling structure.	Historical	-28,0248629 953712	26,75855197 01242	NCW	NA
HM8	Harmony PV	Remains of building structure.	Unclear	-28,0253489 781171	26,7605979 926884	NCW	NA
JL1	Joel PV	Isolated dolerite artefact: bi-directional core, heavily reduced	MSA-LSA	-28,24715198 94897	26,8277529 627084	NCW	NA
JL2	**Joel PV**	**Concentration of artefacts: Anvil, flake fragment, chert outcrop with exploitation evidence**	**MSA-LSA**	**-28,247044 0305769**	**26,8308319 710195**	**IIIC**	**AVOID completely**
JL3		Isolated quartzite artefacts: poorly preserved core - heavily weathered and rolled, rolled flake	unknown	-28,2532779 872417	26,8349339 906126	NCW	NA
JL4	Joel PV	Isolated chert artefact: flake potentially associated with bladelet production	LSA	-28,2490820 06514	26,8273689 877241	NCW	NA
JL5	**Joel PV**	**Concentration of artefacts in a**	**MSA-LSA**	**-28,250538**	**26,8279530**	**IIIB**	**AVOID completely**

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		datable context: 1)single platform chert core; 2) chert flake; 3) chert core; 4) point; 5) silcrete retouched point on a blade; 6) miniature quartz flake; 6) dolerite big flake; 7) silcrete flake; 8) silcrete fragment		**026914**	**387371**		
JL6	Joel PV	Isolated chert artefacts: two chert cores	LSA	-28,2455849 926918	26,8313020 281493	NCW	NA
TG1	Target PV	Isolated artefacts: two miniature cores associated with microlithic flake production	LSA	-27,7608890 365809	26,6334529 872983	NCW	NA
CM1	**Moab PV**	**Isolated artefacts on sub-volcanic rock: Levallois core; Bladelet core and several flakes**	**MSA/LSA**	**-26,987904 9807786**	**26,8075089 901685**	**IIIC**	**AVOID completely**
CM2	Moab PV	Chert outcrop with evidence of hominin exploitation	Stone Age	-26,9811560 39983	26,7780160 06574	NCW	NA
CM3	Moab PV	Isolated chert artefacts: several flakes	LSA	-26,9765090 290457	26,78688196 46537	NCW	NA

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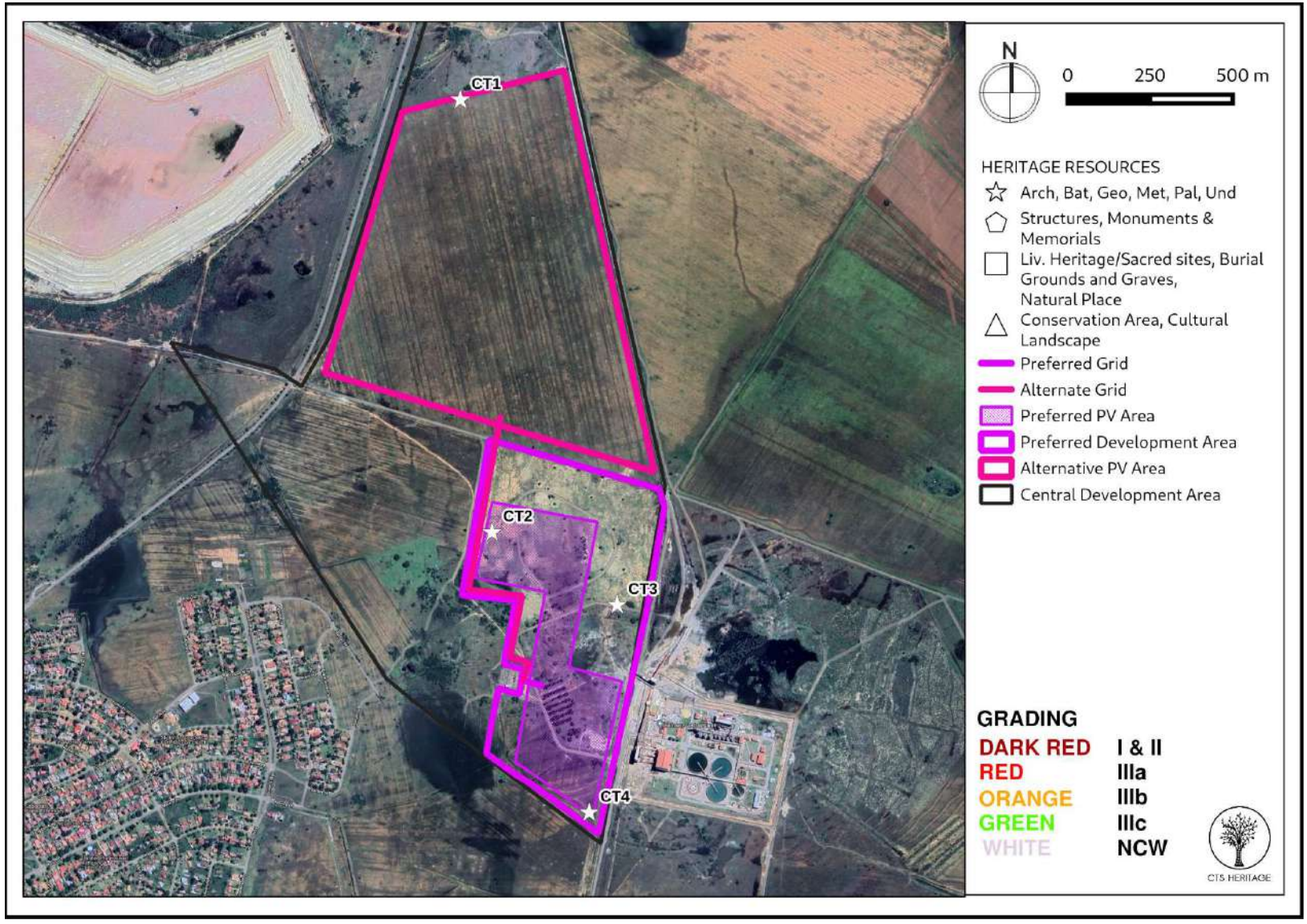

Figure 6.1: Map of field observations relative to the proposed development at the proposed Central PV Facility

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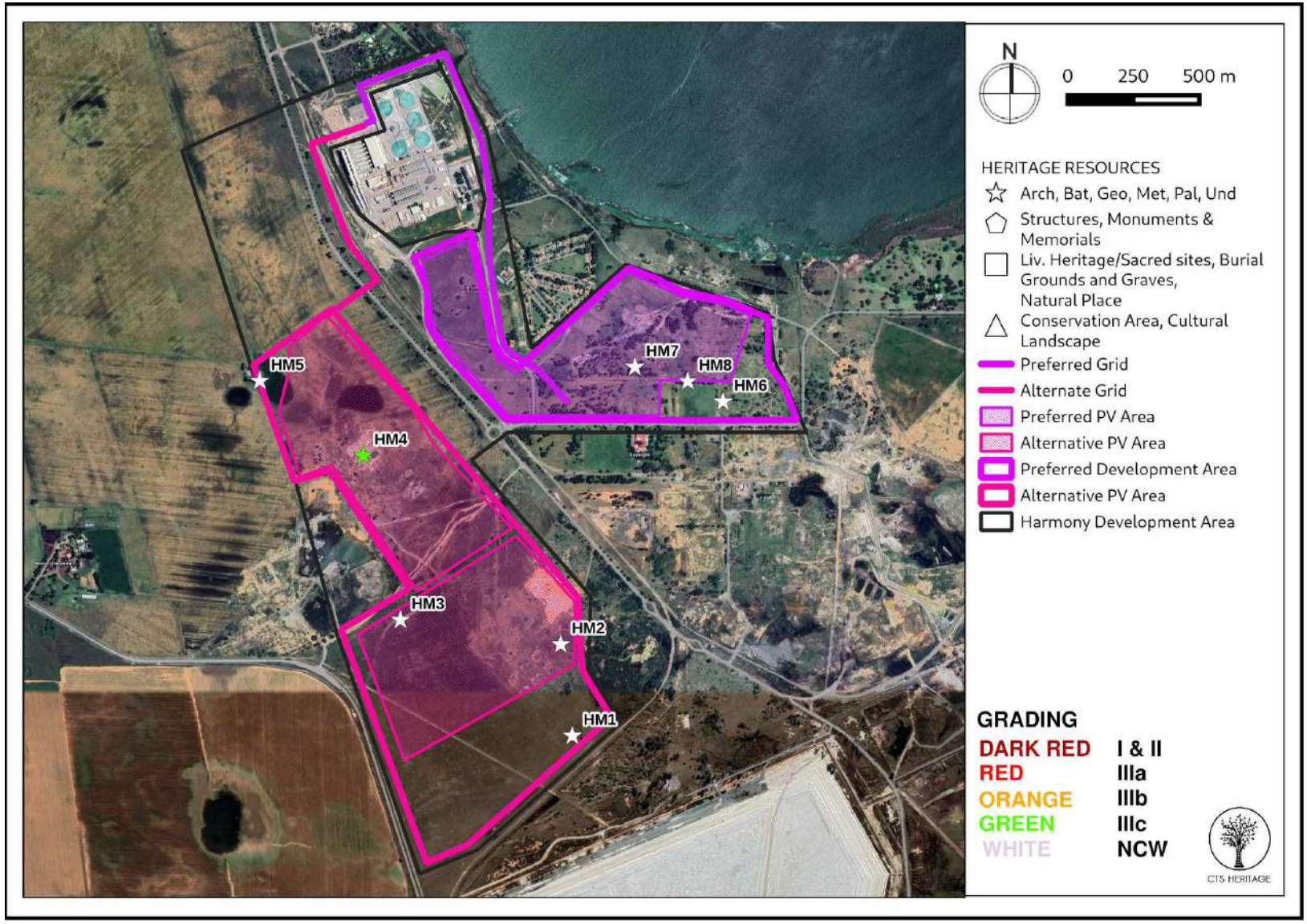

