HERITAGE IMPACT ASSESSMENT

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

Proposed upgrade of National Route 1 Section 4 between Doornfontein (KM 63.0) and Laingsburg (KM 81.7), two bridges and eighty-six minor culverts, eight major culverts in the Western Cape Province, Central Karoo District Municipality at Laingsburg Local Municipality

Case No: HWC24071904EJV0719

Prepared by CTS Heritage

CTS HERITAGE

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For

Earthlink

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EXECUTIVE SUMMARY

1. Site Name:

National Road 1 section 4 between Doornfontein. (km 63.0) and Laingsburg (km 81.7)

2. Location:

National Route 1 Section 4 between Doornfontein (KM 63.0) and Laingsburg (KM 81.7)

3. Locality Plan:

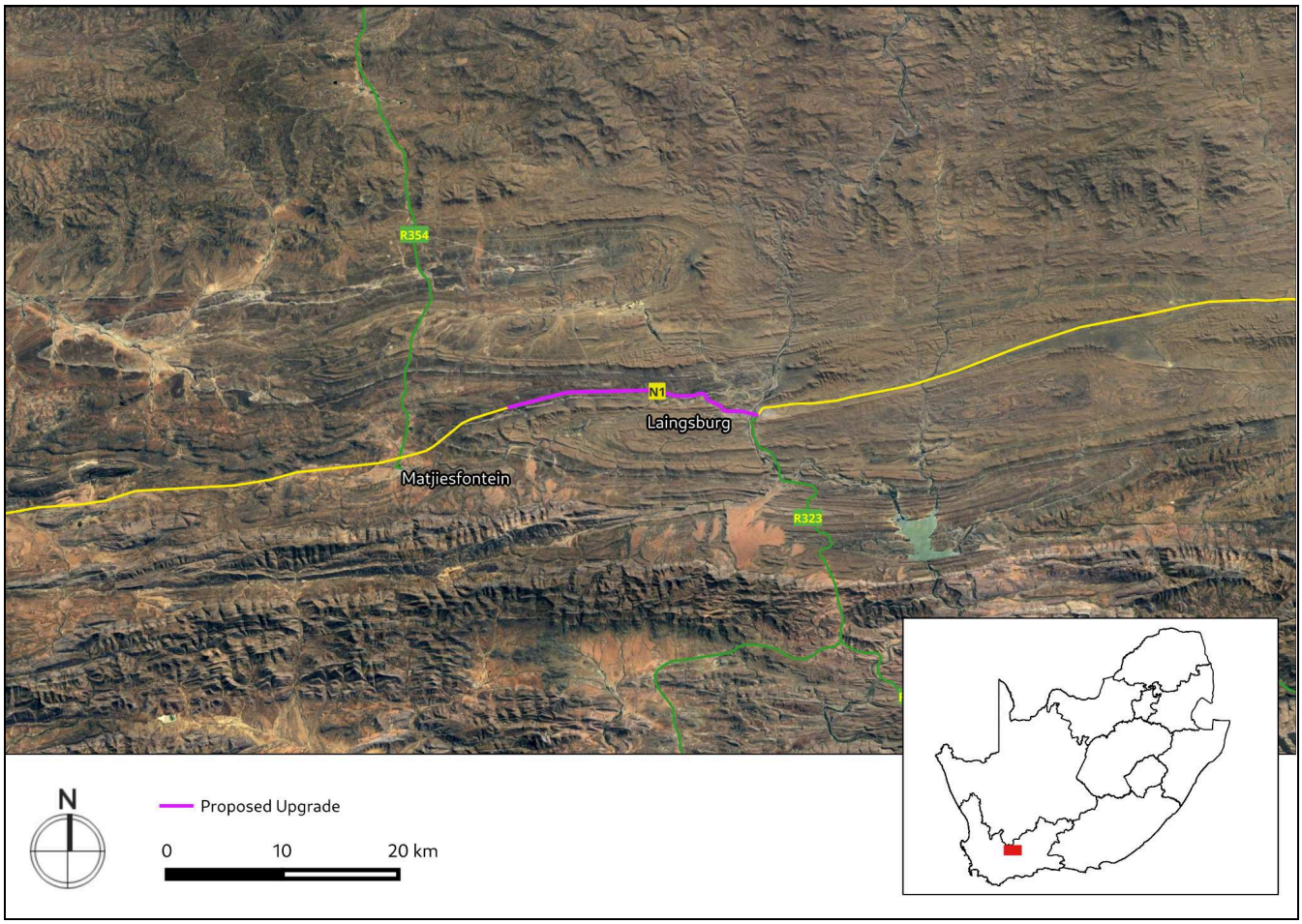

Figure A: Location of the proposed development area

4. Description of Proposed Development:

This project is situated on National Road 1 section 4 between Doornfontein. (km 63.0) and Laingsburg (km 81.7) for upgrading the existing carriageway capacity.

5. Anticipated Impacts on Heritage Resources:

During the field assessment, 8 conservation-worthy heritage resources were identified. They include 2 historical plaaswerfs, the tree lane leading up to one of the farm werfs, as well as the tree lanes in the town, one raw material source for lithics, a Voortrekker Monument, and the two church buildings in Laingsburg. Most of these will not be impacted upon by the proposed upgrades as they fall outside the road reserve.

The tree lanes have been identified as a cultural landscape element that contributes to the experience of the landscape. Mature trees are rare in the broader landscape and are therefore a defining feature of towns in the Karoo. It therefore contributes to the townscape as well as a sense of place, and impact on these trees should be avoided. If impact cannot be avoided, mature trees should be planted alongside the upgraded road. Current trees that exist in the town include pine trees in front of the church, Schinus molle trees (Pepper trees) near the entrance of the town, poplar trees in the cemetery, and bluegum groves.

The proposed upgrade of National Route 1 (N1) Section 4 between Doornfontein and Laingsburg traverses an area underlain by geological and palaeontological significant formations, notably the Dwyka and Ecca Groups. The palaeontological sensitivity of these formations varies, with the Ecca Group, particularly the Whitehill Formation, being known for its significant fossil content, including mesosaurid reptiles and various trace fossils.

The Dwyka Group is characterised by low-diversity trace fossils and generally exhibits low palaeontological sensitivity. In contrast, the Ecca Group formations, especially the Whitehill Formation, have yielded important fossil material, including well-preserved mesosaurid reptiles, trace fossils, and various microfossils. This formation is of high palaeontological significance. The primary impact on fossil heritage will occur during the construction phase due to potential destruction, damage, or disturbance of fossils. However, given the sparse occurrence of scientifically significant fossils in most of the bedrock formations, the overall severity of impacts is considered moderate. However, the presence of the existing N1 road infrastructure is expected to reduce the likelihood of significant fossil impact, though the confidence in this assessment remains moderate due to the absence of field assessments.

To mitigate these impacts, it is recommended that during excavation or rock removal activities beyond the current road and marginal boundaries, a palaeontologist must be present during all construction and excavation activities in the Whitehill Formation. This is particularly important near the rock outcrop closest to Laingsburg. The HWC Chance Fossil Finds Protocol must be integrated into the Environmental Management Programme (EMPr).

By adhering to these recommendations, the proposed N1 upgrade can proceed with minimised impact on palaeontological resources.

6. Recommendations:

- Impact to the tree lanes, identified in Figure 8.1-8.4 should be avoided. If this is not possible, these tree lanes should be replaced with mature trees once the upgrades are completed.
- A palaeontologist must be present during all construction and excavation activities in the Whitehill Formation. This is particularly important near the rock outcrop closest to Laingsburg.
- The HWC Chance Fossil Finds Protocol must be integrated into the Environmental Management Programme (EMPr).
- 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 since 2016 heads up the heritage division of the organisation. She 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. Prior to joining CTS Heritage, 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. Since 2016, Jenna has drafted over 250 Screening and Heritage Impact Assessments throughout South Africa.

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3 Response to NID
4 Evidence of PPP

1. INTRODUCTION

1.1 Background Information on Project

This project is situated on National Road 1 section 4 between Doornfontein. (km 63.0) and Laingsburg (km 81.7) for upgrading the existing carriageway capacity.

The major aspects of this project include the following:

- Asphalt Surfacing with Crushed stone base with a partial in situ reconstructed sub-base for the section between km 63.0 and km 80.0,
- Asphalt surfacing with an asphalt base, with a cement stabilised sub-base for the section between km 80.0 and km 81.7,
- New geometry for Section 1: Rural (km 63.0 – km 76.7): Dual carriageway
    - Each carriageway cross section will comprise 2 x 3.7 lanes, 1m inside surfaced shoulder and 2.5m outside surfaced shoulder with an 8.6m median.
- New geometry for Section 2: “Pass” (km 76.7 – km 79.9): 4-lane configuration
    - The cross-section will comprise of 1 x 3.5m fast lane, 1 x 3.7 slow lane and a 2.5m surfaced shoulder per direction with a 2.8m median with concrete barrier.
- New geometry for Section 3: Laingsburg Town (km 80.2 – km 81.4): 4-lane configuration (reduced outside shoulders.)
    - The cross-section will comprise of 1 x 3.4m fast lane, 1 x 3.6 slow lane and a 0.5m surfaced shoulder per direction with a 2m kerbed median for pedestrian refuge when crossing the N1.
    - With 4 prominent intersections between km 80.5 and km 81.3 (length of 800m), this option will be the preferred option for the town section. The extra lane on each side will also provide shared turning and passing lanes at intersections, which at present is currently non-existent.
- The existing horizontal alignment will be retained except for the following proposed areas:
    - Rural section: The new carriageway is proposed to be constructed on the left-hand side due to river streams next to the existing right-hand side carriageway.
    - “Pass” section: A possible horizontal re-alignment option is proposed on the LHS to prevent the fill batter going into the river on the RHS or to construct a fill retaining wall on the riverside.
    - Town section: With the new proposed Buffels River bridge, there will be a horizontal re-alignment between km 81.160 t0 km 81.480 tie-in opposite sides of the bridge to a 4-lane configuration with 2.0 median and dual carriageway with 5.5m median.
- The existing vertical alignment in the “pass” and town section will be retained.
    - A cross fall of 2.5% will be used over sections where the vertical grades are less than 0.5%.
- The horizontal and vertical alignment is to adhere to the following design speeds:
    - Section 1: Rural (km 63.0 – km 76.7) – 120km/h,

  - Section 2: “Pass” section (km 76.7 – km 79.6) – 80km/h,
  - Section 3: Laingsburg Town (km 79.6 – km 81.7) – 60km/h
- The pavement strategy is as follows:
  - Section 1 & 2 (km 63.0 to km 79.9): The pavement will be rehabilitated,
  - Section 3 (km 79.9 to km 81.7): The pavement will be reconstructed full depth,
  - A new pavement structure will be constructed for any re-alignment and widening sections.
- There are eighty-six minor culverts along the road. In most instances, the culverts are in need of some form of repair
  - Many culverts need to be upgraded to larger box culverts or larger diameter pipes,
  - It is recommended that all culverts are replaced to have a minimum diameter of 900mm in order to ease the maintenance function.
- The two major bridges in town will require a vertical upgrade together with widening
- There are a total of eight (8) major culverts on the road
  - The structures are in a relatively good condition, with some rehabilitation works required
- Only 2 of the 8 major culverts is envisaged to be upgraded hydraulically to meet the current design standards and guidelines
- The remaining 6 culverts will simply be extended to cater for the new proposed road prism width
- The following can be highlighted in terms of the safety/accident analysis
  - A large number of the statistics show the accidents as occurring due to driver negligence, loss of control or unknown causes.
  - This could also be due to the corridor traffic having a high truck composition with drivers being impatient along sections with only one lane per direction,
  - As a safety element, the current one lane per direction on this section was noted as leading to unsafe behaviour due to driver frustration behind the high truck traffic on the corridor,
  - This means that the construction of a 2 + 1 Configuration, 4 lane configurations through the “Pass” section and Town section will hopefully reduce the most significant accident types
- The road signs, road markings and guardrails are generally in a good condition
- The fencing is in a poor condition
- Due to the upgrading of the road which will include, amongst others, a new cross-section and possible re-alignment, it is proposed that all road furniture be replaced
- A number of utility services will be affected by the upgrade of the road:
  - Laingsburg Municipality (stormwater and sewer),
  - Eskom,
  - Vodacom (part of Neotel)
  - Cell C (part of Neotel)

  - MTN (part of Neotel)
  - Neotel
  - Telkom
- It is expected that additional land will be required to accommodate the widening of the roadway in deep cuts and high fills, in Laingsburg town and at some bridge structures.
- Land will also be required for the following:
  - New major intersections,
  - New minor intersections,
  - New access/ frontage roads,
  - New or expanded borrow pits,
  - New law enforcement areas

Additional construction material will be required for the rehabilitation of the existing carriageway and the construction of the new widened cross-section.

1.2 Description of Property and Affected Environment

The study area consists of 18km of road, with the eastern end ending in the town of Laingsburg. Approximately 2.7km of the 18km is located within the town of Laingsburg, specifically along the southern edge of the historical core of Laingsburg and the Bergsig neighbourhood. The section of the road to be upgraded continues west through a short pass that cuts through bedrock. Some parts of this area are surrounded on both sides by bedrock cliffs that had been created when the road cut through these slight koppies. The southern side of this area also has steep hillsides that slope down to the Bobbejaansrivier.

The rest of the study area falls within the rural Laingsburg area in the Great Karoo. The area has two quarries, two farm werfs, and a collection of new fibre manholes that have been installed next to the road. The whole road has multiple culverts that cross over small streams.

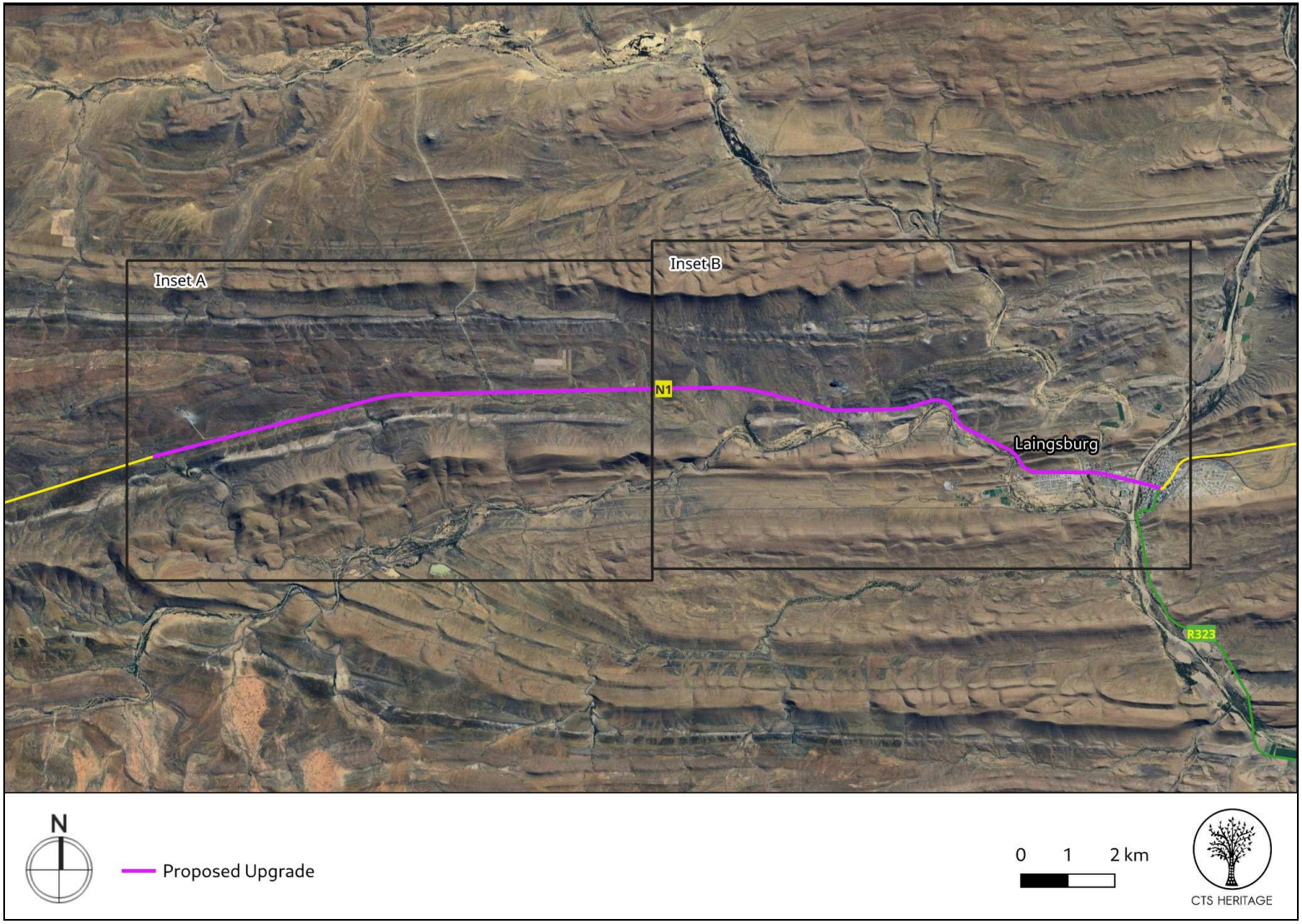

Figure 1.1 Overview Map. Satellite image (2024) indicating the proposed development area at closer range.

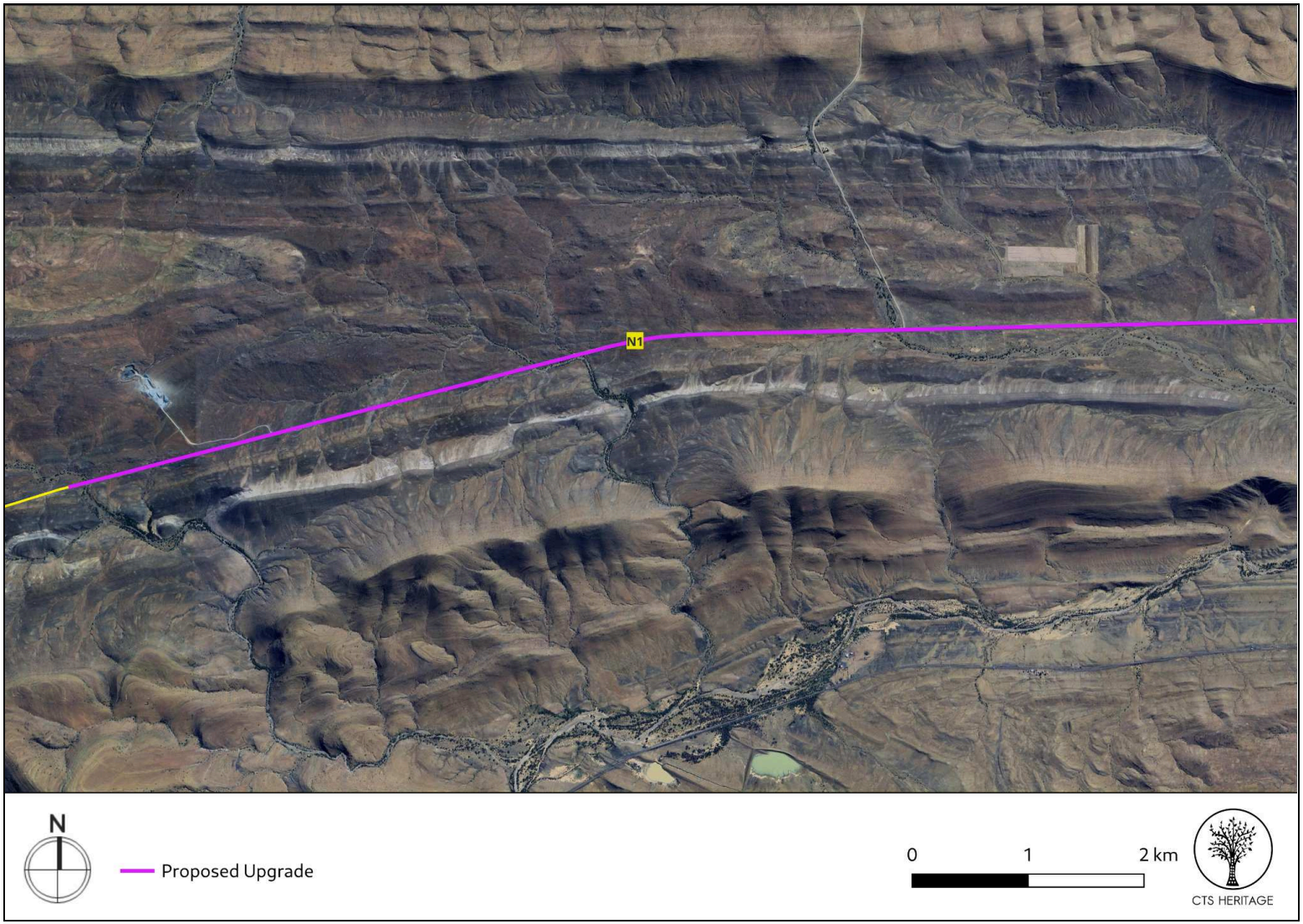

Figure 1.2 Overview Inset Map A. Satellite image (2024) indicating the proposed development at closer range.

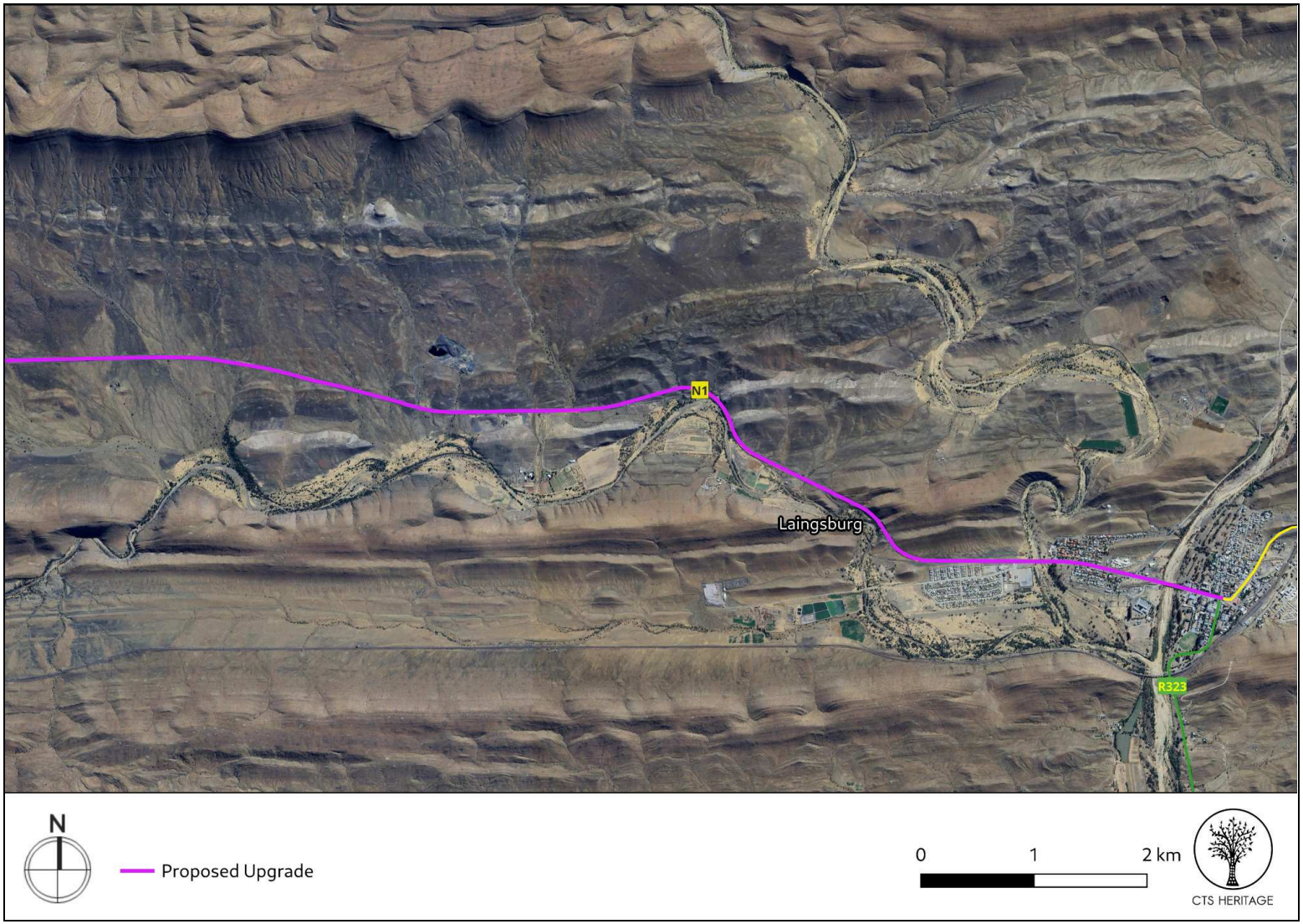

Figure 1.3 Overview Inset Map B. Satellite image (2024) indicating the proposed development at closer range.

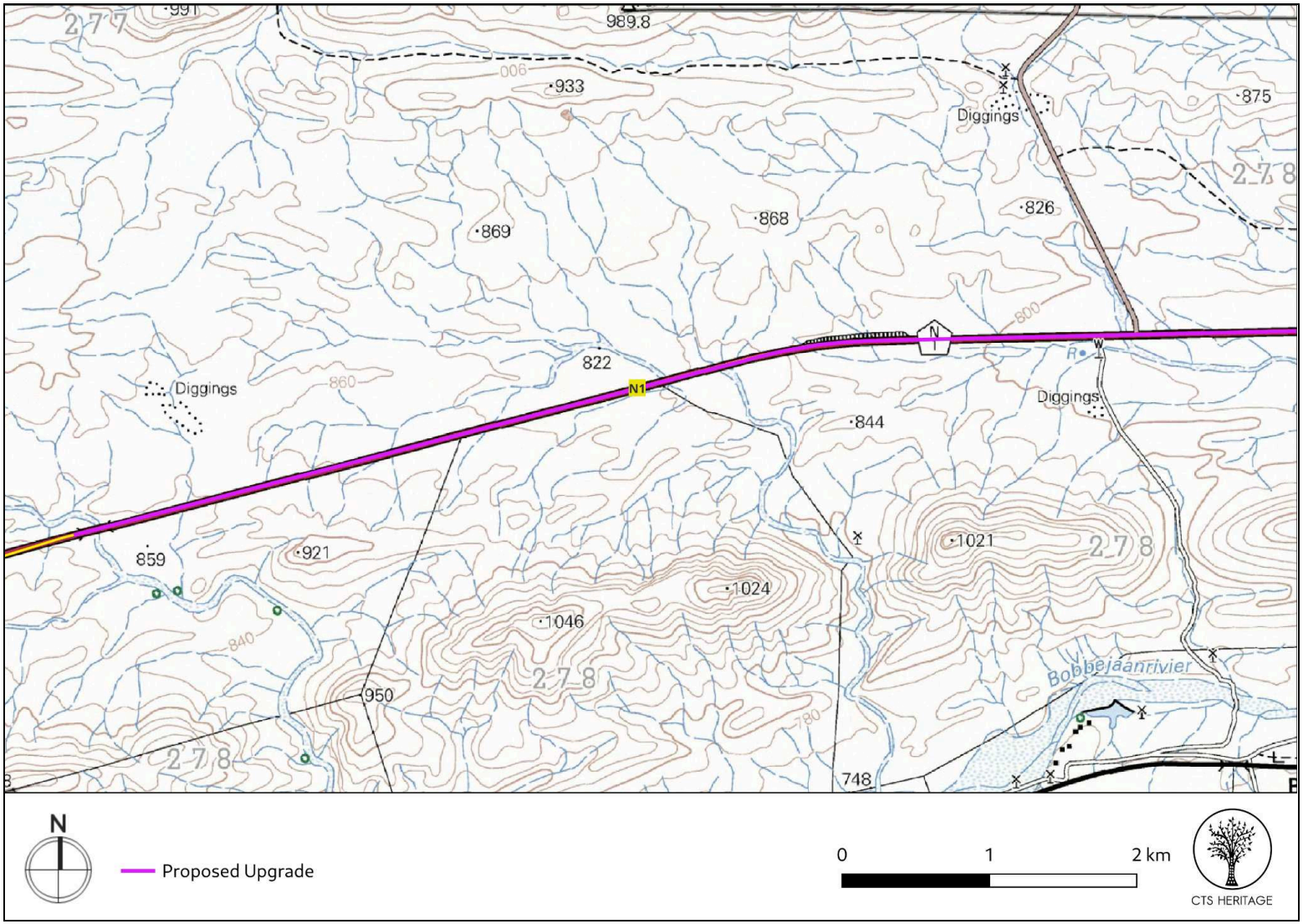

Figure 1.4 Overview Inset Map A. 1:50 000 TopMap for the development area

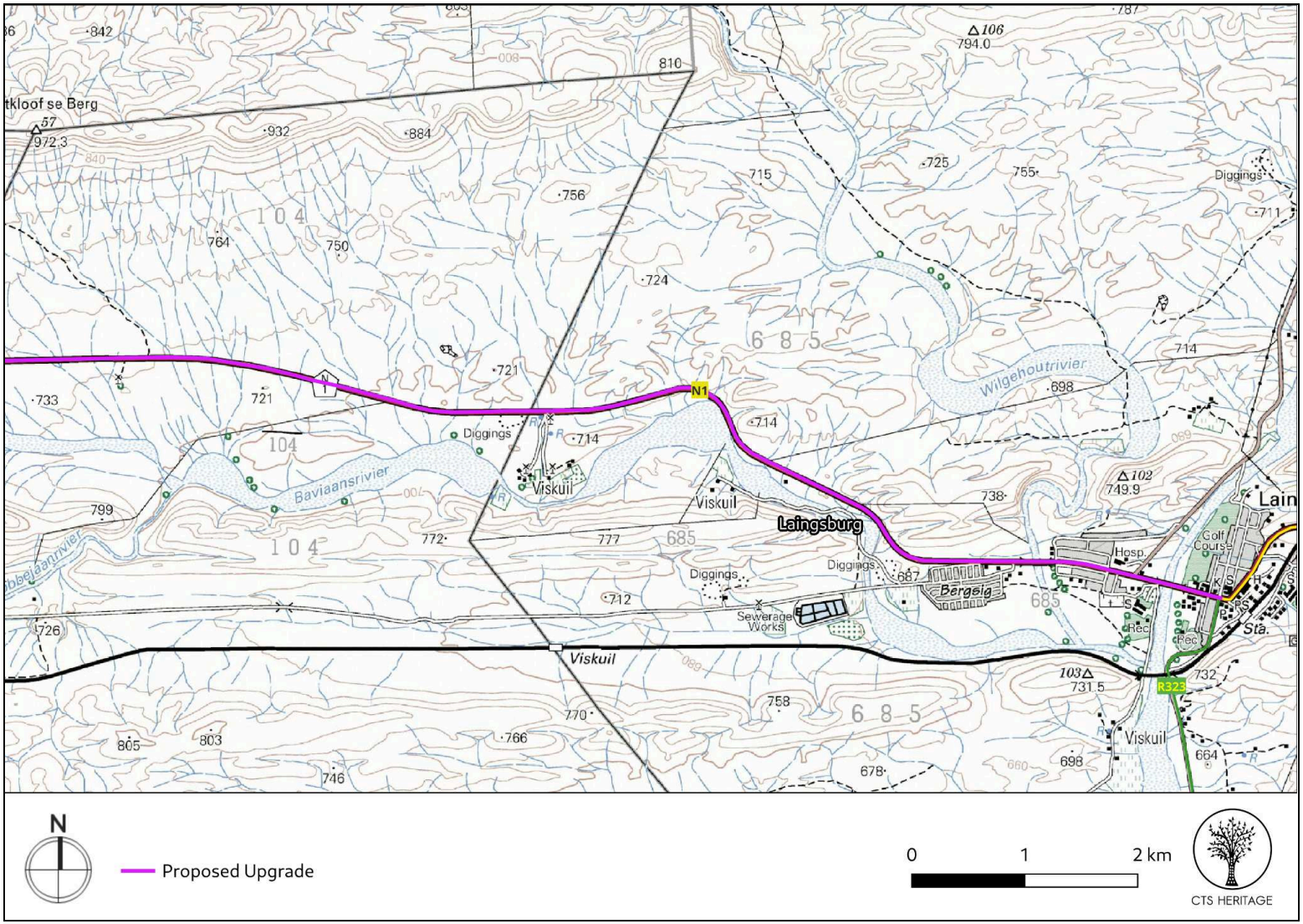

Figure 1.5 Overview Inset Map B. 1:50 000 TopMap for the development area

2. METHODOLOGY

2.1 Purpose of HIA

On 27 August 2024, HWC responded to the NID submission for this project indicating that an HIA is required for this project that satisfies the requirements of section 38(3) of the NHRA. This HIA must, in addition, have specific reference to the following:

- Archaeological Impact Assessment
- Palaeontological Impact Assessment

The HIA must have an overall assessment of the impacts to heritage resources which are not limited to the specific studies referenced above. Therefore, the purpose of this Heritage Impact Assessment (HIA) is to satisfy the requirements of section 38(8), and therefore section 38(3) of the National Heritage Resources Act (Act 25 of 1999).

2.2 Summary of Steps Followed

- A Desktop Study was conducted of relevant reports previously written (please see the reference list for the age and nature of the reports used)
- An archaeologist (M. Crafford) conducted a survey of the site and its environs on 16 July 2024 to determine what archaeological resources are likely to be impacted by the proposed upgrade of the N1.
- A palaeontologist conducted a desktop assessment of palaeontological resources likely to be disturbed by the proposed development.
- The identified resources were assessed to evaluate their heritage significance and impacts to these resources were assessed.
- Alternatives and mitigation options were discussed with the Environmental Assessment Practitioner

2.3 Assumptions and Uncertainties

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

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

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

2.4 Constraints & Limitations

The study area is large, at nearly 18km long, and stretches alongside the N1, which is a very busy road with a 120km speed limit. Not all areas are accessible on foot. The number of rocks on the surface also made it difficult to easily identify lithics. However, sufficient coverage was ascertained in order to determine the archaeological sensitivity of the development area.

2.5 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

3.1.1 Background

This application is for the proposed upgrade of National Route 1 (N1) Section 4 between Doornfontein and Laingsburg, two bridges, eighty-six minor culverts, and eight major culverts in the Western Cape Province, Central Karoo District Municipality at Laingsburg Local Municipality. Laingsburg is located on a tributary of the Groot River, namely the Buffels River. It takes its name from John Laing, Commissioner of Crown Lands in the Cabinets of Sprigg and Rhodes. It was established as a town in 1881 on the farm, Vischkuil aan de Buffels Rivier, and became a municipality in 1906 (Raper et. al., 2018).

3.1.2 Cultural Landscape, Built Landscape and Historical Background

The proposed development falls within the Karoo. The name 'Karoo' has its roots in the Khoisan word meaning 'place of great dryness'. It once supported large grassy flatlands and the San and Khoekhoen migrated across the region for hunting and grazing purposes. Less than two hundred years ago large herds of antelope still roamed the grass plains. With the occupation of the area by stock farmers, the sheep gradually replaced the game and the grass receded along with changing grazing and weather patterns (Winter et al 2009; Winter & Oberholzer 2013). By the late 17th century, the Khoenhoen had moved from the region into the more water-rich southern Karoo and the coastal plains. During the early colonial period, the harshness of the Karoo region formed an almost impenetrable barrier from the Cape to the interior for colonial explorers, hunters and travellers. The 18th century was characterised by a marked increase in the rate of expansion of the boundaries of the settlement at the Cape. This was associated with the emergence of the migrant stock farmer (trekboer) (Guelke 1982 in Winter et al 2009). Early routes into the interior largely followed the tracks initially used by migrating herds of game or the cattle herds and sheep flocks of the Khoekhoen on their seasonal route between coastal and inland grazing grounds. These routes were later reinforced by generations of trek farmers moving between the markets at the Cape and their farms (Winter et al 2009).

