

PALAEONTOLOGICAL AND HERITAGE IMPACT
ASSESSMENT FOR THE PROPOSED MANGAUNG
METROPOLITAN MUNICIPALITY NORTHERN BULK
DISTRIBUTION PIPELINE, BLOEMFONTEIN, FREE STATE
PROVINCE.



Report prepared for

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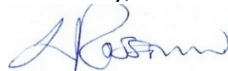
Specialist Info

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Declaration of Independence

Paleo Field Services remains financially independent, with no vested interest in project activities or outcomes except for professional fees. Its sole remuneration comes from agreed-upon services for each project. Paleo Field Services accepts client-provided information as accurate.

Yours truly,

A handwritten signature in blue ink, appearing to read "L Rossouw".

June 2026

SUMMARY

A Phase 1 Archaeological and Palaeontological Impact Assessment (AIA/PIA) was undertaken for the proposed Mangaung Metropolitan Municipality Bulk Distribution Pipeline project, comprising the installation of a ~13 km Bulk pipeline, a ~2.5 km Sewer pipeline, and a ~1.25 km Water pipeline within a predominantly urban and peri-urban setting north of Bloemfontein, Free State Province. **Palaeontology** — The three pipeline routes are underlain by sedimentary strata of the late Permian Adelaide Subgroup (Beaufort Group, Karoo Supergroup), which are regionally assigned a high palaeontological sensitivity. However, field verification confirmed that across all three alignments, fossil-bearing bedrock is variably mantled by eluvium, late Quaternary aeolian-derived topsoils, and residual dolerite weathering material, resulting in a low effective palaeontological sensitivity at surface level. No fossil material was observed during the field assessment. The probability of encountering in situ fossiliferous material during construction is considered low, provided excavations remain within the overlying soil mantle. The palaeontological impact significance of the three routes is therefore assessed as low, and the development is supported from a palaeontological perspective, subject to (1) the implementation of a Chance Finds Procedure (CFP) within the project's Environmental Management Programme (EMPr) and (2) notification of a qualified palaeontologist for routine palaeontological monitoring if excavations extend into unweathered sedimentary (Adelaide Subgroup) bedrock below the soil mantle. **Archaeology** — The surveyed alignments traverse landscapes variably modified by agriculture, road infrastructure, fluvial reworking, grazing, and peri-urban expansion, with generally low archaeological visibility and preservation potential within the active route corridors. No in situ heritage resources — including Stone Age artefact scatters, graves, or structures older than 60 years — were recorded within 5 m of any pipeline footprint. A localised cluster of probable historical graves and associated stone-built features (late 19th–early 20th century) is located on a dolerite kopje near the N1/R700 junction on the farm Olrig 1710, situated 50–400 m from the bulk pipeline footprint. Two stone-built gateway pillars, recorded near an unpaved access track linking a modern homestead to the R700 public road possibly predate the current peri-urban landscape, and is located 16 m east of the bulk pipeline footprint. The historical cluster and stone-built gateway pillars are respectively assessed as being of Local Significance (Grade 3A) and Generally Protected (GP A) and fall outside the direct pipeline footprints. The archaeological impact significance of the three pipeline routes is assessed as low, provided that (1) the identified historical features and stone-built gateway pillars are protected by a minimum 30 m no-go buffer and a 10 m no-go buffer, respectively, (2) construction remains confined to approved corridors, and (3) a CFP is implemented during all ground disturbance. The proposed development may proceed from both an archaeological and palaeontological perspective, subject to the abovementioned recommendations.

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INTRODUCTION

A Phase 1 Archaeological and Palaeontological Impact Assessment (AIA/PIA) was undertaken for the proposed Mangaung Metropolitan Municipality Bulk Distribution Pipeline project, which comprises the installation of a ~13 km bulk pipeline, a ~2.5 km sewer pipeline, and a ~1.25 km water pipeline within a predominantly urban and peri-urban setting north of Bloemfontein (**Fig. 1 & 2, Map Reference:** 1:50 000 scale topographic map 2926AA Bloemfontein and 1:250 000 scale geological map 2926 Bloemfontein). The proposed pipeline network follows a largely linear corridor aligned along existing major road infrastructure and traverses a mosaic of transformed land uses, including cultivated fields, open grassland, and fragmented residential and commercial nodes including the Shell Ultra City Bloemfontein and surrounding developments near Somerton and Tredenham Hill (**Fig. 3 – 5**). The assessment evaluates the heritage potential within the proposed development footprint, with particular consideration given to linear excavation impacts and cumulative disturbance along infrastructure corridors in compliance with Section 38 of the National Heritage Resources Act (Act No. 25 of 1999).

LEGAL FRAMEWORK

The assessment is required as a prerequisite for new development in terms of the National Heritage Resources Act (NHRA) 25 of 1999. The NHRA identifies what is defined as a heritage resource, the criteria for establishing its significance and lists specific activities for which a heritage specialist study may be required. The NHRA prescribes a system of grading of places/objects via Section 7 and makes provision for the general protection of heritage resources via Sections 34, 35, 36, and 37 (in respect of the built environment, archaeology/palaeontology, burial grounds/graves and monuments/memorials, respectively), while Section 38 sets out guidelines under which heritage impact assessments are required when new developments may impact upon heritage resources.

Section 38(1) applies when a development triggers heritage assessment requirements but does not require an environmental authorisation from another regulatory authority, including:

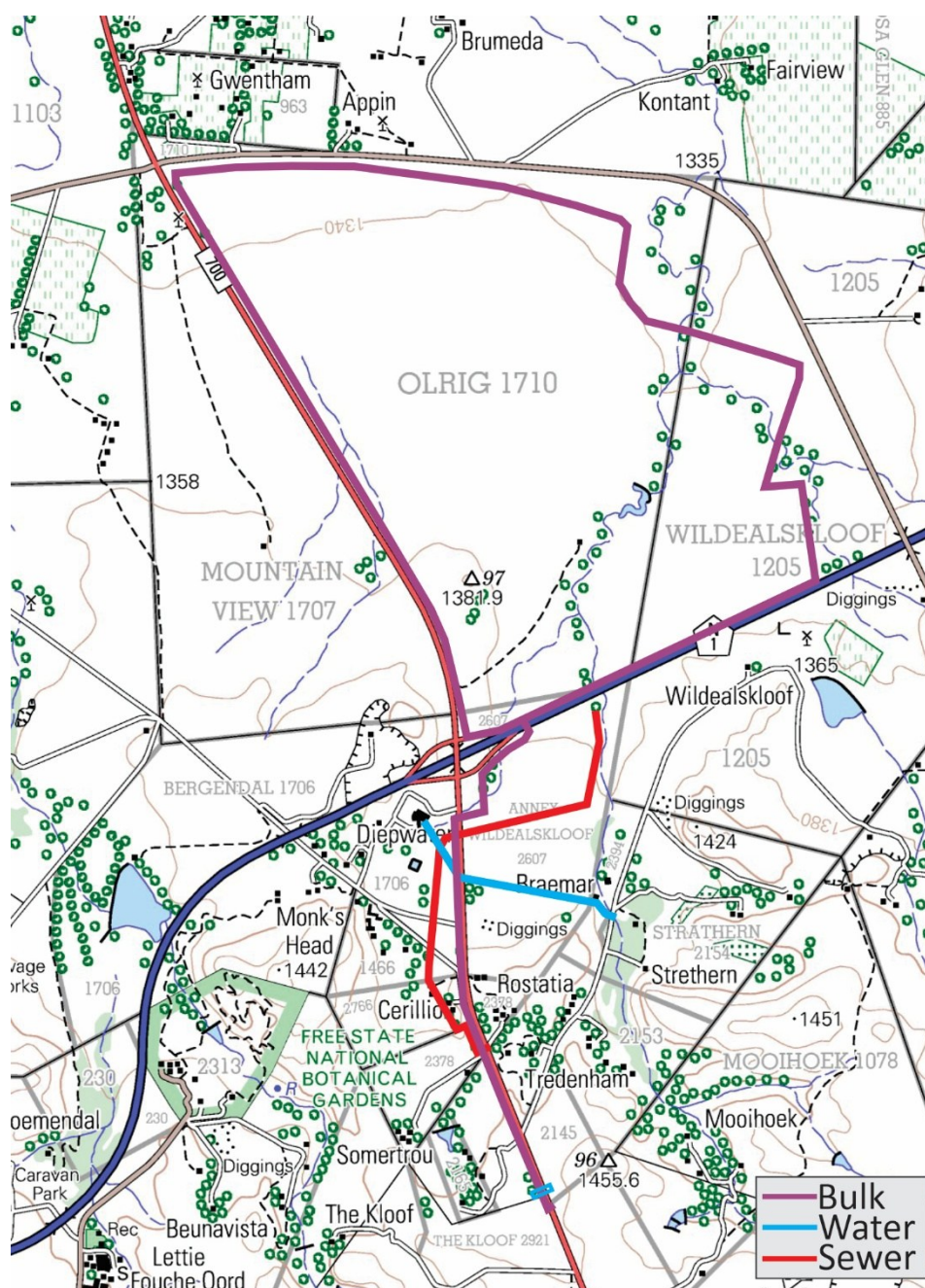


Figure 1. Proposed pipeline footprint marked on portion of 1:50 000 topographic map 2926AA Bloemfontein.