Figure 6.2: Map of field observations relative to the proposed development at the proposed Harmony PV Facility

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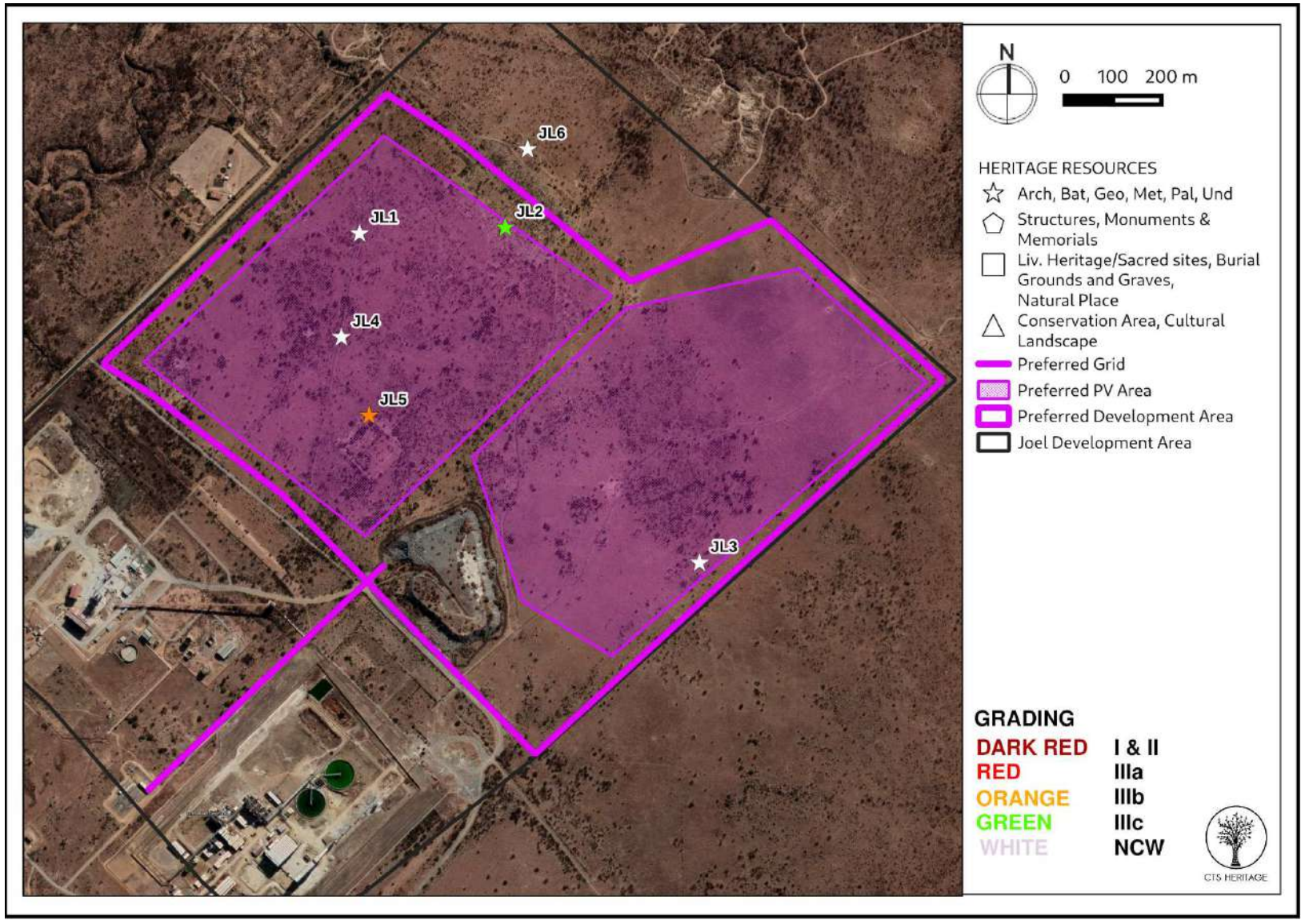

Figure 6.3: Map of field observations relative to the proposed development at the proposed Joel PV Facility

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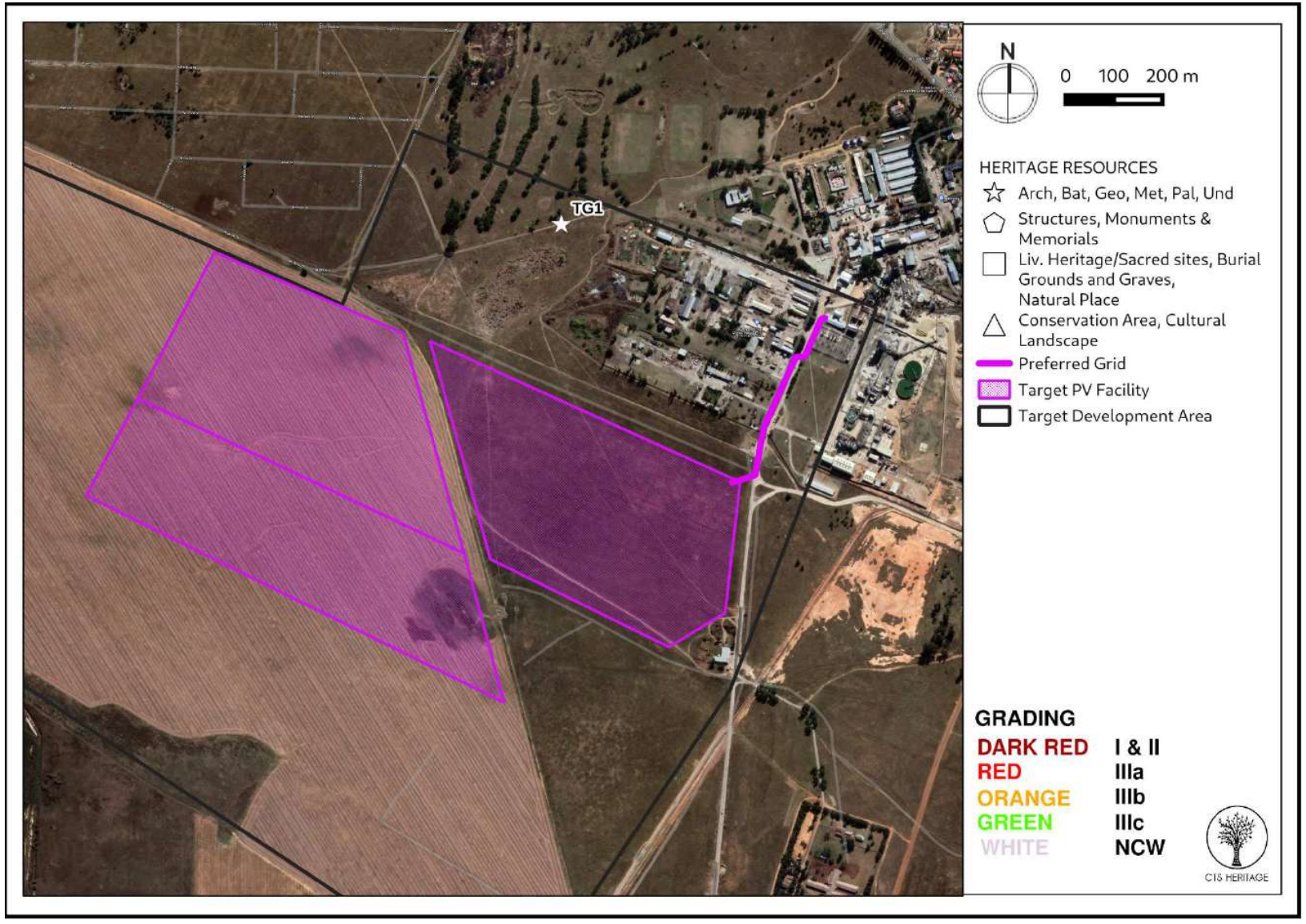

Figure 6.4: Map of field observations relative to the proposed development at the proposed Target PV Facility