De Kock and Schulz (2011, SAHRIS NID 503543) in their HIA located less than 10km southeast of the western end of the proposed upgrade, describe the landscape as "*an arid Karoo landscape and is located along a lower-lying, gentle, north-facing slope and with the Witteberg mountain range as natural backdrop to the south.*" One Provincial Heritage Site (PHS) is located within a 100m radius of the development (See Table 1 below). This site, Dutch Reformed Church, Voortrekker Street, Laingsburg (SAHRIS ID 28191) but has been mapped incorrectly on SAHRIS. The correct location is approximately 400m eastwards and is still within 100m of the proposed upgrade (Figure 3.1-3.2). The Laingsburg cemetery is also within 200m of the proposed upgrade.

In 2020, CTS Heritage conducted an HIA less than 13km southwest of the proposed development (SAHRIS NID

27482). They identified the N1 as a scenic route, and based on the historical map, it follows along the historical route connecting Laingsburg to the Cape (Figure 3.5). The key aspects of the cultural landscape resources that are known from the area include the N1 scenic route, and the surrounding Moordenaars Karoo, which CTS Heritage (2020) describes as "*The lower Matjiesfontein valley is covered with dull Karoo bossies well under 1m in height and subtle landforms including hidden depressions and hillocks. The Witteberg mountains rise steeply to the east.*"

As the proposed development constitutes an upgrade to the existing N1 alignment, it is unlikely that any significant cultural landscape resources will be negatively impacted by the proposed upgrade.

3.1.3 Archaeology

Recently, several heritage assessments have been completed within proximity to the area proposed for development (Figure 2.1-2.2). According to Nilssen (2014, SAHRIS NID 504763), "*The Karoo houses a long and rich archaeological record dating from the earliest stages of Stone Age technology that are over a million years old, to the historic period that consists of the last few hundred years of human occupation (see Nilssen 2011 and references therein). Archaeological sites include caves and rock shelters, open-air artefact scatters, rock engravings and historic structures with their associated cultural materials.*" According to the ACO (2013, SAHRIS NID 503074), "*Because of the scarcity of caves and shelters, more than 90% of Karoo archaeological sites are open sites of stone artefacts, ostrich eggshell fragments and occasionally, pottery. Bone remains are rarely preserved. Artefacts of both the Early and Middle Stone Ages are widespread and may generally be described as an ancient litter that occurs at a low frequency across the landscape. Where definable scatters of Early and Middle Stone Age material occur, they are considered to be significant heritage sites. More intensive occupation of the Karoo started around 13,000 years ago during the Later Stone Age, which is essentially the heritage of Khoisan groups who lived throughout the region. The legacy of the San includes numerous open sites while traces of their presence can also be found in most large rock shelters, often in the form of rock art. They frequently settled a short distance from permanent water sources (springs or waterholes) and made use of natural shelters such as rock outcrops or large boulders or even large bushes. In the Great Karoo, natural elevated features such as dolerite dykes and ridges played a significant role in San settlement patterns*" and as such, this broader area is renowned for its well-preserved rock art and other artefacts from this time, including rock engravings and rock gongs. As the proposed development is found in a flat area without visible outcrops or natural shelters, it is unlikely that rock engravings or similar exist within the proposed area.

Based on the information included in Hart and Webley in an HIA that encompasses most of the northern area between the proposed development and Sutherland (2013, SAHRIS NID 138341), Early, Middle and Later Stone Age archaeological artefacts are expected to occur in this area, as well as stone-walled kraals and what are described as open Khoekhoen encampments situated among the Kameeldoring trees along the dry river beds in the

bottom of the valleys. Archaeological sites of this kind are very rare in the Western Cape, having been only previously recorded in the Richtersveld (Hart and Webley, 2013). A recent survey by the eastern Cederberg Group (eCRAG) on the neighbouring Rietfontein farm revealed a series of rock art sites on the Dwyka tillites. These findings have opened up a new geographical area for rock art research.

In 2020, CTS Heritage conducted an HIA for the proposed upgrade of the N1 between Monument River and Doornfontein, the part of the N1 that starts at the western end. Their findings are relevant and provide insight into the types of heritage resources that can be expected near the current study area. Almost all of the known heritage sites on SAHRIS (Appendix A, and Figure 3.1) were identified during this HIA. "*A number of isolated Middle Stone Age and Later Stone Age archaeological artefacts were identified in the vicinity of some of the proposed borrow pits and quarries. A Later Stone Age campsite with Middle Stone Age material around it was identified at Borrow Pit 6. There were a number of isolated artefacts and one noteworthy archaeological site identified (M025) at Drill Site 5. North-west of the site, closer to the old quarry (M046), there is an area which has a dense accumulation of artefacts. Sites M050 to M053 document part of this potential archaeological site (graded IIIb).*

One modern day memorial was identified beside the N1 near the Matjiesfontein intersection (M037). A formal British graveyard, containing the remains of various English soldiers and Englishmen stationed or living in the area before the war, is one of the heritage resources recorded in the proposed development area for the upgrade of the N1 Section 4 between Monument River (km 46.00) and Doornfontein (km 63.00). Drill site 1 is located on land belonging to Matjiesfontein town and will be visible from the Matjiesfontein PHS. It is also not far downslope from the probable lone guarrie tree (Euclea) under which Olive Schreiner is said to have sat while she drafted a series of articles, Thoughts on South Africa, The Buddhist Priest's Wife as well as On the Banks of a Full River."

As evident by previous assessments in the area, impact on significant heritage resources is likely and further investigation is recommended to mitigate this impact.

3.1.4 Palaeontology

According to the SAHRIS Palaeosensitivity Map (Figure 4.1), the area proposed for development is underlain by geological sediments of moderate sensitivity for impacts to palaeontology. The Geosciences Map 3320 Ladismith Geology Map indicating that the development area is underlain by C-Pd: Dwyka Formation, and Pf: Fort Brown Formation, both in the Ecca Group, and Quaternary sands The Dwyka sediments are known for their tillite, diamictite, and subsidiary shale,the Fort Brown Formation for its dark-coloured shale with thin siltstone and sandstone beds.

According to the Western Cape Palaeotechnic report (Almond and Pether, 2008), the **Dwyka Formation** in the Ecca Group has **low** palaeontological sensitivity. It is known for its trace fossils, organic-walled microfossils, rare

marine invertebrates (eg molluscs), fish, vascular plants interglacial and post-glacial trace fossil assemblages, with a possibility of body fossils (eg molluscs, fish, plants). The fossils are largely from interglacial and immediately post-glacial sediments. The Ecca group, in which the **Fort Brown Formation** falls, has **moderate/medium** palaeontological sensitivity and is known for its sediments with non-marine trace fossils, vascular plants (including petrified wood) and palynomorphs of Glossopteris flora, mesosaurid reptiles, fish (including microvertebrate remains, coprolites), crustaceans, sparse marine shelly invertebrates (molluscs, brachiopods), microfossils (radiolarians etc), as well as insects. According to the Palaeotechnic Report for the Western Cape (Almond and Pether, 2008), **alluvium** has a **very low** sensitivity for impacts to significant palaeontology and as such no further assessment of impacts to palaeontological heritage is recommended.

In the 2020 HIA located less than 13km southwest of the proposed upgrade, CTS Heritage (SAHRIS NID 27482) described the area as follows: "*The study area near Matjiesfontein Village, Western Cape, is situated in semi-arid, hilly terrain along the southern margins of the Great Karoo. The area is drained by numerous small, non-perennial tributaries of the Buffelsrivier drainage system such as the Bobbejaansrivier and its tributary streams. In geological terms it lies within the northern margins of the Cape Fold Belt; the sedimentary bedrocks here are structured by major west-east trending folds, as clearly seen in satellite images, as well as occasional northward-directed thrusts. Examples of these large-scale folds include the rugged quartzitic Witteberge anticline to the south of Matjiesfontein, the Ghaapkop syncline in the east, as well as the major anticline to the north of the N1 with Boelhouerrante at its core. From a stratigraphic viewpoint the bedrocks underlying the project footprint include Early Carboniferous to Early / Middle Permian glacial and marine sediments assigned to the Witteberg Group (Cape Supergroup) as well as to the Dwyka and Ecca Groups. A key section through the geologically significant contact between the Cape and Karoo Supergroups runs across the N1 near the Wauchope Memorial, just west of the present study area. Large parts of the Palaeozoic outcrop area is mantled by Late Caenozoic superficial sediments such as colluvium (scree, hillwash), alluvium, pediment gravels and down wasted surface gravels.*"

As part of this HIA by CTS Heritage, Almond conducted a PIA (2020) and found the following, *"The southern half of the site overlies weathered, tabular-bedded basinal marine and possible lower shoreface sediments of the Prince Albert Formation (Ecca Group) that include a zone of large, lenticular to tabular phosphatic concretions. The commercial potential of these phosphatic ores has been investigated in the 1950s but their exploitation was assessed as uneconomic (Strydom 1950). During the field survey, no trace or body fossils were recorded either within the Dwyka or Ecca Group bedrocks or the overlying unconsolidated superficial sediments, including thick sandy to gravelly alluvium along drainage lines as well as sandy to gravelly soils elsewhere… Without mitigation, the overall impact significance of the proposed SANSA antenna and associated infrastructure project is evaluated as LOW as far as palaeontological heritage resources are concerned."*

A recent survey by the eastern Cederberg Group (eCRAG) on the Rietfontein farm, located about 10km southwest of the western end of the proposed upgrade, revealed a series of rock art sites on the Dwyka tillites. These findings have opened up a new geographical area for rock art research. Dr John Almond had also written up a geological and palaeontological guidebook for the landowners of the farm as this area is frequently visited by palaeontologists. A site containing extremely well-preserved fossilised fish was visited by the group (SAHRIS SITE ID 127223) to the southwest of Matjiesfontein, approximately 14,5km southwest of the proposed development.

As part of the HIA conducted by CTS in 2020, they note the following, "*During the course of the present field study of road cuttings along the N1 (Section 4) as well as of the various borrow pit and quarry sites associated with the road project no new body fossil material was recorded, neither from the Palaeozoic bedrocks nor from the overlying Late Caenozoic superficial sediments.*"

Thus, the Ecca group may be moderately sensitive, but it is area-dependent. With the proposed upgrade area being restricted to the existing road reserves, the impact is unlikely to be significant but a desktop PIA is recommended to mitigate the risk of impacting significant fossil material.

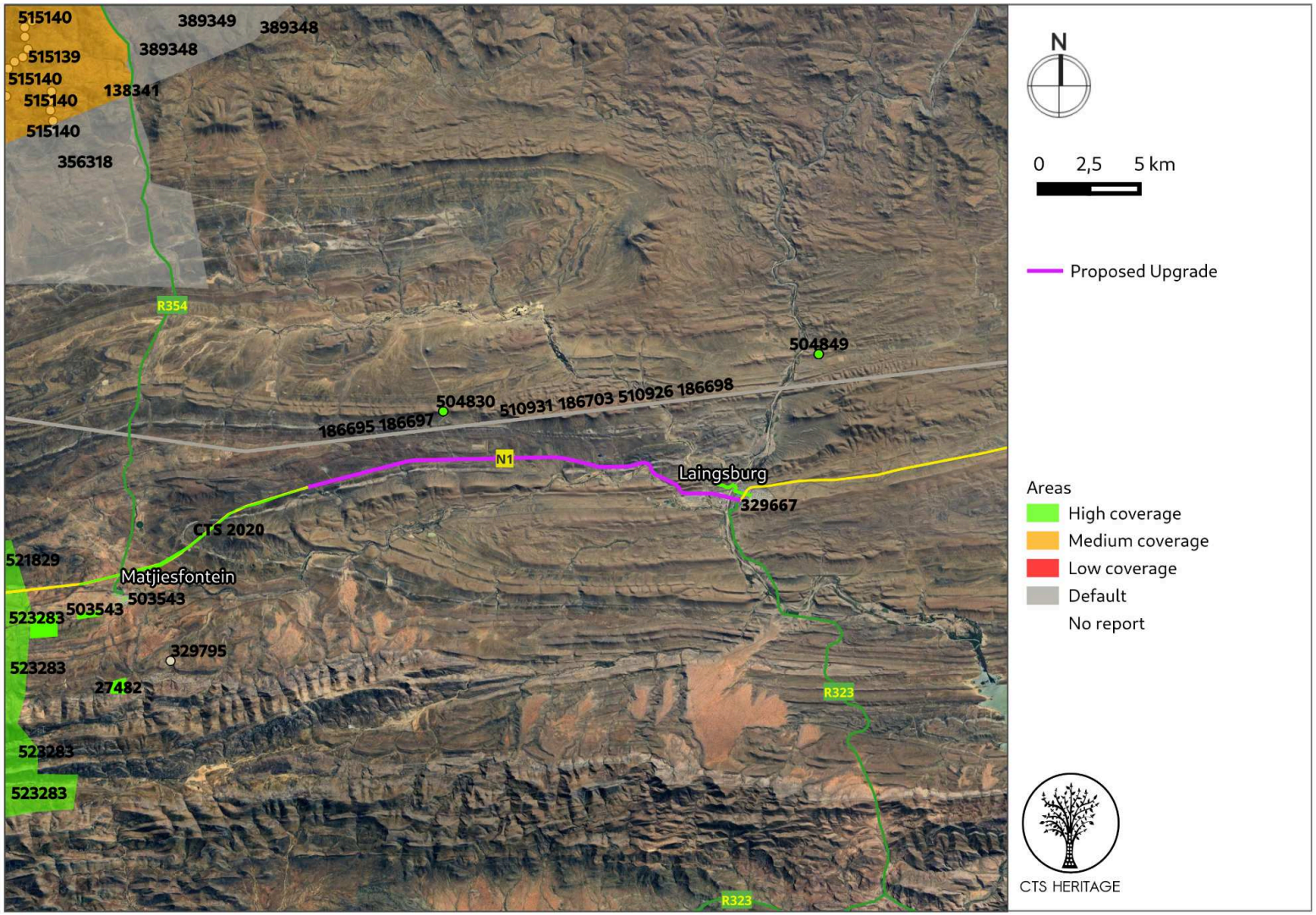

Figure 2: Spatialisation of heritage assessments conducted in proximity to the proposed development

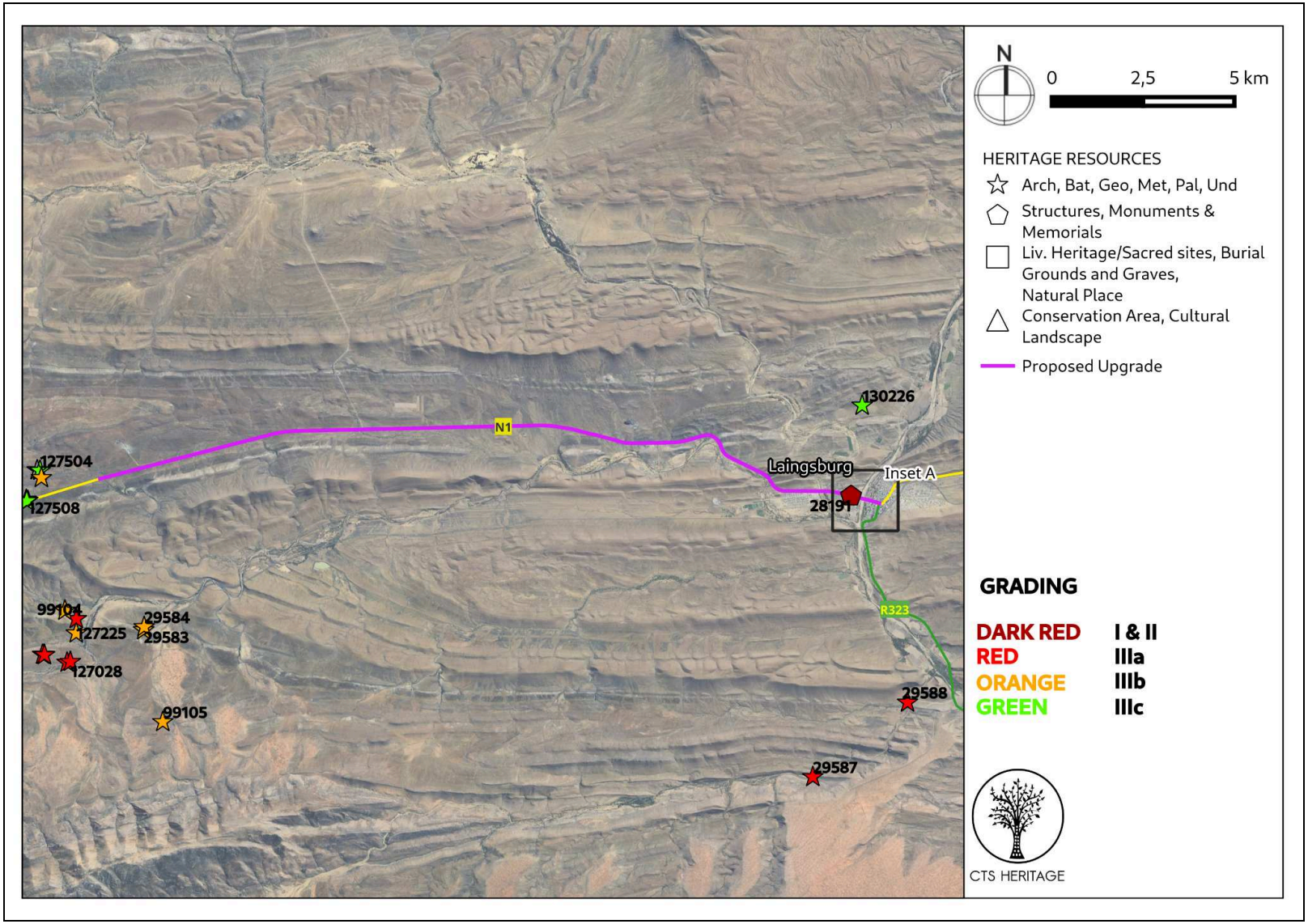

Figure 3.1 Heritage Resources Map. Heritage Resources previously identified in and near the study area, with SAHRIS Site IDs indicated. Please See Appendix 4 for a full description of heritage resource types.

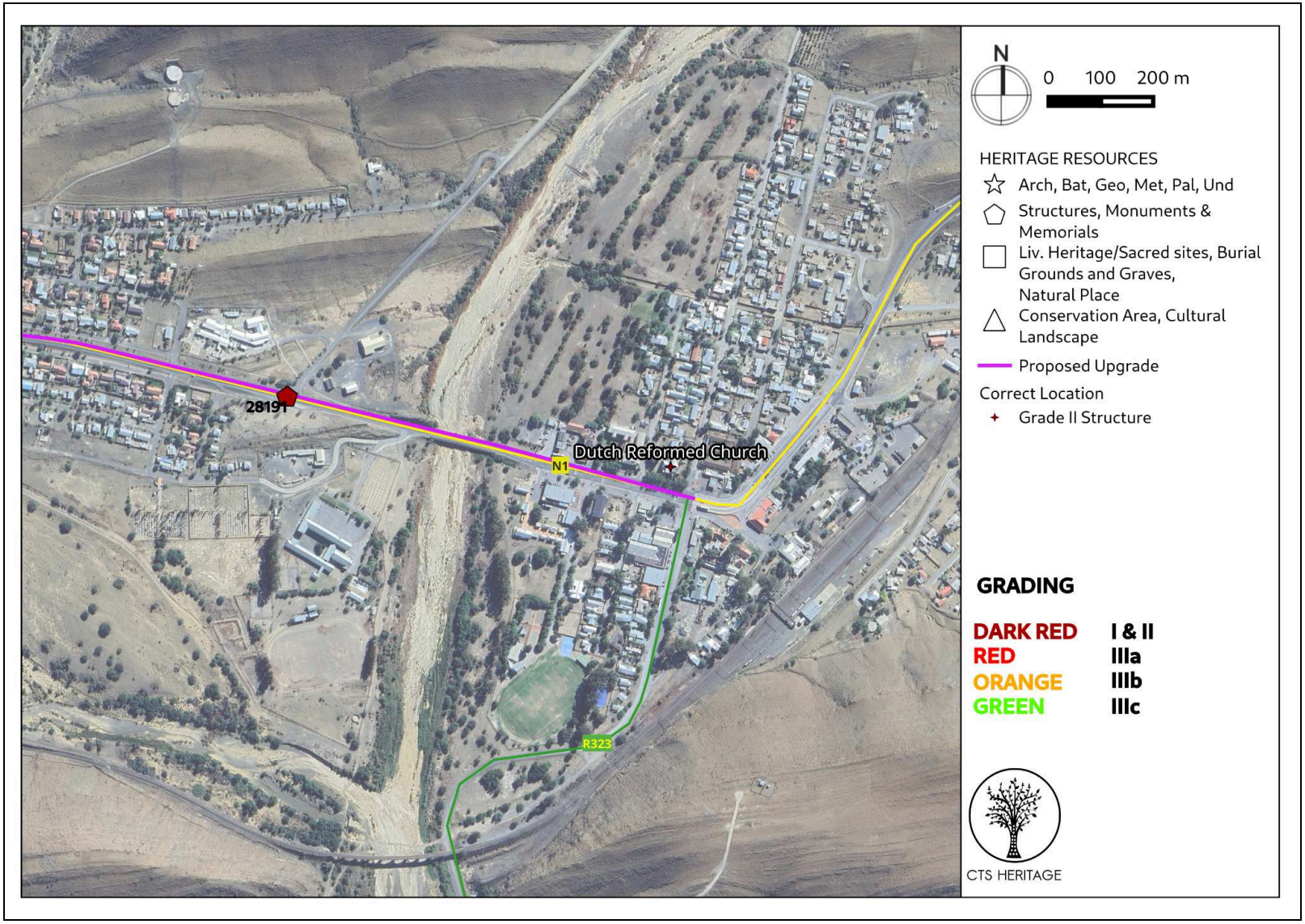

Figure 3.2 Heritage Resources Map. The Grade II Structure of the Dutch Reformed (SAHRIS ID 28191) has been mapped incorrectly on SAHRIS. This map indicates its correct location.

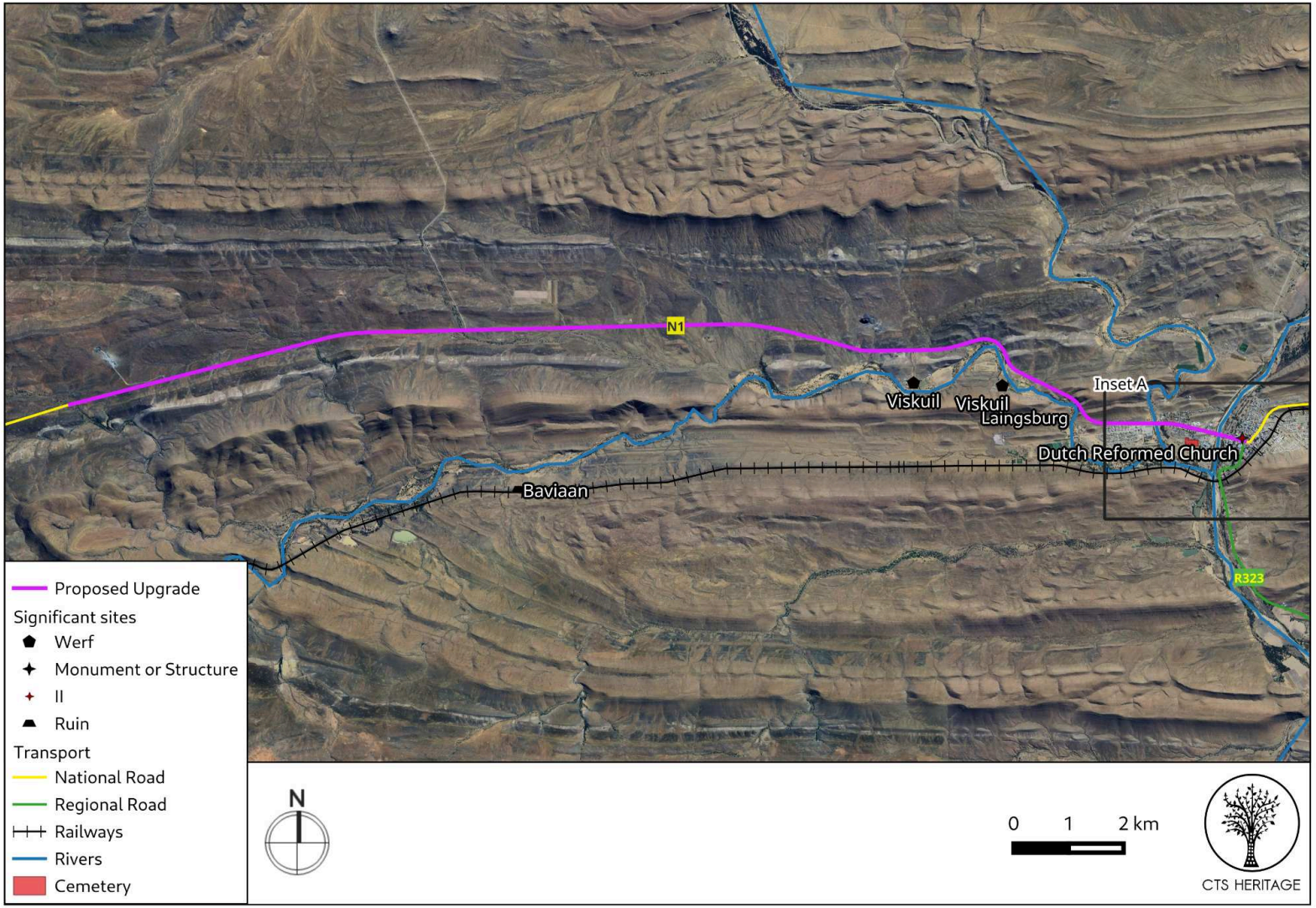

Figure 3.3 Cultural Landscape Map. Map indication sensitive receptors near the proposed development, extracted from the Topo 1:50 000 map.

Figure 3.4 Cultural Landscape Inset Map A. Map indication sensitive receptors near the proposed development, extracted from the Topo 1:50 000 map.

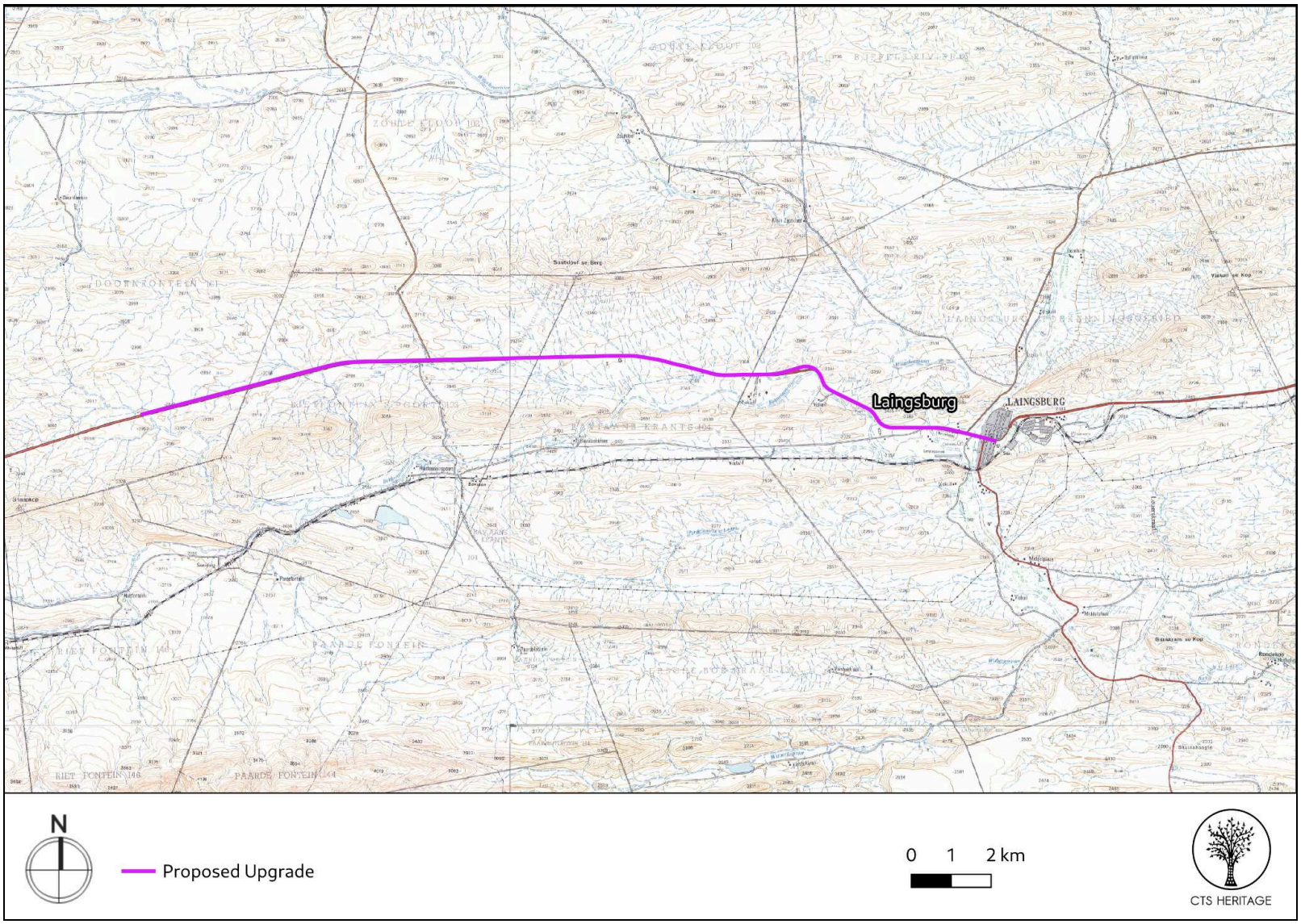

Figure 3.5 Historical Topo Map. First Edition Topographical Map indicating that the N1 follows a historical route

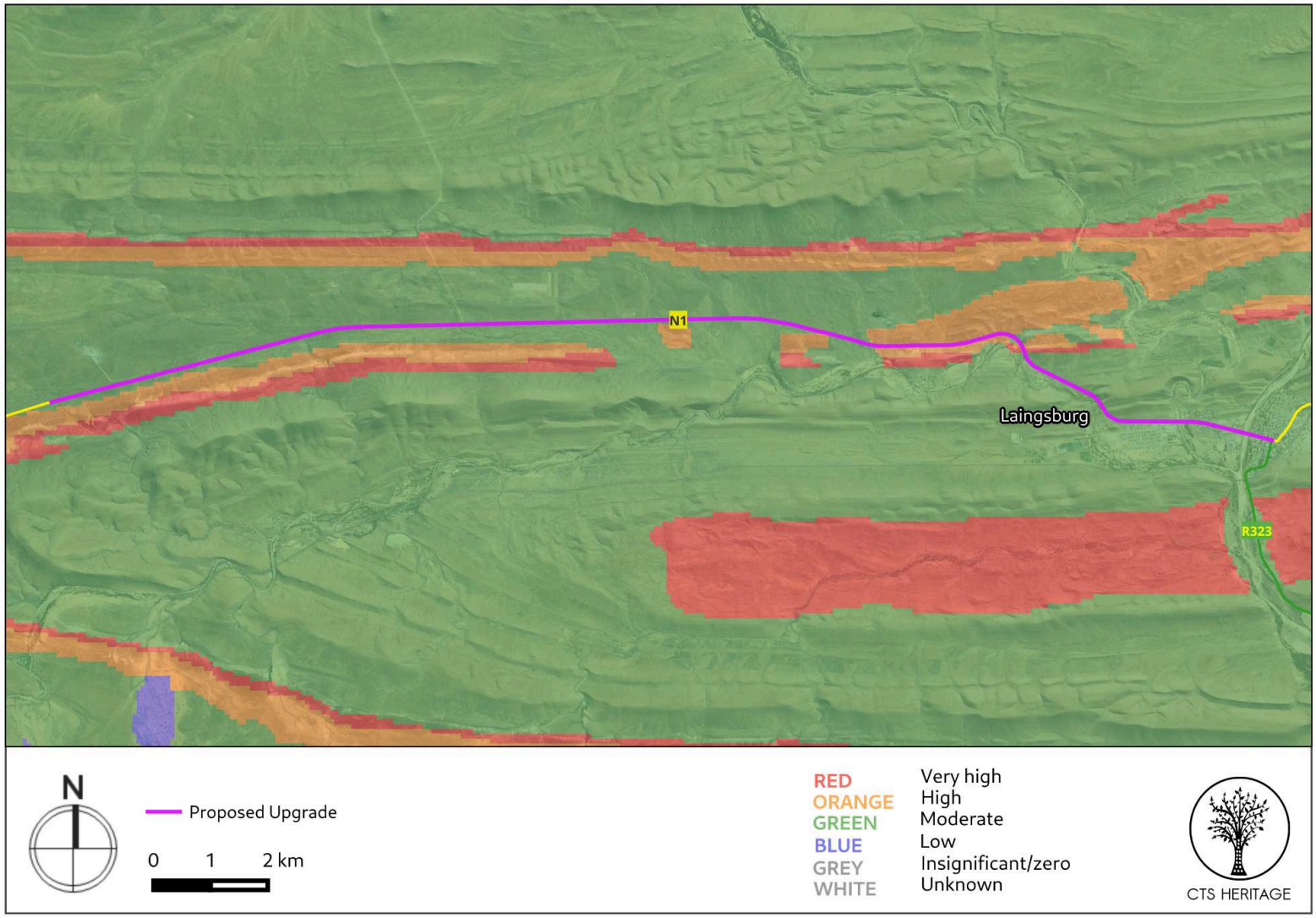

Figure 4.1: Palaeontological sensitivity of the proposed development area

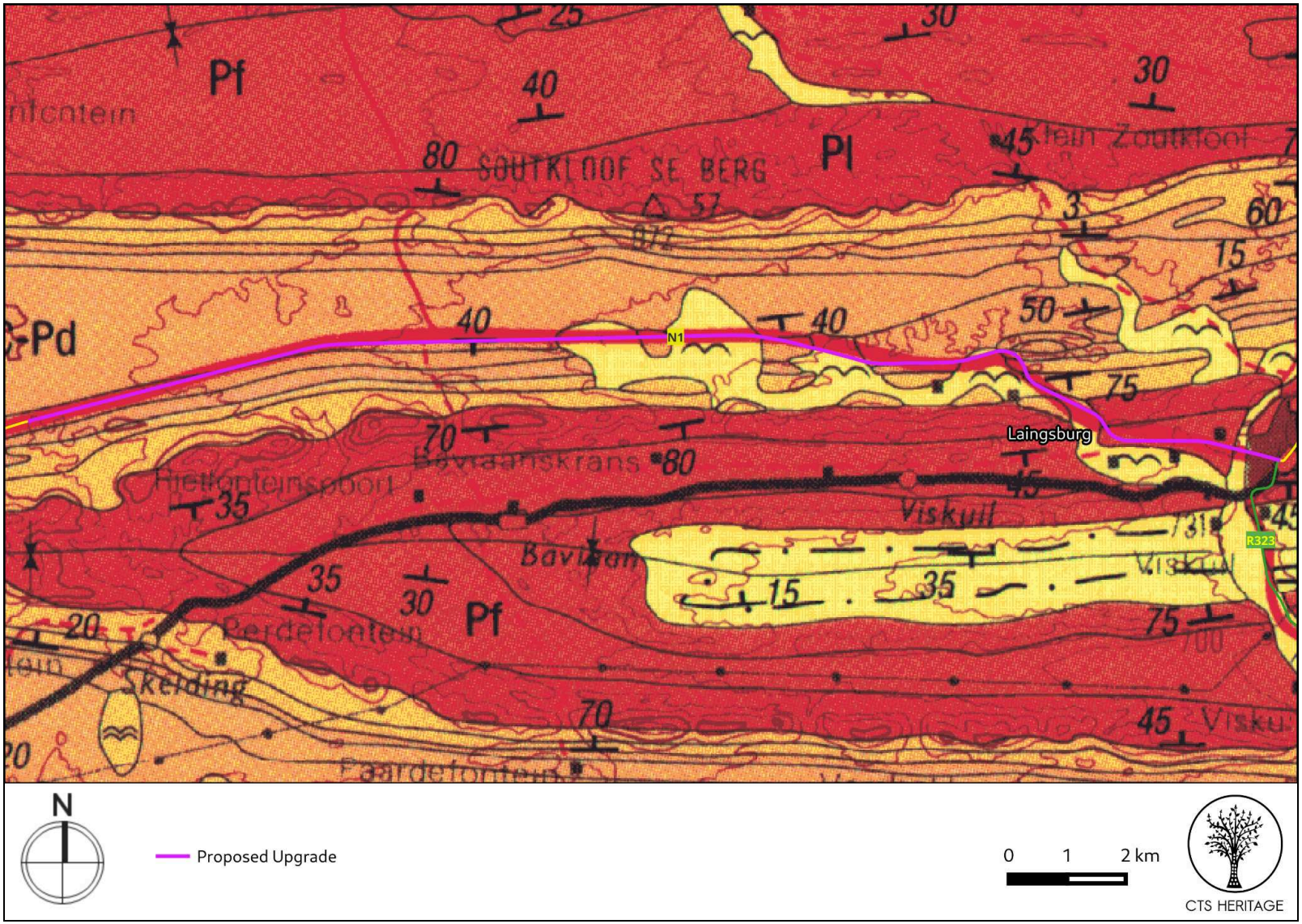

Figure 4.2: Extract from the Council of GeoScience Geology Map tile 3320 Ladismith Geology Map indicating that the development area is underlain by C-Pd: Dwyka Formation, and Pf: Fort Brown Formation, both in the Ecca Group, and Quaternary sands

4. IDENTIFICATION OF HERITAGE RESOURCES

4.1 Summary of Findings of Specialist Reports

4.1.1 Archaeology (Appendix 1)

The section of road located within the town was thoroughly surveyed, and seven other accessible areas next to the road were also surveyed on foot. The existing areas that were not as accessible were surveyed twice by car, at a very slow speed.