1. Construction of a road, powerline or pipeline, canal or other similar form of linear development or barrier longer than 300m.
2. Construction of a bridge or similar structure exceeding 50 m.
3. Development exceeding 5,000 m².
4. Rezoning of land exceeding 10,000 m², or
5. Any development that may impact recognized heritage resources (e.g., archaeological sites, graves, buildings older than 60 years).

Section 38(3) of the NHRA sets the minimum information requirements for a Heritage Impact Assessment report: the responsible heritage resources authority must ensure that any report submitted includes, at least, the core elements listed in Section 38(3)(a)–(g), namely identification and mapping of heritage resources, significance assessment, impact assessment, evaluation against socio-economic benefits, consultation outcomes, consideration of alternatives (where impacts occur), and mitigation planning.

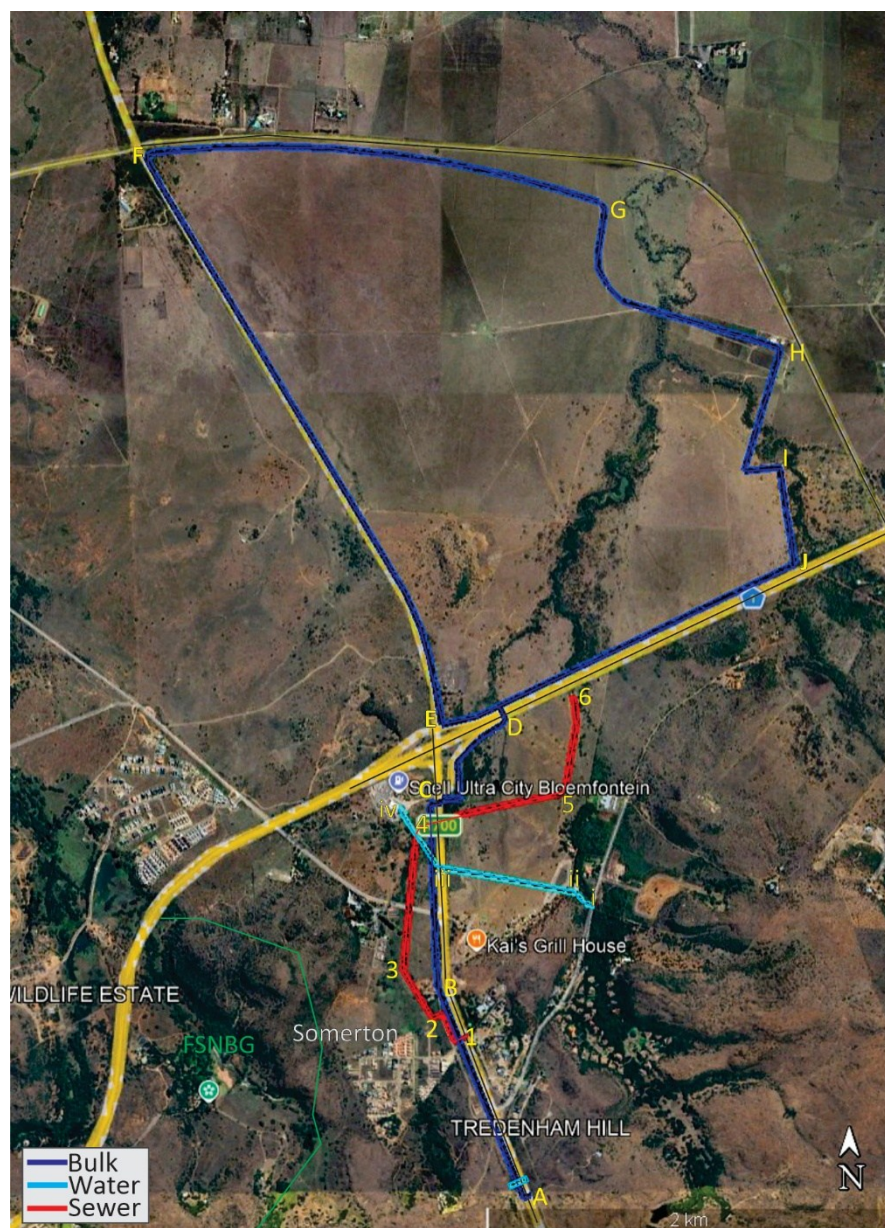


Figure 2. Aerial view of proposed pipeline footprint.

Table 1. Pipeline GPS Coordinates (see Figure 2).

Route	Position S	Position E
Bulk		
A	29° 3'29.37"S	26°13'47.19"E
B	29° 2'55.86"S	26°13'30.54"E
C	29° 2'26.81"S	26°13'29.93"E
D	29° 2'13.71"S	26°13'43.37"E
E	29° 2'13.96"S	26°13'31.51"E
F	29° 0'42.44"S	26°12'37.36"E
G	29° 0'50.63"S	26°14'1.91"E
H	29° 1'13.65"S	26°14'33.91"E
I	29° 1'32.74"S	26°14'33.95"E
J	29° 1'48.16"S	26°14'36.46"E
Sewer		
1	29° 3'4.49"S	26°13'34.71"E
2	29° 3'1.09"S	26°13'29.52"E
3	29° 2'53.53"S	26°13'24.26"E
4	29° 2'29.97"S	26°13'27.14"E
5	29° 2'24.96"S	26°13'53.85"E
6	29° 2'9.62"S	26°13'55.55"E
Water		
i	29° 2'42.99"S	26°13'59.17"E
ii	29° 2'40.90"S	26°13'55.12"E
iii	29° 2'37.07"S	26°13'31.15"E
iv	29° 2'28.38"S	26°13'24.26"E



Figure 3. General view of the Bulk pipeline route with arrow indicating direction of the alignment.

DISCLAIMER, ASSUMPTIONS AND LIMITATIONS

Information provided by the Client and/or Environmental Assessment Practitioner (EAP) was assumed to be accurate and complete for the purposes of this assessment. Observations presented in this report are based solely on aboveground visibility of features and outcrops as encountered during field survey. The reliability and completeness of these observations are subject to several inherent limitations:

- Fossiliferous outcrops are often limited to exposed lithologies and may be obscured by colluvium, vegetation, or soil mantling; the degree of weathering affects the preservation and visibility of fossil material, with heavily weathered surfaces potentially masking fossil content or fragmenting specimens; stratigraphic context is inferred from visible lithologies only; subsurface fossil-bearing horizons may remain undetected without trenching or coring; access limitations may restrict inspection of key geological exposures, particularly in rugged terrain or areas with restricted land access.
- The surface visibility of archaeological remains is variable and may be significantly reduced by vegetation cover, soil accumulation, or recent land disturbance (e.g., ploughing, erosion, construction); subsurface archaeological remains (e.g., buried structures, features, or artefact scatters) may not be detectable without excavation or remote sensing; weathering and exposure can obscure diagnostic features such as stone alignments, midden deposits, or low-relief structures, especially in areas with high sedimentation or seasonal vegetation growth; accessibility constraints (e.g., fenced properties, steep terrain, or dense bush) may prevent systematic coverage.