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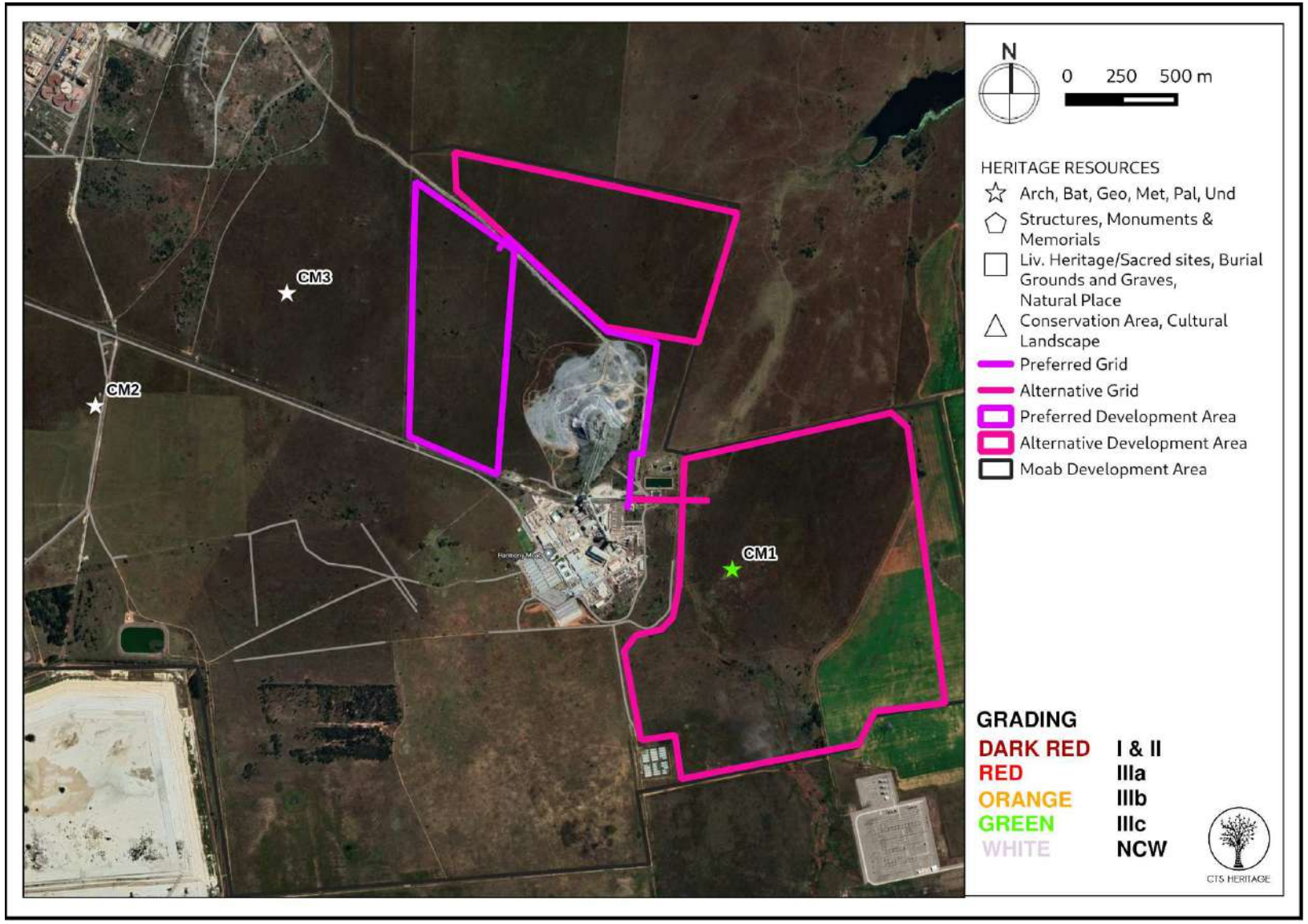

Figure 6.5: Map of field observations relative to the proposed development at the proposed Moab PV Facility

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4.3 Selected photographic record

(a full photographic record is available upon request)

Figure 7.1: Isolated stone artefacts from Harmony: HM1- large side scraper, HM2- single platform core with platform preparation removals, HM3-marginally reduced core with primary removals

Figure 7.2: Concentration of artefacts HM4 next to CHM4: bifacial tool; complete flake and flake fragments.

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Figure 7.3: Demolished and dilapidated historical structures from Harmony: HM5, HM6, HM7, and HM8

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Figure 7.4: Isolated stone artefacts from Central: CT 1-core with primary removals, CT2-prepared weather platform flake, CT3- bifacial tool with alternating retouch on both faces, CT4-core with primary removals.

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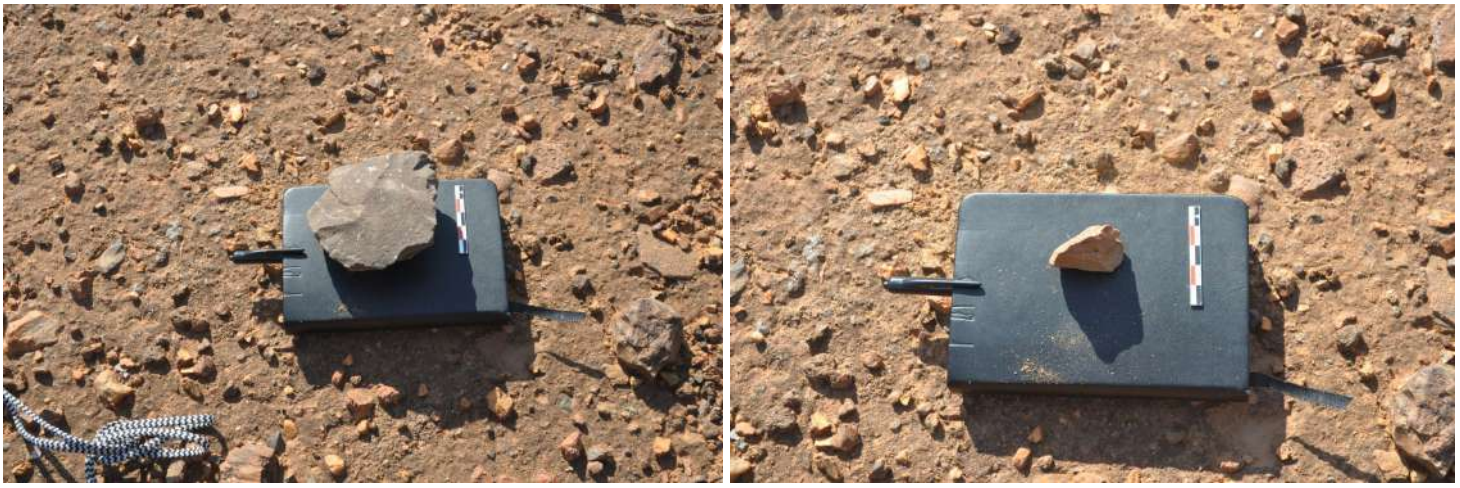

Figure 7.5: Deflated concentration of archaeological remains at Moab CM1: Levallois core and Bladelet core

Figure 7.7: Ex situ archaeological remains at Moab: CM2-Chert outcrop with evidence of hominin exploitation, CM3-flakes

Figure 7.8: Ex situ archaeological remains from Target: TG1: two miniature cores associated with microlithic flake production

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Figure 7.9: Ex-situ archaeological remains from Joel: JL1-bi-directional core, JL2-hammerstone-anvil, JL3-core and flake, JL4- flake potentially associated with bladelet production, JL6-two cores.

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Figure 7.10: Concentration of artefacts in a datable context: 1)single platform chert core; 2) chert flake; 3) chert core; 4) point; 5) silcrete retouched point on a blade; 6) miniature quartz flake; 6) dolorite big flake; 7) silcrete flake; 8) silcrete fragment

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Figure 7.11: Burrows associated with artefacts at JL5.

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5. ASSESSMENT OF THE IMPACT OF THE DEVELOPMENT

5.1 Assessment of impact to Archaeological Resources

5.1.1 Harmony

All archaeological finds at Harmony were documented in what appear to be *ex-situ* surface contexts, yet the absence of evidence for trampling of artefacts at HM4 suggests that post-depositional effects may be minimal and that the artefacts may have eroded out of associated fluvial deposits. The river terrace deposits may be dateable with luminescence techniques, although the direct association of the archaeology with the fluvial stratigraphy would require further investigation to establish.

Based on the surface observations at Harmony, excavation associated with the development should be aware of the potential for sub-surface Stone Age materials if this excavation encroaches on the laminated river deposits. The documented archaeology at Harmony is classified as scientifically LOW SIGNIFICANCE, however the site at HM4 should be avoided if possible through the implementation of a 30m no-go buffer (Figure 7.1).

Concerning the Stone Age archaeology at Harmony, there are no objections to the authorization of the proposed development, provided that if any evidence of human remains are exposed during excavation, that development activities cease in the area of the identified remains.

5.1.2 Central

The potential for finding a dateable *in-situ* archaeological horizon at Central based on current surface observations outlined above appears to be low. The documented archaeology at Central is therefore classified as scientifically LOW SIGNIFICANCE.

Concerning the archaeology observed during the survey of the potentially affected area at Central, there are no objections to the authorization of the proposed development, provided that if any evidence of buried human remains are exposed during excavation, that development activities cease in the area of the identified remains.

No impacts to significant heritage resources are anticipated.

5.1.3 Target

The potential for finding a dateable *in-situ* archaeological horizon at Target based on current surface observations outlined above appears to be low. The documented archaeology at Target is therefore classified as scientifically LOW SIGNIFICANCE.

Concerning the archaeology observed during the survey of the potentially affected area at Target, there are no objections to the authorization of the proposed development, provided that if any evidence of buried human remains are exposed during excavation, that development activities cease in the area of the identified remains.

No impacts to significant heritage resources are anticipated.

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5.1.4 Joel

All archaeological finds at Joel were documented in what appear to be *ex-situ* surface contexts. However, the absence of evidence for trampling of artefacts, particularly at JL5, suggests that post-depositional effects on surface stone scatters may be marginal, and artefacts may have been exposed relatively recently. Further, the presence of artefacts that are currently eroding out of quaternary sediments at JL5 suggests that there may be sub-surface archaeological occurrences within the footprint. The potential for finding a preserved and dateable *in-situ* archaeological horizon based on surface observations and based on the availability of current dating techniques (luminescence would be the only set of applicable methods to this context), however, is low based on the absence of dateable organic materials and the bioturbated nature of sediments partially encompassing some of the artefacts (JL5). This site is graded IIIB for its potential to contribute to the body of scientific knowledge.