Due to the limited access, seven road workers and a traffic police officer were asked if they were aware of any graves next to the roadside. Three of them recalled memorial crosses that had been placed on the roadside, but which they have since removed. One of the workers mentioned the graveyard at Matjiesfontein and a smaller one near the Monument River, but both of these fall outside the study area.

The field assessment identified various tree lanes as a valuable socio-cultural resource. As trees also hardly occur naturally in this landscape, they also contribute to the townscape, as well as the sense of place.

4.1.2 Palaeontology (Appendix 2)

The fossil record of geological units present in the current study area - Dwyka Group and Ecca Group (Prince Albert (Pp), Whitehill (Pw), Collingham (Pc), Vischkuil (Pv), Laingsburg (Pl), and Fort Brown (Pf) formations) are summarised in Table 1. The palaeontological heritage in the geological units is based on work conducted by Almond & Pether (2008), Almond 2008a, 2008b, 2010a, 2015a). This section outlines fossil assemblages from the main sedimentary rock units within the study area.

- **Dwyka Group**

The Dwyka Group (C-Pd) interglacial mudrocks occasionally present a low diversity marine fauna of invertebrates (molluscs, starfish, brachiopods, coprolites etc), palaeoniscoid fish, petrified wood, leaves (rare) and palynomorphs of *Glossopteris* Flora. Well-preserved non-marine ichnofauna (traces of fish, arthropods) are also present in laminated mudrocks, with possible stromatolites, oolites at top of succession (Amond & Pether, 2008). Palaeontological impact assessment in the broader area have stated that the Dwyka Group in the area comprises unfossiliferous (e.g. Almond 2016). These deposits have therefore been classified as having a **LOW** level of palaeontological sensitivity.

- **Ecca Group**

Prince Albert Formation (Ppr): The fossil biota of the postglacial mudrocks of the Prince Albert Formation is comprehensively summarised by Cole (2005). Epichnial (bedding plane) trace fossil assemblages of the non-marine *Mermia* Ichnofacies, primarily featuring the ichnogenera *Umfolozia* (arthropod trackways) and *Undichna* (fish swimming trails), are commonly found in the basinal mudrock facies. Limited-simple, horizontal to

oblique endichnial burrows forming dense monospecific ichnoassemblages have been recorded from the Ceres Karoo (Almond, 2010a). These assemblages have been documented by Anderson (1974, 1975, 1976, 1981) and briefly reviewed by Almond (2008a, 2008b, 2010a, 2010b). Diagenetic nodules contain remains of palaeoniscoid (primitive bony fish), sharks, spiral bromalites (coprolites, spiral gut infills attributable to sharks or temnospondyl amphibians), and petrified wood have been found in the Ceres Karoo (Almond 2008b). Rare shark remains (*Dwykaselachus)* are recorded near Prince Albert on the southern margin of the Great Karoo (Oelofsen 1986). Microfossil remains in this formation include sponge spicules, foraminiferal and radiolarian protozoans, acritarchs, and miospores (Mosavel, & Cole, 2019). These deposits have therefore been classified as having a **MODERATE** level of palaeontological sensitivity.

Whitehill Formation (Pw): The Whitehill Formation contains some of the most important fossils including mesosaurid reptiles (*Mesosaurus tenuidens*, and *Stereosternum tumidum*), which are some of the earliest known marine reptiles (Araujo & Oelofsen, 1987). Additionally, rare cephalochordates, various palaeoniscoid fish, (primitive bony fish), and numerous small eocarid/notocarid crustaceans have been documented (Oelofsen, 1987, VIsser, 1992, Evans, 2005). Insects, predominantly found as isolated wings with some complete specimens and trace fossils such as trackways and possible shark coprolites have been documented (Geersema et al., 2002). Organic-walled spores and pollens (palynomorphs), petrified wood from primitive gymnosperms, and other sparse vascular plant remains like *Glossopteris* leaves and lycopods add to the formation's fossil diversity (Almond 2012). Almond (2012) states in his report that although fossils in the Whitehill Formation are generally rare, they are often well-preserved. Grey diagenetic nodules in other areas of the Whitehill outcrop, such as near Prince Albert, have produced well-preserved three-dimensional crustacean fossils. The palaeontological significance of the Whitehill Formation is **HIGH** to **VERY HIGH** and can provide significant fossil material of scientific interest.

Collingham Formation (Pc): The palaeontology of the Collingham Formation has been studied by Viljoen (1992, 1994) and Almond (2008a). The formation has a low diversity, with localised sections of abundant ichnofossils (worm burrows, arthropod trackways), vascular plant remains (petrified and compressed wood, leaves, lycopsids, etc.) (Amond and Pether 2008a). Thicker turbidite beds, particularly in the upper part of the formation, often contain transported, water-logged plant debris and tool marks created by logs. Large blocks of silicified wood have been discovered in the Laingsburg area (Almond 2012). Trace fossil assemblages include horizontal epichnial grooves about 2 cm wide with segmented levees, likely produced by gastropods ("*Scolicia*"), narrow bilobate arthropod furrows ("*Isopodichnus*"), reticulate horizontal burrows (possibly washed out *Megagrapton*-like systems), and densely packed horizontal burrows with a rope-like surface texture covering selected bedding planes (cf *Palaeophycus*) (Anderson (1974). Banching burrows, rare arthropod trackways (*Umfolozia*), and fish swimming trails (*Undichna*) have been recorded (Almond, 2012). A significant discovery from the upper

Collingham Formation near Laingsburg is the trackway of a giant sweep-feeding eurypterid, with fragmentary body fossils of similar animals also found in contemporary South American sediments (Almond 2002). These deposits have therefore been classified as having a **MODERATE** level of palaeontological sensitivity.

Vischkuil Formation (Pv): Rare occurrences of trace fossils may be present in the form of multiple epichnial grooves and horizontal burrows (*Cruziana* and *Nereites*). Trace fossils closely match the descriptions of *Scolicia* and *Isopodichnus* as described by Anderson (1974) in similar facies elsewhere in the basin. The most common are thin horizontal *Scolicia* grooves (1.0–2.0 mm in diameter) which appear as randomly oriented paths with no fixed movement direction. The second most common trace fossils are shallow, wide (up to 1.0 cm) *Isopodichnus* epichnial grooves that occasionally show traction marks and maintain more directional pathways. The abundance of Nereites and the occasional occurrence of Cruziana indicate abyssal plain conditions and support low settling rates and starved periods. hese deposits have therefore been classified as having a **MODERATE** level of palaeontological sensitivity.

Laingsburg Formation (Pl): The Laingsburg FOrmation is not much different to the Vischkuil Formation in terms of Palaeontology. hese deposits have therefore been classified as having a **MODERATE** level of palaeontological sensitivity.

Fort Brown Formation (Pf): Trace fossil assemblages are scarce, however bioturbation level may be locally abundant. Trace fossils assemblages include: horizontal interface burrows and distinctive, transversely-ribbed pellet burrows of an unnamed ichnogenus as well as large *Teichichnus spreiten* burrows, undulose *Undichna*, and *Kouphichnium* (Almond 2016). Other trace assemblages of the *Cruziana* and *Skolithos* ichnofacies are found in the shallower water settings towards the top of the Fort Brown Formation (Kingsley, 1977). Plant fragments, disarticulated palaeoniscoid fish scales and silicified wood are also found in the Fort Brown Formation common in Ecca delta front successions (Bamford 1999, Theron et al. 1991). Isolated tetrapod bones, presumably transported offshore by floods, have been recorded from the Fort Brown Formation in the Eastern Cape (Kingsley 1977, Rubidge & Oelofsen 1981). Some of these may belong to temnospondyl amphibians. These deposits have therefore been classified as having a **MODERATE** level of palaeontological sensitivity (Almond & Pether, 2008a).

4.2 Heritage Resources Identified

In terms of the heritage resources identified in the archaeological field assessment, see Table 2 below and Appendix 1 for full descriptions and images.

Table 2: Artefacts identified during the field assessment development area

POINT ID	Description	Density	Type	Period	Co-ordinates		Grading	Mitigation
1	NG Kerk 4 July 1904, stained glass windows, sandstone, with a lane of trees in front of the structure	n/a	Structure	Early 20th C	-33.196276	20.858121	Currently graded as Grade II on SAHRIS as it was an Old National Monument	No impact anticipated
2	NG Church Stephanus Greeff Saal, 23 July 1955	n/a	Structure	Mid 20th C	-33.196648	20.8570631	IIIc	No impact anticipated
3	Ox wagon monument 1838, different battles on one side of the monument, Voortrekker/ Boer Leaders on the other side	n/a	Monument	No date visible	-33.195586	20.8522349	IIIc	No impact anticipated
5	Possible raw lithic material source	Outcrop	Archaeological	Stone Age	-33.189945	20.8280544	IIIc	No impact anticipated
7	Klipwerf farmhouse with surrounding infrastructure	n/a	Structure	Historical	-33.188730	20.8187030	IIIc	No impact anticipated
9	Liebenhof farm entrance with tree lane	n/a	Structure	Unclear	-33.184289	20.8049497	IIIc	No impact anticipated
10	Liebenhof farm werf	n/a	Structure	Historical	-33.188328	20.8037503	IIIc	No impact anticipated

4.3 Mapping and Spatialisation of Heritage Resources

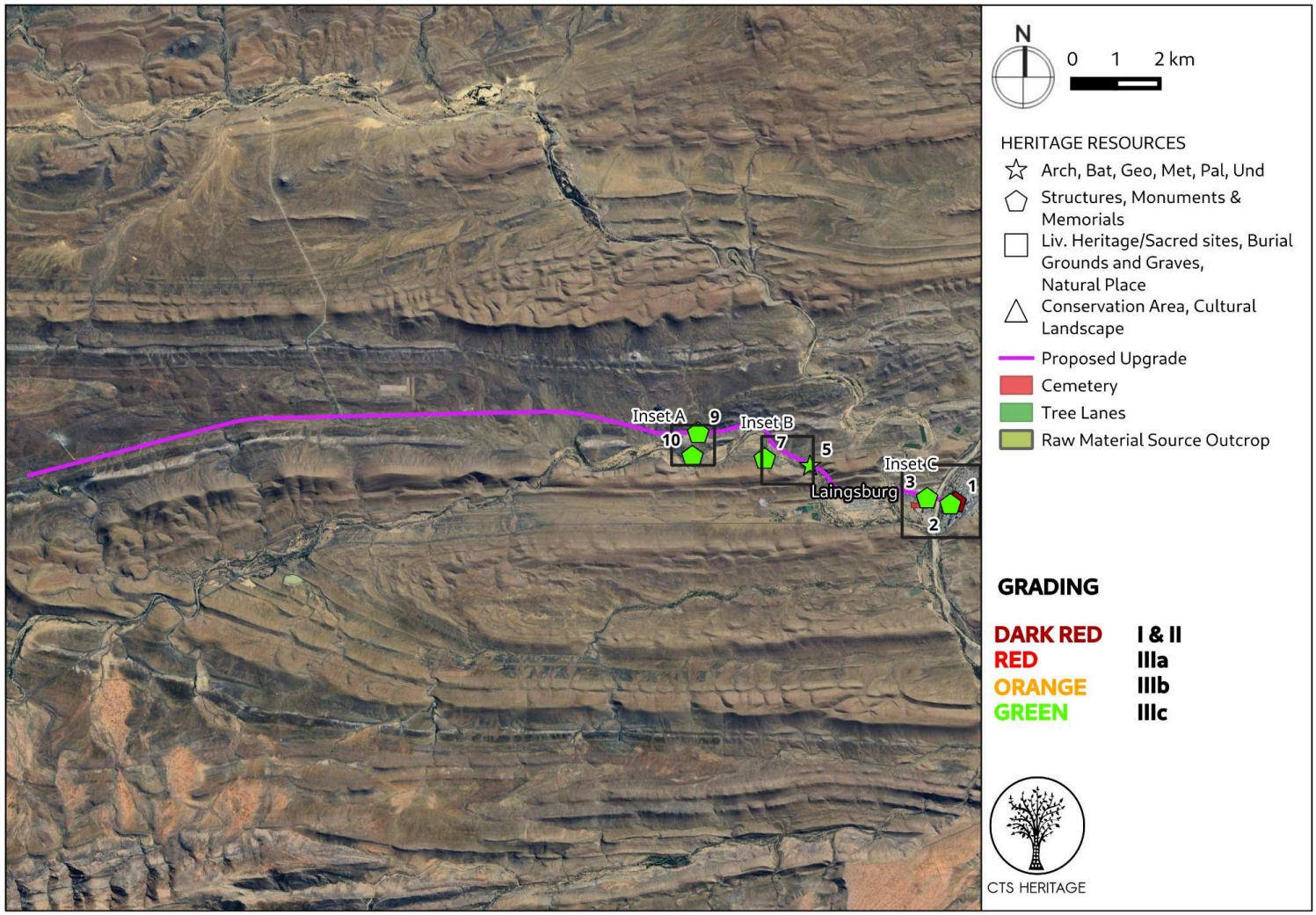

Figure 5.1: All heritage resources within proximity to the development area

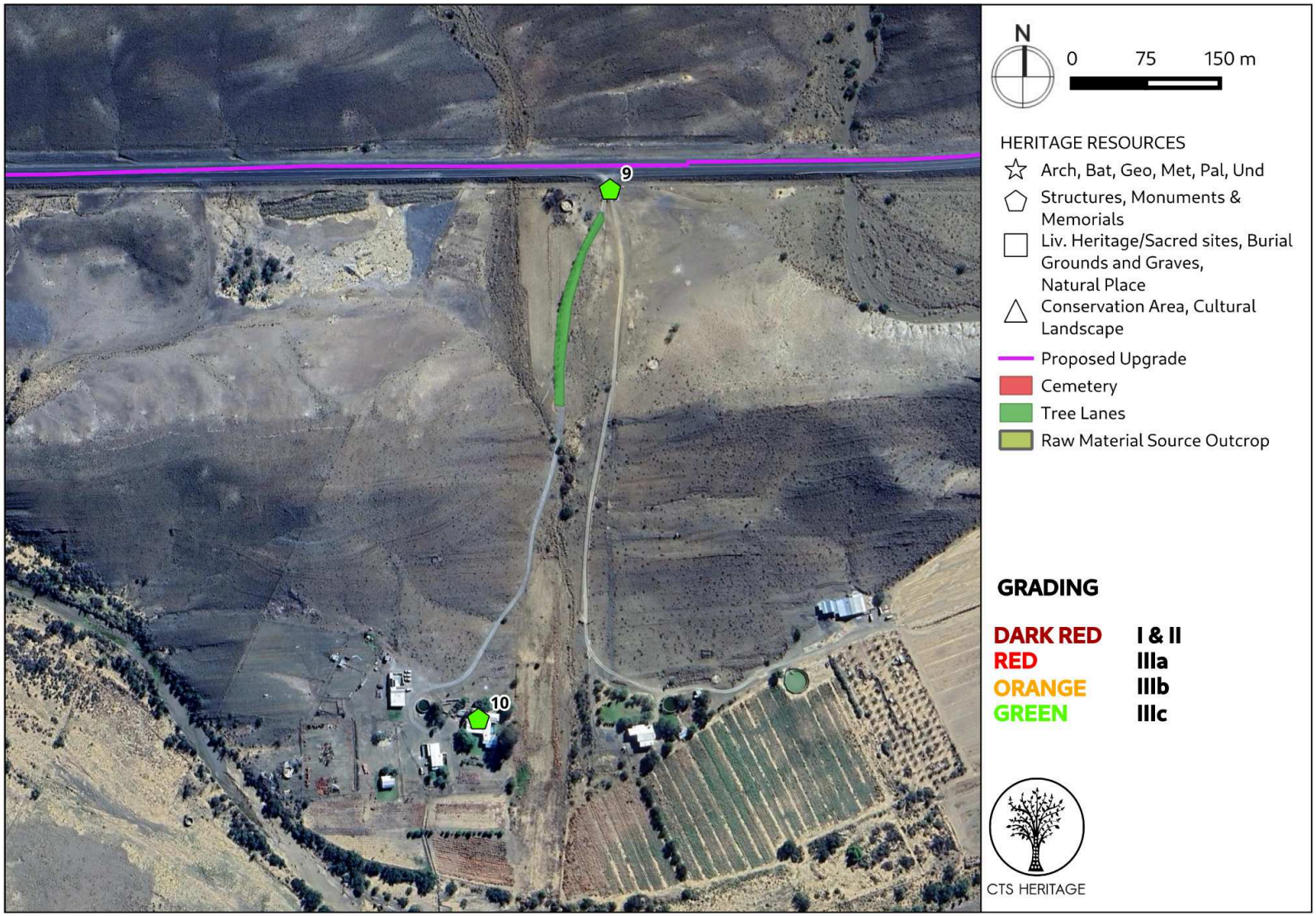

Figure 5.2: Inset Map A of all sites and observations noted within the development area as well as proposed mitigation measures

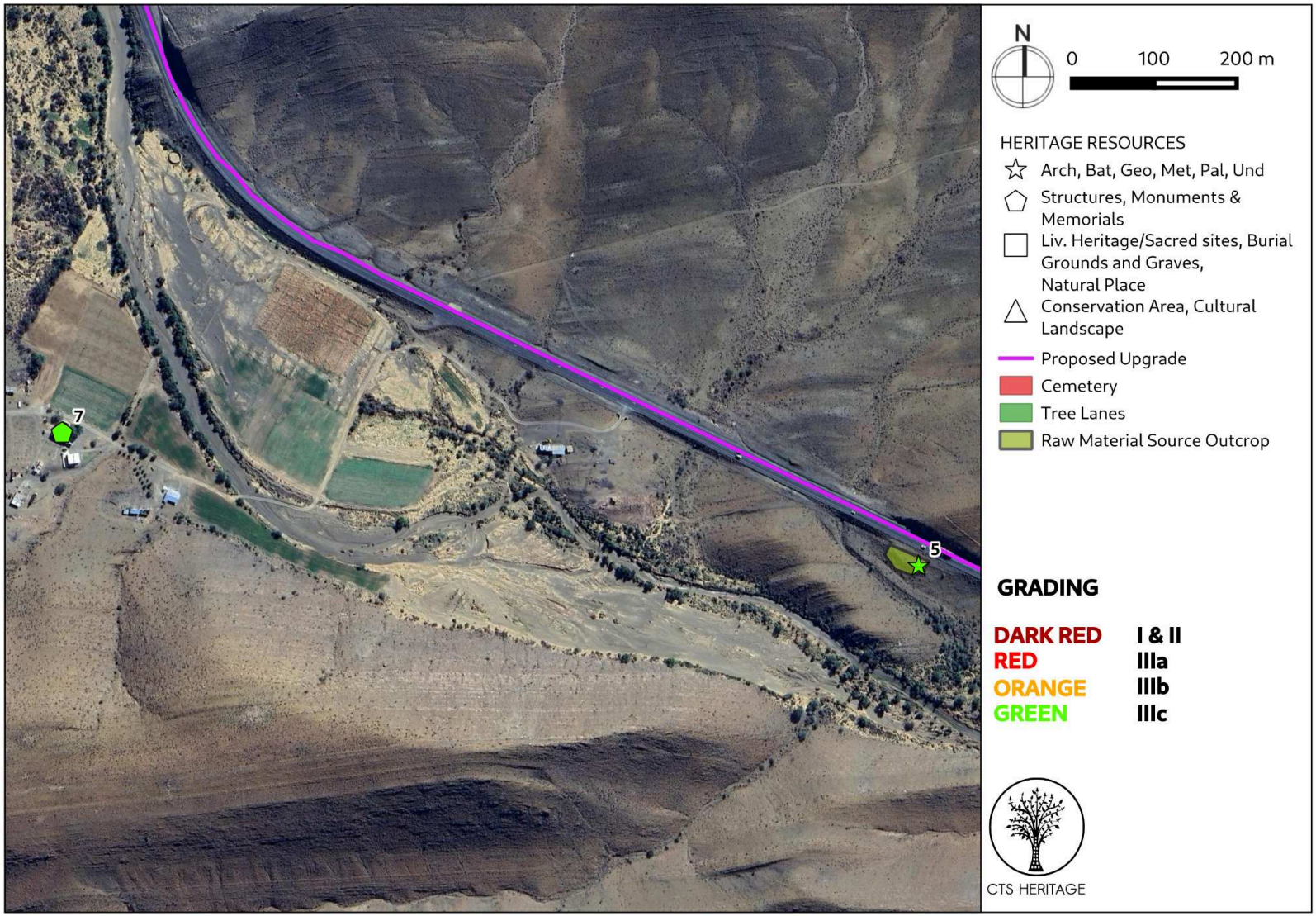

Figure 5.3: Inset Map B of all sites and observations noted within the development area as well as proposed mitigation measures

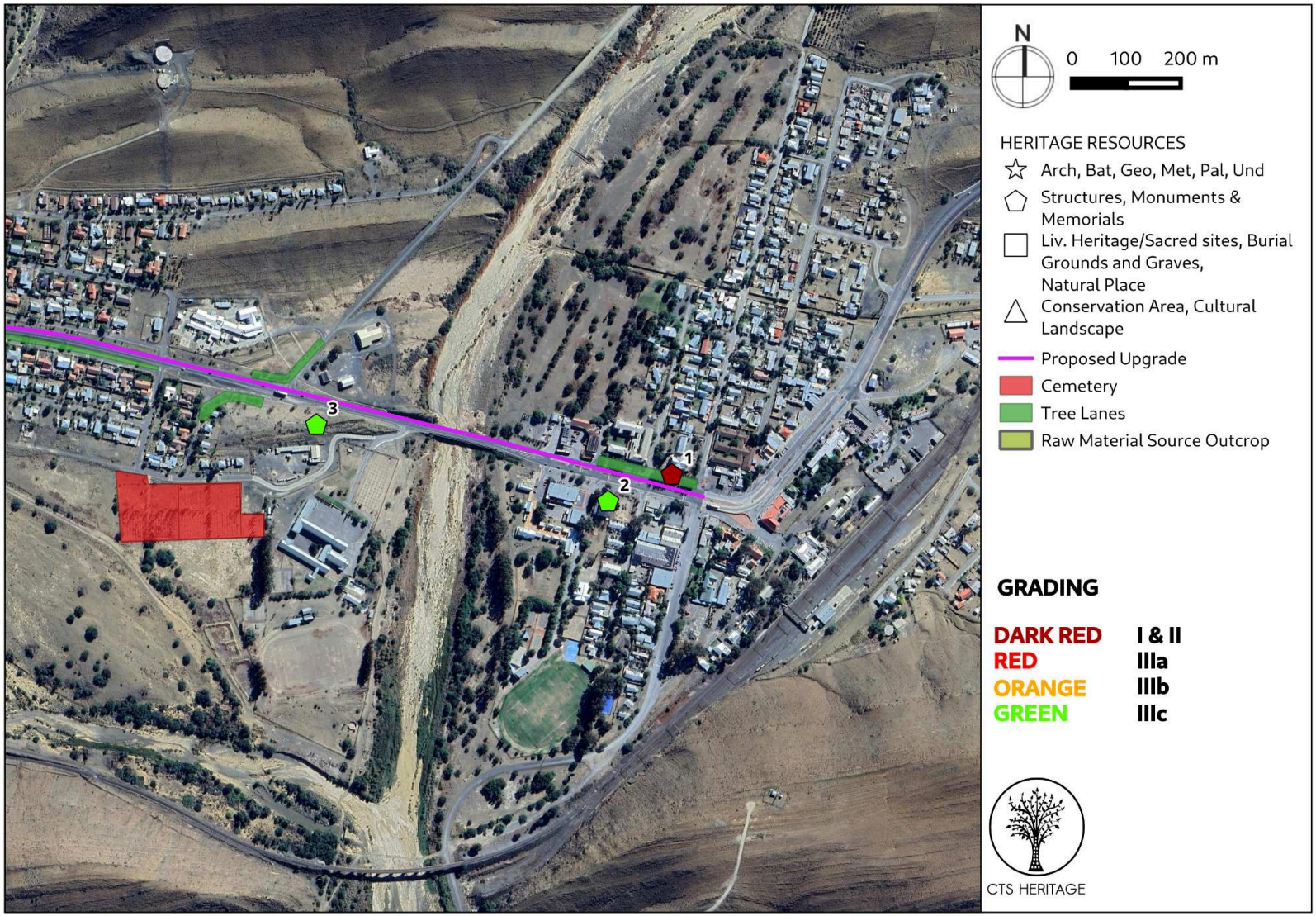

Figure 5.4: Inset Map C of all sites and observations noted within the development area as well as proposed mitigation measures

5. ASSESSMENT OF THE IMPACT OF THE DEVELOPMENT

5.1 Assessment of Impact to Heritage Resources

5.1.1 Cultural Landscape and VIA

In 2020, CTS Heritage conducted an HIA less than 13km southwest of the proposed development (SAHRIS NID 27482). They identified the N1 as a scenic route, and based on the historical map, it follows along the historical route connecting Laingsburg to the Cape (Figure 3.5). The key aspects of the cultural landscape resources that are known from the area include the N1 scenic route, and the surrounding Moordenaars Karoo, which CTS Heritage (2020) describes as "*The lower Matjiesfontein valley is covered with dull Karoo bossies well under 1m in height and subtle landforms including hidden depressions and hillocks. The Witteberg mountains rise steeply to the east.*"

As the proposed development constitutes an upgrade to the existing N1 alignment, it is unlikely that any significant cultural landscape resources will be negatively impacted by the proposed upgrade.

5.1.2 Archaeology

16 observations were made during the field survey, of which one is currently graded on SAHRIS as Grade II as it is an old National Monument, six are Grade IIIc, and the other 9 are not conservation worthy (NCW). The old National Monument which is currently graded as Grade II on SAHRIS, as discussed in section 3.2 Cultural Landscape, Built Landscape and Historical Background, the Dutch Reformed Church, Voortrekker Street, Laingsburg (SAHRIS ID 28191) had been mismapped on SAHRIS. Its location was confirmed during the assessment (Obs 1). No impact to this old National Monument is anticipated to result from the proposed road upgrade. Should any impact take place, it is recommended that a section 27(18) permit application be made to HWC to address any changes to this site.

The location of the Dutch Reformed Church has been mapped incorrectly on SAHRIS. Rather, this location is actually the site of a Voortrekker Monument/ Plinth sculpture commemorating some of the Voortrekker leaders and the battles in which they fought (Obs 3). Another structure in town that holds socio-cultural significance is the church hall, constructed in 1955 (Obs 2). In the Laingsburg Rural area, two other farm werfs were identified and based on the first edition Topo map, both have historical value (Obs 7 and 10). Three farmwerf entrances were observed (Obs 4, 9 and 14), as well as two entrances to quarry mines (Obs 12 and 16).

The remaining conservation-worthy resources have been graded as IIIc. Most of these resources fall outside the road reserve and will not be impacted by the proposed upgrades. However, there are several lanes of trees that have been identified that contribute to the cultural landscape of the town. These trees have also been graded as IIIc, and impact to these tree avenues should be avoided. If this is not possible, new mature tree lanes should be

planted once the upgrades are finished. Examples of the existing tree lanes are the pine trees in front of the church and Schinus molle trees (Pepper trees) near the entrance of the town.

An additional tree lane for which the same recommendations apply is identified at Observation 9. The Liebenhof farm entrance itself is not conservation-worthy, however, the tree lane starting at the entrance and leading up to the farm werf is. Impact to this tree avenue on them should be avoided. If this is not possible, a new mature tree lane should be planted once the upgrades are finished.

One possible raw lithic source was identified (Obs 5), which was also graded as IIIc. A single lithic (Obs 6), exposed pipes (Obs 8) and a historical culvert which had been integrated into a modern culvert were also observed, and have no conservation value.

One of the roadside memorials mentioned by the roadworkers was noted, but this site falls outside of the road reserve. No graves or rock art sites were identified during the fieldwork within the road reserve. The graveyard identified during the desktop background screener phase is more than 200m away from the proposed upgrades, as well as being separated from the N1 by the Bergsig neighbourhood, and no impact is anticipated.

Table 4.1 Impacts of the proposed development to archaeological resources

NATURE: The construction phase of the project will require excavation, which may impact on archaeological heritage resources if present.				
		Without Mitigation		**With Mitigation**
MAGNITUDE	**M (3)**	No archaeological heritage resources of significance were identified within the development footprint, however some were identified within the broader development area	**L (1)**	No archaeological heritage resources of significance were identified within the development footprint, however some were identified within the broader development area
DURATION	**H (5)**	Where an impact to a resource occurs, the impact will be permanent.	**H (5)**	Where an impact to resources occurs, the impact will be permanent.
EXTENT	**L (1)**	Localised within the site boundary	**L (1)**	Since only the possible fossils within the area would be microscopic blue-green algae in some stromatolites, the spatial scale will be localised within the site boundary.
PROBABILITY	**M (3)**	It is possible that significant heritage resources will be impacted if the layout provided is followed	**L (1)**	It is unlikely that significant heritage resources will be impacted if the layout provided is followed
SIGNIFICANCE	**L**	(3+5+1)x3=24	**L**	(1+5+1)x1=7
STATUS		Neutral		Neutral
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?	**M**	Possible	**L**	Unlikely
CAN IMPACTS BE MITIGATED		Yes		Yes

MITIGATION: - Impact to the tree lanes, identified in Figure 8.1-8.4 should be avoided. If this is not possible, these tree lanes should be replaced with mature trees once the upgrades are completed. - 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.
RESIDUAL RISK: Should any significant resources be impacted (however unlikely) residual impacts may occur, including a negative impact due to the loss of potentially scientific cultural resources.

5.1.3 Palaeontology

Previous studies (desktop and field studies) reveal that the area proposed for the N1 upgrade, between Doornfontein and Laingsburg, is underlain by sedimentary rock formations ranging from the Early to MIddle Palaeozoic eras. These formations, particularly from the Dwyka and Ecca Groups, contain variable degrees of fossils of importance, particularly those of the Whitehill Formation.

Sediments of Dwyka Group and Lower to Middle Ecca Group bedrocks are extensively tectonically deformed and weathered in the area. These rocks are exposed along the N1, and have been extensively studied for their fossil content, as indicated by the various authors used in this report. The Dwyka Group constitutes most of the project area and has yielded a low-diversity trace fossil assemblages which are of limited scientific interest. The Ecca Group sediments, constitutes a more local area and are known to yield a moderate level of diverse fossils, particularly trace fossils, which are not of utmost scientific importance. A small section of the Ecca Group - the Whitehill Formation is exposed along the N1 towards the town of Laingsburg. This is very local and does not cover a large area, the potential for providing significant-scientific fossils is unlikely but not completely excluded. It should be noted that this formation has yielded scientifically interesting fossils like the mesosaurus.

The potential impact of the proposed N1 upgrade on local fossil heritage resources is primarily confined to the construction phase. The destruction, damage, or disturbance of fossils during construction could result in direct negative impacts on palaeontological heritage resources within the development footprint. Although these impacts can often be mitigated, they cannot be fully rectified and are therefore considered permanent.

Given that the sedimentary formations within the study area contain/potentially contain fossils, the impact on fossil heritage is definite. However, most of the fossils in question are likely to be of widespread occurrence within the outcrop areas of the formations, suggesting a low likelihood of losing unique or rare fossil heritage. Due to the generally sparse occurrence of scientifically important, well-preserved, unique, or rare fossil material within the majority of the bedrock formations, the severity of these impacts is rated as moderate.

No to minimal significant further impacts on fossil heritage are anticipated during the planning, operational, and decommissioning phases. Provided that the proposed recommendations for palaeontological monitoring and

mitigation are followed, there are no objections on palaeontological heritage grounds to the authorization of the N1 upgrade project. However, due to the absence of a field assessment of the study area, confidence levels for this palaeontological heritage assessment are only moderate. These conclusions are supported by previous palaeontological field assessments undertaken in the broader study region, which indicate that the overall impact significance of proposed developments is low, with a slight probability of significant impacts on unique or rare fossils, particularly in the Whitehill Formation.

Table 4.2: Impacts of the proposed development of the PV facilities to palaeontological resources

NATURE: The construction phase of the project will require excavation, which may impact on palaeontological heritage resources if present.				
		Without Mitigation		**With Mitigation**
MAGNITUDE	**H (8)**	The area proposed for development is underlain by sediments of very high palaeontological sensitivity although no specific areas for exclusion have been identified within the development footprint	**H (8)**	The area proposed for development is underlain by sediments of very high palaeontological sensitivity although no specific areas for exclusion have been identified within the development footprint
DURATION	**H (5)**	Where an impact to resources occurs, the impact will be permanent.	**H (5)**	Where an impact to resources occurs, the impact will be permanent.
EXTENT	**L (1)**	Localised within the site boundary	**L (1)**	Since only the possible fossils within the area would be microscopic blue-green algae in some stromatolites, the spatial scale will be localised within the site boundary.
PROBABILITY	**H (4)**	The potential impact to fossil heritage resources is high	**L (1)**	The potential impact to fossil heritage resources is low
SIGNIFICANCE	**H**	(8+5+1)x4=56	**L**	(8+5+1)x1=14
STATUS		Negative		Positive
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?	**H**	Possible	**H**	Possible
CAN IMPACTS BE MITIGATED		Yes		Yes
MITIGATION: - A palaeontologist must be present during all construction and excavation activities in the Whitehill Formation. This is particularly important near the rock outcrop closest to Laingsburg. - The attached Chance Fossil Finds Procedure must be implemented				
RESIDUAL RISK: Should any significant resources be impacted (however unlikely) residual impacts may occur, including a negative impact due to the loss of potentially scientific cultural resources.				