METHODOLOGY

The site assessment was carried out in line with the National Heritage Resources Act (Act No. 25 of 1999) and the 2007 SAHRA Minimum Standards for Archaeological and Palaeontological Impact Assessments. Initial site ratings were based on existing field data, relevant databases, and published literature. Topographic, aerial and geological maps were used for illustrative

purposes and to identify potential fossil-bearing formations. Fieldwork involved direct observation through foot surveys, with vehicle access where possible. A Garmin Etrex Vista handheld GPS (set to the WGS 84 datum) and a digital camera were used to record spatial and visual data throughout the survey. GPS coordinates are presented in *Degrees, Minutes, Seconds* format in the report.



Figure 4. General view of the Sewer pipeline route with arrow indicating direction of the alignment.

TERMS OF REFERENCE

The Terms of Reference outlines the scope and objectives for assessing potential impacts on heritage resources—both tangible and intangible—arising from the proposed development, in accordance with relevant legislative standards.



Figure 5. General view of the Water pipeline route with arrow indicating direction of the alignment.

1. Conduct site investigation for a Heritage *Impact Assessment (HIA)* to identify and map heritage sites and occurrences in the affected area(s) and provide an assessment of their significance. This must be done regardless of the sensitivity indicated on the *DESTEA National Web Based Environmental Screening Tool*, as the Department of Environmental Affairs and its entities make no warranty—express or implied—regarding the accuracy, reliability, usefulness, or completeness of the *archaeological and cultural heritage theme layer*.
2. Conduct a site investigation for a Palaeontological Impact Assessment (PIA) using the SAHRIS PalaeoSensitivity Map (**Fig. 6**), regardless of the sensitivity indicated on the *DESTEA National Web Based Environmental Screening Tool*. Identify and map fossils

or exposures in the area and assess their significance. This is required as the Department of Environmental Affairs does not guarantee the accuracy or completeness of the *palaeontology theme layer*.

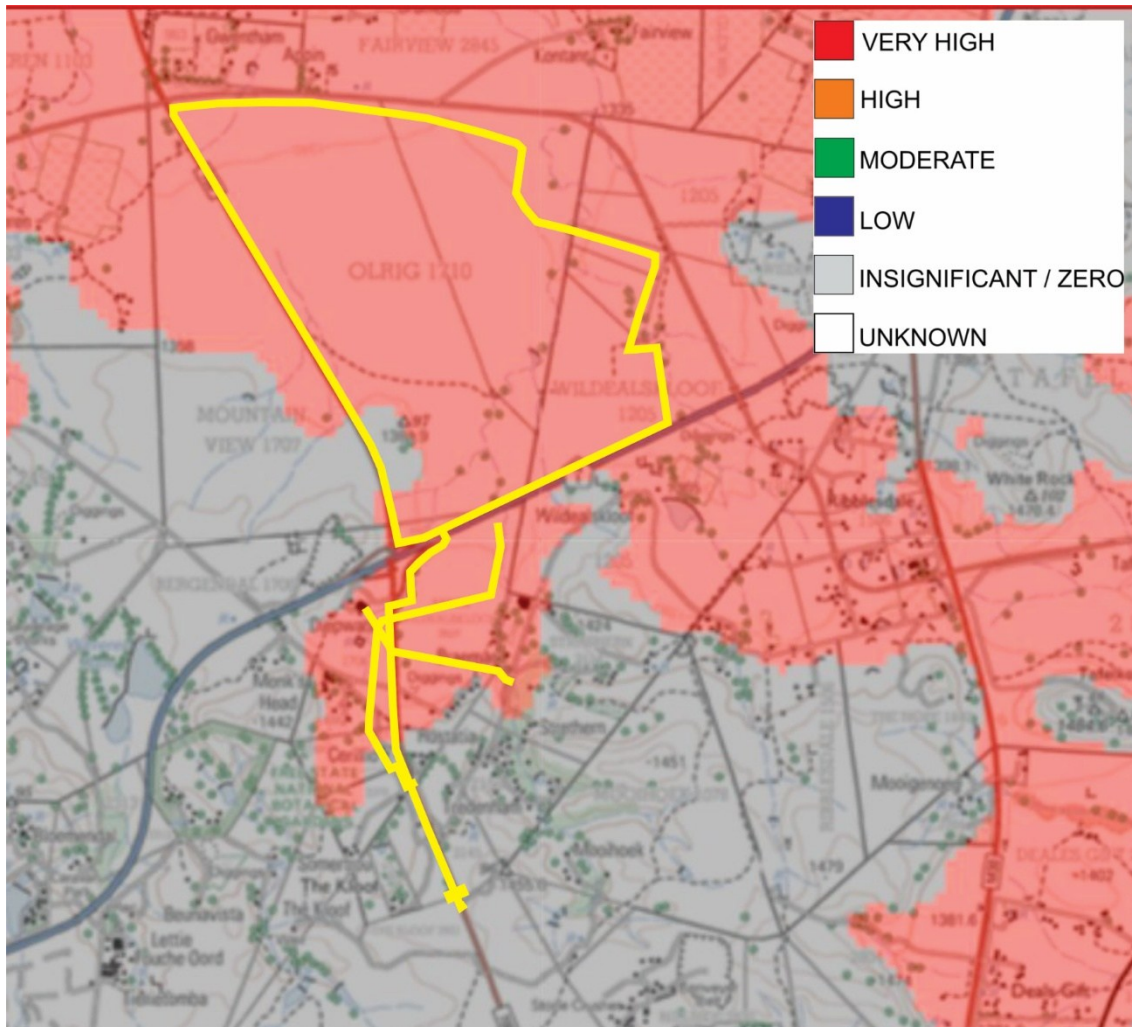


Figure 6. The three pipeline routes marked by yellow lines on portion of SAHRIS palaeosensitivity map.

3. Assess impacts of the proposed development on heritage resources relative to the sustainable social and economic benefits to be derived from the development *if planned impacts will result in the loss of any resources*.
4. Provide a system of grading of places and objects which form part of the national estate, and which distinguishes between at least the categories as prescribed under Section 7 of the NHRA (**Table 2**).

Table 2. Description of Field Rating categories as prescribed in Section 7(1) of the NHRA where SAHRA must by regulation establish a system of grading of places and objects which form part of the national estate, and which distinguishes between at least the categories— (a) Grade 1: Heritage resources with qualities so exceptional that they are of special national significance; (b) Grade 2: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; (c) Grade 3: Heritage resources which can be considered to have special qualities which make them locally significant; and Generally Protected: Other heritage resources which may require mitigation before destruction.

Field Rating	Grade (NHRA No. 25 of 1999, Section 7)	Significance	Mitigation
National Significance (NS)	Grade 1	-	Conservation: national site nomination
Provincial Significance (PS)	Grade 2	-	Conservation: provincial site nomination
Local Significance (LS)	Grade 3A	High significance	Conservation: mitigation not advised
Local Significance (LS)	Grade 3B	High significance	Mitigation (part of site should be retained)
Generally Protected A	-	High/medium significance	Mitigation before destruction
Generally Protected B	-	Medium significance	Recording before destruction
Generally Protected C	-	Low significance	Destruction

PALAEONTOLOGICAL BACKGROUND

The palaeontological background of the northern Bloemfontein area is defined by the relationship between fossil-bearing Late Permian Karoo strata and younger Quaternary sediments within the broader Modder River landscape (**Fig. 7**). The regional geology around Bloemfontein includes rocks of the Beaufort Group, specifically the Adelaide Subgroup, represented by the late Permian Balfour Formation, which consists of alternating sandstone and mudstone layers with fossil-bearing potential (*Pa*, **Fig. 8**). The Karoo strata in the region