Based on the surface observations outlined above, the presence of sub-surface contextualised materials at Joel cannot be excluded as a possibility. Excavation associated with the development should therefore be aware of the potential for sub-surface Stone Age materials. As such, it is recommended that a no-development area of 50m is implemented around site JL5 (Figure 7.2).

JL2 represents a site that accumulated because of the chert raw-material source nearby, so flakes are largely primary. JL2 also has a hammerstone with visible pitting associated with percussion activities – probably knapping. This site has been graded IIIC and it is recommended that a no-development area of 30m is implemented around this site to ensure that it is conserved.

The documented archaeology at Joel is classified as scientifically LOW SIGNIFICANCE apart from the site at JL5 which is classified as MODERATE SIGNIFICANCE.

Concerning the Stone Age archaeology at Joel, there are no objections to the authorization of the proposed development, *provided that the monitoring recommendations outlined above are adhered to*, and provided that if any evidence of human remains are exposed during excavation, that development activities cease in the area of the identified remains.

5.1.5 Moab

The potential for finding a dateable *in-situ* archaeological horizon based on current surface observations outlined above appears to be low. The documented archaeology at Moab is therefore classified as scientifically LOW SIGNIFICANCE.

Concerning the archaeology observed during the extensive survey of the potentially affected area at Moab, there are no objections to the authorization of the proposed development, provided that if any evidence of buried human remains are exposed during excavation, that development activities cease in the area of the identified remains.

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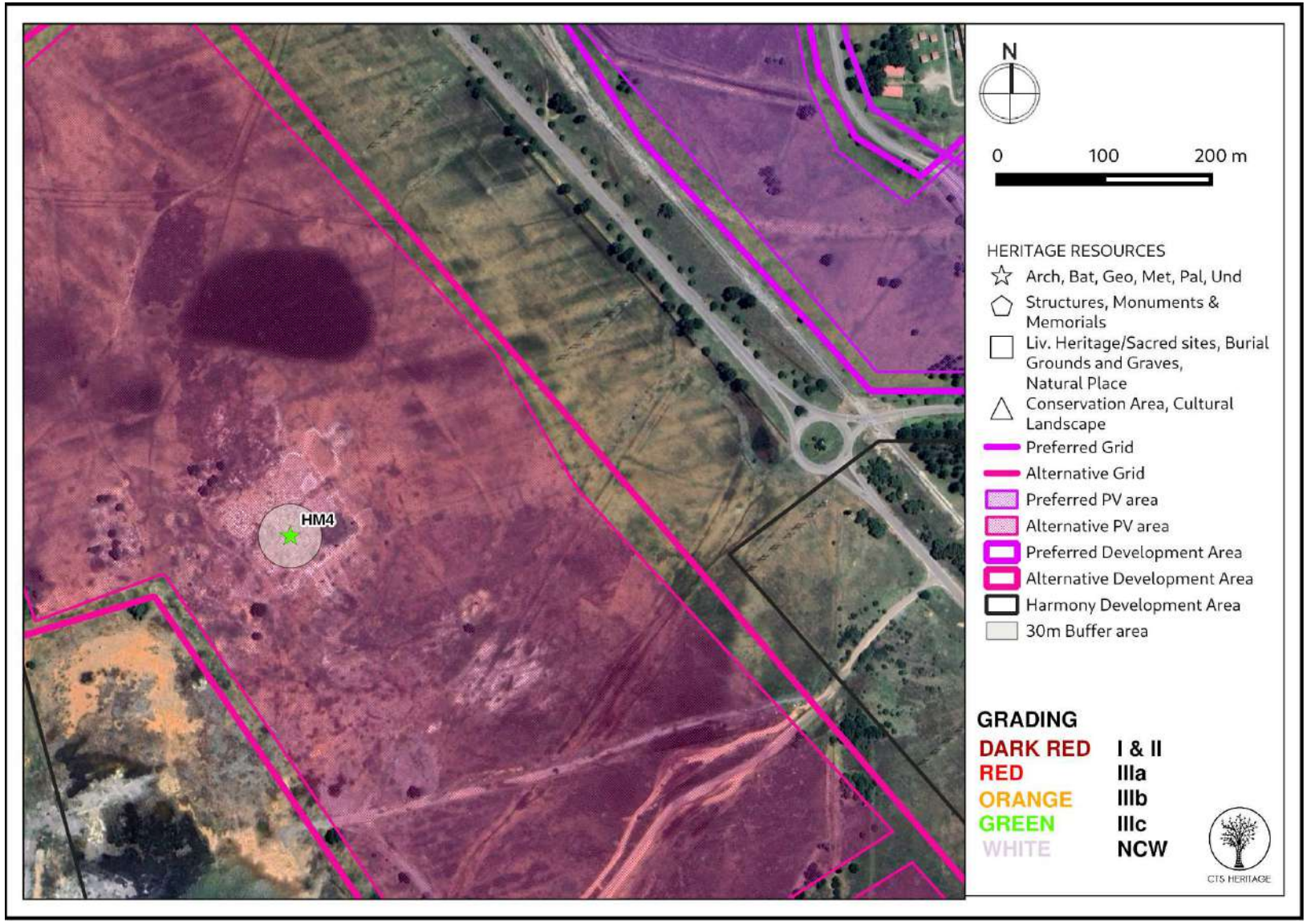

Figure 7.1: Map of significant sites relative to proposed development with recommended buffers around site HM4 (30m Buffer)

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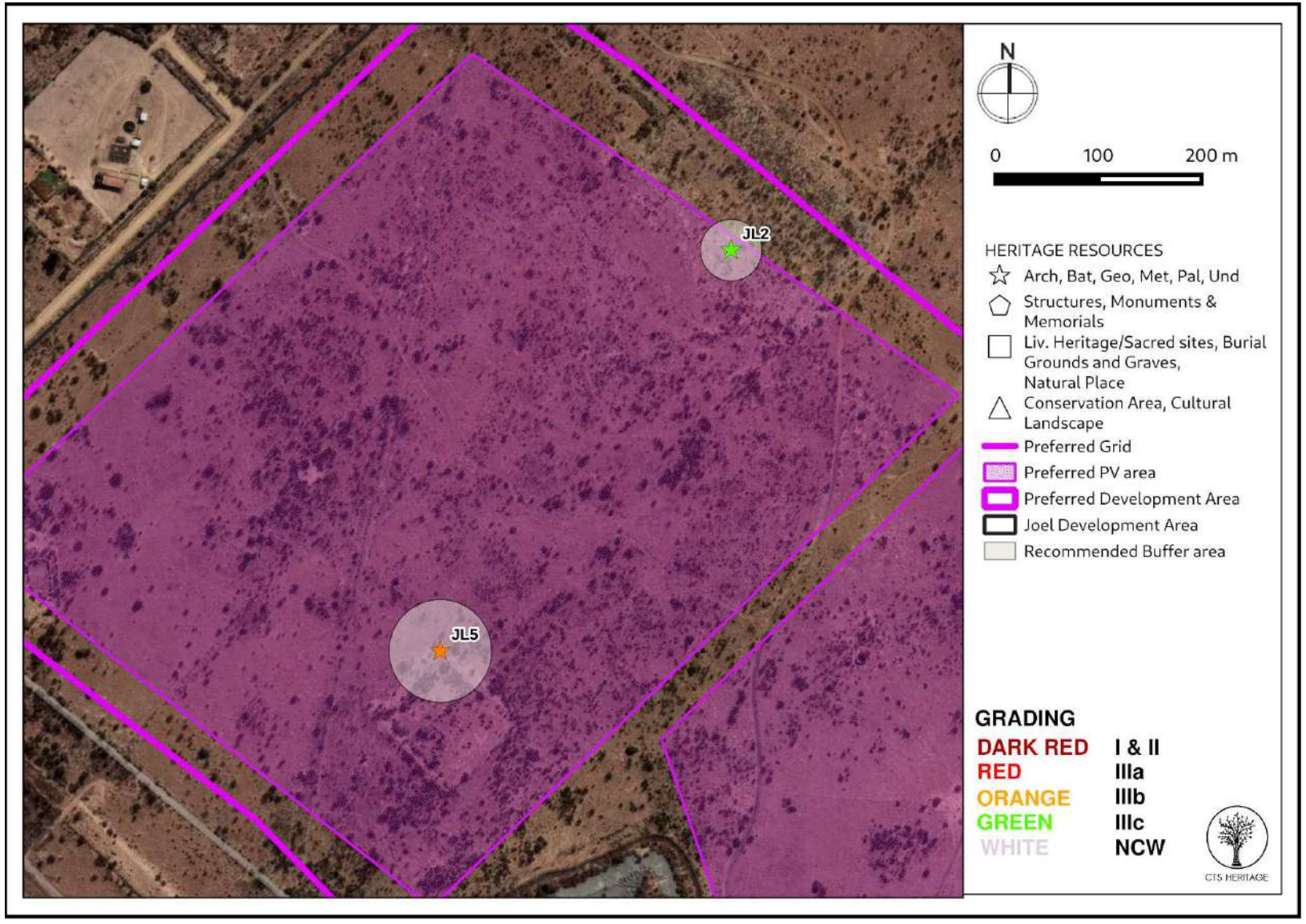