5.2 Sustainable Social and Economic Benefit

Socio-economic benefits that are likely to result from this development include:

- Enhances regional connectivity.
- Reduces travel times and improves road safety.
- Boosts tourism and supports local businesses by facilitating easier access.
- Creates temporary employment opportunities during the construction phase.
- Provides a financial injection into the local economy.
- Improves livelihoods for local residents

Based on the outcomes of this heritage assessment, the anticipated socio-economic benefits to be derived from the project outweigh any anticipated negative impacts to heritage resources.

5.3 Proposed Development Alternatives

No alternative layouts have been assessed as part of this project, however the entire assessment area was surveyed for impacts to heritage resources. The layout provided is unlikely to negatively impact on significant heritage resources and as such, no alternatives are proposed from a heritage perspective on condition that the recommendations made below are implemented.

5.4 Site Verification Statement

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

- The cultural value of the broader area has some significance in terms of its historic tree avenues which may be impacted (MODERATE)
- No significant archaeological resources were identified within the development footprint although very significant archaeological resources were identified within the broader area (MODERATE)
- No highly significant palaeontological resources were identified within the development area, however the geology underlying the development area is very sensitive for impacts to significant fossils (MODERATE)

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

5.5 Cumulative Impacts

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

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

In terms of cumulative impacts to heritage resources, impacts to archaeological and palaeontological resources are sufficiently dealt with on a case by case basis. The primary concern from a cumulative impact perspective would be to the cultural landscape. The cultural landscape is defined as the interaction between people and the places that they have occupied and impacted. In some places in South Africa, the cultural landscape can be more than 1 million years old where we find evidence of Early Stone Age archaeology (up to 2 million years old), Middle Stone Age archaeology (up to 200 000 years old), Later Stone Age archaeology (up to 20 000 years old), evidence of indigenous herder populations (up to 2000 years old) as well as evidence of colonial frontier settlement (up to 300 years old) and more recent agricultural layers.

As the proposed development constitutes an upgrade to an existing road alignment, the proposed development is unlikely to result in unacceptable risk or loss, nor will the proposed development result in a complete change to the sense of place of the area or result in an unacceptable increase in impact. The landscape within which the proposed project areas are located, is not worthy of formal protection as a heritage resource and has the capacity to accommodate such a development from a heritage perspective.

6. RESULTS OF PUBLIC CONSULTATION

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

There is one registered conservation body that has declared an interest in the area to be impacted. As such, the Simon van der Stel Foundation and the Laingsburg Local Authority have been provided with 30 days in which to comment on this HIA. Evidence of this consultation is provided in Appendix 4.

7. CONCLUSION

During the field assessment, 8 conservation-worthy heritage resources were identified. They include 2 historical plaaswerfs, the tree lane leading up to one of the farm werfs, as well as the tree lanes in the town, one raw material source for lithics, a Voortrekker Monument, and the two church buildings in Laingsburg. Most of these will not be impacted upon by the proposed upgrades as they fall outside the road reserve.

The tree lanes have been identified as a cultural landscape element that contributes to the experience of the landscape. Mature trees are rare in the broader landscape and are therefore a defining feature of towns in the Karoo. It therefore contributes to the townscape as well as a sense of place, and impact on these trees should be avoided. If impact cannot be avoided, mature trees should be planted alongside the upgraded road. Current trees that exist in the town include pine trees in front of the church, Schinus molle trees (Pepper trees) near the entrance of the town, poplar trees in the cemetery, and bluegum groves.

The proposed upgrade of National Route 1 (N1) Section 4 between Doornfontein and Laingsburg traverses an area underlain by geological and palaeontological significant formations, notably the Dwyka and Ecca Groups. The palaeontological sensitivity of these formations varies, with the Ecca Group, particularly the Whitehill Formation, being known for its significant fossil content, including mesosaurid reptiles and various trace fossils.

The Dwyka Group is characterised by low-diversity trace fossils and generally exhibits low palaeontological sensitivity. In contrast, the Ecca Group formations, especially the Whitehill Formation, have yielded important fossil material, including well-preserved mesosaurid reptiles, trace fossils, and various microfossils. This formation is of high palaeontological significance. The primary impact on fossil heritage will occur during the construction phase due to potential destruction, damage, or disturbance of fossils. However, given the sparse occurrence of scientifically significant fossils in most of the bedrock formations, the overall severity of impacts is considered moderate. However, the presence of the existing N1 road infrastructure is expected to reduce the likelihood of

significant fossil impact, though the confidence in this assessment remains moderate due to the absence of field assessments.

To mitigate these impacts, it is recommended that during excavation or rock removal activities beyond the current road and marginal boundaries, a palaeontologist must be present during all construction and excavation activities in the Whitehill Formation. This is particularly important near the rock outcrop closest to Laingsburg. The HWC Chance Fossil Finds Protocol must be integrated into the Environmental Management Programme (EMPr).

By adhering to these recommendations, the proposed N1 upgrade can proceed with minimised impact on palaeontological resources.

8. RECOMMENDATIONS

- Impact to the tree lanes, identified in Figure 8.1-8.4 should be avoided. If this is not possible, these tree lanes should be replaced with mature trees once the upgrades are completed.
- A palaeontologist must be present during all construction and excavation activities in the Whitehill Formation. This is particularly important near the rock outcrop closest to Laingsburg.
- The HWC Chance Fossil Finds Protocol must be integrated into the Environmental Management Programme (EMPr).
- 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	**Report Type**	**Author/s**	**Date**	**Title**
27482	HIA Phase 1	CTS Heritage	10/2020	HIA: Proposed SANSA Space Operations at portion 8 of Farm Matjiesfontein Western Cape
27706	HIA	CTS Heritage	22/10/2021	NUProposed establishment of 132kV powerline to evacuate power from the Karreebosch WEF to the National Grid in the Western and Northern CapeLL
53187	HIA Phase 1	Timothy Hart, Lita Webley	01/03/2011	HERITAGE IMPACT ASSESSMENT PROPOSED WIND ENERGY FACILITY
138341	**Heritage Specialist Report**	**Tim Hart, Lita Webley**	**31/03/2011**	**Roggeveld PROPOSED WIND ENERGY FACILITY**
155976	HIA Phase 3	CTS Heritage	11/05/2020	ARCHAEOLOGICAL and PALAEONTOLOGICAL WALKDOWN REPORT for the final layout for the proposed 86MW Oya Wind Energy Facility and associated infrastructure, between Matjiesfontein and Sutherland in the Western and Northern Cape Provinces
186695	HIA Phase 1	McEdward Murimbika	01/08/2014	Proposed Gamma-Kappa 2nd 765kV Eskom Transmission Powerline and Substations Upgrade Development in Western Cape PHASE 1 HERITAGE IMPACT ASSESSMENT STUDY REPORT
186697	AIA Desktop	Foreman Bandama, Shadreck Chirikure	01/08/2014	An Archaeological Scoping and Assessment report for the proposed Gamma (Victoria West, Northern Cape) - Kappa (Ceres â€“ Western Cape) 765Kv (2) Eskom power transmission line
186698	PIA Desktop	JF Durand	09/06/2013	GAMMA-KAPPA 765kV Transmission Line, Western Cape Province Scoping Report Palaeontology
186703	Visual Impact Assessment		01/01/2014	The Proposed Gamma Kappa 2nd 765KV Transmission Powerline And Substations Upgrade, Northern And Western Cape (NEAS Reference DEA/EIA/0001267/2012 DEA Reference14/12/16/3/3/2/353) Visual Impact Assessment
329667	**Heritage Statement**	**Peter Nilssen**	**18/04/2012**	**Proposed Upgrade of the Laingsburg Water Supply Pipeline,Laingsburg, Western Cape Province**
329795	HIA	Quahnita Samie	29/08/2012	Heritage Impact Assessment Worcester-Cape Winelands District Municipality, Western Cape
337370	PIA Phase 1	Duncan Miller	01/03/2011	Palaeontological Impact Assessment Proposed Roggeveld Wind Energy Facility
356318		Mariagrazia Galimberti, Kyla Bluff, Nicholas Wiltshire	01/02/2016	Heritage Screener CTS15_015a EOH Rietkloof Wind Energy Facility
503543	**NID and HIA**	**Stéfan De Kock, Kathleen Schulz**	**31/012011**	**Proposed Urban Formalisation And Infill Development: Matjesfontein 148/9 & Erven 17, 18, 50 (Matjiesfontein), Laingsburg District**

514783	HIA Phase 1	Tim Hart	14/11/2018	Proposed Witberg Wind Energy Facility Amendment 2018 Supplementary assessment of the proposed amendments.
521829	HIA Phase 1	Tim Hart	19/03/2019	Witberg WEF Amendment
523283	HIA Phase 1	Tim Hart	03/05/2019	Proposed Witberg Wind Energy Facility Amendment 2018 Supplementary assessment of the proposed amendments. (Assessment conducted under Section 38 (8) of the National Heritage Resources Act (No. 25 of 1999) as part of an EIA)
	HIA	CTS Heritage	May 2020	Borrow Pits to be used for the Upgrade of the N1 between Monument River and Doornfontein

Additional references

Raper, P.E., Moller, L.A. and Plessis, T. (2018) Dictionary of Southern African Place Names. Jeppestown: Jonathan Ball.

APPENDICES

APPENDIX 1: Archaeological Assessment (2024)

ARCHAEOLOGICAL SPECIALIST STUDY

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

Proposed upgrade of National Route 1 Section 4 between Doornfontein (KM 63.0) and Laingsburg (KM 81.7), two bridges and eighty-six minor culverts, eight major culverts in the Western Cape Province, Central Karoo District Municipality at Laingsburg Local Municipality

Prepared by

CTS HERITAGE

Jenna Lavin
Mabeth Crafford

In Association with

Earthlink

July 2024

CTS HERITAGE

EXECUTIVE SUMMARY

This project is situated on National Road 1 section 4 between Doornfontein. (km 63.0) and Laingsburg (km 81.7) for upgrading the existing carriageway capacity.

During the field assessment, eight conservation-worthy heritage resources were identified. They include two historical plaaswerfs, the tree lane leading up to one of the farm werfs, as well as the tree lanes in the town, one raw material source for lithics, a Voortrekker Monument, and the two church buildings in Laingsburg. Most of these will not be impacted upon by the proposed upgrades as they fall outside the road reserve.

The tree lanes have been identified as a cultural landscape element that contributes to the experience of the landscape. Mature trees are rare in the broader landscape and are therefore a defining feature of towns in the Karoo. It therefore contributes to the townscape as well as a sense of place, and impact on these trees should be avoided. If impact cannot be avoided, mature trees should be planted alongside the upgraded road. Current trees that exist in the town include pine trees in front of the church, Schinus molle trees (Pepper trees) near the entrance of the town, poplar trees in the cemetery, and bluegum groves.

Recommendations

- Impact to the tree lanes, identified in Figure 8.1-8.4 should be avoided. If this is not possible, these tree lanes should be replaced with mature trees once the upgrades are completed.
- 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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1. INTRODUCTION

1.1 Background Information on Project

This project is situated on National Road 1 section 4 between Doornfontein. (km 63.0) and Laingsburg (km 81.7) for upgrading the existing carriageway capacity.

The major aspects of this project include the following:

- Asphalt Surfacing with Crushed stone base with a partial in situ reconstructed sub-base for the section between km 63.0 and km 80.0,
- Asphalt surfacing with an asphalt base, with a cement stabilised sub-base for the section between km 80.0 and km 81.7,
- New geometry for Section 1: Rural (km 63.0 – km 76.7): Dual carriageway
    - Each carriageway cross section will comprise 2 x 3.7 lanes, 1m inside surfaced shoulder and 2.5m outside surfaced shoulder with an 8.6m median.
- New geometry for Section 2: "Pass" (km 76.7 – km 79.9): 4-lane configuration
    - The cross-section will comprise of 1 x 3.5m fast lane, 1 x 3.7 slow lane and a 2.5m surfaced shoulder per direction with a 2.8m median with concrete barrier.
- New geometry for Section 3: Laingsburg Town (km 80.2 – km 81.4): 4-lane configuration (reduced outside shoulders.)
    - The cross-section will comprise of 1 x 3.4m fast lane, 1 x 3.6 slow lane and a 0.5m surfaced shoulder per direction with a 2m kerbed median for pedestrian refuge when crossing the N1.
    - With 4 prominent intersections between km 80.5 and km 81.3 (length of 800m), this option will be the preferred option for the town section. The extra lane on each side will also provide shared turning and passing lanes at intersections, which at present is currently non-existent.
- The existing horizontal alignment will be retained except for the following proposed areas:
    - Rural section: The new carriageway is proposed to be constructed on the left-hand side due to river streams next to the existing right-hand side carriageway.
    - "Pass" section: A possible horizontal re-alignment option is proposed on the LHS to prevent the fill batter going into the river on the RHS or to construct a fill retaining wall on the riverside.
    - Town section: With the new proposed Buffels River bridge, there will be a horizontal re-alignment between km 81.160 t0 km 81.480 tie-in opposite sides of the bridge to a 4-lane configuration with 2.0 median and dual carriageway with 5.5m median.
- The existing vertical alignment in the "pass" and town section will be retained.
    - A cross fall of 2.5% will be used over sections where the vertical grades are less than 0.5%.
- The horizontal and vertical alignment is to adhere to the following design speeds:
    - Section 1: Rural (km 63.0 – km 76.7) – 120km/h,
    - Section 2: "Pass" section (km 76.7 – km 79.6) – 80km/h,
    - Section 3: Laingsburg Town (km 79.6 – km 81.7) – 60km/h
- The pavement strategy is as follows:
    - Section 1 & 2 (km 63.0 to km 79.9): The pavement will be rehabilitated,
    - Section 3 (km 79.9 to km 81.7): The pavement will be reconstructed full depth,

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    - A new pavement structure will be constructed for any re-alignment and widening sections.
- There are eighty-six minor culverts along the road. In most instances, the culverts are in need of some form of repair
    - Many culverts need to be upgraded to larger box culverts or larger diameter pipes,
    - It is recommended that all culverts are replaced to have a minimum diameter of 900mm in order to ease the maintenance function.
- The two major bridges in town will require a vertical upgrade together with widening
- There are a total of eight (8) major culverts on the road
    - The structures are in a relatively good condition, with some rehabilitation works required
- Only 2 of the 8 major culverts is envisaged to be upgraded hydraulically to meet the current design standards and guidelines
- The remaining 6 culverts will simply be extended to cater for the new proposed road prism width
- The following can be highlighted in terms of the safety/accident analysis
    - A large number of the statistics show the accidents as occurring due to driver negligence, loss of control or unknown causes.
    - This could also be due to the corridor traffic having a high truck composition with drivers being impatient along sections with only one lane per direction,
    - As a safety element, the current one lane per direction on this section was noted as leading to unsafe behaviour due to driver frustration behind the high truck traffic on the corridor,
    - This means that the construction of a 2 + 1 Configuration, 4 lane configurations through the “Pass” section and Town section will hopefully reduce the most significant accident types
- The road signs, road markings and guardrails are generally in a good condition
- The fencing is in a poor condition
- Due to the upgrading of the road which will include, amongst others, a new cross-section and possible re-alignment, it is proposed that all road furniture be replaced
- A number of utility services will be affected by the upgrade of the road:
    - Laingsburg Municipality (stormwater and sewer),
    - Eskom,
    - Vodacom (part of Neotel)
    - Cell C (part of Neotel)
    - MTN (part of Neotel)
    - Neotel
    - Telkom
- It is expected that additional land will be required to accommodate the widening of the roadway in deep cuts and high fills, in Laingsburg town and at some bridge structures.
- Land will also be required for the following:
    - New major intersections,
    - New minor intersections,

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- New access/ frontage roads,
- New or expanded borrow pits,
- New law enforcement areas

Additional construction material will be required for the rehabilitation of the existing carriageway and the construction of the new widened cross-section.

1.2 Description of Property and Affected Environment

The study area consists of 18km of road, with the eastern end ending in the town of Laingsburg. Approximately 2.7km of the 18km is located within the town of Laingsburg, specifically along the southern edge of the historical core of Laingsburg and the Bergsig neighbourhood. The section of the road to be upgraded continues west through a short pass that cuts through bedrock. Some parts of this area are surrounded on both sides by bedrock cliffs that had been created when the road cut through these slight koppies. The southern side of this area also has steep hillsides that slope down to the Bobbejaansrivier.

The rest of the study area falls within the rural Laingsburg area in the Great Karoo. The area has two quarries, two farm werfs, and a collection of new fibre manholes that have been installed next to the road. The whole road has multiple culverts that cross over small streams.

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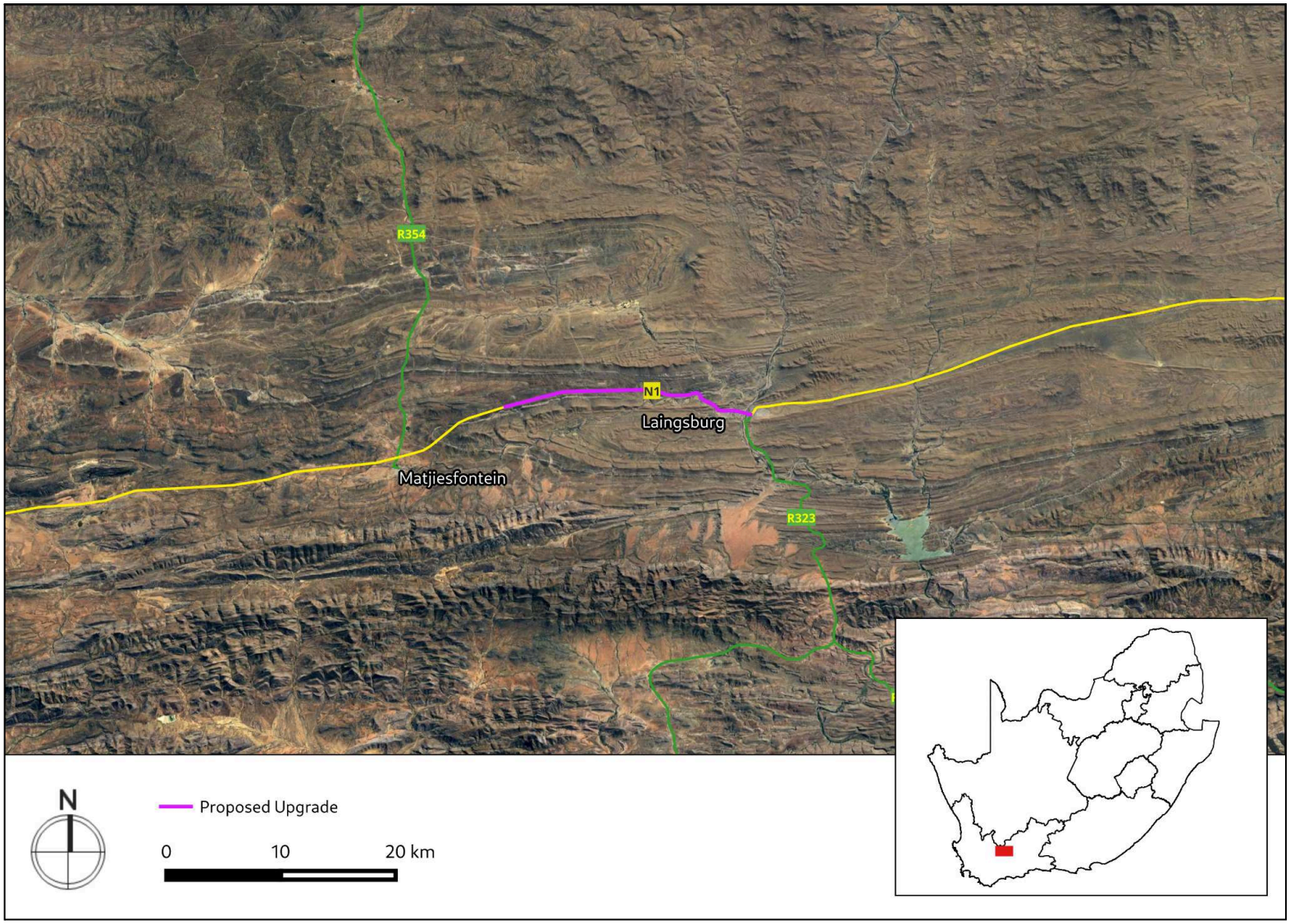

Figure 1.1: Satellite image indicating proposed location of development

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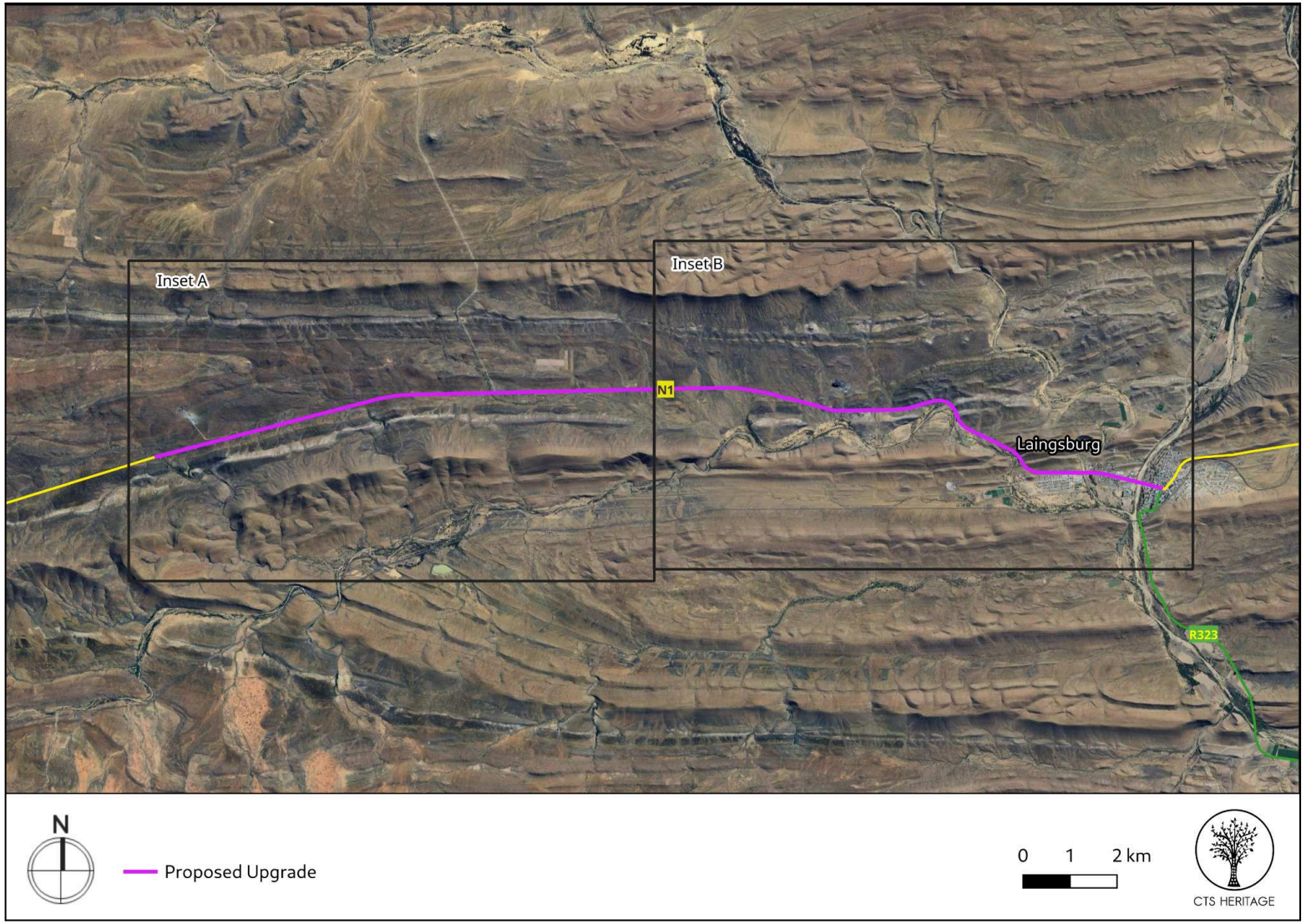

Figure 1.2 Overview Map. Satellite image (2024) indicating the proposed development area at closer range.

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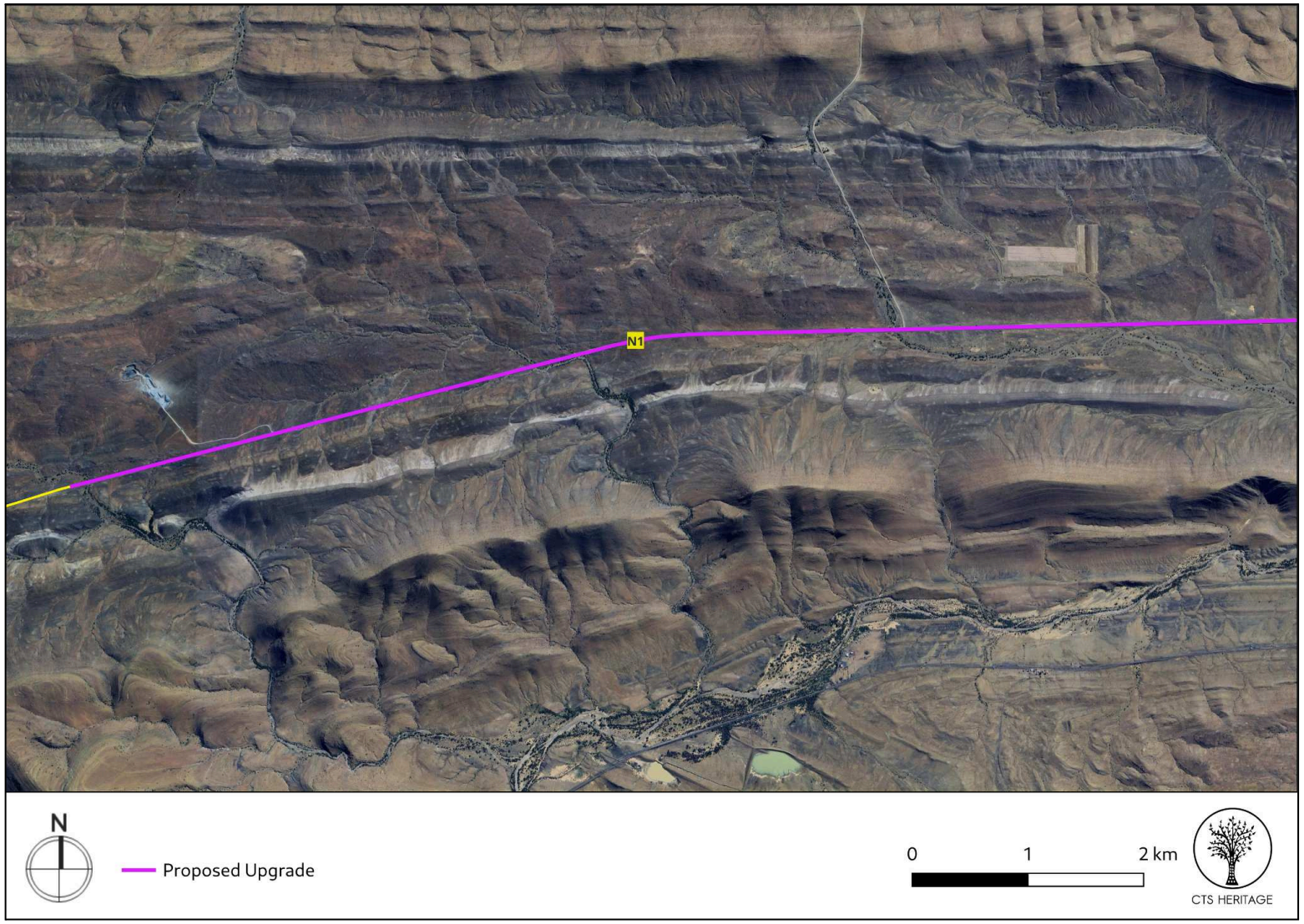

Figure 1.3 Overview Inset Map A. Satellite image (2024) indicating the proposed development at closer range.

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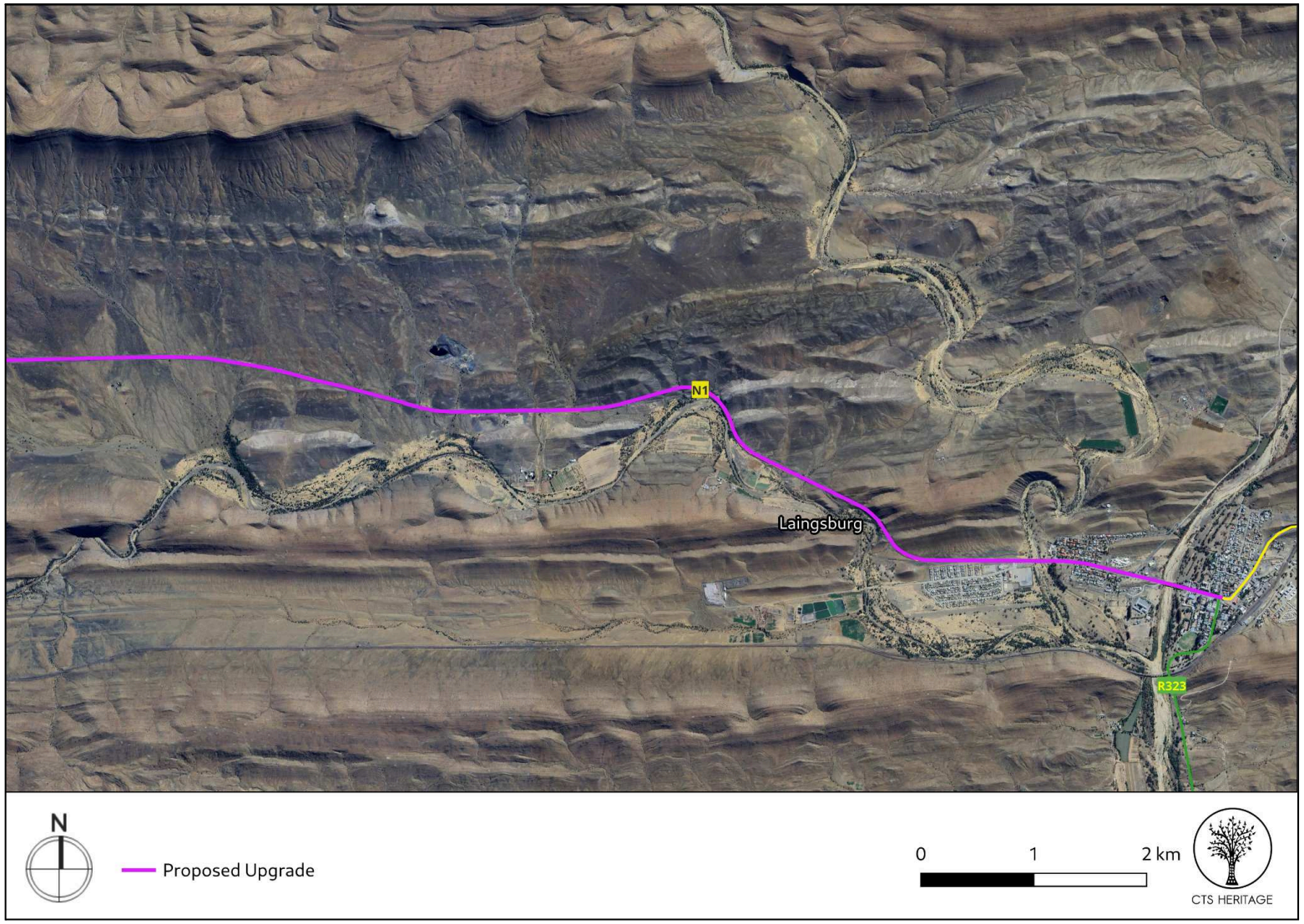

Figure 1.4 Overview Inset Map B. Satellite image (2024) indicating the proposed development at closer range.