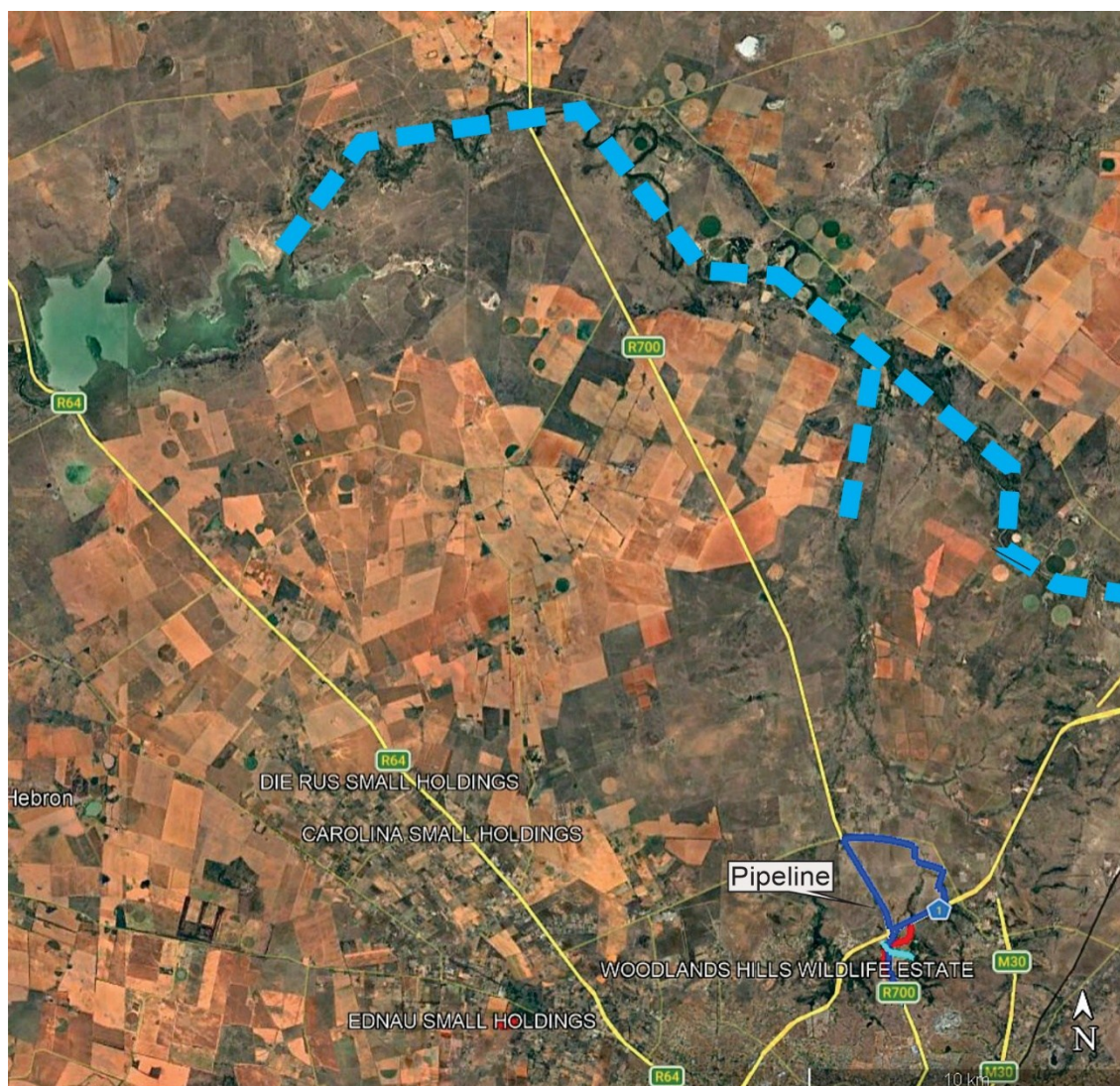


Figure 7. Aerial view of fossil-bearing and archaeologically significant overbank sediments of the Modder River catchment between Krugersdrift Dam and Glen in relation to the location of the study area.

are assigned to the palaeontologically sensitive Dicynodon Assemblage Zone (now more appropriately referred to as the Daptocephalus Assemblage Zone, or DaAZ) Therapsids from the DaAZ are noted as generally being preserved in mudrock horizons, commonly as dispersed or isolated specimens associated with calcareous nodules. Other fossil categories in the regional Permian sequence include molluscs, insects, plant fossils such *Glossopteris* and *Dadoxylon* (now assigned to *Agathoxylon* under modern taxonomic conventions) and trace fossils including arthropod trails and worm burrows.

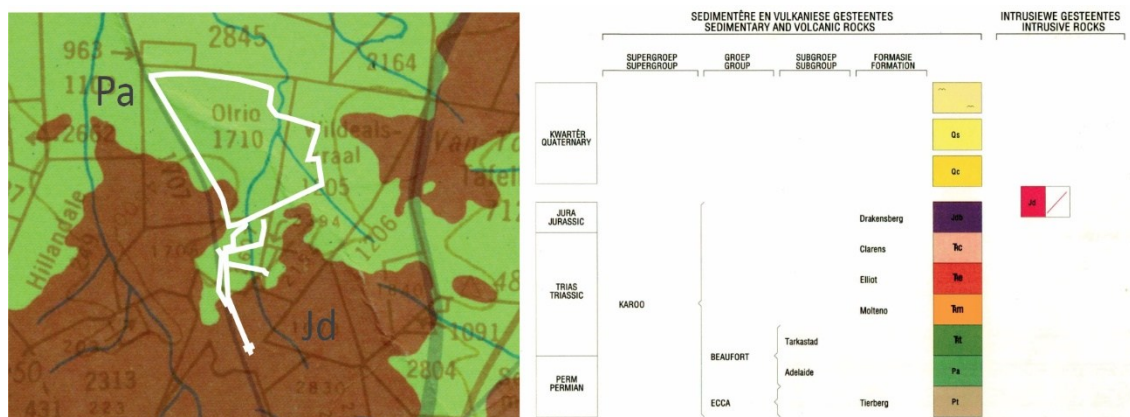


Figure 8. The project area (white lines) is underlain by lithologies of the late Permian Adelaide Subgroup (Beaufort Group), comprising alternating sandstone and mudstone successions with moderate to high palaeontological sensitivity (*Pa*). These sedimentary units are locally intruded by Jurassic-age dolerite sills and dykes of the Karoo Dolerite Suite (*Jd*), which are not palaeontological significant.

The younger superficial deposits of the northern Bloemfontein region are also important palaeontologically, especially where they are connected to fluvial, spring or pan environments. Quaternary-age surface deposits can be highly fossiliferous in places, particularly in fluvial contexts along major river systems or near spring areas and pans. The alluvial deposits of the nearby Modder River and its tributaries north of the assessed footprints are contains abundant Quaternary mammalian fossils, including Florisian material, with individual specimens and fossilized hyena burrows recorded from Late Pleistocene alluvial sediments in this river system. The fossil-bearing potential of the Modder River system has been known for almost 150 years, as noted by the recovery of a frontlet and horn cores of *Pelorovis antiquus* as early as 1839 and the discovery of remains of *Megalotragus priscus* around the turn of the previous century. This places the northern Bloemfontein area within a long-recognized regional zone of Quaternary fossil occurrence associated with riverine sedimentary contexts.