Figure 7.2: Map of significant sites relative to proposed development with recommended mitigation for JL2 (30m Buffer) and JL5 (50m Buffer)

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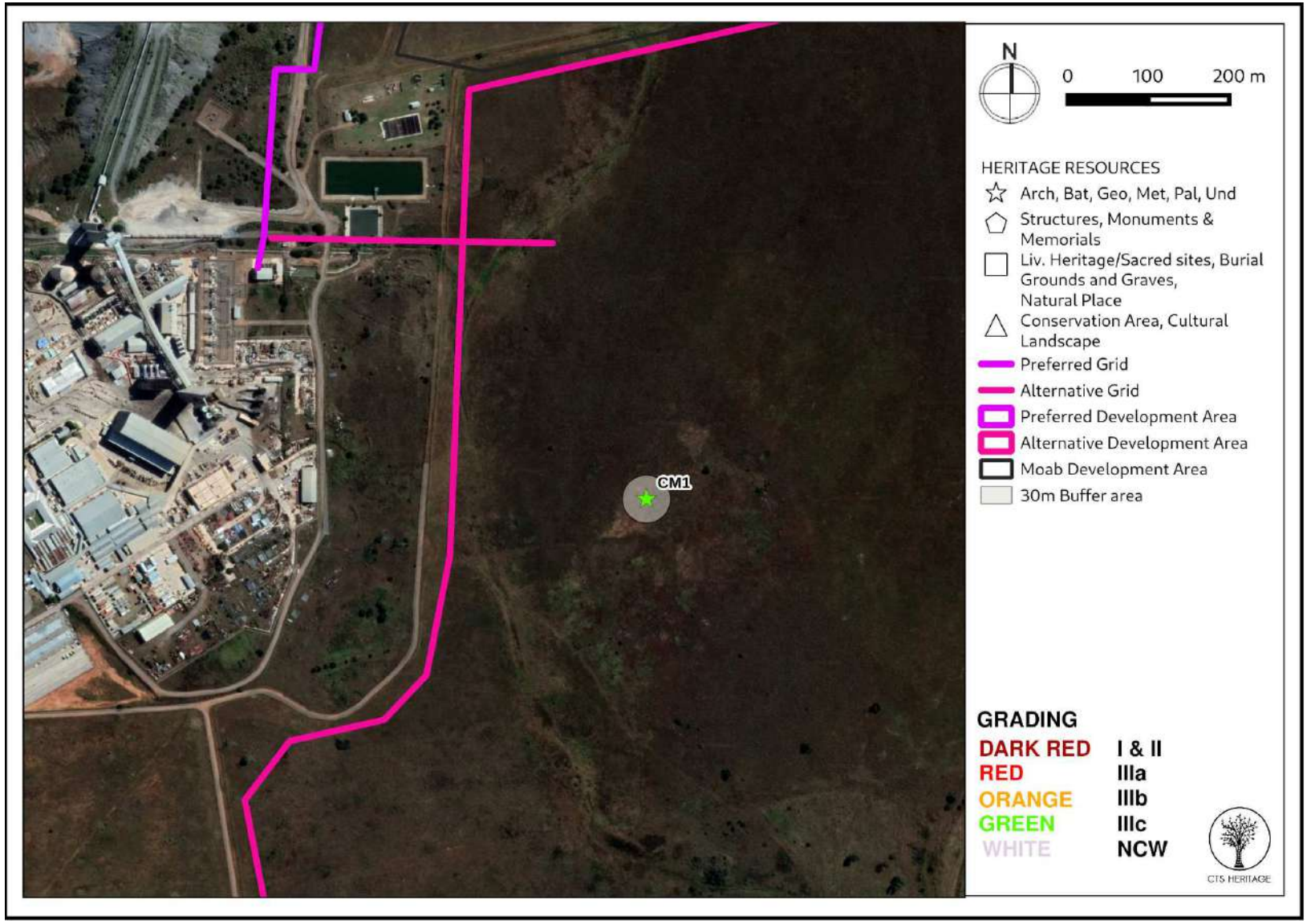

Figure 7.3: Map of significant sites relative to proposed development with recommended mitigation for CM1 (30m Buffer)

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6. CONCLUSION AND RECOMMENDATIONS

All of the areas surveyed as part of this assessment have been transformed through agricultural interventions and/or mining activity. As such, it is not surprising that the results of the survey only identified four sites of scientific cultural value - HM4 within the Alternative Area proposed for the Harmony PV development graded IIIC, JL2, graded IIIC and JL5 graded IIIB within the area proposed for the Joel PV development and CM1, graded IIIC, within the Alternative Area proposed for the Moab PV development.

The identified sites of archaeological significance have the potential to provide scientific insight into the past and as such, it is recommended that these areas are not impacted by the proposed development. It is therefore recommended that no-go development buffers as per the recommendations below are implemented. Further, it is recommended that these sites are mapped on all relevant SDPs and that on-going conservation measures are put in place in the EMPrs for the developments.

Recommendations

There is no objection to the proposed development in terms of impacts to archaeological heritage on condition that:

- The 30m buffer area recommended around sites CM1, JL2 and HM4 is implemented
- The 50m buffer area recommended around site JL5 is implemented
- Should any buried archaeological resources or human remains or burials be uncovered during the course of development activities, work must cease in the vicinity of these finds. The South African Heritage Resources Agency (SAHRA) must be contacted immediately in order to determine an appropriate way forward.

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7. REFERENCES

Heritage Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
108777	Heritage Impact Assessment Specialist Reports	Anton van Vollenhoven	30/11/2011	A REPORT ON A CULTURAL HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED WITS GOLD DBM PROJECT CLOSE TO VIRGINIA, FREE STATE PROVINCE
120259	PIA Desktop	Barry Millsteed		Desktop Palaeontological Heritage Impact Assessment Report for the Oryx Solar Energy Facility
120639	Archaeological Specialist Reports	Jaco van der Walt	30/08/2013	Aracheological Impact Assessment report for the Proposed Everest Solar Energy Facility
124729	Heritage Scoping	Jaco van der Walt	08/05/2013	Archaeological Scoping Report for the Proposed Oryx Energy Facility
136650	Archaeological Specialist Reports	Jaco van der Walt	30/08/2013	Archaeological Impact Assessment report for the Oryx Solar Energy Facility
138939	Heritage Impact Assessment Specialist Reports	Karen Van Ryneveld, Gideon Groenewald	17/10/2013	Phase 1 Archaeological Impact Assessment & Palaeontological Assessment Lebone Solar Farm The Remaining Extent of the Farm Onverwag No. 728 and Portion 2 of the Farm Vaalkranz Np. 220, Welkom, Free State Province
158469	Heritage Impact Assessment Specialist Reports	Karen Van Ryneveld	19/10/2013	PHASE 1 ARCHAEOLOGICAL IMPACT ASSESSMENT. THE THABONG SOLAR FARM, UITKYK 509, WELKOM, FREE STATE, SOUTH AFRICA
164148	Heritage Impact Assessment Specialist Reports	Lloyd Rossouw	06/12/2013	Phase 1 Palaeontological and Archaeological Impact Assessment of the proposed Phokeng Township extension at Thabong, Matjhabeng Local Municipality, Free State Province.
169703		Lloyd Rossouw		
186709	PIA Desktop	Gideon Groenewald	14/10/2013	PALAEONTOLOGICAL ASSESSMENT OF THE PROPOSED DEVELOPMENT OF A 75MW PHOTOVOLTAIC SOLAR FARM, ON THE FARM UITKYK 509, WELKOM, FREE STATE PROVINCE.
266924	Archaeological Specialist Reports		26/01/2015	Archaeological Impact Assessment report for the Proposed Uitsig 5MW Solar Energy Facility close to Henneman in the Free State Province
334505		John	22/07/2015	Palaeontological specialist assessment: desktop study for the proposed

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		Almond		Hennenman 5MW solar energy facility.
369115	HIA Phase 1	Candice Keeling	09/09/2016	Heritage Impact Assessment of Ernest Oppenheimer Hospital, Erf 7186, Reitzpark, Welkom, Orange Free State. Proposed Upgrade of Existing Facilities - September 2016
6036	AIA Phase 1	Cobus Dreyer	15/09/2005	Archaeological and Historical Investigation of the Proposed New Filling Station at Virginia, Free State
7579	AIA Phase 1	Cobus Dreyer	10/03/2008	First Phase Archaeological and Cultural Heritage Investigation of the Proposed Oppenheimer Park Golf Estate, Welkom, Free State
7625	AIA Phase 1	Francois P Coetzee	01/02/2008	Cultural Heritage Survey of the Proposed Phakisa Housing Development, Welkom, Free State
7724	AIA Phase 1	Cobus Dreyer	20/06/2007	First Phase Archaeological and Cultural Heritage Assessment of the Proposed New MTN Cell Phone Mast at Pumlani Cemetery, Thabong, Welkom, Free State
7863	AIA Phase 1	Cobus Dreyer	30/08/2006	First Phase Archaeological and Cultural Heritage Investigation of the Proposed Sandrivier Golf Estate, Virginia, Free State
8034	AIA Phase 1	Cobus Dreyer	05/03/2004	Archaeological and Historical Investigation of the Graves at the Proposed Housing Developments near Thabong, Welkom, Free State
110093	PIA Desktop	Job M. Kibii		Palaeontological Impact Assessmnent Deskop Study Report for the Proposed Merapi (Excelsior) PV Solar Energy Facilities
110094	HIA Phase 1	Nkosinathi Godfrey Tomose		Heritage Imapct Assessment Study for the Proposed PV Solar Energy Facilities, near Excelsior, Free State Province
117067	HIA Phase 1	Frans Prins	31/01/2013	Cultural Heritage Desktop Assessment of the proposed Bio-energy Facility, Harmony Gold Mine , Welkom, Free State Province
120639	Archaeological Specialist Reports	Jaco van der Walt	30/08/2013	Aracheological Impact Assessment report for the Proposed Everest Solar Energy Facility
323795	Heritage Impact Assessment Specialist Reports		31/03/2014	Cultural Heritage Impact Assessment Report for the Proposed SANRAL Thabong Interchange Development, Welkom Region, Free State Province
384235	AIA Phase 1	Lloyd Rossouw	30/09/2016	Phase 1 Archaeological Impact Assessment of a proposed new water pipeline and associated infrastructure between Ventersburg and the Koppie Alleen pump station, FS Province
384495	Heritage Scoping	Nkosinathi Godfrey Tomose	20/12/2016	Heritage Scoping Study for the Proposed Prospecting Rights Application on Farms Adamsons Vley 655, Jonkers Rust 72, Du Preez Leger 324 and Stillewoning 703