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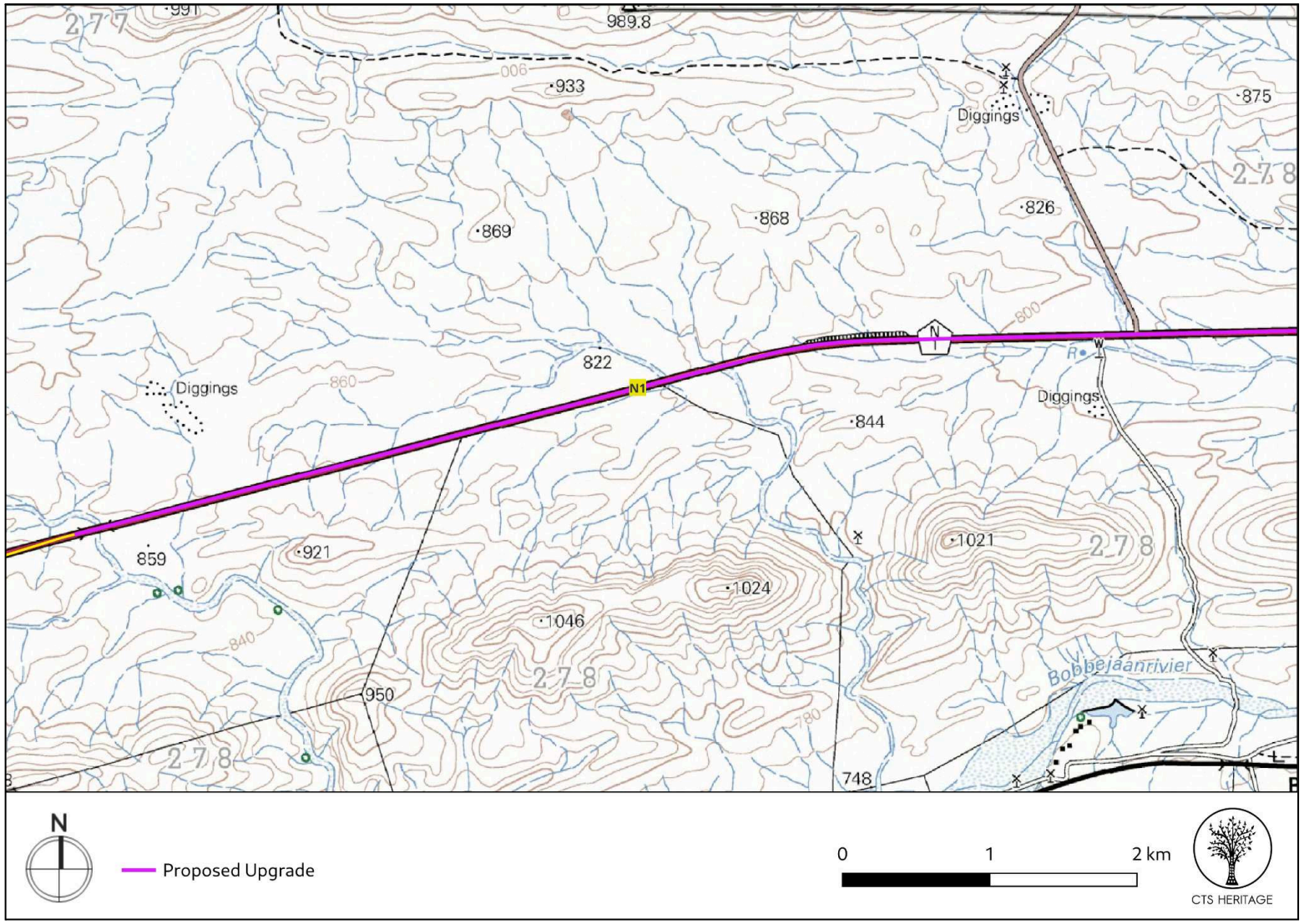

Figure 1.5 Overview Inset Map A. 1:50 000 TopMap for the development area

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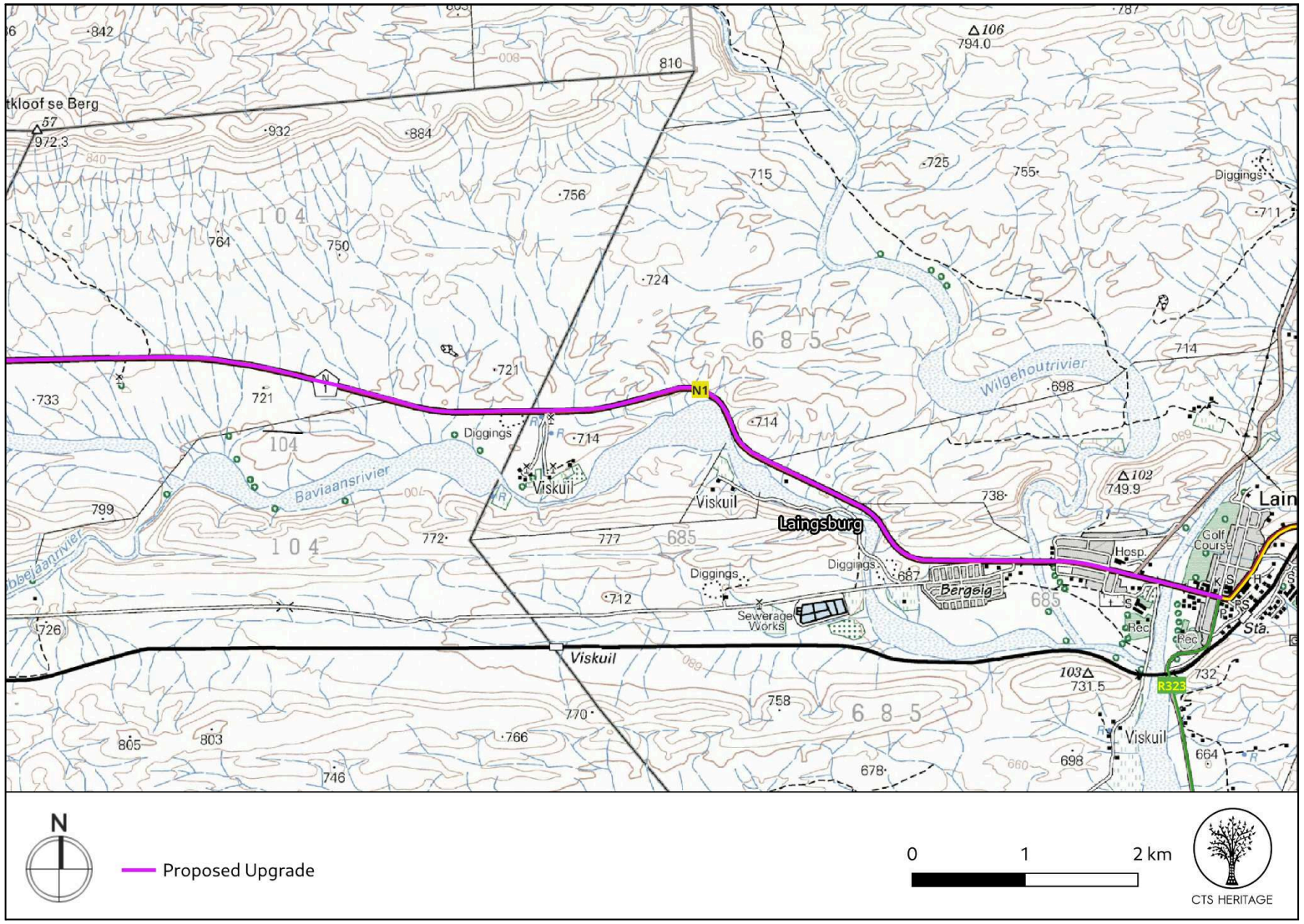

Figure 1.6 Overview Inset Map B. 1:50 000 TopMap for the development area

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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 (M. Crafford) conducted a survey of the site and its environs on 16 July 2024 to determine what archaeological resources are likely to be impacted by the proposed upgrade of the N1.
- The area proposed for development was assessed on foot, 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

The study area is large, at nearly 18km long, and stretches alongside the N1, which is a very busy road with a 120km speed limit. Not all areas are accessible on foot. The number of rocks on the surface also made it difficult to easily identify lithics. However, sufficient coverage was ascertained in order to determine the archaeological sensitivity of the development area.

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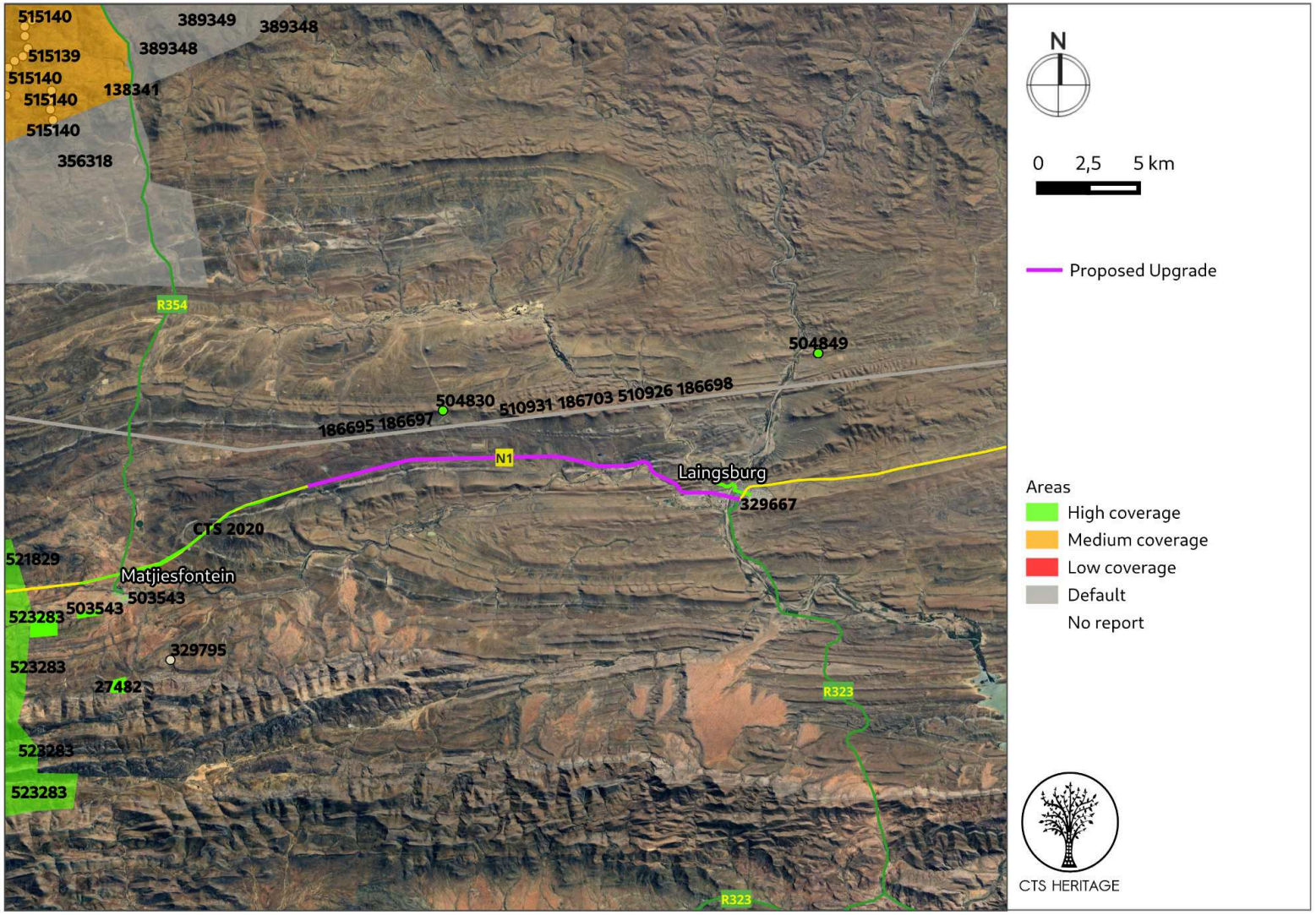

Figure 2: Close up satellite image indicating proposed location of development in relation to heritage studies previously conducted

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3. HISTORY AND EVOLUTION OF THE SITE AND CONTEXT

3.1 Background

This application is for the proposed upgrade of National Route 1 (N1) Section 4 between Doornfontein and Laingsburg, two bridges, eighty-six minor culverts, and eight major culverts in the Western Cape Province, Central Karoo District Municipality at Laingsburg Local Municipality. Laingsburg is located on a tributary of the Groot River, namely the Buffels River. It takes its name from John Laing, Commissioner of Crown Lands in the Cabinets of Sprigg and Rhodes. It was established as a town in 1881 on the farm, Vischkuil aan de Buffels Rivier, and became a municipality in 1906 (Raper et. al., 2018).

3.2 Cultural Landscape, Built Landscape and Historical Background

The proposed development falls within the Karoo. The name 'Karoo' has its roots in the Khoisan word meaning 'place of great dryness'. It once supported large grassy flatlands and the San and Khoekhoen migrated across the region for hunting and grazing purposes. Less than two hundred years ago large herds of antelope still roamed the grass plains. With the occupation of the area by stock farmers, the sheep gradually replaced the game and the grass receded along with changing grazing and weather patterns (Winter et al 2009; Winter & Oberholzer 2013). By the late 17th century, the Khoenhoen had moved from the region into the more water-rich southern Karoo and the coastal plains. During the early colonial period, the harshness of the Karoo region formed an almost impenetrable barrier from the Cape to the interior for colonial explorers, hunters and travellers. The 18th century was characterised by a marked increase in the rate of expansion of the boundaries of the settlement at the Cape. This was associated with the emergence of the migrant stock farmer (trekboer) (Guelke 1982 in Winter et al 2009). Early routes into the interior largely followed the tracks initially used by migrating herds of game or the cattle herds and sheep flocks of the Khoekhoen on their seasonal route between coastal and inland grazing grounds. These routes were later reinforced by generations of trek farmers moving between the markets at the Cape and their farms (Winter et al 2009).

De Kock and Schulz (2011, SAHRIS NID 503543) in their HIA located less than 10km southeast of the western end of the proposed upgrade, describe the landscape as "*an arid Karoo landscape and is located along a lower-lying, gentle, north-facing slope and with the Witteberg mountain range as natural backdrop to the south."* One Provincial Heritage Site (PHS) is located within a 100m radius of the development (See Table 1 below). This site, Dutch Reformed Church, Voortrekker Street, Laingsburg (SAHRIS ID 28191) has been mapped incorrectly on SAHRIS. The correct location is approximately 400m eastwards and is still within 100m of the proposed upgrade (Figure 3.1-3.2). The Laingsburg cemetery is also within 200m of the proposed upgrade.

In 2020, CTS Heritage conducted an HIA less than 13km southwest of the proposed development (SAHRIS NID 27482). They identified the N1 as a scenic route, and based on the historical map, it follows along the historical route connecting Laingsburg to the Cape (Figure 3.5). The key aspects of the cultural landscape resources that are known from the area include the N1 scenic route, and the surrounding Moordenaars Karoo, which CTS Heritage (2020) describes as "*The lower Matjiesfontein valley is covered with dull Karoo bossies well under 1m in height and subtle landforms including hidden depressions and hillocks. The Witteberg mountains rise steeply to the east."*

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3.3 Archaeology

Recently, several heritage assessments have been completed within proximity to the area proposed for development (Figure 2.1-2.2). According to Nilssen (2014, SAHRIS NID 504763), "*The Karoo houses a long and rich archaeological record dating from the earliest stages of Stone Age technology that are over a million years old, to the historic period that consists of the last few hundred years of human occupation (see Nilssen 2011 and references therein). Archaeological sites include caves and rock shelters, open-air artefact scatters, rock engravings and historic structures with their associated cultural materials*." According to the ACO (2013, SAHRIS NID 503074), "*Because of the scarcity of caves and shelters, more than 90% of Karoo archaeological sites are open sites of stone artefacts, ostrich eggshell fragments and occasionally, pottery. Bone remains are rarely preserved. Artefacts of both the Early and Middle Stone Ages are widespread and may generally be described as an ancient litter that occurs at a low frequency across the landscape. Where definable scatters of Early and Middle Stone Age material occur, they are considered to be significant heritage sites. More intensive occupation of the Karoo started around 13,000 years ago during the Later Stone Age, which is essentially the heritage of Khoisan groups who lived throughout the region. The legacy of the San includes numerous open sites while traces of their presence can also be found in most large rock shelters, often in the form of rock art. They frequently settled a short distance from permanent water sources (springs or waterholes) and made use of natural shelters such as rock outcrops or large boulders or even large bushes. In the Great Karoo, natural elevated features such as dolerite dykes and ridges played a significant role in San settlement patterns*" and as such, this broader area is renowned for its well-preserved rock art and other artefacts from this time, including rock engravings and rock gongs. As the proposed development is found in a flat area without visible outcrops or natural shelters, it is unlikely that rock engravings or similar exist within the proposed area.

Based on the information included in Hart and Webley in an HIA that encompasses most of the northern area between the proposed development and Sutherland (2013, SAHRIS NID 138341), Early, Middle and Later Stone Age archaeological artefacts are expected to occur in this area, as well as stone-walled kraals and what are described as open Khoekhoen encampments situated among the Kameeldoring trees along the dry river beds in the bottom of the valleys. Archaeological sites of this kind are very rare in the Western Cape, having been only previously recorded in the Richtersveld (Hart and Webley, 2013). A recent survey by the eastern Cederberg Group (eCRAG) on the neighbouring Rietfontein farm revealed a series of rock art sites on the Dwyka tillites. These findings have opened up a new geographical area for rock art research.

In 2020, CTS Heritage conducted an HIA for the proposed upgrade of the N1 between Monument River and Doornfontein, the part of the N1 that starts at the western end. Their findings are relevant and provide insight into the types of heritage resources that can be expected near the current study area. Almost all of the known heritage sites on SAHRIS (Appendix A, and Figure 3.1) were identified during this HIA. "*A number of isolated Middle Stone Age and Later Stone Age archaeological artefacts were identified in the vicinity of some of the proposed borrow pits and quarries. A Later Stone Age campsite with Middle Stone Age material around it was identified at Borrow Pit 6. There were a number of isolated artefacts and one noteworthy archaeological site identified (M025) at Drill Site 5. North-west of the site, closer to the old quarry (M046), there is an area which has a dense accumulation of artefacts. Sites M050 to M053*

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document part of this potential archaeological site (graded IIIb).

One modern-day memorial was identified beside the N1 near the Matjiesfontein intersection (M037). A formal British graveyard, containing the remains of various English soldiers and Englishmen stationed or living in the area before the war, is one of the heritage resources recorded in the proposed development area for the upgrade of the N1 Section 4 between Monument River (km 46.00) and Doornfontein (km 63.00). Drill site 1 is located on land belonging to Matjiesfontein town and will be visible from the Matjiesfontein PHS. It is also not far downslope from the probable lone guarrie tree (Euclea) under which Olive Schreiner is said to have sat while she drafted a series of articles, Thoughts on South Africa, The Buddhist Priest's Wife as well as On the Banks of a Full River."

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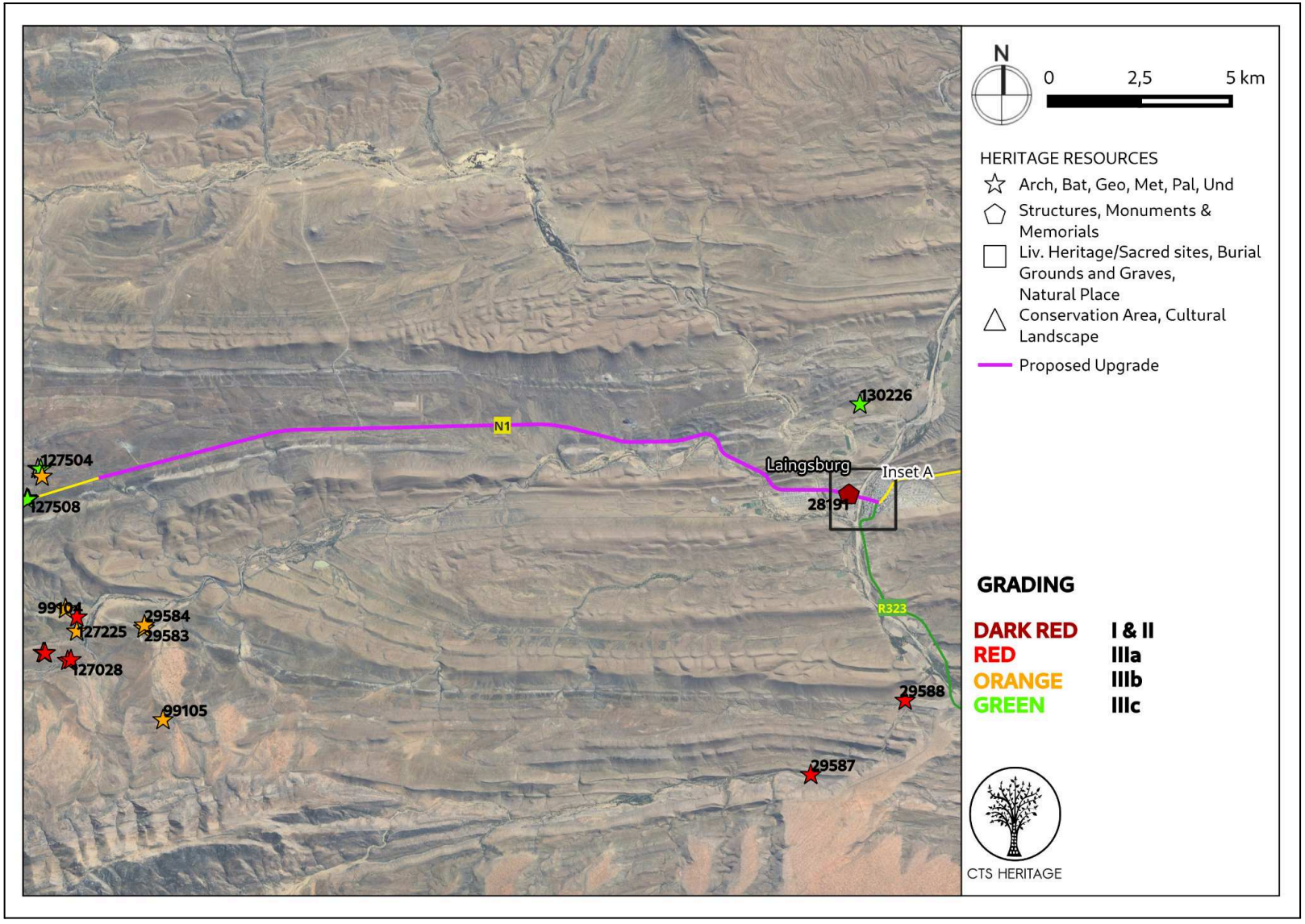

Figure 3.1 Heritage Resources Map. Heritage Resources previously identified in and near the study area, with SAHRIS Site IDs indicated. Please See Appendix 4 for a full description of heritage resource types.

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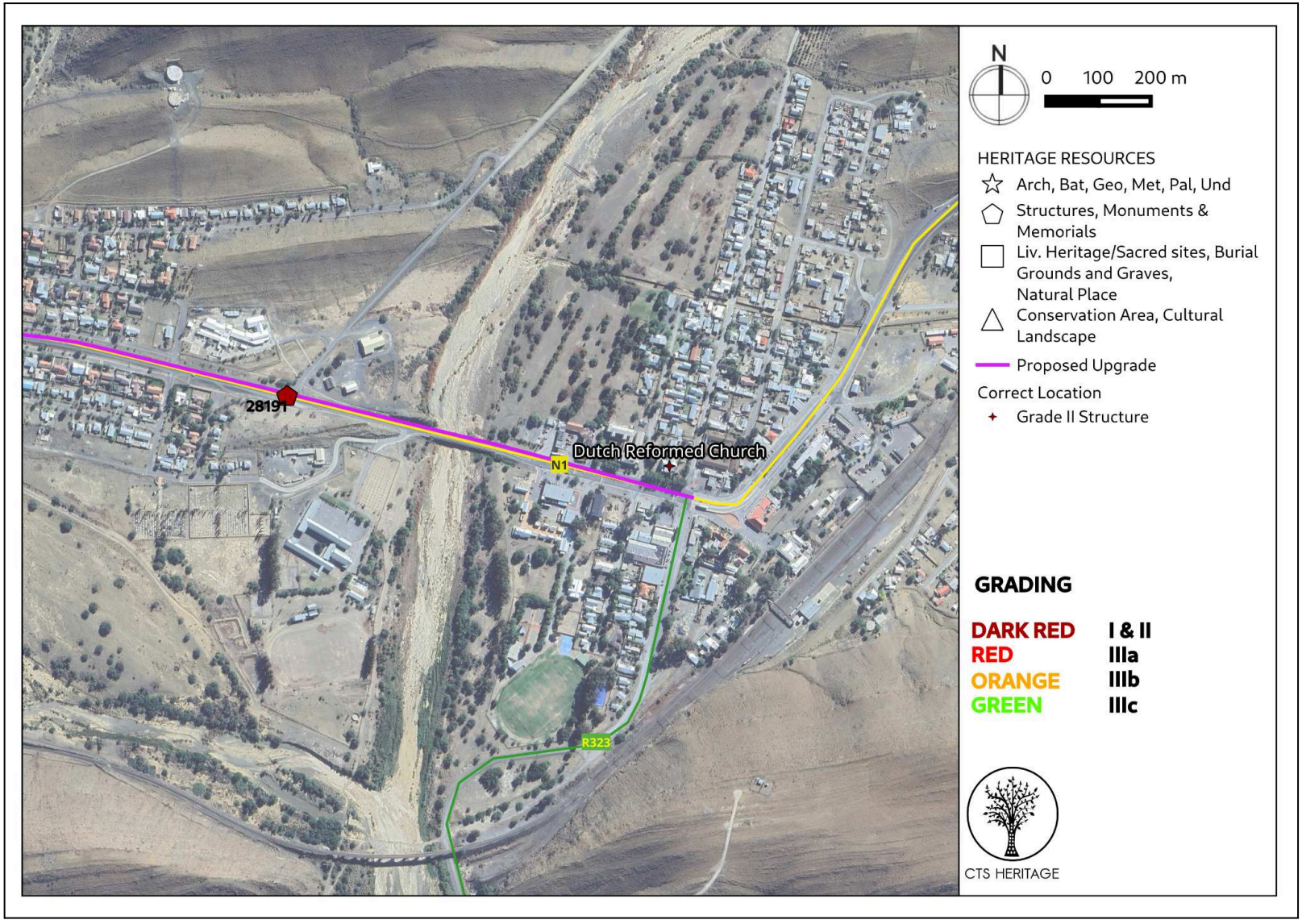

Figure 3.2 Heritage Resources Map. The Grade II Structure of the Dutch Reformed (SAHRIS ID 28191) has been mapped incorrectly on SAHRIS. This map indicates its correct location.

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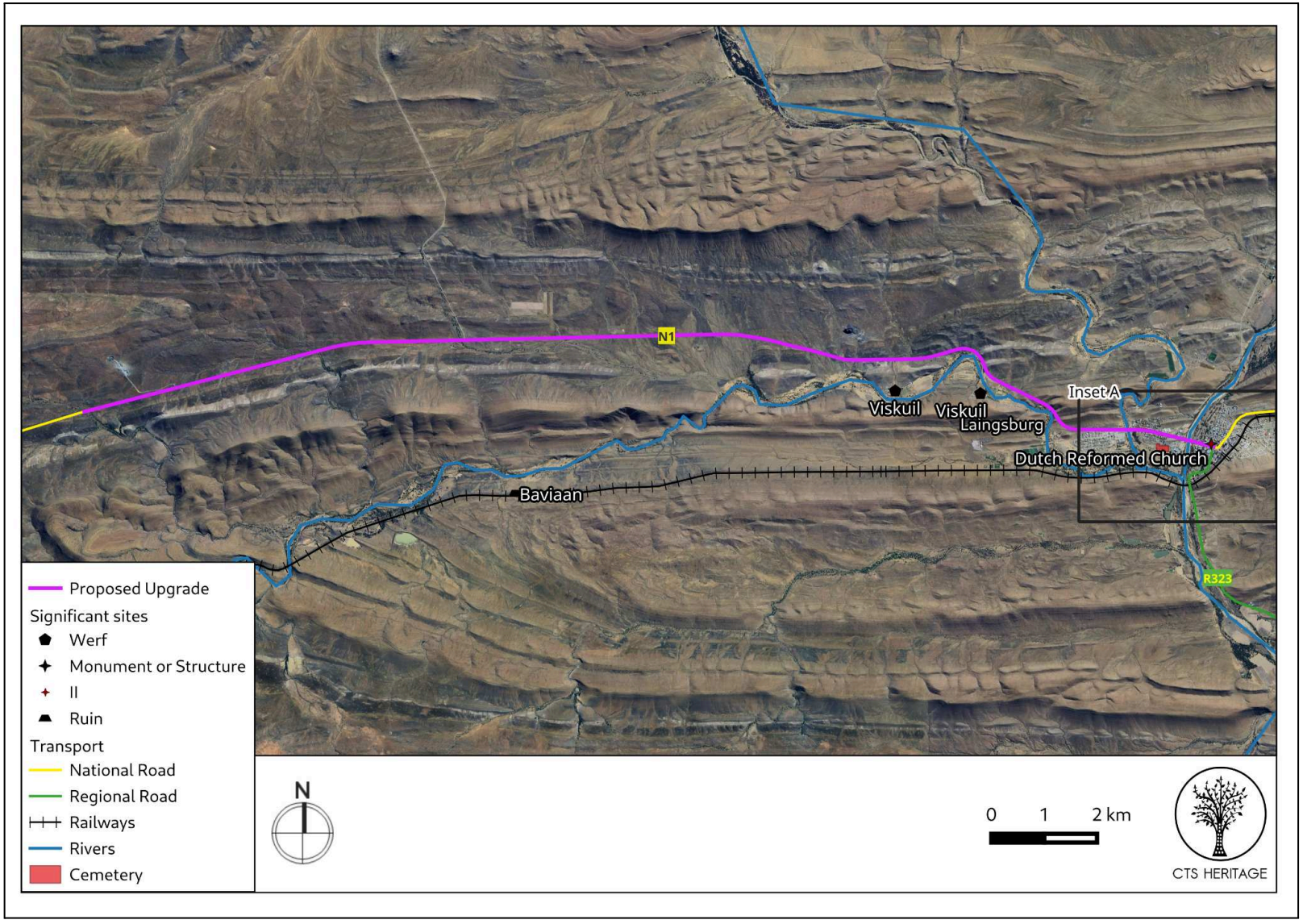

Figure 3.3 Cultural Landscape Map. Map indication sensitive receptors near the proposed development, extracted from the Topo 1:50 000 map.

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Figure 3.4 Cultural Landscape Inset Map A. Map indication sensitive receptors near the proposed development, extracted from the Topo 1:50 000 map.

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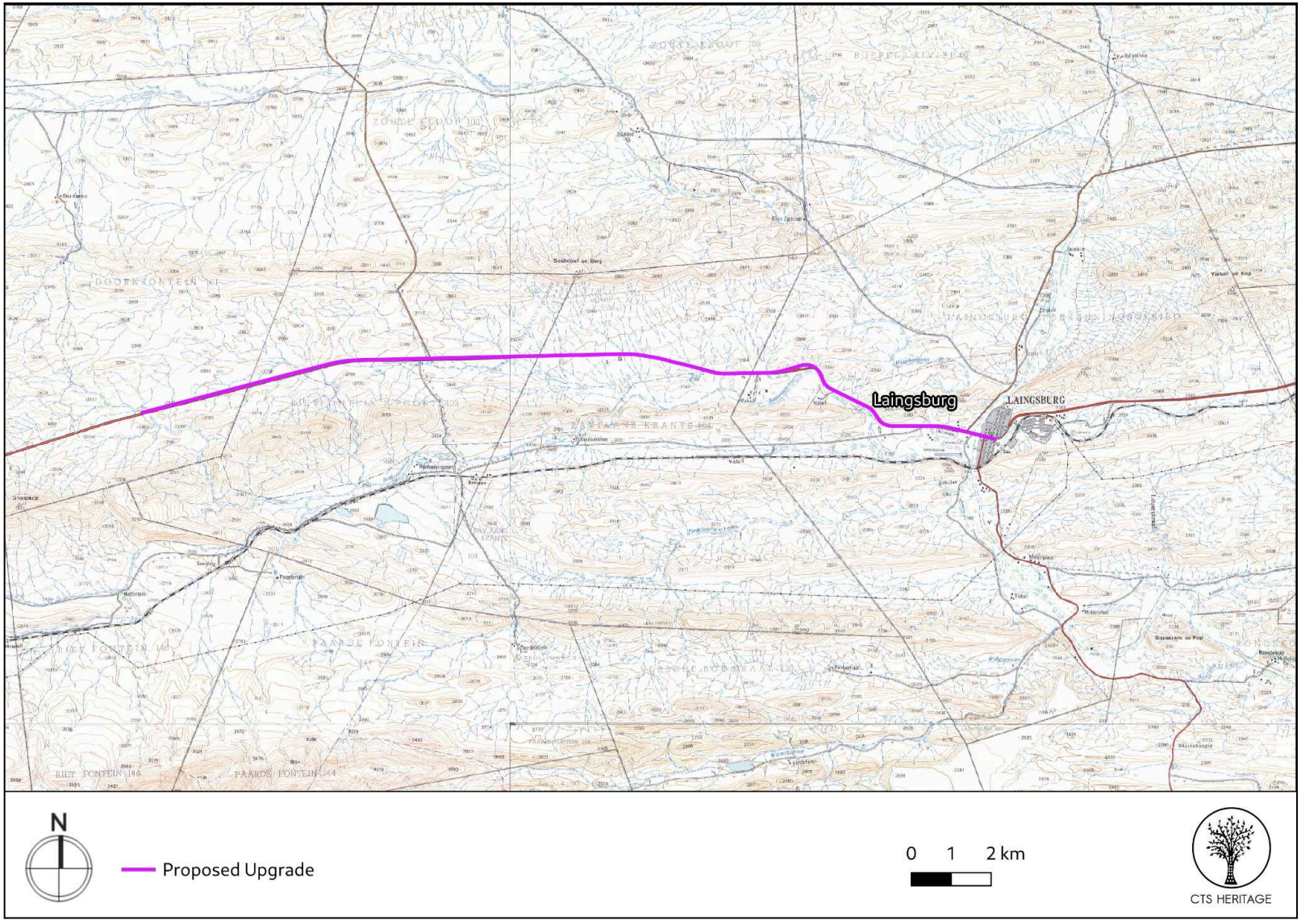

Figure 3.5 Historical Topo Map. First Edition Topographical Map indicating that the N1 follows a historical route

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4. IDENTIFICATION OF HERITAGE RESOURCES

4.1 Field Assessment

The section of road located within the town was thoroughly surveyed, and seven other accessible areas next to the road were also surveyed on foot. The existing areas that were not as accessible were surveyed twice by car, at a very slow speed.

Due to the limited access, seven road workers and a traffic police officer were asked if they were aware of any graves next to the roadside. Three of them recalled memorial crosses that had been placed on the roadside, but which they have since removed. One of the workers mentioned the graveyard at Matjiesfontein and a smaller one near the Monument River, but both of these fall outside the study area.

The field assessment identified various tree lanes as a valuable socio-cultural resource. As trees also hardly occur naturally in this landscape, they also contribute to the townscape, as well as the sense of place.

Figure 4.1: Facing towards the eastern end located in Laingsburg. The lane of pine trees to the left is in front of the church.

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Figure 4.2:Facing towards the west, from near the eastern end of the proposed upgrade. The trees on the right are in front of the church, and the yellow building on the left is the church hall.

Figure 4.3: The bridge thaat corsses the Buffelsrivier

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Figure 4.4: The lane of trees near the entrance of the town that contributed both to a sense of palace, as well as providing shade for residents walking to the newer built Bergsig are

Figure 4.5: The footbridge connecting the newer Bergsig Area to the rest of the town

Figure 4.6:Facing west, towards the entrance of Laingsburg

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Figure 4.7: In the distance the first section of the road outside the town cuts through bedrock

Figure 4.8: Facing east, towards a part of the route that cuts through the bedrock area.

Figure 4.9: Facing west, just before the road straightens out.

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Figure 4.10: A closer up view of the road cutting into one of the koppie's bedrock

Figure 4.11: There were several areas with refuse piles next to the road

Figure 4.12: Facing west, with a slight koppie on the left

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Figure 4.13: Facing west, with the Klipwerf farm on the left

Figure 4.14: Facing west, indicating the types of vegetation present in the study area

Figure 4.15: There were large areas where the road stretched out

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Figure 4.16: One of the current culverts. The streambeds all consisted of fine sand with rocks that were easily carried downstream

Figure 4.17: Facing east, towards Laingsburg, with the Sutherland gravel road turnoff on the left

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Figure 4.18: Facing west, near the western end of the proposed upgrades

Figure 4.19: Facing east, near the western end of the proposed upgrades

Figure 4.20:Facing east, towards Laingsburg, from the most western end of the proposed upgrades, approximately 18km from the historical core of the town.