FIELD ASSESSMENT – PALAEOONTOLOGY

The Bulk water pipeline traverses a predominantly low-relief pediplain characterised by gently undulating, grass-covered terrain with extensive surface weathering and limited topographic variation. Adelaide Subgroup strata underlying this route are variably mantled by eluvium and late Quaternary windblown sand-derived topsoils, resulting in a near-complete

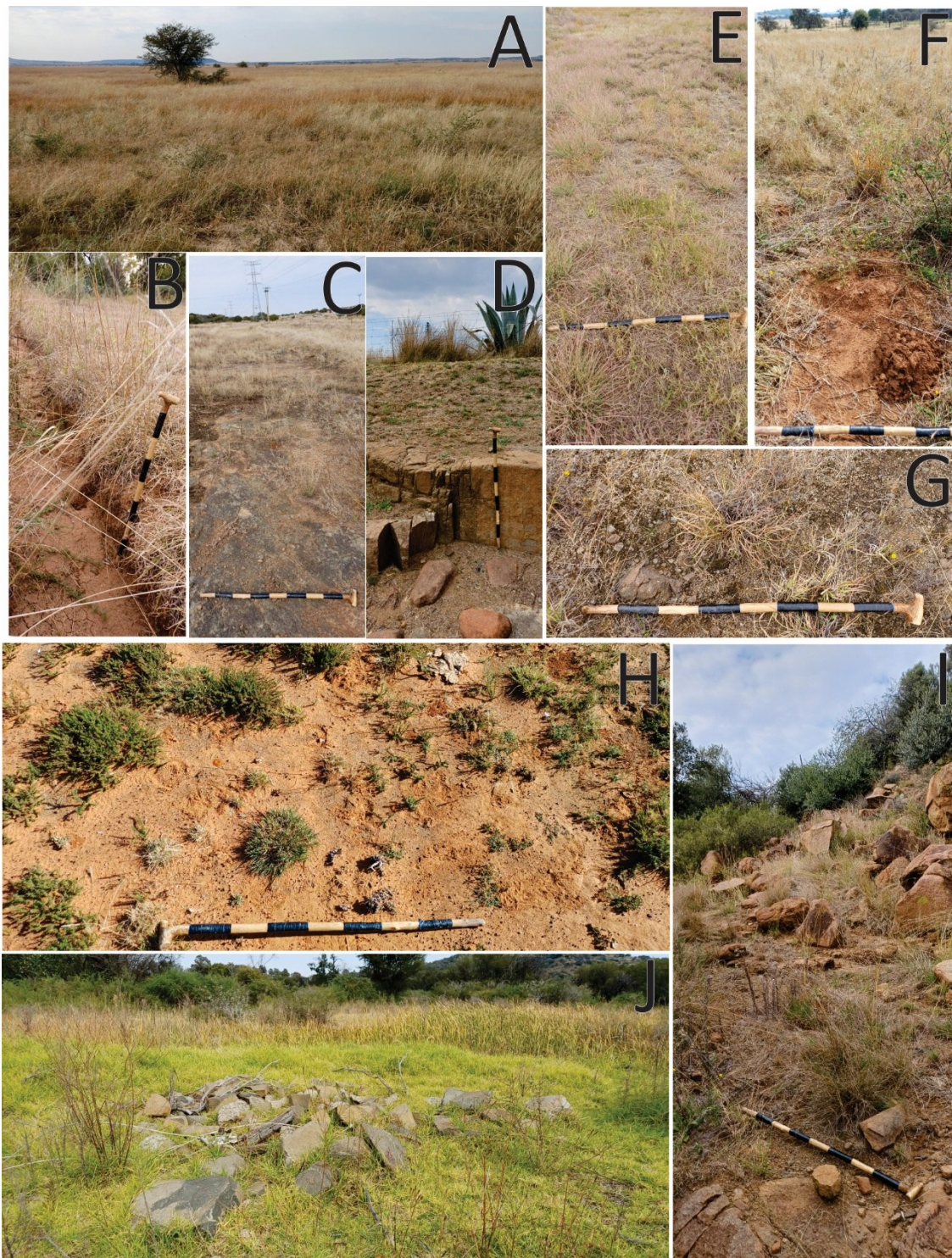


Figure 9. Across all three pipeline alignments, sedimentary bedrock is extensively mantled by eluvium, colluvium, and late Quaternary windblown sand-derived topsoils, and largely devoid of natural exposures, apart from isolated dolerite outcrops. Scale 1 = 10 cm.

absence of bedrock exposure across much of the alignment. Starting in the south, shallow, well-developed soil profiles are interspersed with occasional surface lag gravels and localised

exposures of dolerite, which outcrop regularly as resistant remnants within the weathered landscape (**Fig. 9 A-D**). Across the central to northern sectors, an extensive, low-relief grassland surface is dominated by dense, well-established grass cover, indicating that the underlying Adelaide Subgroup bedrock is entirely mantled by a relatively thick veneer of pedogenically developed soils. Under these conditions, the palaeontological sensitivity of the Adelaide Subgroup is effectively suppressed at surface level, as any fossil-bearing strata remain deeply buried beneath transported and residual cover. The likelihood of encountering in situ fossiliferous material during shallow excavations is therefore considered low, provided that construction activities do not penetrate below the soil mantle into unweathered bedrock.

The Sewer pipeline alignment is situated within a more geomorphologically variable and locally incised setting associated with a minor drainage line system. Adelaide Subgroup strata along this route are variably obscured by thicker accumulations of alluvial sediment, colluvial inputs, and late Quaternary windblown sand-derived topsoils, while dolerite outcrops are regularly exposed along marginal slopes (**Fig. 9 E-G**). The route follows shallow valley bottoms characterised by increased vegetation density and seasonally wetter conditions, as reflected by the presence of reeds and hydrophilic grasses. The combination of fluvial reworking and variable sediment cover means that, while Adelaide Subgroup fossils are unlikely to be encountered under these conditions, the possibility of exposing fossil material if construction activities penetrate below the soil mantle cannot be entirely excluded.

The Water pipeline route extends across a gently sloping plain as well as a distinct wetland zone also encountered by the Sewer pipeline route. Adelaide Subgroup strata along this alignment are variably covered by eluvium and late Quaternary windblown sand-derived topsoils, with dolerite outcrops regularly exposed along hill flanks to the east (**Fig. 9 H-J**). Downslope, the terrain transitions into a broad, relatively flat grassland plain with thick soil cover and minimal surface exposure, indicative of stable pedogenic conditions under which fossil-bearing strata are most likely deeply buried and inaccessible. A wet, reed-filled drainage or seepage zone is located west of the R700, while toward the more developed sections near the Shell Service Station, the landscape is modified by infrastructure but still retains

underlying deep topsoil signatures. Overall, the route reflects a transition from a colluvial slope environment — where dolerite exposure heightens the likelihood of contact metamorphic zones, to low-energy depositional conditions and shallow drainage — where thick sediment cover effectively reduces surface-level palaeontological sensitivity.

PALAEOLOGICAL IMPACT AND RECOMMENDATIONS (NHRA SECTION 38(3))

a) Identification and mapping of all heritage resources.

The proposed pipeline infrastructure (bulk, sewer, and water pipelines) traverses terrains underlain predominantly by the Adelaide Subgroup (Beaufort Group, Karoo Supergroup), which is of high palaeontological sensitivity in principle due to its well-documented vertebrate fossil assemblages.

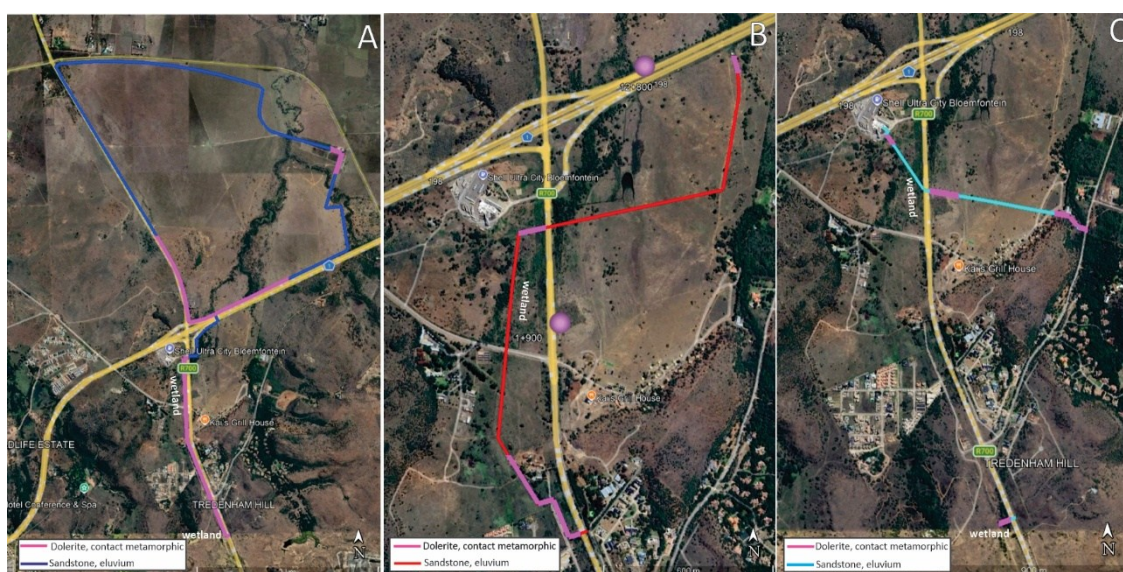


Figure 10 (A–C). Pink lines delineate observed surface exposures of Karoo Dolerite Suite intrusions, encountered as both weathered surface rubble or intact outcrop during the field survey. These exposures are locally associated with thermally altered Adelaide Subgroup sedimentary rocks. The dark blue (A), red (B) and light blue (C) lines broadly demarcate sections where underlying bedrock is extensively mantled by a veneer of residual eluvium, slope-derived colluvium, or reworked late Quaternary aeolian sediments, resulting in a paucity of natural bedrock exposure.