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APPENDIX 3: Palaeontological Assessment (2022)

Palaeontological Impact Assessment for the proposed development of the Harmony Target PV Facility, Allanridge, Free State Province

CTS22_101

Desktop Study (Phase 1)

For

CTS Heritage

03 July 2022

Prof Marion Bamford
Palaeobotanist
P Bag 652, WITS 2050

Johannesburg, South Africa
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Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf
Experience: 33 years research and lecturing in Palaeontology
25 years PIA studies and over 300 projects completed

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by CTS Heritage, Cape Town, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

Executive Summary

A Palaeontological Impact Assessment was requested for the proposed Target PV facility for Harmony Mine, immediately west of Allanridge, Free State.

To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed site lies on the potentially fossiliferous sands and alluvium of the Quaternary. The area has been greatly disturbed by farming and mining activities and no potential traps for Quaternary fossils (pans) are visible from the satellite imagery. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor, environmental officer or other designated responsible person once excavations have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised.

Table of Contents

i. Background

Harmony Gold mines is proposing to develop photovoltaic farms (PVs) with grid connections on some of its properties in the Free State. This report is for the Target PV Facility located immediately adjacent to the town of Allanridge and approximately 15km from the town of Odendaalsrus in the Free State Province. It is located within the Local Municipality of Matjhabeng and the District Municipality Lejweleputswa. It will be the existing Harmony Mine (Figures 1-2).

A Palaeontological Impact Assessment was requested for the Target PV project. To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 1: National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6).

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ai	Details of the specialist who prepared the report,	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page 1
c	An indication of the scope of, and the purpose for which, the report was prepared	Section i.
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section ii.
f	The specific identified sensitivity of the site related to the activity and its	Section 4

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
	associated structures and infrastructure	
g	An identification of any areas to be avoided, including buffers	N/A
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section vii.
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section vi.
k	Any mitigation measures for inclusion in the EMPr	Section 8, Appendix A
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8, Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 6
nii	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Sections 6, 8
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies of any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A
2	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

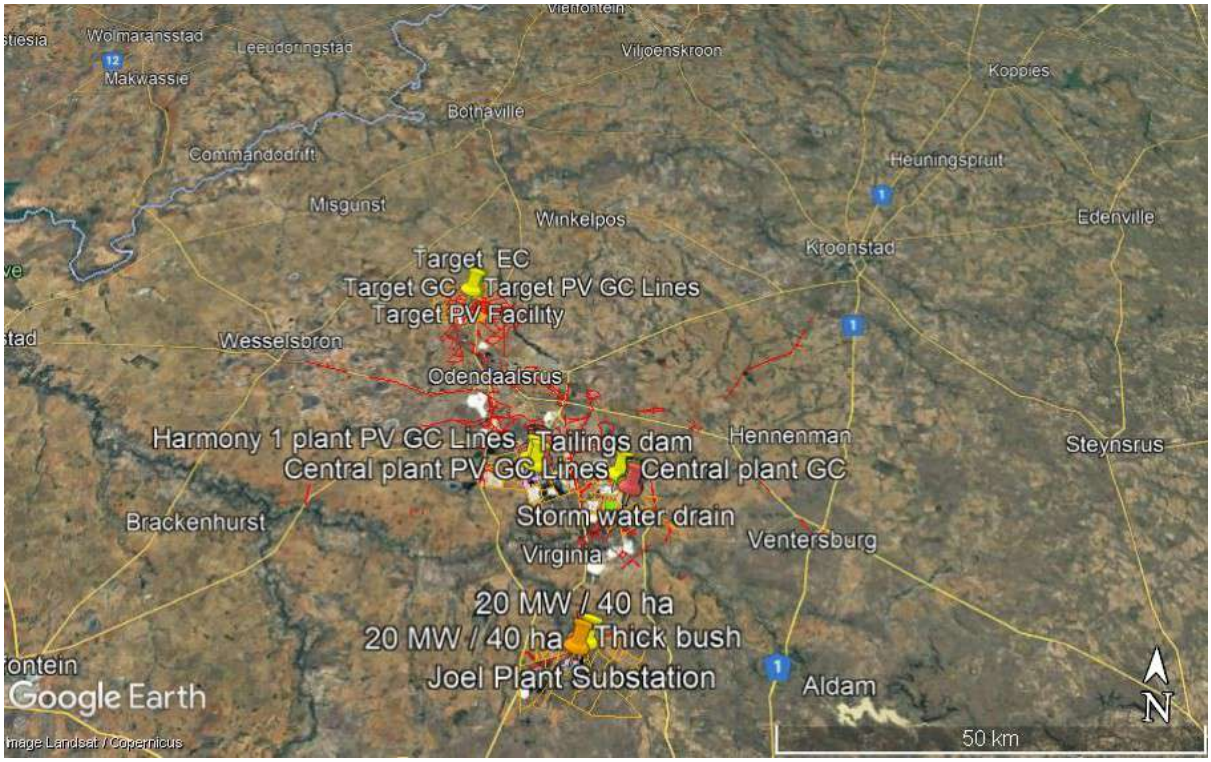

Figure 1: Google Earth map of the general area to show the relative land marks. The Target PV facility is west of Allanridge shown by the labelling, north of the other facilities.

Figure 2: Google Earth Map of the proposed development of the Target PV facility with the sections shown by the pink and yellow outlines.

ii. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.

The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

iii. Geology and Palaeontology

iv. Project location and geological context

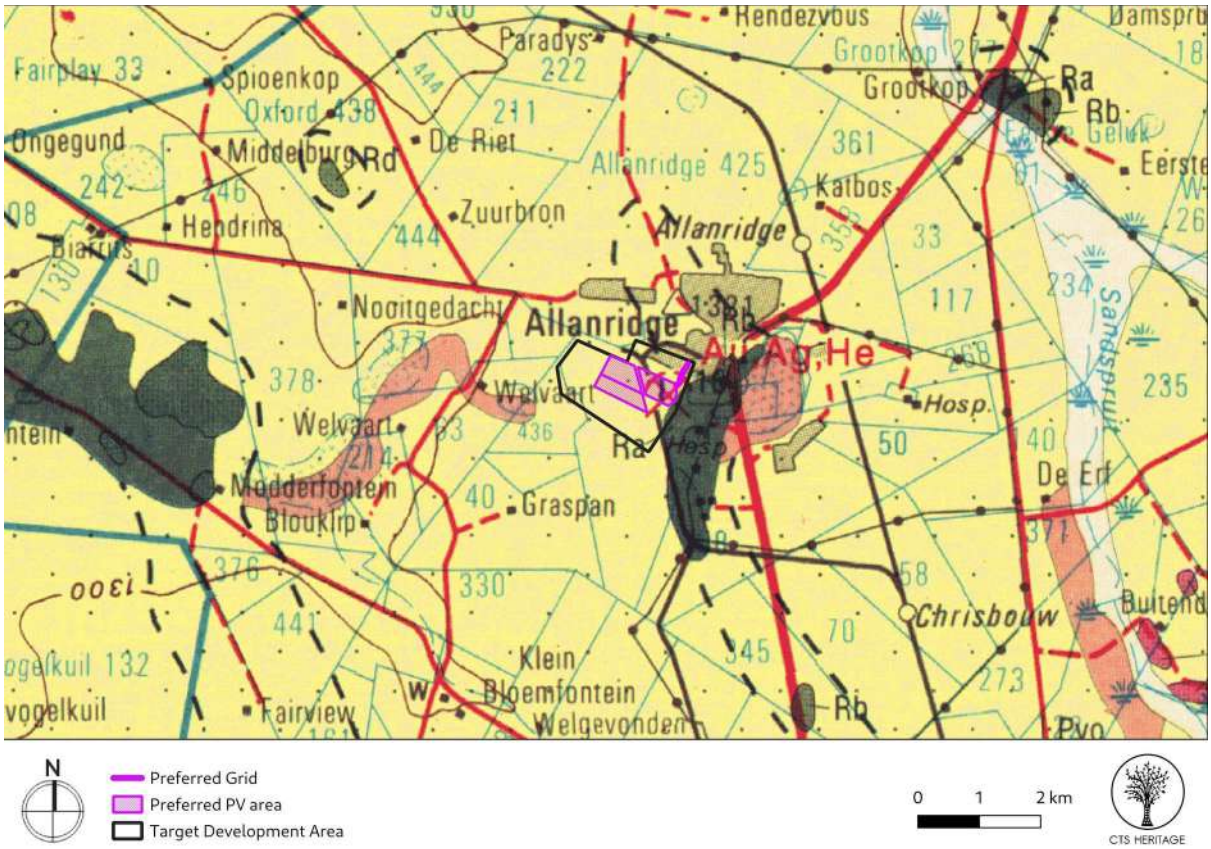

Figure 3: Geological map of the area around the proposed Target PV facility. The location of the proposed project is indicated within the lilac rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2626 West Rand.