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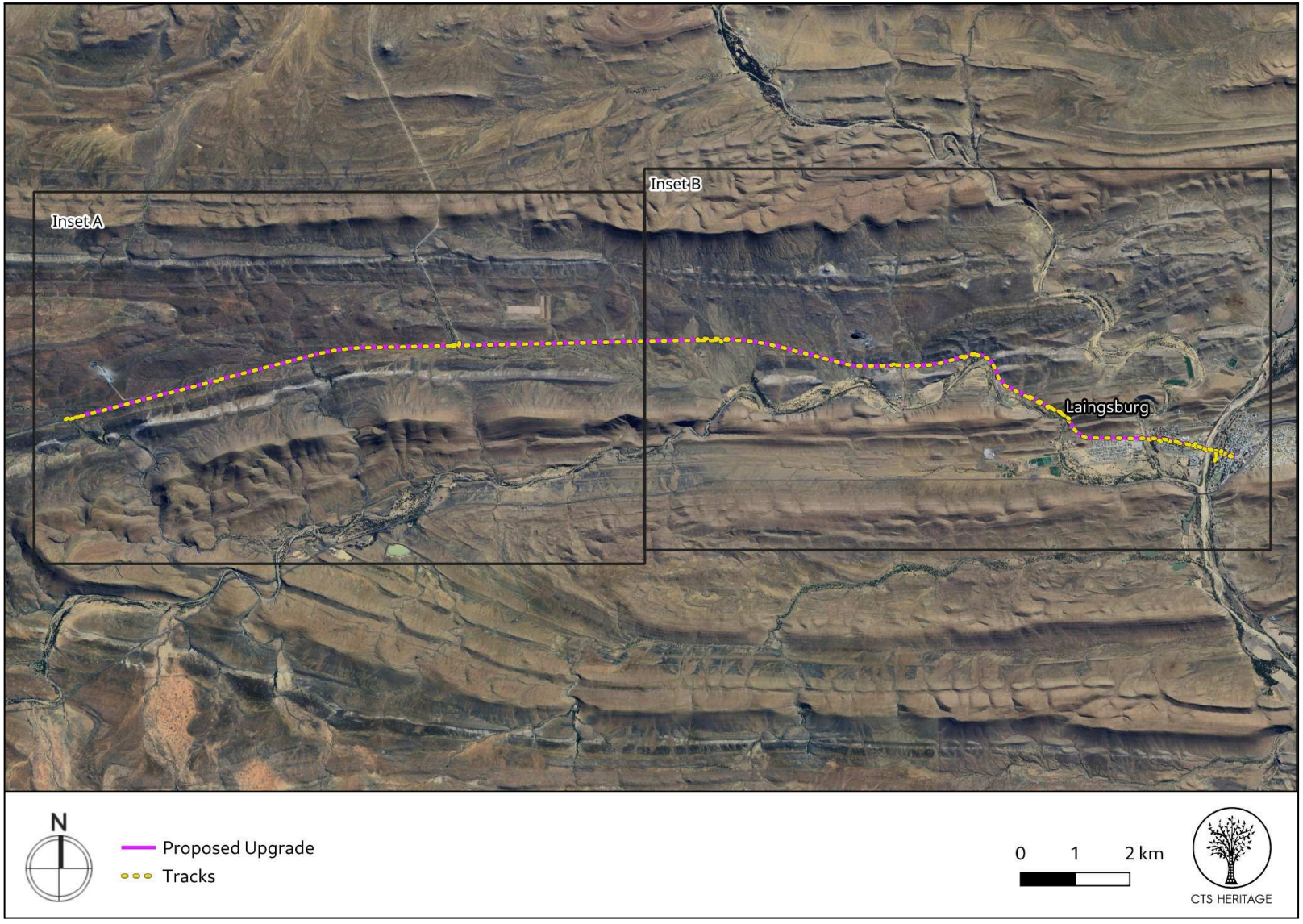

Figure 5.1. Track paths of archaeological field assessment

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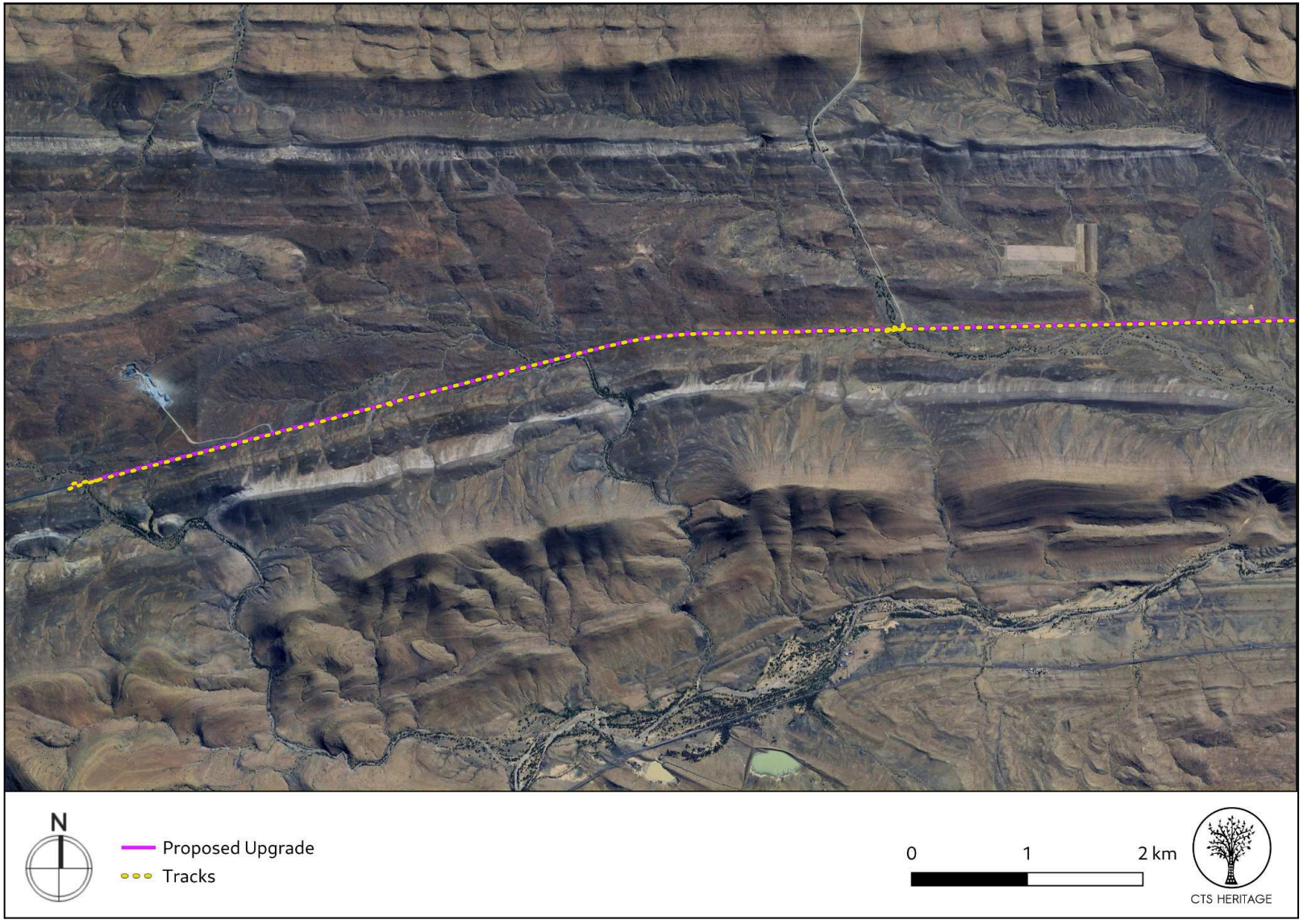

Figure 5.2. Inset Map A: Track paths of archaeological field assessment

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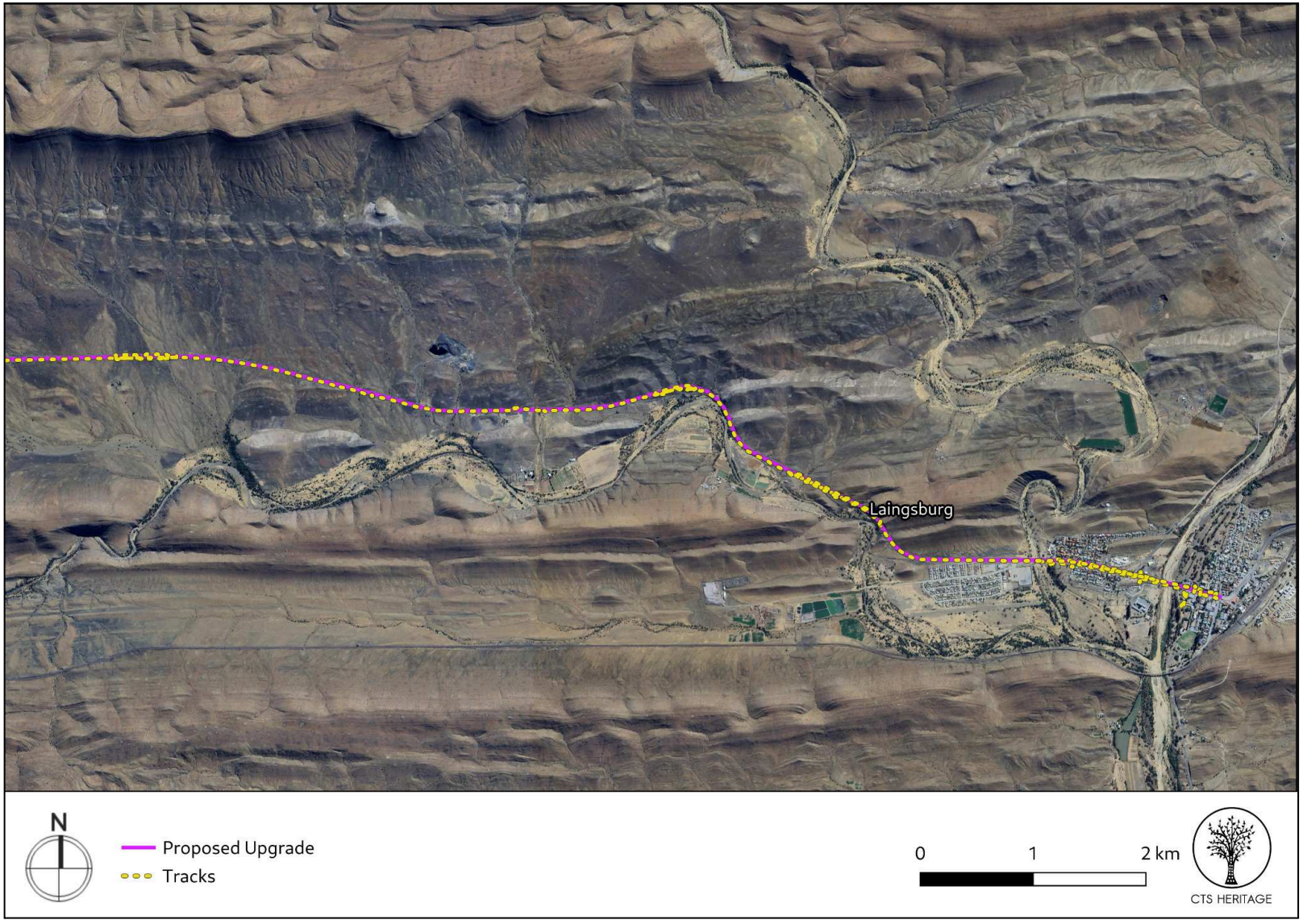

Figure 5.3. Inset Map B: Track paths of archaeological field assessment

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4.2 Archaeological Resources Identified

Table 1: Observations noted during the field assessment

POINT ID	Description	Density	Type	Period	Co-ordinates		Grading	Mitigation
1	NG Kerk 4 July 1904, stained glass windows, sandstone, with a lane of trees in front of the structure	n/a	Structure	Early 20th C	-33.196276	20.858121	Currently graded as Grade II on SAHRIS as it was an Old National Monument	No impact anticipated
2	NG Church Stephanus Greeff Saal, 23 July 1955	n/a	Structure	Mid 20th C	-33.196648	20.8570631	IIIc	No impact anticipated
3	Ox wagon monument 1838, different battles on one side of the monument, Voortrekker/ Boer Leaders on the other side	n/a	Monument	No date visible	-33.195586	20.8522349	IIIc	No impact anticipated
4	Klipwerf entrance	n/a	Observation	Unclear	-33.188590	20.8248072	NCW	n/a
5	Possible raw lithic material source	Outcrop	Archaeological	Stone Age	-33.189945	20.8280544	IIIc	No impact anticipated
6	Intrusive quartz lithic	n/a	Archaeological	MSA/ LSA	-33.189750	20.8282662	NCW	n/a
7	Klipwerf farmhouse with surrounding infrastructure	n/a	Structure	Historical	-33.188730	20.8187030	IIIc	No impact anticipated
8	Exposed pipes	n/a	Observation	Modern	-33.182768	20.8161222	NCW	n/a
9	Liebenhof farm entrance with tree lane	n/a	Structure	Unclear	-33.184289	20.8049497	IIIc	No impact anticipated
10	Liebenhof farm werf	n/a	Structure	Historical	-33.188328	20.8037503	IIIc	No impact anticipated
11	K.P.A. Road Reserve Area	n/a	Observation	N/a	-33.183908	20.8028480	NCW	n/a
12	Quarry area entrance	n/a	Observation	Modern	-33.180441	20.7716328	NCW	n/a
13	Historical culvert, age unknown	n/a	Observation	Historical	-33.181265	20.7306303	NCW	n/a
14	Entrance to Baviaans Farm	n/a	Structure	Modern	-33.181472	20.7288595	NCW	n/a
15	Wooden cross with stones painted white. Possible memorial cross. Outside road reserve	n/a	Observation	Modern	-33.186289	20.6914688	NCW	n/a
16	Mining pit entrance	n/a	Observation	Modern	-33.188013	20.6822568	NCW	n/a

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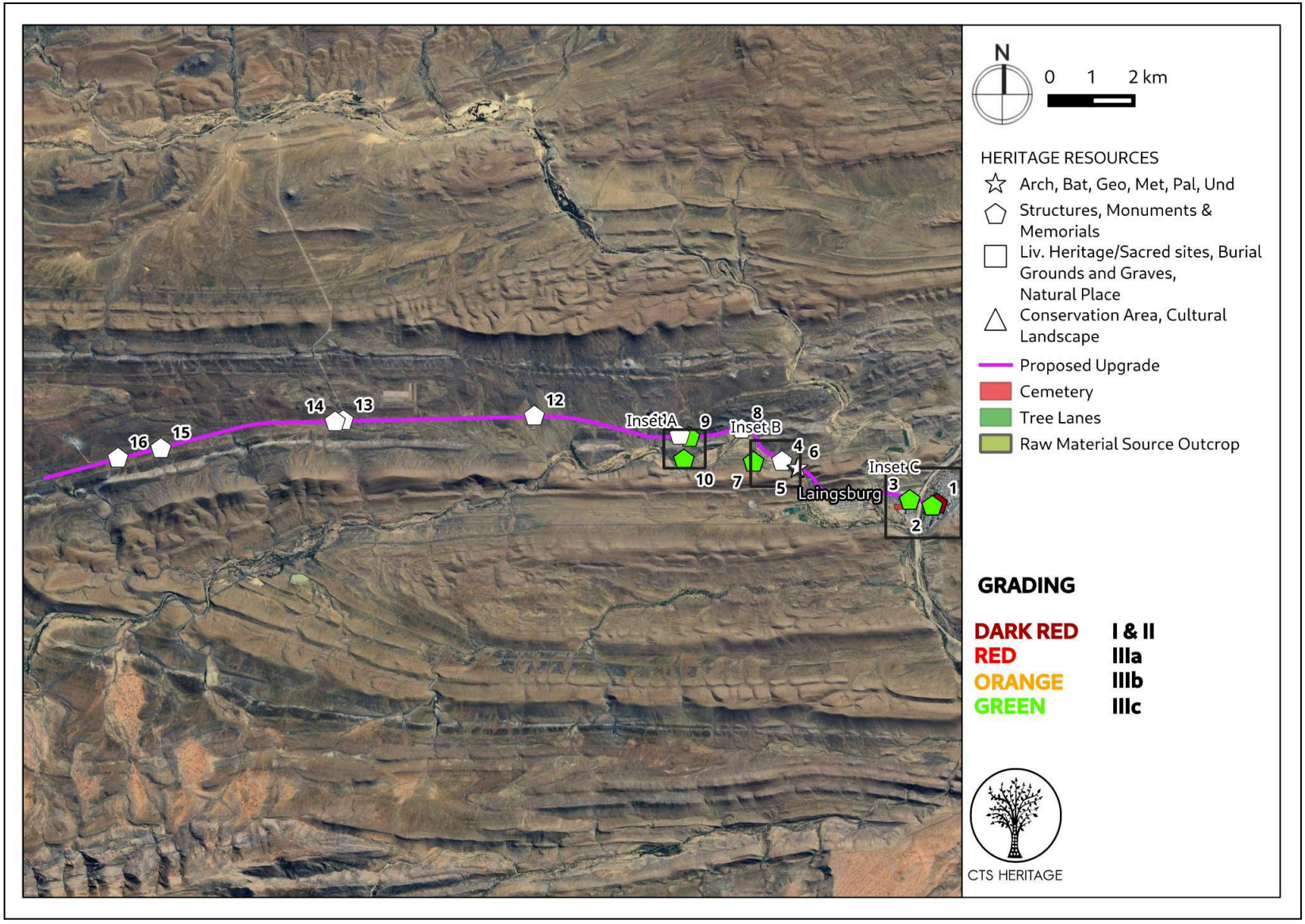

Figure 6.1: Map of all sites and observations noted within the development area

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Figure 6.2: Inset Map A of all sites and observations noted within the development area

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Figure 6.3: Inset Map B of all sites and observations noted within the development area

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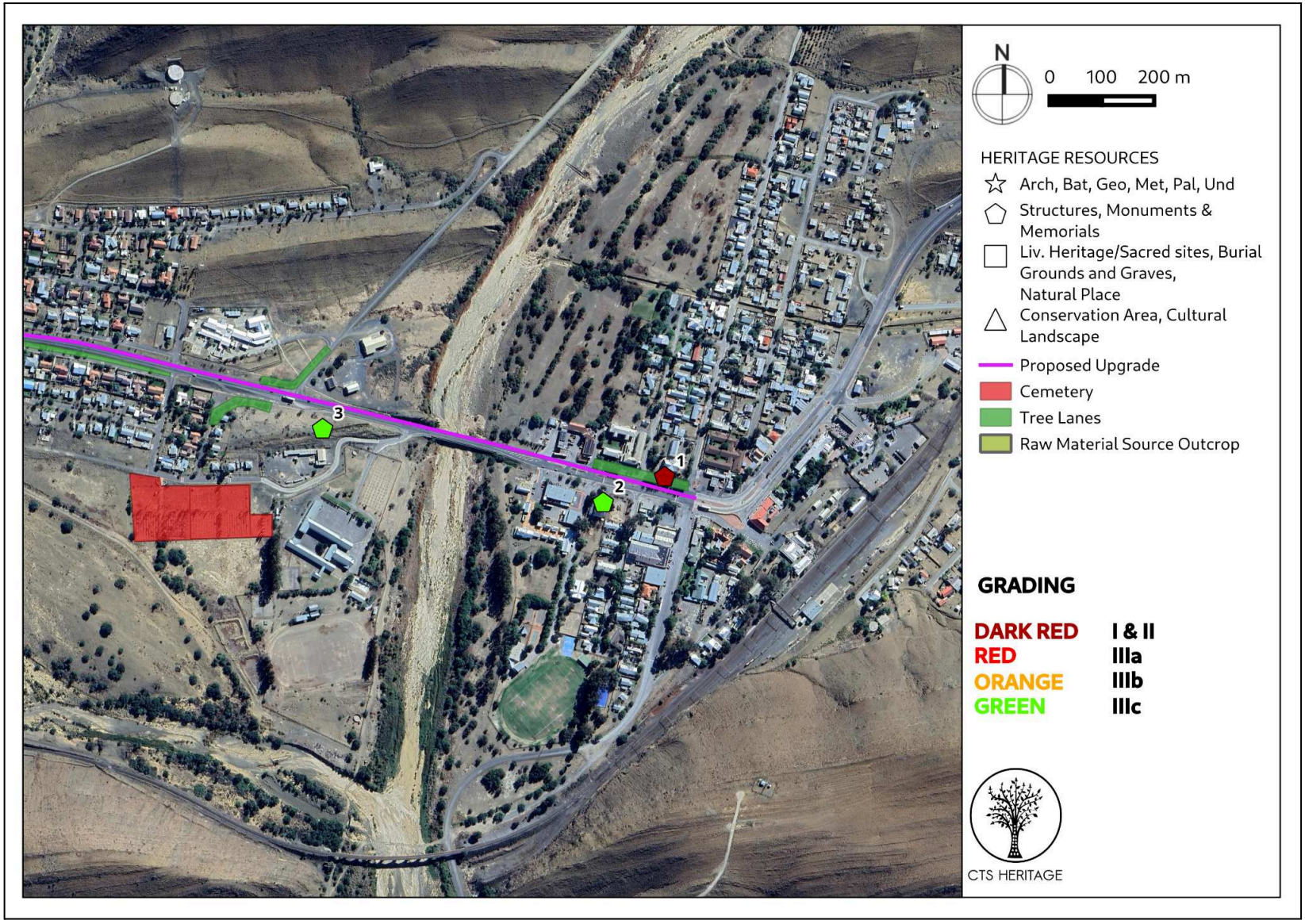

Figure 6.4: Inset Map C of all sites and observations noted within the development area

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4.3 Selected photographic record

(a full photographic record is available upon request)

Figure 7.1: Observation 001

Figure 7.2: Observation 002

Figure 7.3: Observation 003

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Figure 7.4: Observation 004

Figure 7.5: Observation 005

Figure 7.6: Observation 006

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Figure 7.7: Observation 007

Figure 7.8: Observation 008

Figure 7.9: Observation 009

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Figure 7.10: Observation 010

Figure 7.11: Observation 011

Figure 7.12: Observation 012

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Figure 7.13: Observation 013

Figure 7.14: Observation 014

Figure 7.15: Observation 015

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Figure 7.15: Observation 016

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5. ASSESSMENT OF THE IMPACT OF THE DEVELOPMENT

5.1 Assessment of Impact to Archaeological Resources

16 observations were made during the field survey, of which one is currently graded on SAHRIS as Grade II as it is an old National Monument, six are Grade IIIc, and the other 9 are not conservation worthy (NCW). The old National Monument, as discussed in section 3.2 Cultural Landscape, Built Landscape and Historical Background, the Dutch Reformed Church, Voortrekker Street, Laingsburg (SAHRIS ID 28191) had been mismapped on SAHRIS. Its location was confirmed during the assessment (Obs 1). No impact to this old National Monument is anticipated to result from the proposed road upgrade. Should any impact take place, it is recommended that a section 27(18) permit application be made to HWC to address any changes to this site.

The location of the Dutch Reformed Church has been mapped incorrectly on SAHRIS. Rather, this location is actually the site of a Voortrekker Monument/ Plinth sculpture commemorating some of the Voortrekker leaders and the battles in which they fought (Obs 3). Another structure in town that holds socio-cultural significance is the church hall, constructed in 1955 (Obs 2). In the Laingsburg Rural area, two other farm werfs were identified and based on the first edition Topo map, both have historical value (Obs 7 and 10). Three farm entrances were observed (Obs 4, 9 and 14), as well as two entrances to quarry mines (Obs 12 and 16).

The remaining conservation-worthy resources have been graded as IIIc. Most of these resources fall outside the road reserve and will not be impacted by the proposed upgrades. However, there are several lanes of trees that have been identified that contribute to the cultural landscape of the town. These trees have also been graded as IIIc, and impact to these tree avenues should be avoided. If this is not possible, new mature tree lanes should be planted once the upgrades are finished. Examples of the existing tree lanes are the pine trees in front of the church and Schinus molle trees (Pepper trees) near the entrance of the town.

An additional tree lane for which the same recommendations apply is identified at Observation 9. The Liebenhof farm entrance itself is not conservation-worthy, however, the tree lane starting at the entrance and leading up to the farm werf is. Impact to this tree avenue on them should be avoided. If this is not possible, a new mature tree lane should be planted once the upgrades are finished.

One possible raw lithic source was identified (Obs 5), which was also graded as IIIc. A single lithic (Obs 6), exposed pipes (Obs 8) and a historical culvert which had been integrated into a modern culvert were also observed, and have no conservation value.

One of the roadside memorials mentioned by the roadworkers was noted, but this site falls outside of the road reserve. No graves or rock art sites were identified during the fieldwork within the road reserve. The graveyard identified during the desktop background screener phase is more than 200m away from the proposed upgrades, as well as being separated from the N1 by the Bergsig neighbourhood, and no impact is anticipated.

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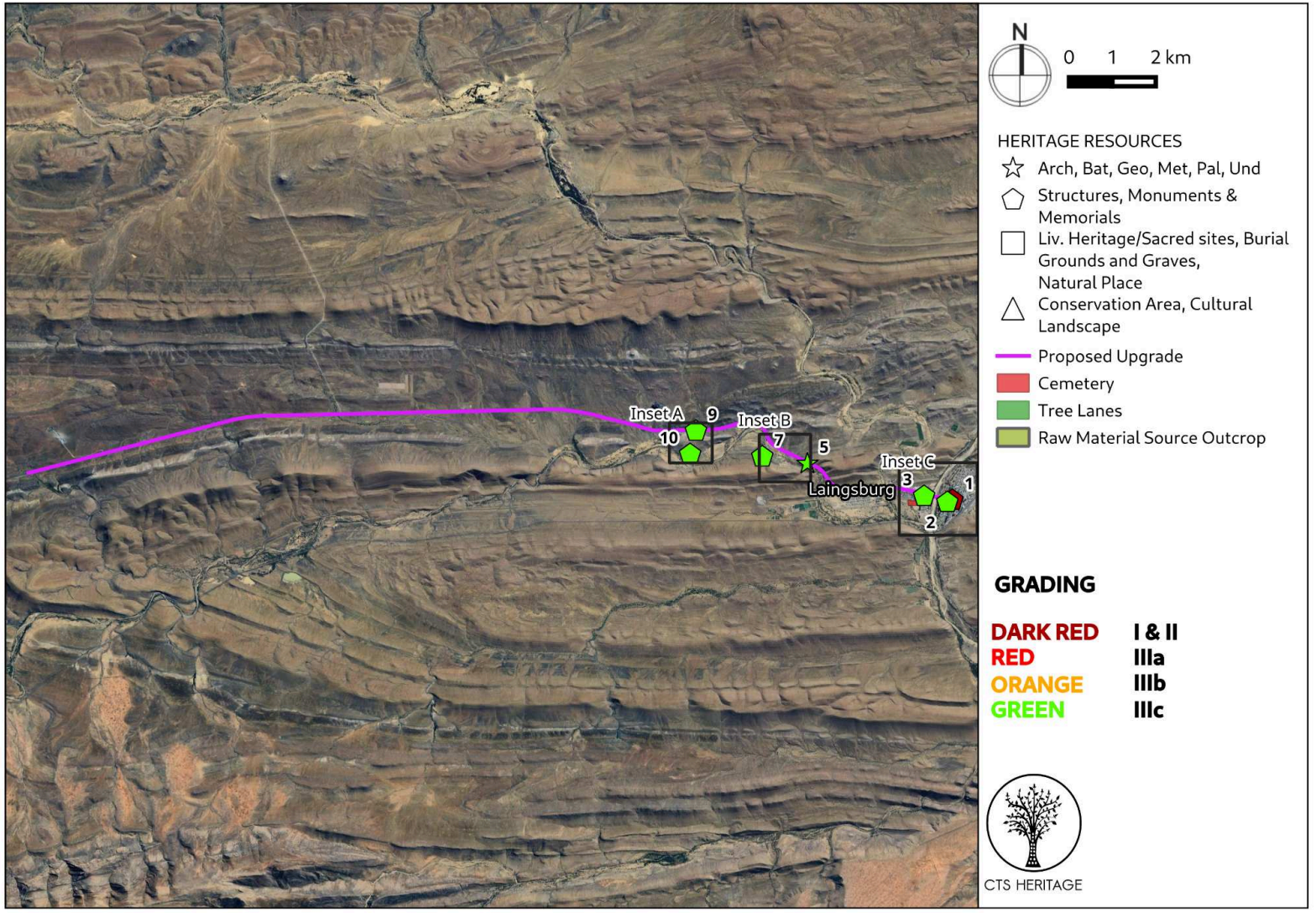

Figure 8.1: Map of all sites and observations noted within the development area as well as proposed mitigation measures

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Figure 8.2: Inset Map A of all sites and observations noted within the development area as well as proposed mitigation measures

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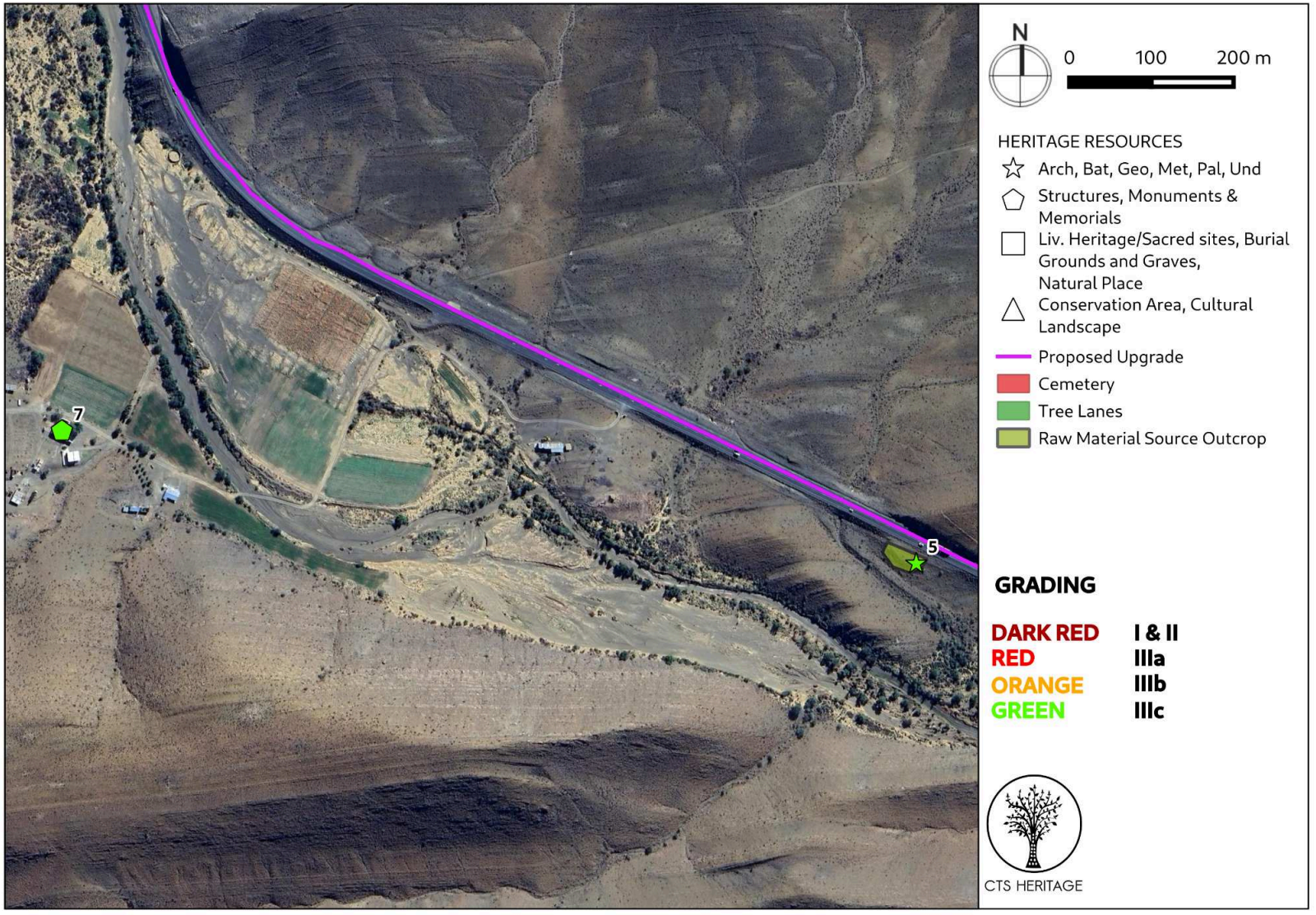

Figure 8.3: Inset Map B of all sites and observations noted within the development area as well as proposed mitigation measures

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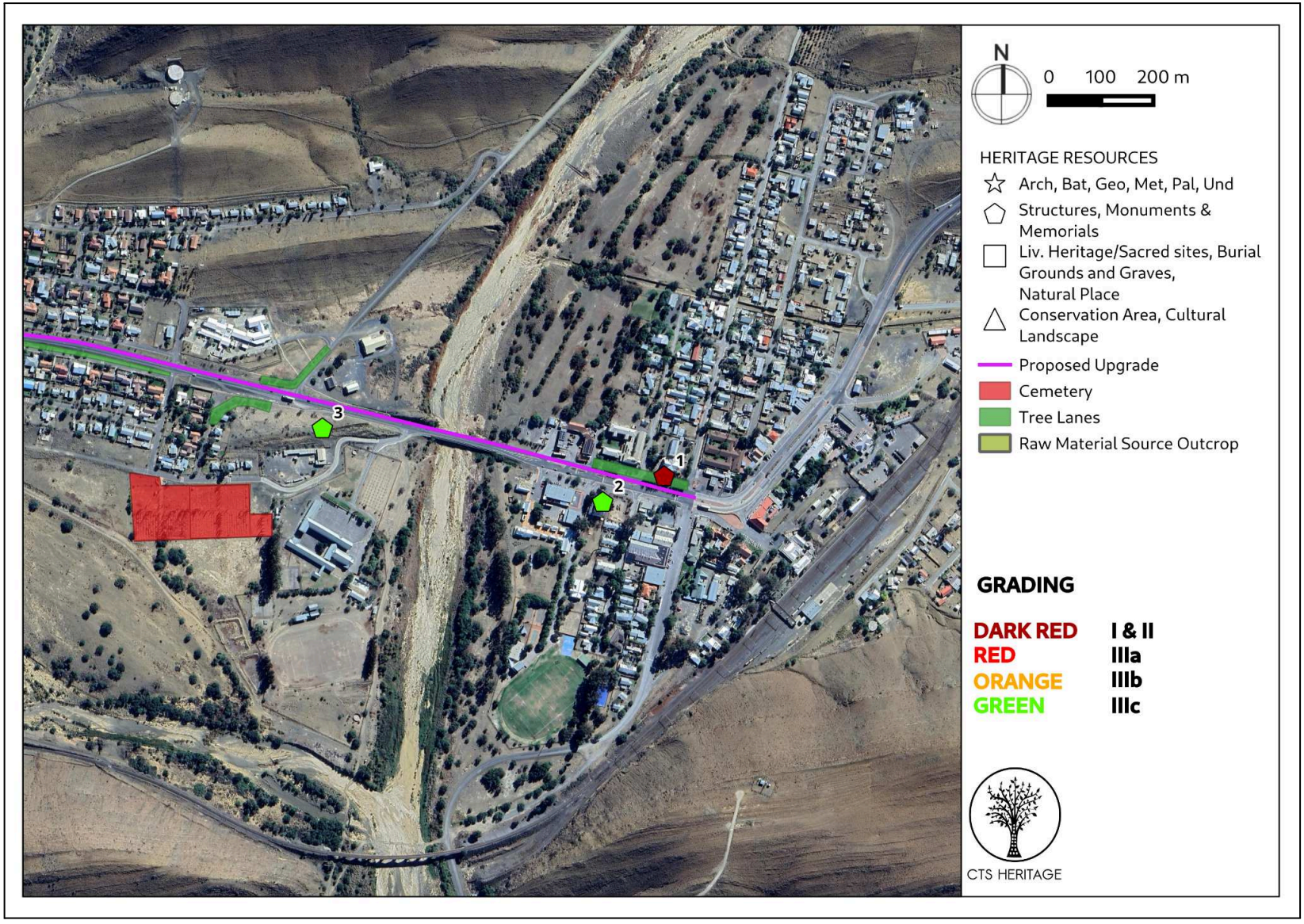

Figure 8.4: Inset Map C of all sites and observations noted within the development area as well as proposed mitigation measures

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6. CONCLUSION AND RECOMMENDATIONS

During the field assessment, eighth conservation-worthy heritage resources were identified. They include two historical plaaswerfs, the tree lane leading up to one of the farm werfs, as well as the tree lanes in the town, one raw material source for lithics, a Voortrekker Monument, and the two church buildings in Laingsburg. Most of these will not be impacted upon by the proposed upgrades as they fall outside the road reserve.

The tree lanes have been identified as a cultural landscape element that contributes to the experience of the landscape. Mature trees are rare in the broader landscape and are therefore a defining feature of towns in the Karoo. It therefore contributes to the townscape as well as a sense of place, and impact on these trees should be avoided. If impact cannot be avoided, mature trees should be planted alongside the upgraded road. Current trees that exist in the town include pine trees in front of the church, Schinus molle trees (Pepper trees) near the entrance of the town, poplar trees in the cemetery, and bluegum groves.