However, across all three pipeline alignments, field observations confirm that the bedrock is extensively mantled by eluvium, colluvium, and late Quaternary windblown sand-derived topsoils, and largely devoid of natural exposures, apart from isolated dolerite outcrops (**Fig. 10**). No in situ fossil material, fossil fragments, or potentially fossiliferous outcrops were

identified during the survey. Under these conditions, any potentially fossil-bearing strata are buried and not expressed at surface level, effectively limiting the presence of observable palaeontological heritage resources within the study area.

b) Assessment of the significance of identified heritage resources.

Although the Adelaide Subgroup is regionally significant, the local significance within the study area is low, due to the absence of fossil occurrences or exposed fossil-bearing strata, and a thick soil mantle obscuring bedrock. Any palaeontological resources that may be present are inferred to occur at depth and are not currently accessible within the shallow subsurface zone affected by the proposed development.

c) Assessment of the nature and extent of potential impacts.

The Bulk Water Pipeline (~13 km) traverses a low-relief pediplain with thick soils where fossil-bearing strata are effectively sealed beneath soil cover. Impact significance: Low, provided excavations remain within the soil mantle. The Sewer Pipeline (~2.5 km) is located within a more incised, drainage-linked environment with alluvial and colluvial deposits with a slightly higher potential for deep exposure of buried strata, though still unlikely. Impact significance: Low to Very Low, with a likely increase where deeper excavation may occur. The Water Pipeline (~1.25 km) crosses colluvial (dolerite) slopes, a grassland plain, and a wetland area where sediment accumulation and pedogenic soils dominate. Local dolerite exposure may indicate contact metamorphic zones, generally unfavourable for fossil preservation. Impact significance: Low. Overall, the likelihood of impacting palaeontological resources during construction is low, unless excavation penetrates below the soil mantle into unweathered Adelaide Subgroup bedrock.

d) Evaluation of impacts in relation to the anticipated social and economic benefits of the proposed development.

The project is anticipated to support broader social upliftment through the enhancement of municipal infrastructure.

e) Consultation with affected communities and other interested parties regarding potential impacts on heritage resources.

Unlike archaeological or cultural heritage, fossils are non-renewable scientific resources, that have no direct living community ownership or custodianship, and that derive their significance primarily from scientific (research) value, rather than social, spiritual, or cultural association.

f) Consideration of alternatives where heritage resources may be adversely affected, including alternative layouts or development options.

Given that all the assessed alignments traverse similarly mantled landscapes, and no fossiliferous exposures were identified along any of the surveyed routes, there is no palaeontological basis to consider alternative alignments. From a palaeontological perspective, the proposed routes are considered acceptable, with no identified constraints requiring redesign or relocation.

g) Specification of mitigation measures to avoid, minimise, or manage adverse impacts on heritage resources during construction, operation, and operational phases of the development.

Although impacts are assessed as low, and no pre-construction mitigation is required except for the implementation of a Chance Finds Procedure (CFP) for the duration of construction and notification of a qualified palaeontologist for routine palaeontological monitoring if fossil material is exposed during excavation, or excavations extend into unweathered sedimentary bedrock below the soil mantle.

Recommendation

Based on the results of the field assessment:

- The palaeontological sensitivity of the study area is effectively low at surface level, despite the regional significance of the Adelaide Subgroup.
- The probability of encountering fossil material during construction is low, provided excavations remain within overlying soils or contact metamorphic sediments.
- The development is therefore supported from a palaeontological perspective, subject to the implementation of a Chance Finds Procedure.

The proposed Mangaung Bulk Distribution Pipeline project may proceed without further palaeontological assessment or mitigation, on condition that a Chance Finds Procedure is included in the project's Environmental Management Programme (EMPr).

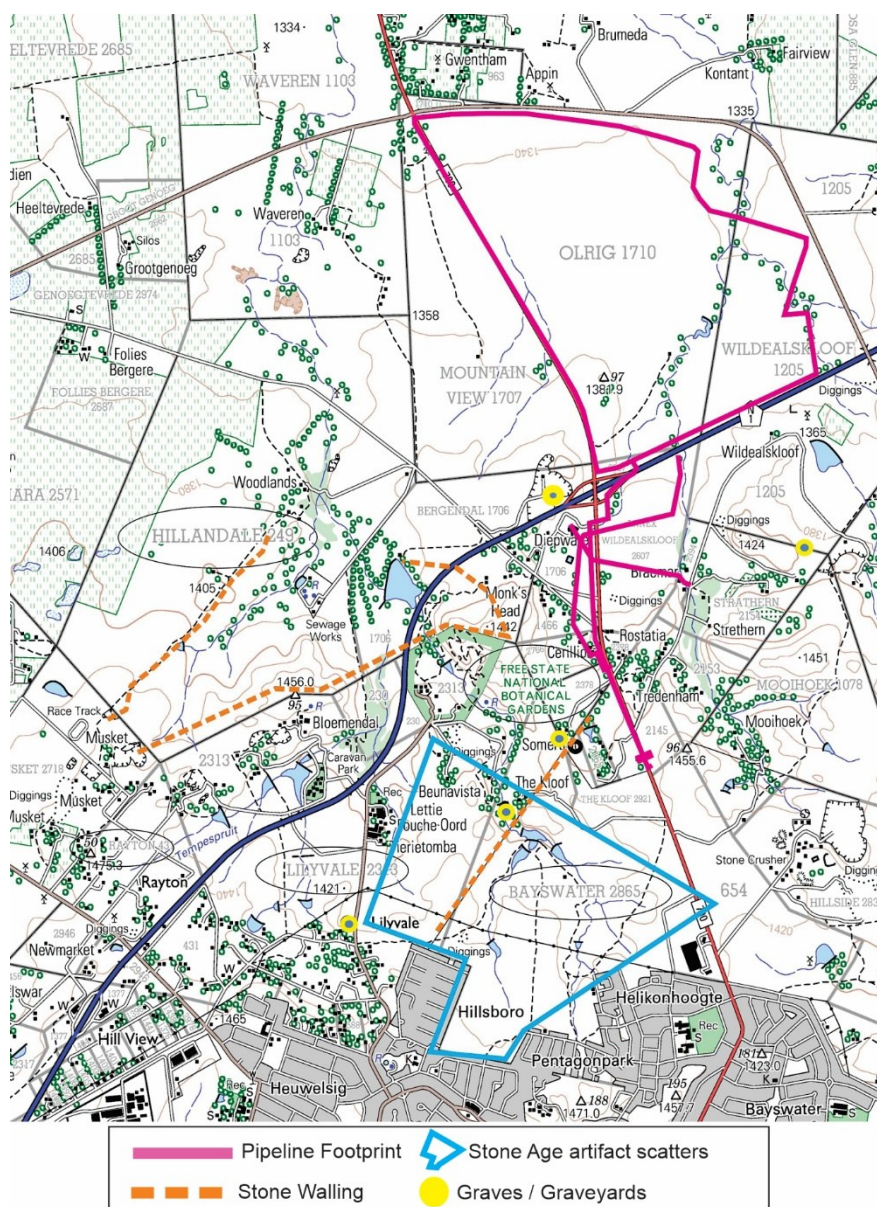


Figure 11. Position of previously recorded heritage sites/features marked on portion of 1:50 000 topographic map 2926AA Bloemfontein.