Table 2: Explanation of symbols for the geological map and approximate ages (Johnson et al., 2006; Partridge et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Alluvium, sand, soil	Quaternary, ca 1.0 Ma to present
Jd	Jurassic dykes	Dolerite	Jurassic Ca 183 Ma
Pvo	Volkskrust Fm, Ecca Group, Karoo SG	Dark grey shales, siltstone	Early to middle Permian Ca 290-270 Ma
Ra	Allanridge Fm, Pniel Group, Ventersdorp SG	Mafic lava, tuff; amydloidal and porphyritic in places	Palaeoproterozoic >2600 Ma

The project lies in the north-central part of the main Karoo Basin where it unconformably overlies the outliers of the Ventersdorp Supergroup. Much of the area is covered by young sands and alluvium of Quaternary age (Figure 3).

The Ventersdorp Supergroup unconformably overlies the Witwatersrand Supergroup, and is itself unconformably overlain by the Transvaal Supergroup. At the base of the Ventersdorp Supergroup is the predominantly volcanic Klipriviersberg Group. Next is the Platberg Group with a mixture of volcanic and sedimentary formations. The two overlying formations, the Bothaville and Allanridge Formations, have recently been grouped into the Pniel Group (Meintjies and van der Westhuizen, 2018). Like most of this group, the **Allanridge Formation** is volcanic, being made up of mafic lava and tuff and is amygdaloidal at the base. It does not preserve any fossils.

The Karoo Supergroup rocks cover a very large proportion of South Africa and extend from the northeast (east of Pretoria) to the southwest and across to almost the KwaZulu Natal south coast. It is bounded along the southern margin by the Cape Fold Belt and along the northern margin by the much older Transvaal Supergroup rocks. Representing some 120 million years (300 – 183Ma), the Karoo Supergroup rocks have preserved a diversity of fossil plants, insects, vertebrates and invertebrates. It is divided into the basal Dwyka Group, Ecca, Beaufort and Stormberg Groups. Extensive dolerite dykes cut through the sequence of Karoo rocks during the Jurassic, associated with the

Drakensberg volcanics. These dolerite dykes are of igneous origin and do not preserve fossils.

Only a few outcrops of the **Volksrust Formation** (Ecca Group) are present in the region. These shales were deposited in a deep water setting in the inland Karoo sea as it gradually filled with sediments (Johnson et al., 2006).

The Quaternary Kalahari sands form an extensive cover of much younger deposits over much of the Northern Cape Province, Botswana and northern Free State. Haddon and McCarthy (2005) proposed that the Kalahari basin formed as a response to down-warp of the interior of the southern Africa, probably in the Late Cretaceous. This, along with possible uplift along epeirogenic axes, back-tilted rivers into the newly formed Kalahari basin and deposition of the Kalahari Group sediments began. Sediments included basal gravels in river channels, sand and finer sediments. A period of relative tectonic stability during the mid-Miocene saw the silcretisation and calcretisation of older Kalahari Group lithologies, and this was followed in the Late Miocene by relatively minor uplift of the eastern side of southern Africa and along certain epeirogenic axes in the interior. More uplift during the Pliocene caused erosion of the sand that was then reworked and redeposited by aeolian processes during drier periods, resulting in the extensive dune fields that are preserved today.

There are numerous pans in the Kalahari, generally 3–4 km in diameter (Haddon and McCarthy, 2005). According to Goudie and Wells (1995) there are two conditions required for the formation of pans. Firstly, the fluvial processes must not be integrated, and second, there must be no accumulation of aeolian material that would fill the irregularities or depressions in the land surface. Favoured materials or substrates for the formation of pans in South Africa are Dwyka and Ecca shales and sandstones (ibid).

v. Palaeontological context

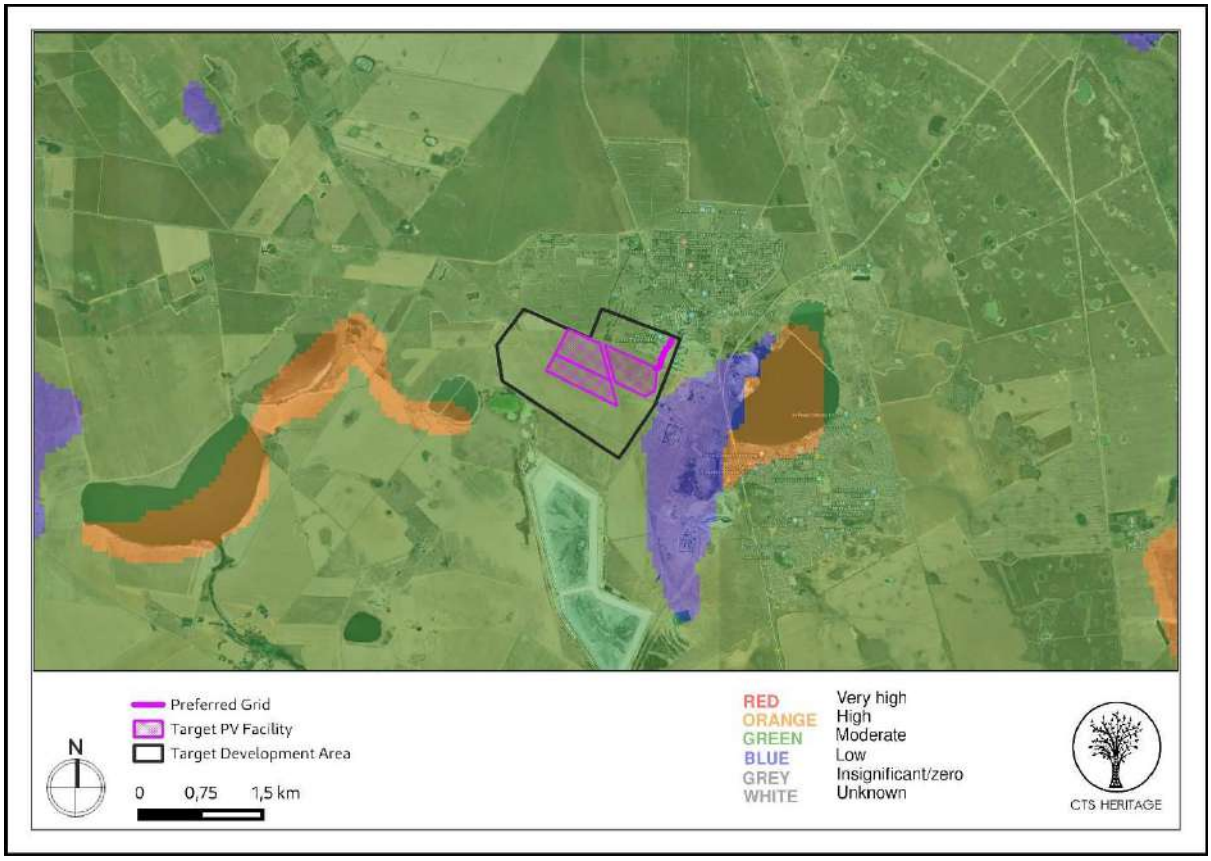

Figure 4: SAHRIS palaeosensitivity map for the site for the proposed Target PV Facility west of Allanridge shown within the lilac rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site for development is on Quaternary sands. Six formations are recognised in the Kalahari Group but they are not often indicated on the geological maps. A more recent review by Botha (2021) attempts to correlate the Quaternary sediments but they are difficult to date or to determine their source. In this part of the Free State the Hoopstad Aeolian sands are present. According to Harmse (1963, in Botha, 2021) this extensive red and grey sandy soil cover is associated with three generations of aeolian sand sheets. Moreover, these generations of aeolian sand form the soil substrate in the heart of the nation's maize cultivation region, yet their geological origin and age remains understudied (Botha, 2021, p. 825).

Quaternary sands and alluvium do not preserve fossils because they are transported and porous. For preservation of fossils, a low energy deposit with sedimentation of fine grained silts or muds that exclude decomposing organisms such as bacteria, fungi and invertebrates is required to maintain a highly reducing environment (Cowan, 1995). Only if there are traps such as palaeo-pans or palaeo-springs that provide traps for water and fine sediments, would plants or bones be preserved

and fossilised. No such features are visible in the satellite imagery in the project footprint.

vi. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3:

Table 3a: Criteria for assessing impacts

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M +	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H +	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	**H**	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

Table 3b: Impact Assessment

PART B: Assessment		
SEVERITY/ NATURE	**H**	-
	M	-

PART B: Assessment		
	L	Quaternary sands and soils do not preserve fossils; so far there are no records from the Quaternary of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be negligible
	L+	-
	M +	-
	H +	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	**L**	Since the only possible fossils within the area would be trapped fossils in the pans or springs, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	**-**
	L	It is very unlikely that any fossils would be found in the loose soils and sands that cover the area. Nonetheless, a Fossil Chance Find Protocol should be added to the eventual EMPr.