Recommendations

- Impact to the tree lanes, identified in Figure 8.1-8.4 should be avoided. If this is not possible, these tree lanes should be replaced with mature trees once the upgrades are completed.
- 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**
27482	HIA Phase 1	CTS Heritage	10/2020	HIA: Proposed SANSA Space Operations at portion 8 of Farm Matjiesfontein Western Cape
27706	HIA	CTS Heritage	22/10/2021	NUProposed establishment of 132kV powerline to evacuate power from the Karreebosch WEF to the National Grid in the Western and Northern CapeLL
53187	HIA Phase 1	Timothy Hart, Lita Webley	01/03/2011	HERITAGE IMPACT ASSESSMENT PROPOSED WIND ENERGY FACILITY
138341	**Heritage Specialist Report**	**Tim Hart, Lita Webley**	**31/03/2011**	**Roggeveld PROPOSED WIND ENERGY FACILITY**
155976	HIA Phase 3	CTS Heritage	11/05/2020	ARCHAEOLOGICAL and PALAEONTOLOGICAL WALKDOWN REPORT for the final layout for the proposed 86MW Oya Wind Energy Facility and associated infrastructure, between Matjiesfontein and Sutherland in the Western and Northern Cape Provinces
186695	HIA Phase 1	McEdward Murimbika	01/08/2014	Proposed Gamma-Kappa 2nd 765kV Eskom Transmission Powerline and Substations Upgrade Development in Western Cape PHASE 1 HERITAGE IMPACT ASSESSMENT STUDY REPORT
186697	AIA Desktop	Foreman Bandama, Shadreck Chirikure	01/08/2014	An Archaeological Scoping and Assessment report for the proposed Gamma (Victoria West, Northern Cape) - Kappa (Ceres â€“ Western Cape) 765Kv (2) Eskom power transmission line
186698	PIA Desktop	JF Durand	09/06/2013	GAMMA-KAPPA 765kV Transmission Line, Western Cape Province Scoping Report Palaeontology
186703	Visual Impact Assessment		01/01/2014	The Proposed Gamma Kappa 2nd 765KV Transmission Powerline And Substations Upgrade, Northern And Western Cape (NEAS Reference DEA/EIA/0001267/2012 DEA Reference14/12/16/3/3/2/353) Visual Impact Assessment
329667	**Heritage Statement**	**Peter Nilssen**	**18/04/2012**	**Proposed Upgrade of the Laingsburg Water Supply Pipeline,Laingsburg, Western Cape Province**
329795	HIA	Quahnita Samie	29/08/2012	Heritage Impact Assessment Worcester-Cape Winelands District Municipality, Western Cape
337370	PIA Phase 1	Duncan Miller	01/03/2011	Palaeontological Impact Assessment Proposed Roggeveld Wind Energy Facility
356318		Mariagrazia Galimberti, Kyla Bluff, Nicholas Wiltshire	01/02/2016	Heritage Screener CTS15_015a EOH Rietkloof Wind Energy Facility
503543	**NID and HIA**	**Stéfan De Kock, Kathleen Schulz**	**31/012011**	**Proposed Urban Formalisation And Infill Development: Matjesfontein 148/9 & Erven 17, 18, 50 (Matjiesfontein), Laingsburg District**
514783	HIA Phase 1	Tim Hart	14/11/2018	Proposed Witberg Wind Energy Facility Amendment 2018 Supplementary assessment of the proposed amendments.
521829	HIA Phase 1	Tim Hart	19/03/2019	Witberg WEF Amendment

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523283	HIA Phase 1	Tim Hart	03/05/2019	Proposed Witberg Wind Energy Facility Amendment 2018 Supplementary assessment of the proposed amendments. (Assessment conducted under Section 38 (8) of the National Heritage Resources Act (No. 25 of 1999) as part of an EIA)
	HIA	CTS Heritage	May 2020	Borrow Pits to be used for the Upgrade of the N1 between Monument River and Doornfontein

Additional references

Raper, P.E., Moller, L.A. and Plessis, T. (2018) Dictionary of Southern African Place Names. Jeppestown: Jonathan Ball.

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APPENDIX 2: Palaeontological Assessment (2024)

PALAEONTOLOGICAL SPECIALIST STUDY

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

Proposed upgrade of National Route 1 Section 4 between Doornfontein (KM 63.0) and Laingsburg (KM 81.7), two bridges and eighty-six minor culverts, eight major culverts in the Western Cape Province, Central Karoo District Municipality at Laingsburg Local Municipality

Prepared by

CTS HERITAGE

And

Ryan Nel

In Association with

Earthlink

July 2024

EXECUTIVE SUMMARY

The proposed project involves the upgrade of National Route 1 (N1) Section 4, stretching between Doornfontein and Laingsburg in the Western Cape Province, Central Karoo District Municipality, Laingsburg Local Municipality. This upgrade includes two bridges, eighty-six minor culverts, and eight major culverts. The primary objective is to enhance the infrastructure to improve transportation efficiency and safety along this significant route.

The project area is underlain by geological formations of the Dwyka and Ecca Groups of the Karoo Supergroup. The Dwyka Group, dating from the Late Carboniferous to Early Permian, consists of tillite, diamictite, and subsidiary shale. Overlying this is the Ecca Group, which includes the Prince Albert, Whitehill, Collingham, Vischkuil, Laingsburg, and Fort Brown Formations, dating from the Early to Middle Permian. These formations are known to have yielded fossil content, particularly the Whitehill Formation, which has yielded well-preserved mesosaurid reptiles and various trace fossils.

The palaeontological sensitivity of the project area varies. The Dwyka Group exhibits low-diversity trace fossils and generally has LOW palaeontological sensitivity. In contrast, the Ecca Group formations are mostly of MODERATE palaeosensitivity, except the Whitehill Formation, which has a HIGH to VERY HIGH palaeontological significance due to the presence of significant fossil material. The primary impact on fossil heritage will occur during the construction phase due to potential destruction, damage, or disturbance of fossils. However, given the sparse occurrence of scientifically significant fossils in most of the bedrock formations, the overall severity of impacts is considered moderate.

To mitigate these impacts, it is recommended that during excavation or rock removal activities beyond the current road and marginal boundaries, a palaeontologist must be present during all construction and excavation activities in the Whitehill Formation. This is particularly important near the rock outcrop closest to Laingsburg. Incorporating the HWC Chance Fossil Finds Protocol into the Environmental Management Programme (EMPr) will guide construction personnel on the steps to take in the event of an unexpected fossil discovery. By adhering to these recommendations, the proposed N1 upgrade can proceed with minimised impact on palaeontological resources.

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1. INTRODUCTION

1.1 Background Information on Project

This project is situated on National Road 1 section 4 between Doornfontein. (km 63.0) and Laingsburg (km 81.7) for upgrading the existing carriageway capacity.

The major aspects of this project include the following:

- Asphalt Surfacing with Crushed stone base with a partial in situ reconstructed sub-base for the section between km 63.0 and km 80.0,
- Asphalt surfacing with an asphalt base, with a cement stabilised sub-base for the section between km 80.0 and km 81.7,
- New geometry for Section 1: Rural (km 63.0 – km 76.7): Dual carriageway
    - Each carriageway cross section will comprise 2 x 3.7 lanes, 1m inside surfaced shoulder and 2.5m outside surfaced shoulder with an 8.6m median.
- New geometry for Section 2: “Pass” (km 76.7 – km 79.9): 4-lane configuration
    - The cross-section will comprise of 1 x 3.5m fast lane, 1 x 3.7 slow lane and a 2.5m surfaced shoulder per direction with a 2.8m median with concrete barrier.
- New geometry for Section 3: Laingsburg Town (km 80.2 – km 81.4): 4-lane configuration (reduced outside shoulders.)
    - The cross-section will comprise of 1 x 3.4m fast lane, 1 x 3.6 slow lane and a 0.5m surfaced shoulder per direction with a 2m kerbed median for pedestrian refuge when crossing the N1.
    - With 4 prominent intersections between km 80.5 and km 81.3 (length of 800m), this option will be the preferred option for the town section. The extra lane on each side will also provide shared turning and passing lanes at intersections, which at present is currently non-existent.
- The existing horizontal alignment will be retained except for the following proposed areas:
    - Rural section: The new carriageway is proposed to be constructed on the left-hand side due to river streams next to the existing right-hand side carriageway.
    - “Pass” section: A possible horizontal re-alignment option is proposed on the LHS to prevent the fill batter going into the river on the RHS or to construct a fill retaining wall on the riverside.
    - Town section: With the new proposed Buffels River bridge, there will be a horizontal re-alignment between km 81.160 t0 km 81.480 tie-in opposite sides of the bridge to a 4-lane configuration with 2.0 median and dual carriageway with 5.5m median.
- The existing vertical alignment in the “pass” and town section will be retained.
    - A cross fall of 2.5% will be used over sections where the vertical grades are less than 0.5%.
- The horizontal and vertical alignment is to adhere to the following design speeds:
    - Section 1: Rural (km 63.0 – km 76.7) – 120km/h,
    - Section 2: “Pass” section (km 76.7 – km 79.6) – 80km/h,
    - Section 3: Laingsburg Town (km 79.6 – km 81.7) – 60km/h
- The pavement strategy is as follows:

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  - Section 1 & 2 (km 63.0 to km 79.9): The pavement will be rehabilitated,
  - Section 3 (km 79.9 to km 81.7): The pavement will be reconstructed full depth,
  - A new pavement structure will be constructed for any re-alignment and widening sections.
- There are eighty-six minor culverts along the road. In most instances, the culverts are in need of some form of repair
  - Many culverts need to be upgraded to larger box culverts or larger diameter pipes,
  - It is recommended that all culverts are replaced to have a minimum diameter of 900mm in order to ease the maintenance function.
- The two major bridges in town will require a vertical upgrade together with widening
- There are a total of eight (8) major culverts on the road
  - The structures are in a relatively good condition, with some rehabilitation works required
- Only 2 of the 8 major culverts is envisaged to be upgraded hydraulically to meet the current design standards and guidelines
- The remaining 6 culverts will simply be extended to cater for the new proposed road prism width
- The following can be highlighted in terms of the safety/accident analysis
  - A large number of the statistics show the accidents as occurring due to driver negligence, loss of control or unknown causes.
  - This could also be due to the corridor traffic having a high truck composition with drivers being impatient along sections with only one lane per direction,
  - As a safety element, the current one lane per direction on this section was noted as leading to unsafe behaviour due to driver frustration behind the high truck traffic on the corridor,
  - This means that the construction of a 2 + 1 Configuration, 4 lane configurations through the “Pass” section and Town section will hopefully reduce the most significant accident types
- The road signs, road markings and guardrails are generally in a good condition
- The fencing is in a poor condition
- Due to the upgrading of the road which will include, amongst others, a new cross-section and possible re-alignment, it is proposed that all road furniture be replaced
- A number of utility services will be affected by the upgrade of the road:
  - Laingsburg Municipality (stormwater and sewer),
  - Eskom,
  - Vodacom (part of Neotel)
  - Cell C (part of Neotel)
  - MTN (part of Neotel)
  - Neotel
  - Telkom
- It is expected that additional land will be required to accommodate the widening of the roadway in deep cuts and high fills, in Laingsburg town and at some bridge structures.

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- Land will also be required for the following:
    - New major intersections,
    - New minor intersections,
    - New access/ frontage roads,
    - New or expanded borrow pits,
    - New law enforcement areas

Additional construction material will be required for the rehabilitation of the existing carriageway and the construction of the new widened cross-section.

1.2 Description of Property and Affected Environment

The proposed upgrade of N1 Section 4, between Doornfontein and Laingsburg, is located in the Western Cape Province, in the Central Karoo District Municipality at Laingsburg Local Municipality, of South Africa. The proposed N1 route subject to upgrade follows the existing N1 road infrastructure, as indicated by the highlighted paths in the images (Fig. 1.1 - Fig. 1.5).

This specific section of road proposed for upgrade is located near the town of Laingsburg, with a connection to the N1 highway (Fig. 1.1). This major road provides accessibility to surrounding regions and major towns in the region, enabling transportation between these towns. The development area is connected to the R323 road, linking it directly to Laingsburg. Laingsburg itself is one of the larger agricultural towns in the semi-arid Great Karoo, known for its farming activities including goats, sheep, fruits, and vegetables.

The elevation profile for the proposed upgrade was obtained from Google Earth. The profile extends along the exiting N1, starting at 33° 11 '40.50"S 20° 50' 32.63"E, extending westward and ending at 33°11'55.37"S 20° 38' 20.94"E. The profile illustrates elevation changes from 656m to a maximum of 925m, with an elevation gain of 489m and a loss of 221m. This topographic information is important for planning the upgrade road design and to accommodate the natural terrain contours.

The area is characterised by varied landscapes with rolling hills, valleys, escarpments, and ridges. The sparse vegetation includes hardy shrubland and succulents adapted to the dry climate, highlighting the unique biodiversity of the semi-arid Great Karoo.

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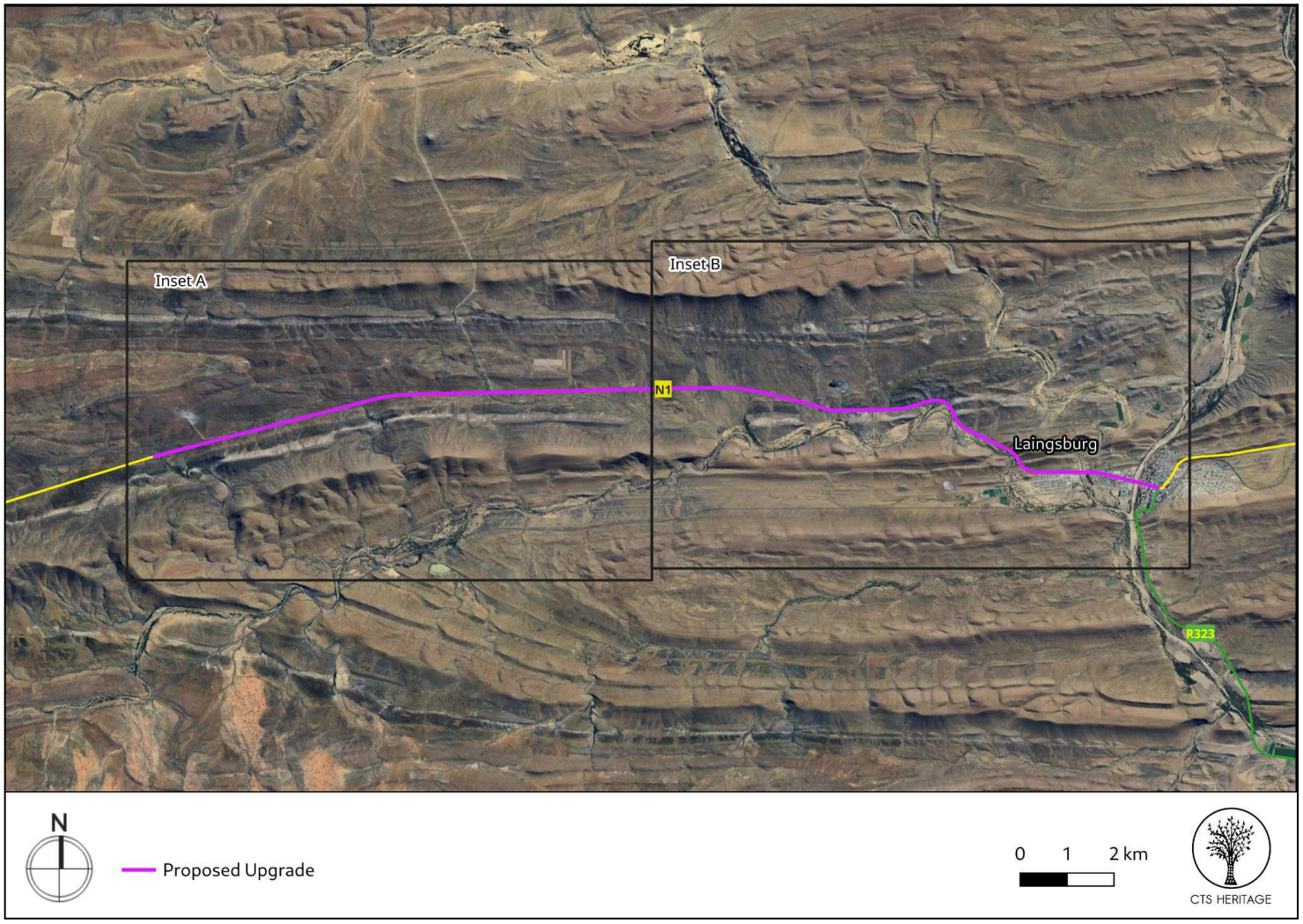

Figure 1.1 Overview Map. Satellite image (2024) indicating the proposed development area at closer range.

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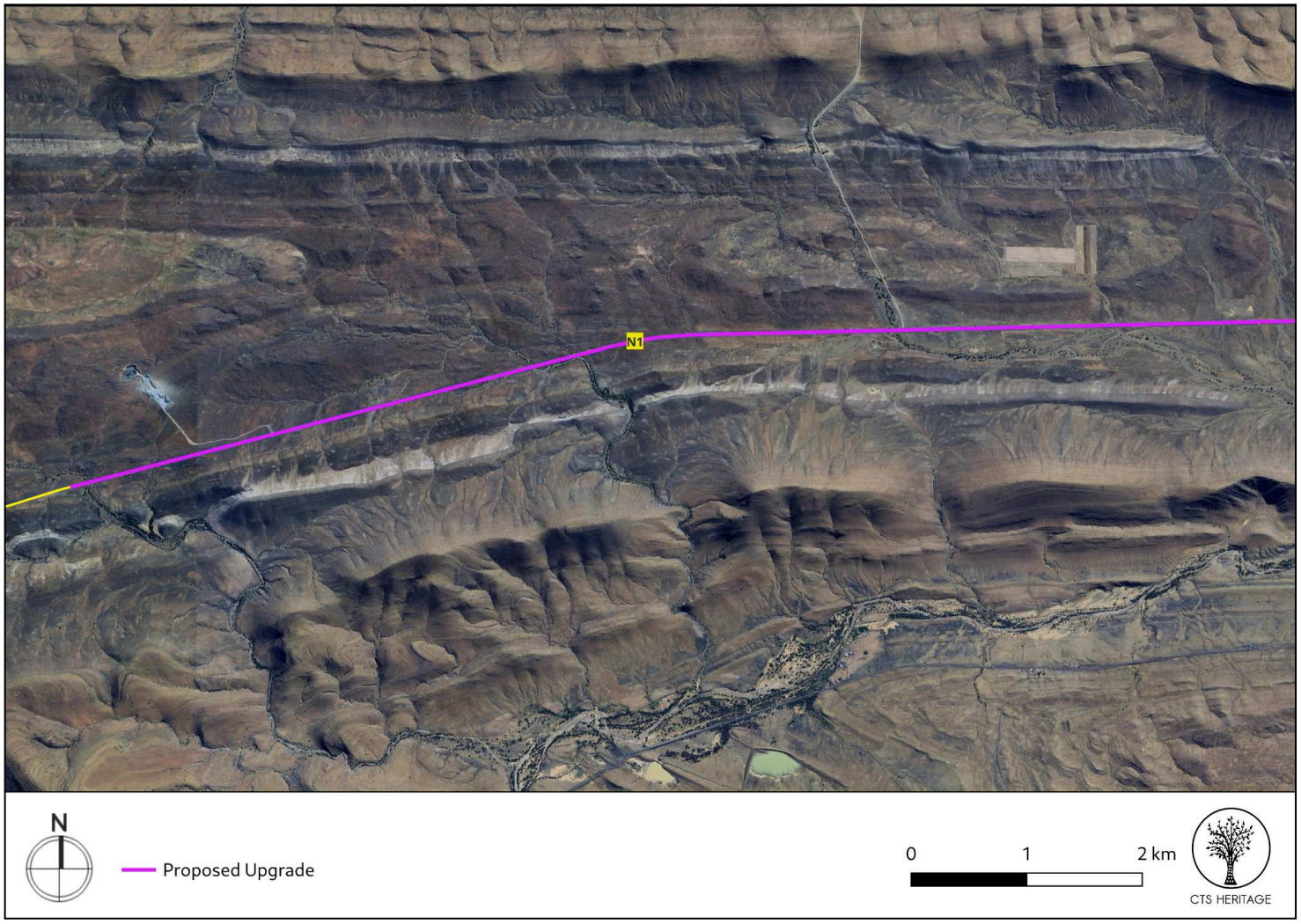

Figure 1.2 Overview Inset Map A. Satellite image (2024) indicating the proposed development at closer range.

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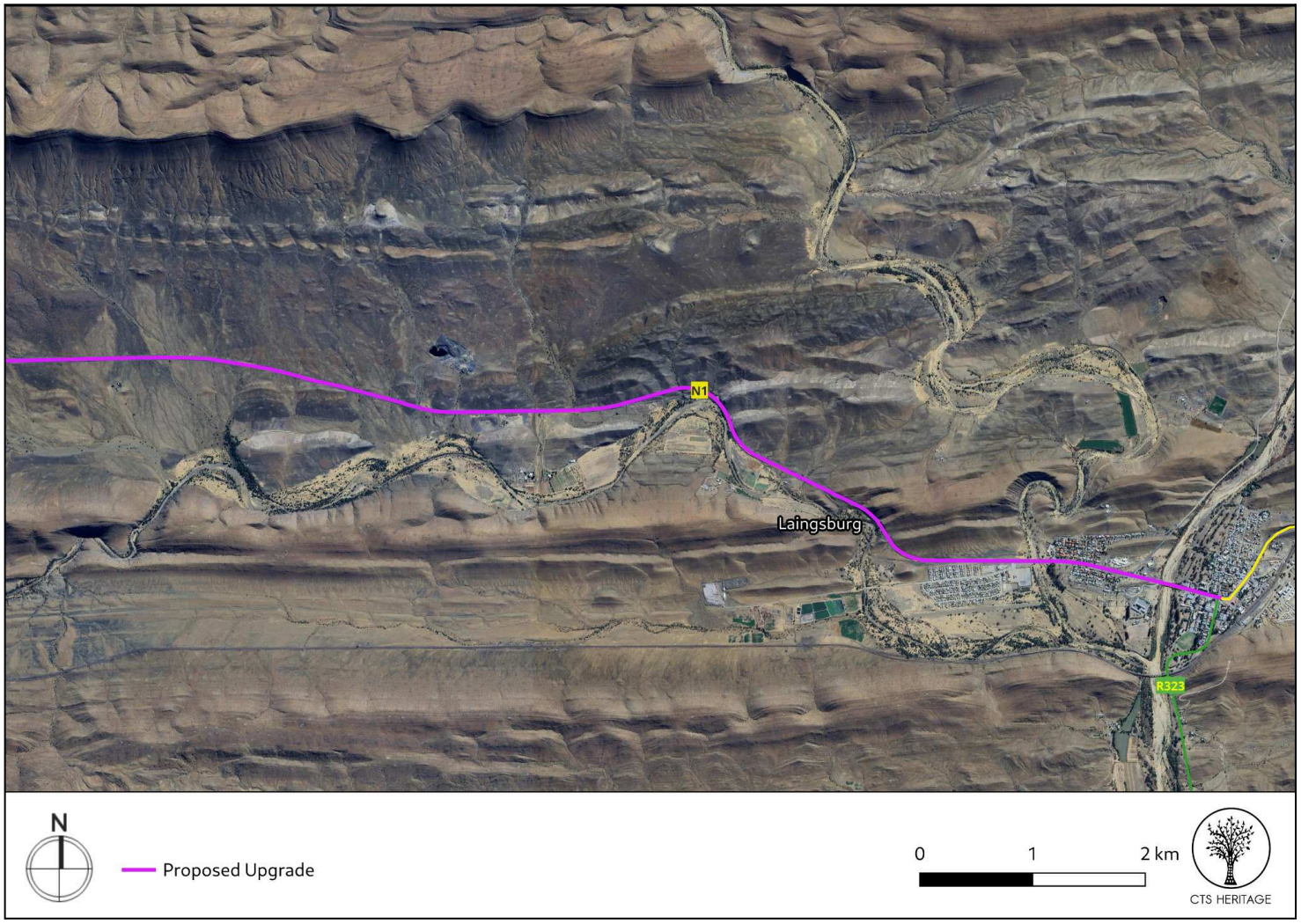

Figure 1.3 Overview Inset Map B. Satellite image (2024) indicating the proposed development at closer range.

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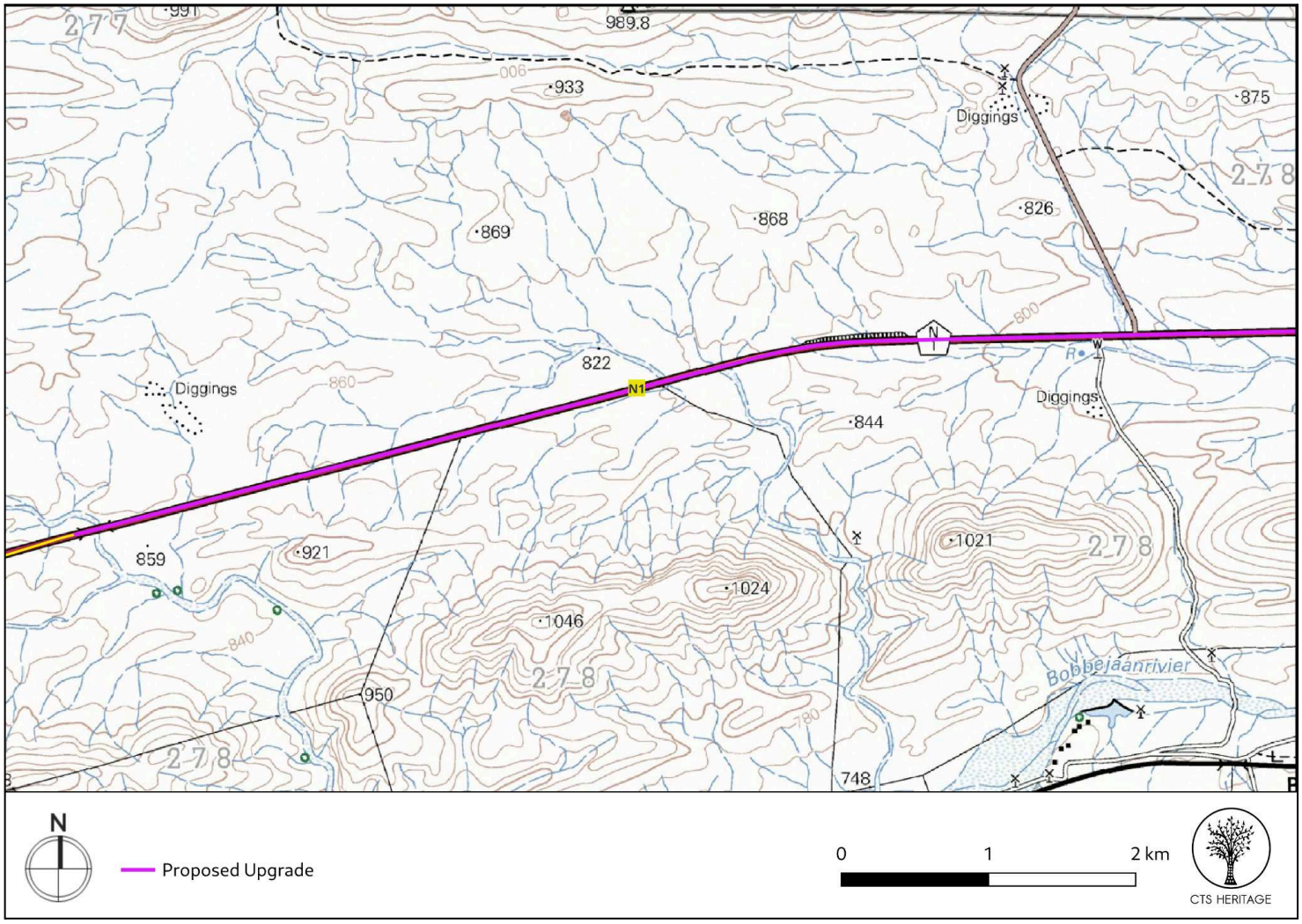

Figure 1.4 Overview Inset Map A. 1:50 000 TopMap for the development area

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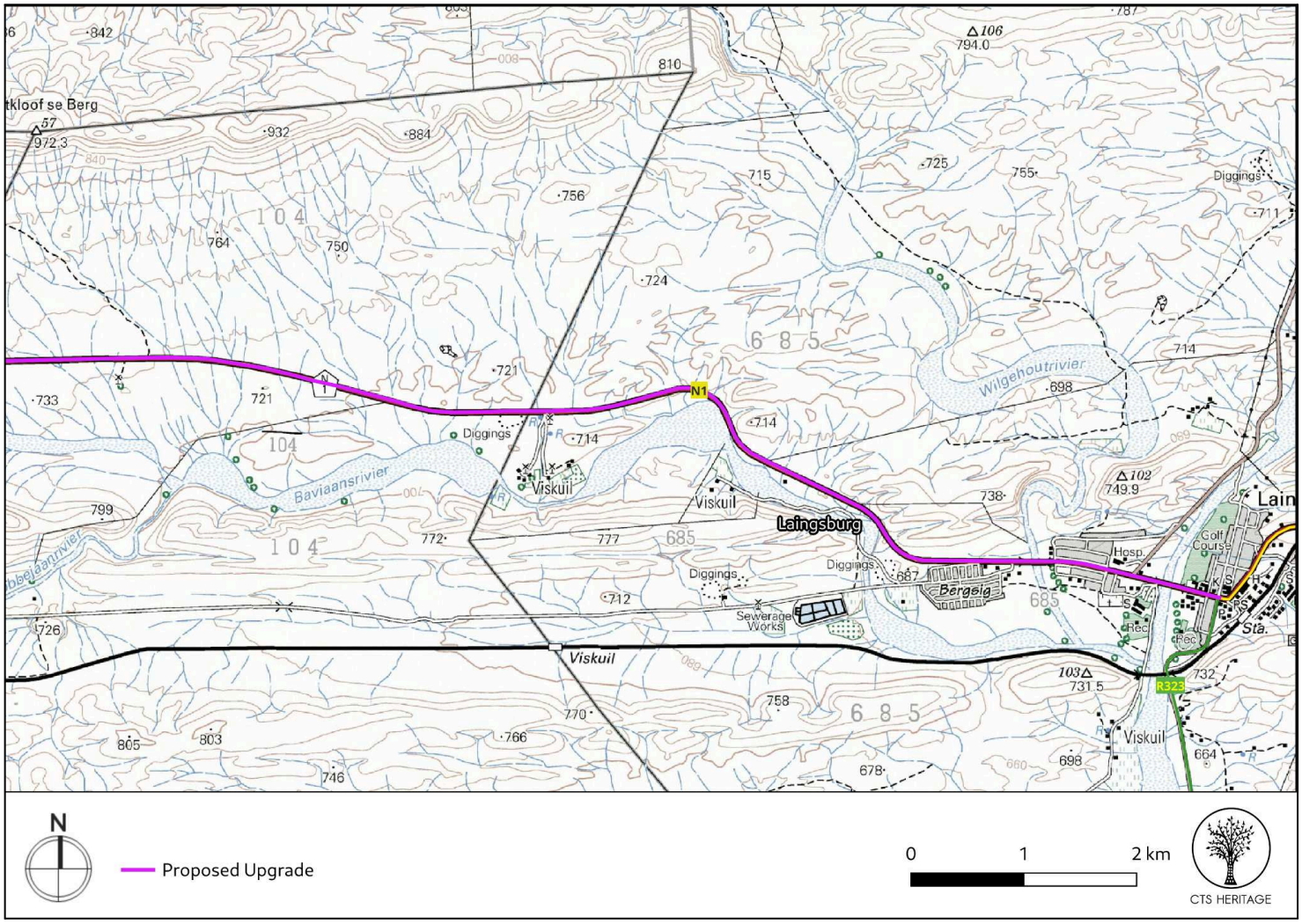

Figure 1.5 Overview Inset Map B. 1:50 000 TopMap for the development area

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2. METHODOLOGY

2.1 Purpose of Palaeontological Study

According to the SAHRIS Palaeosensitivity Map (Figure 4a), the area proposed for development is underlain by sediments of moderate and high paleontological sensitivity. The purpose of this desktop palaeontological 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

- Primary research literature was consulted for detailed accounts of the geology and palaeontological representation across the study area. References of these primary research articles are provided.
- Geological maps (provided at various scales by CTS Heritage and the South African Council for Geosciences) were consulted to identify represented geological contexts within the study area.
- Where possible, other Palaeontological Impact Assessments were consulted to provide additional information on local geomorphological, geological and palaeontological contexts. These often provide valuable additional information to primary research publications and formal geological maps, which can lack resolution at a local scale and it is important that discussions regarding alternative stratigraphic attributions of exposed rocks are noted and considered.

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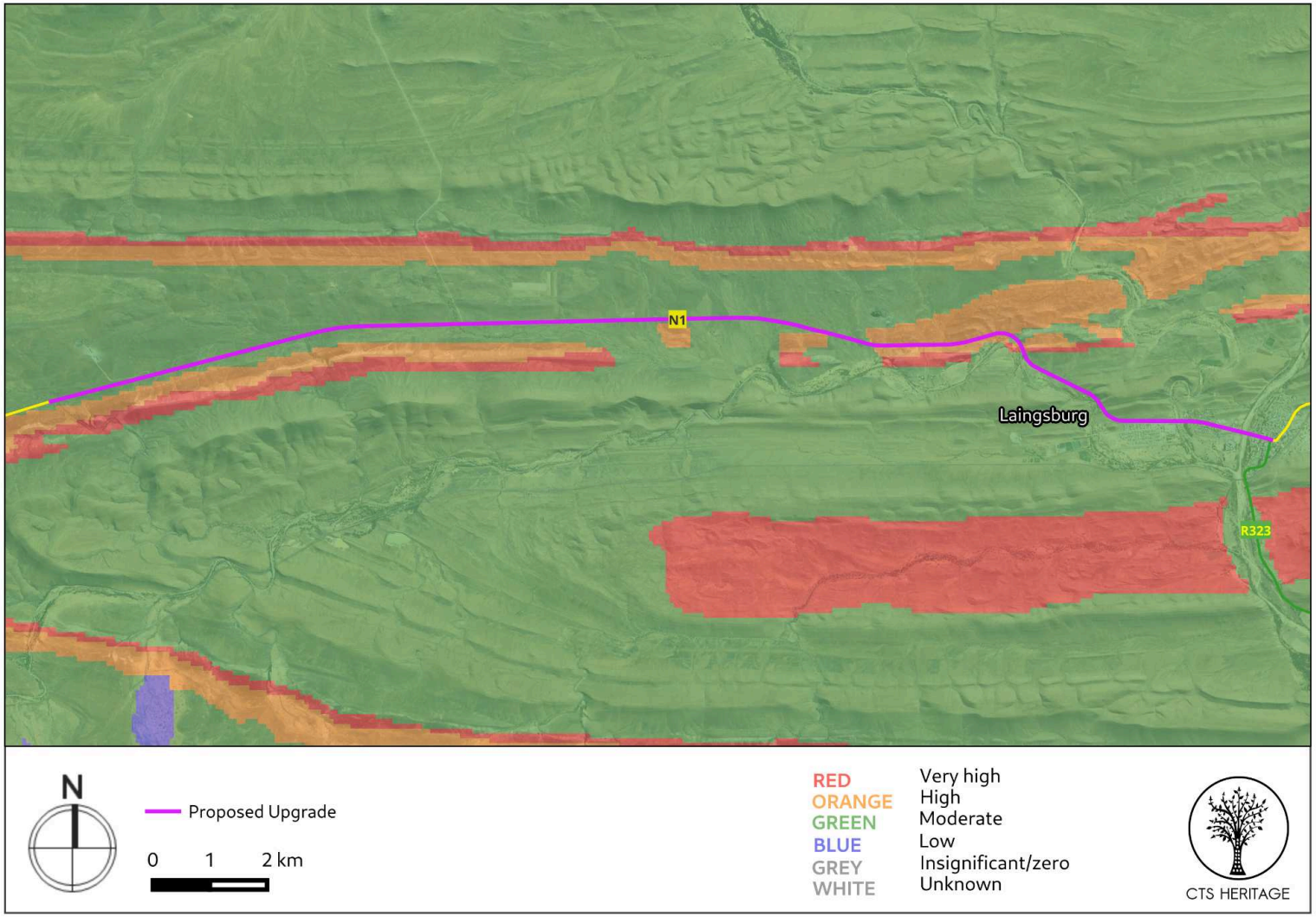

Figure 2: Palaeontological sensitivity of the development area from the SAHRIS PalaeoMap

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3. SITE SENSITIVITY

According to the SAHRIS Palaeosensitivity Map (Figure 4.1), the area proposed for development is underlain by geological sediments of moderate sensitivity for impacts to palaeontology. The Geosciences Map 3320 Ladismith Geology Map indicating that the development area is underlain by C-Pd: Dwyka Formation, and Pf: Fort Brown Formation, both in the Ecca Group, and Quaternary sands The Dwyka sediments are known for their tillite, diamictite, and subsidiary shale,the Fort Brown Formation for its dark-coloured shale with thin siltstone and sandstone beds.