ARCHAEOLOGICAL BACKGROUND

The northern Bloemfontein area has a well-established and varied heritage record in which previously recorded cultural remains are consistently described as falling into four broad

categories: Stone Age remains, South African War remnants, graveyards, and historical structures, including residential buildings as well as stone-built kraal and dam walls (**Fig. 11**).

The prehistoric archaeological record of the northern Bloemfontein landscape is tied especially to the Modder River catchment. This record extends back to the early Middle Stone Age, with localized occurrences of in situ Middle and Later Stone Age material preserved in overbank sediments of the Modder River and its tributaries between Maselspoort and Glen north of Bloemfontein. In addition, widespread traces of prehistoric human occupation, in the form of stone tool scatters and isolated surface finds, have previously been recorded at Bayswater 2865, Lilyvale 2313 and Hillandale 249 (**Fig. 12A**).



Figure 12. Archaeological remains previously recorded in the area include MSA stone tools and remnants related to the Anglo Boer War and early 20th century pastoral farmstead infrastructure: stone wall structures (B), sangars (C), graves (D) and surface-strewn military debris such as bullet casings, tin cans, glass and ceramics (E,F).

The historical significance of northern Bloemfontein is also closely linked to the South African War and its aftermath. The reports note that after Bloemfontein was occupied by British forces on 13 March 1900, the city became a major military centre, and several farms to the north were requisitioned for military purposes, including military hospitals, rifle ranges,

sangars and a large remount camp at Hillandale. Hillandale, owned by Abraham Fischer, was expropriated by the British together with the Tempe farms and is referred to in military correspondence as Fischer's Farm, while the Tempe farms were first expropriated in August 1901 for grazing by horses of the South African Constabulary and were eventually purchased by the War Office in 1904. Material traces of this military occupation remain an important component of the northern Bloemfontein heritage landscape. Archaeological remains related to British military activities include stone wall structures, rubbish dumps, kraals, graveyards and surface-strewn military debris such as bullet casings, tin cans, glass and ceramics (**Fig. 12 B-F**). A large military rubbish dump is specifically recorded on Lilyvale 2313, while surviving stone wall alignments are some of the last remaining traces of British military occupation in the northern part of Bloemfontein. These walls were reportedly built by British Engineers stationed at Tempe and originally formed part of a longer boundary running from the water towers east of Tempe to the edge of Hillandale farm; surviving sections are still noted at the Botanical Gardens and in the Lilyvale and Bayswater areas between Hillsboro and the R700 road south of the N1. Graves, graveyards and isolated burials are known from this broader area, reinforcing the sensitivity of the northern Bloemfontein landscape from a historical heritage perspective. disused

FIELD ASSESSMENT – ARCHAEOLOGY

The bulk pipeline route traverses a landscape that is already moderately transformed by a combination of agricultural use, infrastructure corridors, and ongoing peri-urban expansion (**Fig. 13, waypoints 1 – 6 & Fig. 14**). Built environment features and structural remnants associated with ongoing peri-urban encroachment recorded within a 10 m corridor of the proposed bulk water pipeline route (**Table 3**). These include: a stockpile of displaced dolerite rubble indicative of recent land clearance (Waypoint 1); a derelict cast-concrete agricultural dam in an advanced state of disuse (Waypoint 2 and 3); an occupied homestead compound with corrugated-iron roofing and perimeter fencing (Waypoint 4); and an unpaved access track linking the homestead to the R700 public road (Waypoint 5). None of these features are considered to be older than 60 years or of sufficient architectural, historical or social



Figure 13. Built environment features and structural remnants associated with ongoing peri-urban encroachment recorded within a 10 m corridor of the proposed bulk water pipeline route. These include: a stockpile of displaced dolerite rubble indicative of recent land clearance (1); a derelict cast-concrete agricultural dam (2, 3); an occupied homestead compound with corrugated-iron roofing and perimeter fencing (4); and an unpaved access track linking the homestead to the R700 public road (5), flanked by dry-packed dolerite stone gateway pillars (6).

significance to warrant formal protection under Section 34 of the NHRA (No. 25 of 1999). The unpaved access track linking the homestead to the R700 public road is flanked by a dolerite

stone gateway pillar located 16 m east of the footprint (Waypoint 6). which may reflect an earlier phase of rural settlement predating the current peri-urban expansion and should be avoided by a 10 no-go buffer zone during construction phase of the project.

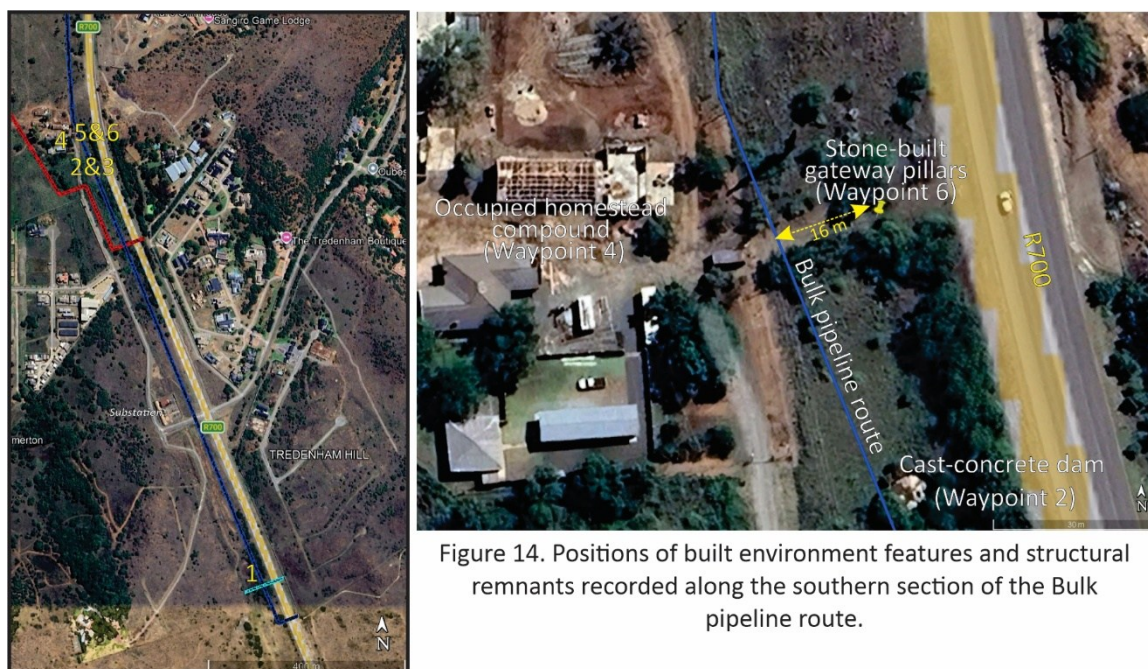


Figure 14. Positions of built environment features and structural remnants recorded along the southern section of the Bulk pipeline route.

Surface compaction, localized wetland areas and sheet wash erosion are visible along the corridor, particularly adjacent to roads while large portions of the terrain in the north show evidence of historical ploughing and grazing. No *in situ* heritage resources were observed within 5 m of the linear footprint, including Stone Age artefact scatters, graves, stone-walled structures, or buildings older than 60 years.

A total of ten historical features located between 50 m and 400 m from the pipeline footprint were previously recorded on and around prominent dolerite kopje near the N1/R700 junction on farm Olrig 1710 (**Fig. 15, waypoints 7–16; Table 3**). The finds represent a localised cluster of stone-walled structures and associated remains constructed from locally sourced dolerite. The features are distributed across the upper slopes and crest of the hill and include the following:

- Graves — At least four curvilinear to sub-circular structures were identified (Waypoints 7 and 8), demarcated by low, flatly packed dolerite cobbles. These are interpreted as graves likely historical (late 19th to early 20th century) origin,

consistent with pastoral farmstead infrastructure commonly associated with the broader Bloemfontein district.