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 the right age to contain fossils but are covered by soils. Furthermore, the material to be excavated are soils and this does not preserve fossils. Since there is a small chance that fossils were trapped in pans that might occur below the soils and 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 low.

vii. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the sandstones, shales and sands are typical for the country and might contain trapped fossils. The sands of the Quaternary period would not preserve fossils. The area has been disturbed from farming and mining so no fossils would be present on the surface.

viii. Recommendation

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 sands and soils of the Quaternary. There is a very small chance that fossils may occur in pans or springs but no such feature is visible in the satellite imagery. 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 amenities have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. Since the impact on the palaeontological heritage would be low, as far as the palaeontology is concerned, the project should be authorised.

ix. References

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Botha, G.A., 2021. Cenozoic stratigraphy of South Africa: current challenges and future possibilities. South African Journal of Geology 124, 817-842.

Goudie, A.S., Wells, G.L., 1995. The nature, distribution and formation of pans in arid zones. Earth Science Reviews 38, 1–69.

Haddon. I.G., McCarthy, T.S., 2005. The Mesozoic–Cenozoic interior sag basins of Central Africa: The Late-Cretaceous–Cenozoic Kalahari and Okavango basins. Journal of African Earth Sciences 43, 316–333.

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., Brandl, G., 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 461 – 499.

Meintjes, P.G., van der Westhuizen, W.A., 2018. Stratigraphy and Geochemistry of the Goedgenoeg and Makwassie Formations, Ventersdorp Supergroup, in the Bothaville area of South Africa. South African Journal of Geology 121(4), 339-362.

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

Van der Westhuizen, W.A., de Bruiyn, H., Meintjes, P.G., 2006. The Ventersdorp Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. pp 187-208.

x. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations / drilling activities begin.

1. The following procedure is only required if fossils are seen on the surface and when excavations commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, bones, insects and fragments) should be put aside in a suitably protected place. This way the project activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the fossil plants, vertebrates, invertebrates or trace fossils in the shales and mudstones (for example see Figure 5). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Trace fossils, fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

xi. Appendix A – Examples of fossils from the Quaternary alluvium and sands

Figure 5: Photographs of different types of fossils that have been recovered from Quaternary alluvial and riverine deposits. Note their fragmentary nature.

xii. Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD

June 2022

I) Personal details

Surname	:	**Bamford**
First names	:	**Marion Kathleen**
Present employment	:	Professor; Director of the Evolutionary Studies Institute. Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa
Telephone	:	+27 11 717 6690
Fax	:	+27 11 717 6694
Cell	:	082 555 6937
E-mail	:	marion.bamford@wits.ac.za ; marionbamford12@gmail.com

ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.
NRF Rating: C-2 (1999-2004); B-3 (2005-2015); B-2 (2016-2020); B-1 (2021-2026)

iii) Professional qualifications

Wood Anatomy Training (overseas as nothing was available in South Africa):
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) Membership of professional bodies/associations
Palaeontological Society of Southern Africa
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991
International Organization of Palaeobotany – 1993+
Botanical Society of South Africa
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
SASQUA (South African Society for Quaternary Research) – 1997+
PAGES - 2008 –onwards: South African representative
ROCEEH / WAVE – 2008+
INQUA – PALCOMM – 2011+onwards

vii) Supervision of Higher Degrees
All at Wits University

Degree	Graduated/ completed	Current
Honours	13	0
Masters	11	3
PhD	11	6
Postdoctoral fellows	15	1

viii) Undergraduate teaching
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 45 students per year
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology; Micropalaeontology – average 12-20 students per year.

ix) Editing and reviewing
Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
Associate Editor Open Science UK: 2021 -
Review of manuscripts for ISI-listed journals: 30 local and international journals
Reviewing of funding applications for NRF, PAST, NWO, SIDA, National Geographic, Leakey Foundation

x) Palaeontological Impact Assessments
Selected from the past five years only – list not complete:

- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS

- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells
- Remhoogte PR 2019 for A&HAS
- Bospoort Agriculture 2019 for Kudzala
- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO
- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lieliefontein N&D 2019 for EnviroPro
- Skeerpoort Farm Mast 2020 for HCAC
- Vulindlela Eco village 2020 for 1World
- KwaZamakhule Township 2020 for Kudzala
- Sunset Copper 2020 for Digby Wells
- McCarthy-Salene 2020 for Prescali
- VLNR Lodge 2020 for HCAC
- Madadeni mixed use 2020 for EnviroPro
- Frankfort-Windfield Eskom Powerline 2020 for 1World
- Beaufort West PV Facility 2021 for ACO Associates
- Copper Sunset MR 2021 for Digby Wells
- Sannaspos PV facility 2021 for CTS Heritage
- Smithfield-Rouxville-Zastron PL 2021 for TheroServe

xi) Research Output

Publications by M K Bamford up to January 2022 peer-reviewed journals or scholarly books: over 160 articles published; 5 submitted/in press; 10 book chapters.

Scopus h-index = 30; Google scholar h-index = 35; -i10-index = 92

Conferences: numerous presentations at local and international conferences.

APPENDIX 4: Chance Fossil Finds Procedure

CTS HERITAGE

CHANCE FINDS OF PALAEONTOLOGICAL MATERIAL

(Adopted from the HWC Chance Fossils Finds Procedure: June 2016)

Introduction

This document is aimed to inform workmen and foremen working on a construction and/or mining site. It describes the procedure to follow in instances of accidental discovery of palaeontological material (please see attached poster with descriptions of palaeontological material) during construction/mining activities. This protocol does not apply to resources already identified under an assessment undertaken under s. 38 of the National Heritage Resources Act (no 25 of 1999).

Fossils are rare and irreplaceable. Fossils tell us about the environmental conditions that existed in a specific geographical area millions of years ago. As heritage resources that inform us of the history of a place, fossils are public property that the State is required to manage and conserve on behalf of all the citizens of South Africa. Fossils are therefore protected by the National Heritage Resources Act and are the property of the State. Ideally, a qualified person should be responsible for the recovery of fossils noticed during construction/mining to ensure that all relevant contextual information is recorded.

Heritage Authorities often rely on workmen and foremen to report finds, and thereby contribute to our knowledge of South Africa's past and contribute to its conservation for future generations.

Training

Workmen and foremen need to be trained in the procedure to follow in instances of accidental discovery of fossil material, in a similar way to the Health and Safety protocol. A brief introduction to the process to follow in the event of possible accidental discovery of fossils should be conducted by the designated Environmental Control Officer (ECO) for the project, or the foreman or site agent in the absence of the ECO It is recommended that copies of the attached poster and procedure are printed out and displayed at the site office so that workmen may familiarise themselves with them and are thereby prepared in the event that accidental discovery of fossil material takes place.

Actions to be taken

One person in the staff must be identified and appointed as responsible for the implementation of the attached protocol in instances of accidental fossil discovery and must report to the ECO or site agent. If the ECO or site agent is not present on site, then the responsible person on site should follow the protocol correctly in order to not jeopardize the conservation and well-being of the fossil material.

Once a workman notices possible fossil material, he/she should report this to the ECO or site agent.Procedure to follow if it is likely that the material identified is a fossil:

- The ECO or site agent must ensure that all work ceases immediately in the vicinity of the area where the fossil or fossils have been found;
- The ECO or site agent must inform SAHRA of the find immediately. This information must include photographs of the findings and GPS co-ordinates;
- The ECO or site agent must compile a Preliminary Report and fill in the attached Fossil Discoveries: Preliminary Record Form within 24 hours without removing the fossil from its original position. The Preliminary Report records basic information about the find including:
    - The date
    - A description of the discovery
    - A description of the fossil and its context (e.g. position and depth of find)
    - Where and how the find has been stored
    - Photographs to accompany the preliminary report (the more the better):
        - A scale must be used
        - Photos of location from several angles
        - Photos of vertical section should be provided
        - Digital images of hole showing vertical section (side);
        - Digital images of fossil or fossils.

Upon receipt of this Preliminary Report, SAHRA will inform the ECO or site agent whether or not a rescue excavation or rescue collection by a palaeontologist is necessary.

- Exposed finds must be stabilised where they are unstable and the site capped, e.g. with a plastic sheet or sand bags. This protection should allow for the later excavation of the finds with due scientific care and diligence. SAHRA can advise on the most appropriate method for stabilisation.
- If the find cannot be stabilised, the fossil may be collect with extreme care by the ECO or the site agent and put aside and protected until SAHRA advises on further action. Finds collected in this way must be safely and securely stored in tissue paper and an appropriate box. Care must be taken to remove the all fossil material and any breakage of fossil material must be avoided at all costs.

No work may continue in the vicinity of the find until SAHRA has indicated, in writing, that it is appropriate to proceed.

CTS HERITAGE

FOSSIL DISCOVERIES: PRELIMINARY RECORDING FORM		
Name of project:		
Name of fossil location:		
Date of discovery:		
Description of situation in which the fossil was found:		
Description of context in which the fossil was found:		
Description and condition of fossil identified:		
GPS coordinates:	*Lat:*	*Long:*
If no co-ordinates available then please describe the location:		
Time of discovery:		
Depth of find in hole		
Photographs (tick as appropriate and indicate number of the photograph)	*Digital image of vertical section (side)*	
	Fossil from different angles	
	Wider context of the find	
Temporary storage (where it is located and how it is conserved)		
Person identifying the fossil Name:		
Contact:		
Recorder Name:		
Contact:		
Photographer Name:		
Contact:		

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