According to the Western Cape Palaeotechnic report (Almond and Pether, 2008), the **Dwyka Formation** in the Ecca Group has **low** palaeontological sensitivity. It is known for its trace fossils, organic-walled microfossils, rare marine invertebrates (eg molluscs), fish, vascular plants interglacial and post-glacial trace fossil assemblages, with a possibility of body fossils (eg molluscs, fish, plants). The fossils are largely from interglacial and immediately post-glacial sediments. The Ecca group, in which the **Fort Brown Formation** falls, has **moderate/medium** palaeontological sensitivity and is known for its sediments with non-marine trace fossils, vascular plants (including petrified wood) and palynomorphs of Glossopteris flora, mesosaurid reptiles, fish (including microvertebrate remains, coprolites), crustaceans, sparse marine shelly invertebrates (molluscs, brachiopods), microfossils (radiolarians etc), as well as insects. According to the Palaeotechnic Report for the Western Cape (Almond and Pether, 2008), **alluvium** has a **very low** sensitivity for impacts to significant palaeontology and as such no further assessment of impacts to palaeontological heritage is recommended.

In the 2020 HIA located less than 13km southwest of the proposed upgrade, CTS Heritage (SAHRIS NID 27482) described the area as follows: "*The study area near Matjiesfontein Village, Western Cape, is situated in semi-arid, hilly terrain along the southern margins of the Great Karoo. The area is drained by numerous small, non-perennial tributaries of the Buffelsrivier drainage system such as the Bobbejaansrivier and its tributary streams. In geological terms it lies within the northern margins of the Cape Fold Belt; the sedimentary bedrocks here are structured by major west-east trending folds, as clearly seen in satellite images, as well as occasional northward-directed thrusts. Examples of these large-scale folds include the rugged quartzitic Witteberge anticline to the south of Matjiesfontein, the Ghaapkop syncline in the east, as well as the major anticline to the north of the N1 with Boelhouerrante at its core. From a stratigraphic viewpoint the bedrocks underlying the project footprint include Early Carboniferous to Early / Middle Permian glacial and marine sediments assigned to the Witteberg Group (Cape Supergroup) as well as to the Dwyka and Ecca Groups. A key section through the geologically significant contact between the Cape and Karoo Supergroups runs across the N1 near the Wauchope Memorial, just west of the present study area. Large parts of the Palaeozoic outcrop area is mantled by Late Caenozoic superficial sediments such as colluvium (scree, hillwash), alluvium, pediment gravels and down wasted surface gravels.*"

As part of this HIA by CTS Heritage, Almond conducted a PIA (2020) and found the following, *"The southern half of the site overlies weathered, tabular-bedded basinal marine and possible lower shoreface sediments of the Prince Albert Formation (Ecca Group) that include a zone of large, lenticular to tabular phosphatic concretions. The commercial potential of these phosphatic ores has been investigated in the 1950s but their exploitation was assessed as*

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uneconomic (Strydom 1950). During the field survey, no trace or body fossils were recorded either within the Dwyka or Ecca Group bedrocks or the overlying unconsolidated superficial sediments, including thick sandy to gravelly alluvium along drainage lines as well as sandy to gravelly soils elsewhere… Without mitigation, the overall impact significance of the proposed SANSA antenna and associated infrastructure project is evaluated as LOW as far as palaeontological heritage resources are concerned."

A recent survey by the eastern Cederberg Group (eCRAG) on the Rietfontein farm, located about 10km southwest of the western end of the proposed upgrade, revealed a series of rock art sites on the Dwyka tillites. These findings have opened up a new geographical area for rock art research. Dr John Almond had also written up a geological and palaeontological guidebook for the landowners of the farm as this area is frequently visited by palaeontologists. A site containing extremely well-preserved fossilised fish was visited by the group (SAHRIS SITE ID 127223) to the southwest of Matjiesfontein, approximately 14,5km southwest of the proposed development.

As part of the HIA conducted by CTS in 2020, they note the following, "*During the course of the present field study of road cuttings along the N1 (Section 4) as well as of the various borrow pit and quarry sites associated with the road project no new body fossil material was recorded, neither from the Palaeozoic bedrocks nor from the overlying Late Caenozoic superficial sediments."*

Thus, the Ecca group may be moderately sensitive, but it is area-dependent. With the proposed upgrade area being restricted to the existing road reserves, the impact is unlikely to be significant but a desktop PIA is recommended to mitigate the risk of impacting significant fossil material.

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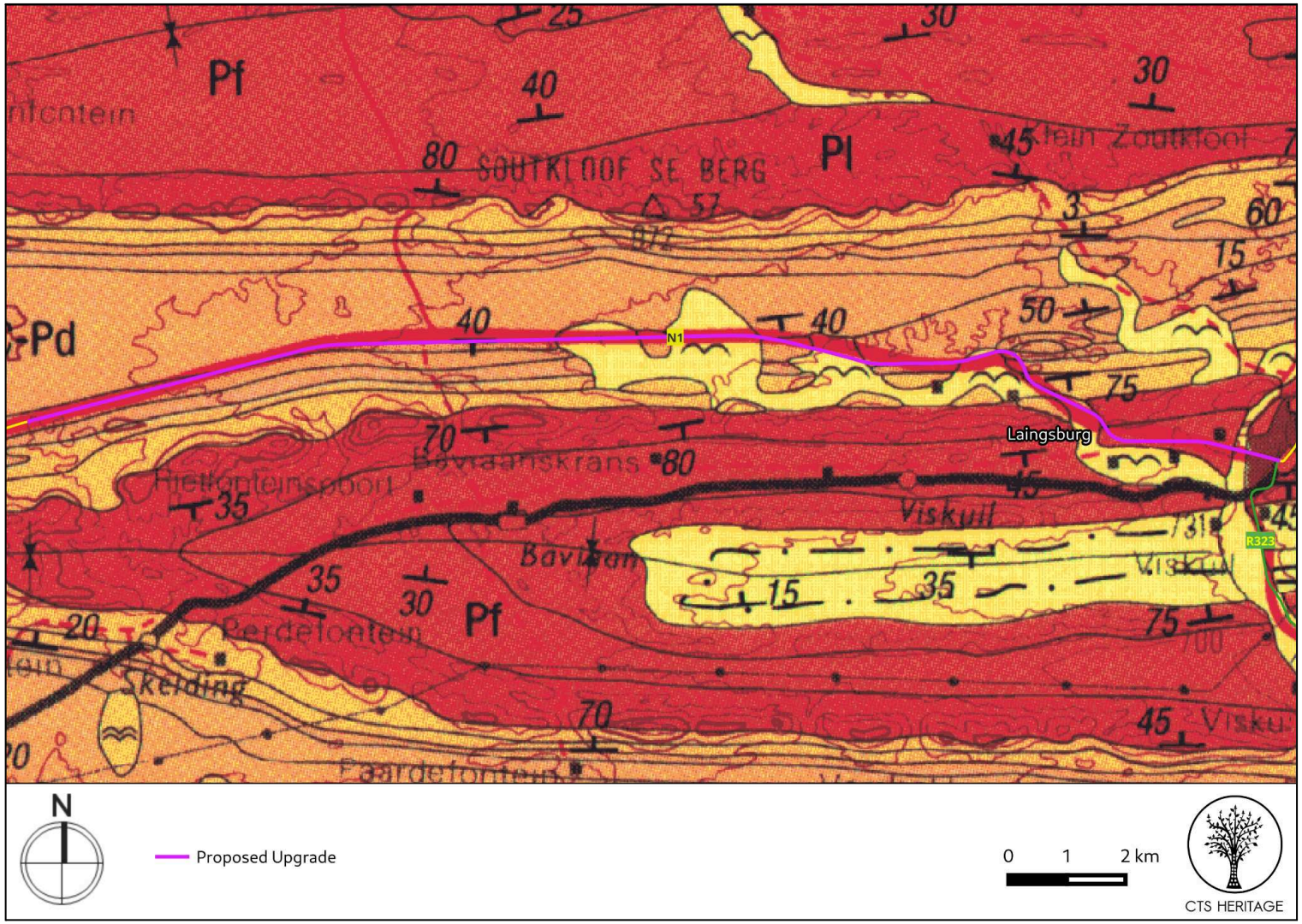

Figure 3. Geology Map. Extract from the Council of GeoScience Geology Map tile 3320 Ladismith Geology Map indicating that the development area is underlain by C-Pd: Dwyka Formation, and Pf: Fort Brown Formation, both in the Ecca Group, and Quaternary sands

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Table 1: Geological Summary Table

Geological unit	Age	Lithology	Symbol on Figure 3	Fossil Heritage	Palaeontological sensitivity	Recommended mitigation
Quaternary	Quaternary 2.58 mya to 0 mya	Alluvium and debris		Calcretised insect burrows (including termites) and root casts (rhizoliths), rare vertebrate remains (e.g. tortoise, mammal), ostrich eggshells (S*truthio*), shells of land snails (e.g. *Trigonephrus*), bivalves and gastropods (e.g. *Corbula*, *unio*) and ostracods (seed shrimps), charophytes (stonewort algae), diatoms, stromatolites, mammalian ichnofossils	Moderate	Any fossil finds to be reported by developer
Karoo Supergroup, Ecca Group, Fort Brown Formation	Middle Permian	Dark coloured shale with thin siltstone and sandstone lenses		Disarticulated microvertebrate remains (eg fish teeth, scales), sponge spicules, spare vascular plants (leaves, petrified wood), moderate diversity trace fossil assemblages (as below plus variety of additional taxa such as large ribbed pellet burrows, arthropod scratch burrows, Siphonichnus etc)	Moderate	Any fossil finds to be reported by developer
Karoo Supergroup, Ecca Group, Laingsburg Formation	Middle Permian	Sandstone, greywacke and siltstone		Disarticulated microvertebrate remains (eg fish teeth, scales), sponge spicules, spare vascular plants (leaves, petrified wood), moderate diversity trace fossil assemblages (as below plus variety of additional taxa such as large ribbed pellet burrows, arthropod scratch burrows, Siphonichnus etc)	Moderate	Any fossil finds to be reported by developer
Karoo Supergroup, Ecca Group, Vischkuil Formation	Middle Permian	Arenaceous shale, siltstone and thin sandstone beds		Disarticulated microvertebrate remains (eg fish teeth, scales), sponge spicules, spare vascular plants (leaves, petrified wood), moderate diversity trace fossil assemblages (as below plus variety of additional taxa such as large ribbed pellet burrows, arthropod scratch burrows, Siphonichnus etc)	Moderate	Any fossil finds to be reported by developer
Karoo Supergroup, Ecca Group, Collingham Formation	Early to Middle Permian	Siltstone, chest and sandstone with thin interbedded shale, and yellow weathering mudstone/ tuff		Low diversity but locally abundant ichnofaunas (horizontal "worm" burrows, arthropod trackways), vascular plant remains (petrified and compressed wood, twigs, leaves etc).	Moderate	Any fossil finds to be reported by developer
Karoo Supergroup, Ecca Group, Whitehill Formation	Early to Middle Permian	Dark grey shale, light-grey weathering with cherty siltstone beds in the upper part		Mesosaurus reptiles, rare cephalochordates, variety of palaeoniscoid fish, small eocarid crustaceans, insects, low diversity of trace fossils (eg king crab trackways, possible shark coprolites), palynomorphs, petrified wood and other sparse vascular plant remains (Glossopteris leaves, lycopods etc)	High	Professional geologist/ palaeontologist to be consulted upon large scale excavations

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Karoo Supergroup, Ecca Group, Prince Albert Formation	EarlyPermian	Dark Grey shale with reddish-brown-weathering siltstone		Low diversity marine invertebrates (bivalves, nautiloids, brachiopods), palaeoniscoid fish, sharks, fish coprolites, protozoans (foraminiferans, radiolarians), petrified wood, palynomorphs (spores, acritarchs), non-marine trace fossils (especially arthropods, fish, also various “worm” burrows), possible stromatolites, oolites	Moderate	Any fossil finds to be reported by developer
Karoo Supergroup, Dwyka Group	Late Carboniferous to the Early Permian 303Ma - 280Ma	Tillite, Diamictite, subsidiary shale		Interglacial mudrocks occasionally with low diversity marine fauna of invertebrates (molluscs, starfish, brachiopods, coprolites etc), palaeoniscoid fish, petrified wood, leaves (rare) and palynomorphs of Glossopteris Flora. Well-preserved nonmarine ichnofauna (traces of fish, arthropods) in laminated mudrocks. Possible stromatolites, oolites at top of succession.	Moderate	Any fossil finds to be reported by developer

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4. IDENTIFICATION OF HERITAGE RESOURCES

4.1 Underlying Geology of Development Area

The geology underlying the proposed upgrade of the N1 road near Laingsburg is illustrated on the Council of GeoScience Geology Map, 3320 Ladismith (Fig. 3), with the units summarised in Table 1. The development area for the proposed N1 upgrade, shown by the purple line on the geology map, traverses multiple geological units (Fig. 3). These units are part of the Dwyka Group and Ecca Group of the Karoo Supergroup.

The Dwyka Group (C-Pd), which dates from the Late Carboniferous to Early Permian (302-288 Ma) (Fildani et al., 2007), forms part of the Karoo Supergroup. During this time, southern Africa formed part of the Supercontinent Gondwana, which drifted over the South Pole, with ice sheets covering sections of southern Africa. As Gondwana continued to drift northwards, the ice sheets melted resulting in the deposition of glacial sedimentary rocks characterised by tillite, diamictite, and subsidiary shale (Theron et al., 1975, Visser & Young, 1990, McCarthy and Rubidge, 2005). Striated pavements and dropstones are also present in the Dwyka Group, which resulted from glaciers moving over the land surface.

Overlying the Dwyka Group are the younger sediments of the Ecca Group. The Ecca Group sediments were deposited from the Early to Middle Permian, within the Karoo Sea (Johnson et al. 2006). Rivers drained from mountainous areas into the Karoo Sea, where sediments were deposited in small deltas which continuously built out into the Karoo Sea (McCarthy and Rubidge, 2005). The Ecca Group is subdivided into the Prince Albert (Pp), Whitehill (Pw), Collingham (Pc), Vischkuil (Pv), Laingsburg (Pl), and Fort Brown (Pf) formations, which all occur in the project area.

- The Prince Albert Formation (Ppr) forms the lowermost subunit of the Ecca Group, dating to the Early Permian (280-275 Ma) (Fildani et al., 2007). The Prince Albert succession consists mainly of tabular-bedded mudrocks of blue-grey, olive-grey to reddish-brown colour with occasional thin (dm) buff sandstones and even thinner (few cm) soft-weathering layers of yellowish water-lain tuff (i.e., volcanic ash layers) (Almond, 2012). Thin cherty beds, pearly-blue phosphatic nodules, rusty iron carbonate nodules, and elongate elliptical concretions impregnated with iron and manganese minerals are present in the Prince Albert Formation (Almond, 2012). The rocks are well-jointed and occasionally display a well-developed tectonic cleavage that results in sharp, elongated cleavage flakes.
- The Prince Albert Formation is overlain by the Whitehill Formation (Pw) of the Ecca Group, dating from the Early to Middle Permian (275 Ma) (Fildani et al., 2007). This formation is characterised by dark grey shale that weathers to light grey. The Whitehill Formation contains finely laminated carbon-rich mudrocks, which were deposited in a large inland sea, contributing to their high organic content. The Whitehill Formation has been subdivided into two major subunits based on their weathering colour in outcrops. The lower and thicker portion is predominantly composed of bluish- to greenish-grey shales and mudstones, which transition upward into more light brownish, buff-weathering, slightly coarser-grained siltstones. This zone is conformably overlain by white-weathering shales, interspersed with occasional chert lenses and pyritic stringers that rarely exceed 20

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mm in thickness. The white appearance of this section is due to the surface weathering of pyrite (sulphide) to sulphate (gypsum) (Branch et a., 2007). Lithologically, only the upper part of the succession consists of the Whitehill-characteristic carbonaceous black shales. A tuffaceous zone is also present (Johnson et al., 2006).

- Above the Whitehill Formation sequences grade vertically upwards into the sandier Upper Ecca Group, which include the Collingham Formation (Pc). The Early to Middle Permian aged Collingham Formation (Pc) overlies the Whitehill Formation and comprises siltstone, chert, and sandstone with thin interbedded shale and yellow weathering mudstone or tuff. The mudstones are parallel laminated, often showing flaser and wavy bedding at the contact of the mudstone and the tuff. The ashfall tuff-zircons have been radiometrically dated to the Middle Permian (274-270 Ma) (Fildani et al., 2007).
- The Vischkuil Formation (Pv), which was deposited during the Middle Permian, conformably overlays the Collingham Formation. It is divided into lower and upper units that consist of arenaceous shale, siltstone, intercalated ash beds, and thin sandstone beds (van Der Merve et al., 2010). The lower Vischkuil Formation spans 190 metres and features undeformed graded siltstone beds and mudstone lithofacies. In contrast, the upper Vischkuil Formation, which is 220 metres thick, predominantly consists of similar facies but also includes three widespread syn-sedimentary deformation units ranging from 10 to 85 metres in thickness (Van Der Merwe et al., 2009).
- The Laingsburg Formation (Pl) overlays the Vischkuil Formation representing sedimentary units deposited during the Late Permian (Fildani et al., 2007). This lower unit of this formation consists predominantly of fine-grained sandstones, which are thought to have been deposited in shallow marine environments. As the basin developed, the deposition of these sandstones was punctuated by periods of increased siliciclastic input, resulting in thicker sequences of siltstone and thin sandstone turbidites, which are characterised by siltstone-prone turbidites deposits (Flint et al., 2011).
- The youngest Ecca Group unit in the area is the Fort Brown Formation (Pf) predominantly comprises dark grey, tabular-bedded mudrocks, interspersed with subordinate fine-grained sandstones or wackes, becoming increasingly significant towards the contact with the overlying Waterford Formation (Johnson et al., 2006; Almond, 2016). The mudrock succession is characterised by cyclically-banded rhythmites, forming upward-coarsening and thickening packages that range from a few metres to tens of metres in thickness. This rhythmic sedimentation pattern is believed to indicate annual fluctuations in sediment supply to the Ecca Basin (Johnson et al. 2006). Deposition took place in a pro deltaic environment and included suspension settling, along with fine-grained turbidite and tempestite event beds. The upper part of the succession commonly features soft-sediment deformation structures related to slumping and loading, such as recumbent folds and ball-and-pillow structures, as well as symmetrical wave ripples and ferruginous carbonate lenses or concretions. Additionally, minor tuff layers have been reported from the Darlington Dam area north of Port Elizabeth (Lock & Johnson 1974).

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4.2 Palaeontological Sensitivity of the Development Area

The fossil record of geological units present in the current study area - Dwyka Group and Ecca Group (Prince Albert (Pp), Whitehill (Pw), Collingham (Pc), Vischkuil (Pv), Laingsburg (Pl), and Fort Brown (Pf) formations) are summarised in Table 1. The palaeontological heritage in the geological units is based on work conducted by Almond & Pether (2008), Almond 2008a, 2008b, 2010a, 2015a). This section outlines fossil assemblages from the main sedimentary rock units within the study area.

Dwyka Group

The Dwyka Group (C-Pd) interglacial mudrocks occasionally present a low diversity marine fauna of invertebrates (molluscs, starfish, brachiopods, coprolites etc), palaeoniscoid fish, petrified wood, leaves (rare) and palynomorphs of *Glossopteris* Flora. Well-preserved non-marine ichnofauna (traces of fish, arthropods) are also present in laminated mudrocks, with possible stromatolites, oolites at top of succession (Amond & Pether, 2008). Palaeontological impact assessment in the broader area have stated that the Dwyka Group in the area comprises unfossiliferous (e.g. Almond 2016). These deposits have therefore been classified as having a **LOW** level of palaeontological sensitivity.

- **Ecca Group**

Prince Albert Formation (Ppr): The fossil biota of the postglacial mudrocks of the Prince Albert Formation is comprehensively summarised by Cole (2005). Epichnial (bedding plane) trace fossil assemblages of the non-marine *Mermia* Ichnofacies, primarily featuring the ichnogenera *Umfolozia* (arthropod trackways) and *Undichna* (fish swimming trails), are commonly found in the basinal mudrock facies. Limited-simple, horizontal to oblique endichnial burrows forming dense monospecific ichnoassemblages have been recorded from the Ceres Karoo (Almond, 2010a). These assemblages have been documented by Anderson (1974, 1975, 1976, 1981) and briefly reviewed by Almond (2008a, 2008b, 2010a, 2010b). Diagenetic nodules contain remains of palaeoniscoid (primitive bony fish), sharks, spiral bromalites (coprolites, spiral gut infills attributable to sharks or temnospondyl amphibians), and petrified wood have been found in the Ceres Karoo (Almond 2008b). Rare shark remains (*Dwykaselachus)* are recorded near Prince Albert on the southern margin of the Great Karoo (Oelofsen 1986). Microfossil remains in this formation include sponge spicules, foraminiferal and radiolarian protozoans, acritarchs, and miospores (Mosavel, & Cole, 2019). These deposits have therefore been classified as having a **MODERATE** level of palaeontological sensitivity.

Whitehill Formation (Pw): The Whitehill Formation contains some of the most important fossils including mesosaurid reptiles (*Mesosaurus tenuidens*, and *Stereosternum tumidum*), which are some of the earliest known marine reptiles (Araujo & Oelofsen, 1987). Additionally, rare cephalochordates, various palaeoniscoid fish, (primitive bony fish), and numerous small eocarid/notocarid crustaceans have been documented (Oelofsen, 1987, VIsser, 1992, Evans, 2005). Insects, predominantly found as isolated wings with some complete specimens and trace fossils such as trackways and possible shark coprolites have been documented (Geersema et al., 2002). Organic-walled spores and pollens (palynomorphs), petrified wood from primitive gymnosperms, and other sparse vascular plant remains like *Glossopteris* leaves and lycopods add to the formation's fossil diversity (Almond 2012). Almond (2012) states in his report that

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although fossils in the Whitehill Formation are generally rare, they are often well-preserved. Grey diagenetic nodules in other areas of the Whitehill outcrop, such as near Prince Albert, have produced well-preserved three-dimensional crustacean fossils. The palaeontological significance of the Whitehill Formation is **HIGH** to **VERY HIGH** and can provide significant fossil material of scientific interest.

Collingham Formation (Pc): The palaeontology of the Collingham Formation has been studied by Viljoen (1992, 1994) and Almond (2008a). The formation has a low diversity, with localised sections of abundant ichnofossils (worm burrows, arthropod trackways), vascular plant remains (petrified and compressed wood, leaves, lycopsids, etc.) (Amond and Pether 2008a). Thicker turbidite beds, particularly in the upper part of the formation, often contain transported, water-logged plant debris and tool marks created by logs. Large blocks of silicified wood have been discovered in the Laingsburg area (Almond 2012). Trace fossil assemblages include horizontal epichnial grooves about 2 cm wide with segmented levees, likely produced by gastropods ("*Scolicia*"), narrow bilobate arthropod furrows ("*Isopodichnus*"), reticulate horizontal burrows (possibly washed out *Megagrapton*-like systems), and densely packed horizontal burrows with a rope-like surface texture covering selected bedding planes (cf *Palaeophycus*) (Anderson (1974). Banching burrows, rare arthropod trackways (*Umfolozia*), and fish swimming trails (*Undichna*) have been recorded (Almond, 2012). A significant discovery from the upper Collingham Formation near Laingsburg is the trackway of a giant sweep-feeding eurypterid, with fragmentary body fossils of similar animals also found in contemporary South American sediments (Almond 2002). These deposits have therefore been classified as having a **MODERATE** level of palaeontological sensitivity.

Vischkuil Formation (Pv): Rare occurrences of trace fossils may be present in the form of multiple epichnial grooves and horizontal burrows (*Cruziana* and *Nereites*). Trace fossils closely match the descriptions of *Scolicia* and *Isopodichnus* as described by Anderson (1974) in similar facies elsewhere in the basin. The most common are thin horizontal *Scolicia* grooves (1.0–2.0 mm in diameter) which appear as randomly oriented paths with no fixed movement direction. The second most common trace fossils are shallow, wide (up to 1.0 cm) *Isopodichnus* epichnial grooves that occasionally show traction marks and maintain more directional pathways. The abundance of Nereites and the occasional occurrence of Cruziana indicate abyssal plain conditions and support low settling rates and starved periods. hese deposits have therefore been classified as having a **MODERATE** level of palaeontological sensitivity.

Laingsburg Formation (Pl): The Laingsburg FOrmation is not much different to the Vischkuil Formation in terms of Palaeontology. hese deposits have therefore been classified as having a **MODERATE** level of palaeontological sensitivity.

Fort Brown Formation (Pf): Trace fossil assemblages are scarce, however bioturbation level may be locally abundant. Trace fossils assemblages include: horizontal interface burrows and distinctive, transversely-ribbed pellet burrows of an unnamed ichnogenus as well as large *Teichichnus spreiten* burrows, undulose *Undichna*, and *Kouphichnium* (Almond 2016). Other trace assemblages of the *Cruziana* and *Skolithos* ichnofacies are found in the shallower water settings towards the top of the Fort Brown Formation (Kingsley, 1977). Plant fragments, disarticulated palaeoniscoid fish scales

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and silicified wood are also found in the Fort Brown Formation common in Ecca delta front successions (Bamford 1999, Theron et al. 1991). Isolated tetrapod bones, presumably transported offshore by floods, have been recorded from the Fort Brown Formation in the Eastern Cape (Kingsley 1977, Rubidge & Oelofsen 1981). Some of these may belong to temnospondyl amphibians. These deposits have therefore been classified as having a **MODERATE** level of palaeontological sensitivity (Almond & Pether, 2008a).

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5. ASSESSMENT OF THE IMPACT OF THE DEVELOPMENT

5.1 Assessment of Impact to Palaeontological Resources

Previous studies (desktop and field studies) reveal that the area proposed for the N1 upgrade, between Doornfontein and Laingsburg, is underlain by sedimentary rock formations ranging from the Early to MIddle Palaeozoic eras. These formations, particularly from the Dwyka and Ecca Groups, contain variable degrees of fossils of importance, particularly those of the Whitehill Formation.

Sediments of Dwyka Group and Lower to Middle Ecca Group bedrocks are extensively tectonically deformed and weathered in the area. These rocks are exposed along the N1, and have been extensively studied for their fossil content, as indicated by the various authors used in this report. The Dwyka Group constitutes most of the project area and has yielded a low-diversity trace fossil assemblages which are of limited scientific interest. The Ecca Group sediments, constitutes a more local area and are known to yield a moderate level of diverse fossils, particularly trace fossils, which are not of utmost scientific importance. A small section of the Ecca Group - the Whitehill Formation is exposed along the N1 towards the town of Laingsburg. This is very local and does not cover a large area, the potential for providing significant-scientific fossils is unlikely but not completely excluded. It should be noted that this formation has yielded scientifically interesting fossils like the mesosaurus.

The potential impact of the proposed N1 upgrade on local fossil heritage resources is primarily confined to the construction phase. The destruction, damage, or disturbance of fossils during construction could result in direct negative impacts on palaeontological heritage resources within the development footprint. Although these impacts can often be mitigated, they cannot be fully rectified and are therefore considered permanent.

Given that the sedimentary formations within the study area contain/potentially contain fossils, the impact on fossil heritage is definite. However, most of the fossils in question are likely to be of widespread occurrence within the outcrop areas of the formations, suggesting a low likelihood of losing unique or rare fossil heritage. Due to the generally sparse occurrence of scientifically important, well-preserved, unique, or rare fossil material within the majority of the bedrock formations, the severity of these impacts is rated as moderate.

No to minimal significant further impacts on fossil heritage are anticipated during the planning, operational, and decommissioning phases. Provided that the proposed recommendations for palaeontological monitoring and mitigation are followed, there are no objections on palaeontological heritage grounds to the authorization of the N1 upgrade project. However, due to the absence of a field assessment of the study area, confidence levels for this palaeontological heritage assessment are only moderate. These conclusions are supported by previous palaeontological field assessments undertaken in the broader study region, which indicate that the overall impact significance of proposed developments is low, with a slight probability of significant impacts on unique or rare fossils, particularly in the Whitehill Formation.

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6. CONCLUSION AND RECOMMENDATIONS

The proposed upgrade of National Route 1 (N1) Section 4 between Doornfontein and Laingsburg traverses an area underlain by geological and palaeontological significant formations, notably the Dwyka and Ecca Groups. The palaeontological sensitivity of these formations varies, with the Ecca Group, particularly the Whitehill Formation, being known for its significant fossil content, including mesosaurid reptiles and various trace fossils.

The Dwyka Group is characterised by low-diversity trace fossils and generally exhibits low palaeontological sensitivity. In contrast, the Ecca Group formations, especially the Whitehill Formation, have yielded important fossil material, including well-preserved mesosaurid reptiles, trace fossils, and various microfossils. This formation is of high palaeontological significance. The primary impact on fossil heritage will occur during the construction phase due to potential destruction, damage, or disturbance of fossils. However, given the sparse occurrence of scientifically significant fossils in most of the bedrock formations, the overall severity of impacts is considered moderate. However, the presence of the existing N1 road infrastructure is expected to reduce the likelihood of significant fossil impact, though the confidence in this assessment remains moderate due to the absence of field assessments.

To mitigate these impacts, it is recommended that during excavation or rock removal activities beyond the current road and marginal boundaries, a palaeontologist must be present during all construction and excavation activities in the Whitehill Formation. This is particularly important near the rock outcrop closest to Laingsburg. The HWC Chance Fossil Finds Protocol must be integrated into the Environmental Management Programme (EMPr).

By adhering to these recommendations, the proposed N1 upgrade can proceed with minimised impact on palaeontological resources.

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27706	HIA	CTS Heritage	22/10/2021	NUProposed establishment of 132kV powerline to evacuate power from the Karreebosch WEF to the National Grid in the Western and Northern CapeLL
53187	HIA Phase 1	Timothy Hart, Lita Webley	01/03/2011	HERITAGE IMPACT ASSESSMENT PROPOSED WIND ENERGY FACILITY
138341	**Heritage Specialist Report**	**Tim Hart, Lita Webley**	**31/03/2011**	**Roggeveld PROPOSED WIND ENERGY FACILITY**
155976	HIA Phase 3	CTS Heritage	11/05/2020	ARCHAEOLOGICAL and PALAEONTOLOGICAL WALKDOWN REPORT for the final layout for the proposed 86MW Oya Wind Energy Facility and associated infrastructure, between Matjiesfontein and Sutherland in the Western and Northern Cape Provinces
186695	HIA Phase 1	McEdward Murimbika	01/08/2014	Proposed Gamma-Kappa 2nd 765kV Eskom Transmission Powerline and Substations Upgrade Development in Western Cape PHASE 1 HERITAGE IMPACT ASSESSMENT STUDY REPORT
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186698	PIA Desktop	JF Durand	09/06/2013	GAMMA-KAPPA 765kV Transmission Line, Western Cape Province Scoping Report Palaeontology
186703	Visual Impact Assessment		01/01/2014	The Proposed Gamma Kappa 2nd 765KV Transmission Powerline And Substations Upgrade, Northern And Western Cape (NEAS Reference DEA/EIA/0001267/2012 DEA Reference14/12/16/3/3/2/353) Visual Impact Assessment
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337370	PIA Phase 1	Duncan Miller	01/03/2011	Palaeontological Impact Assessment Proposed Roggeveld Wind Energy Facility
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		Schulz		
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APPENDIX 3: Response to NID

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Case No.: HWC24071904EJV0719
Enquiries: Emily-Jane Vowles
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ILifa leMveli leNtshona Koloni
Erfenis Wes-Kaap
Heritage Western Cape

Jenna Lavin / Chauke Hlahla Wisdom
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RESPONSE TO NOTIFICATION OF INTENT TO DEVELOP: HIA REQUIRED
In terms of Section 38(8) of the National Heritage Resources Act (Act 25 of 1999) and the Western Cape Provincial Gazette 6061, Notice 298 of 2003

NOTIFICATION OF INTENT TO DEVELOP: PROPOSED N1 UPGRADE BEWEEN DOORNFONTEIN AND LAINGSBURG SUBMITTED IN TERMS OF SECTION 38(1) OF THE NATIONAL HERITAGE RESOURCES ACT (ACT 25 OF 1999)

The matter above has reference.

Heritage Western Cape is in receipt of your application for the above matter received. This matter was discussed at the Heritage Officers Meeting held on 26 August 2024.

You are hereby notified that, since there is reason to believe that the proposed N1 upgrade between Doornfontein and Laingsburg will impact on heritage resources, HWC requires that a Heritage Impact Assessment (HIA) that satisfies the provisions of Section 38(3) of the NHRA be submitted. Section 38(3) of the NHRA provides

*(3) The responsible heritage resources authority must specify the information to be provided in a report required in terms of subsection (2)(a)**: Provided that the following must be included:***

(a) The identification and mapping of all heritage resources in the area affected;
(b) an assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6(2) or prescribed under section 7;
(c) an assessment of the impact of the development on such heritage resources;
(d) an evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
(e) the results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;
(f) if heritage resources will be adversely affected by the proposed development, The consideration of alternatives; and
(g) plans for mitigation of any adverse effects during and after the completion of the proposed development.

(Our emphasis)
This HIA must in addition have specific reference to the following:

- Archaeological Impact Assessment
- Palaeontological Impact Assessment

The HIA must have an overall assessment of the impacts to heritage resources which are not limited to the specific studies referenced above.

The required HIA must have an integrated set of recommendations.

The comments of relevant registered conservation bodies; all Interested and Affected parties; and the relevant Municipality must be requested and included in the HIA where provided. Proof of these requests must be supplied.

Street Address: Protea Assurance Building, Green Market Square, Cape Town, 8000 • **Postal Address:** P.O. Box 1665, Cape Town, 8000 • **Tel:** +27 (0)21 483 5959 • **E-mail:** ceoheritage@westerncape.gov.za

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Our Ref: HM/ CENTRAL KAROO / LAINGSBURG / MULTIPLE ERVEN AND FARMS
Case No.: HWC24071904EJV0719
Enquiries: Emily-Jane Vowles
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ILifa leMveli leNtshona Koloni
Erfenis Wes-Kaap
Heritage Western Cape

If applicable, applicants are strongly advised to review and adhere to the time limits contained the Standard Operational Procedure (SOP) between DEADP and HWC. The SOP can be found using the following link http://www.hwc.org.za/node/293

Kindly take note of the HWC meeting dates and associated agenda closure date in order to ensure that comments are provided within as Reasonable time and that these times are factored into the project timeframes.

HWC reserves the right to request additional information as required.
Should you have any further queries, please contact the official above and quote the case number.

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Waseefa Dhansay
Assistant Director: Professional Services

Heritage Western Cape
Erfenis Wes-Kaap
ILifa leMveli leNtshona Koloni

27 August 2024

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APPENDIX 4: Evidence of PPP