- Stone-walled enclosures — Waypoints 9, 10 and 11 comprise more substantially built stone features, including a partially intact stacked dry-stone structure and an associated wall segment exhibiting deliberate coursing. These are interpreted as remnants of historical habitation or farm-related structures.
- Stone alignments and wall remnants — Discontinuous linear stone alignments were recorded at Waypoint 12, 13 and 16, extending across the lower slope of the hill. These features may represent the remains of a boundary wall, or kraal foundations, and is consistent in construction with the other recorded features.
- Stone rubble concentrations and surface scatter — Waypoints 14 and 15 comprise localised concentrations of dolerite rubble, partially obscured by thorn bush and grass cover. These are interpreted as collapsed or heavily degraded structural remains and/or construction debris associated with the broader settlement cluster.

The sewer pipeline route shows a combination of natural fluvial disturbance and anthropogenic degradation. The presence of sheet wash and sediment redistribution indicates active or episodic water flow, while dense vegetation and wetland species reflect seasonal inundation. Human impacts are evident in the form of encroaching residential development, fencing, informal pathways, and vegetation clearing along the drainage margins. No in situ heritage resources were observed within 5 m of the linear footprint, including Stone Age artefact scatters, graves, stone-walled structures, or buildings older than 60 years.

The water pipeline transects rocky outcrops in the east and display grazing disturbance and minor footpaths leading to small-scale vegetation loss and soil exposure going west. Downslope, the route intersects a wetland area near the R700 that shows clear anthropogenic impacts. Near the Shell Service Station and associated road network, the landscape becomes significantly degraded, with cleared vegetation, compacted soils and rubble heaps. No

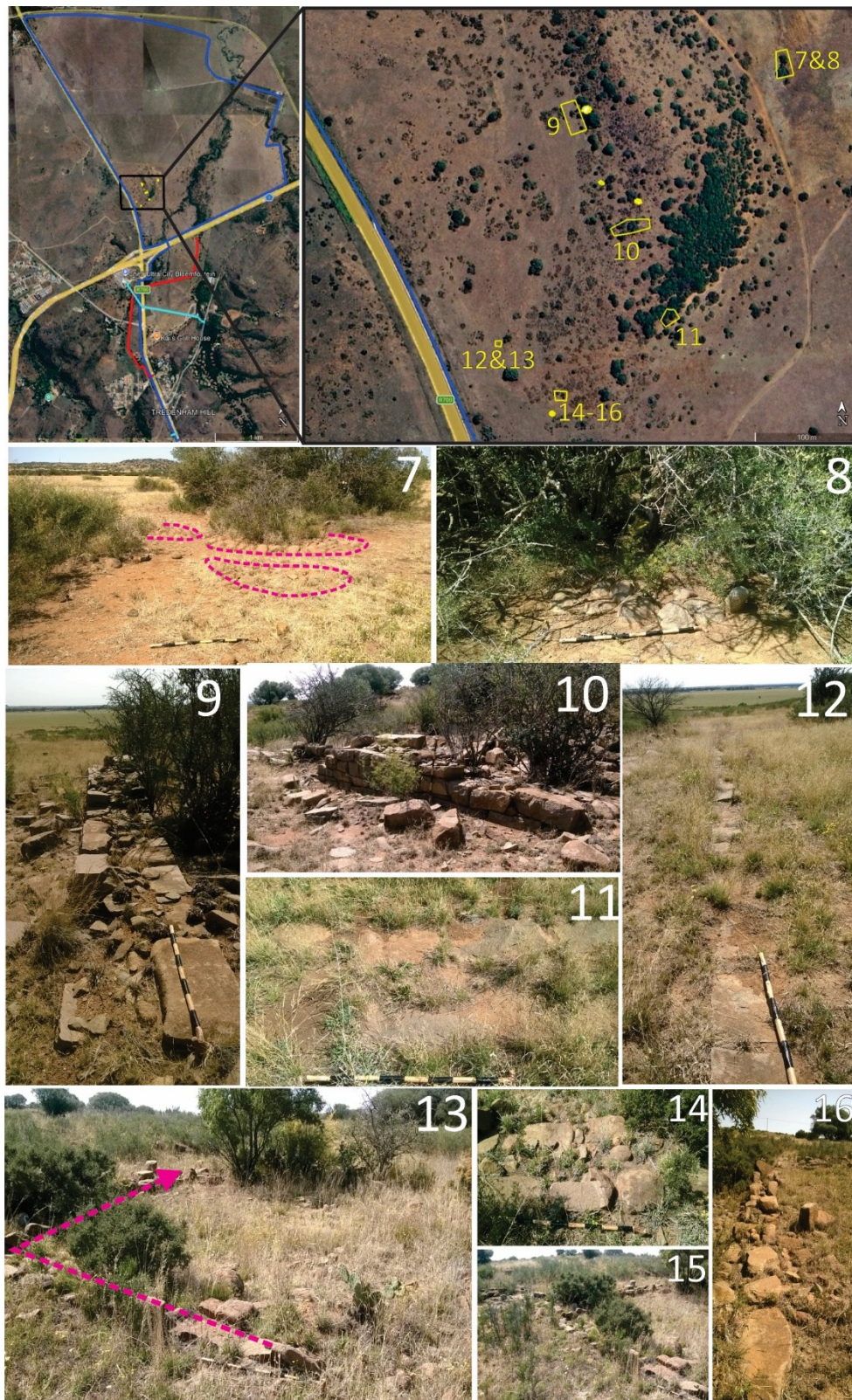


Figure 15. General view of historical features located between 50 m and 400 m from the Bulk pipeline footprint on and around prominent dolerite kopje near the N1/R700 junction on farm Olrig 1710.

archaeologically significant heritage resources were observed within 5 m of the linear footprint, including Stone Age artefact scatters, graves or buildings older than 60 years.

Table 3. Position of Built environment and Historical features listed recorded during the survey and listed in Figure 13 and Figure 15.

#	Description	GPS Coordinates	Field Rating (Table 2)
Bulk			
1	Displaced dolerite rubble heap	29° 3'27.05"S 26°13'44.32"E	Generally Protected C
2	Aboveground cast-concrete dam	29° 2'58.46"S 26°13'31.81"E	Generally Protected C
3	Aboveground cast-concrete dam	29° 2'58.46"S 26°13'31.81"E	Generally Protected C
4	Occupied homestead compound	29° 2'57.12"S 26°13'30.01"E	Generally Protected C
5	Unpaved access track	29° 2'56.92"S 26°13'30.99"E	Generally Protected C
6	Stone-built gateway pillars	29° 2'56.82"S 26°13'31.59"E	Generally Protected A
7	Graves x3	29° 1'46.74"S 26°13'38.18"E	Local Significance (Grade 3A)
8	Graves x1	29° 1'47.02"S 26°13'38.28"E	Local Significance (Grade 3A)
9	Linear stone structure and associated wall segment	29° 1'48.52"S 26°13'30.78"E	Local Significance (Grade 3A)

10	Linear stone structure and associated wall segment	29° 1'51.84"S 26°13'32.63"E	Local Significance (Grade 3A)
11	Linear stone structure and associated wall segment	29° 1'54.62"S 26°13'34.12"E	Local Significance (Grade 3A)
12	Discontinuous linear stone alignments	29° 1'55.37"S 26°13'28.12"E	Local Significance (Grade 3A)
13	Discontinuous linear stone alignments	29° 1'55.37"S 26°13'28.12"E	Local Significance (Grade 3A)
14	Degraded structural remains	29° 1'57.01"S 26°13'30.29"E	Local Significance (Grade 3A)
15	Degraded structural remains	29° 1'57.05"S 26°13'30.20"E	Local Significance (Grade 3A)
16	Discontinuous linear stone alignments	29° 1'57.05"S 26°13'30.20"E	Local Significance (Grade 3A)
Sewer			
17	Modern water treatment works	29° 2'9.33"S 26°13'55.41"E	Generally Protected C
Water			
18	Modern dwelling	29° 2'42.53"S 26°13'57.53"E	Generally Protected C
19	Modern outbuilding	29° 2'40.51"S 26°13'55.88"E	Generally Protected C
20	Shell Ultra Service Station	29° 2'28.30"S 26°13'24.39"E	Generally Protected C

ARCHAEOLOGICAL IMPACT & RECOMMENDATIONS (NHRA S38(3))

a) Identification and mapping of all heritage resources.

No in situ archaeological or other heritage resources were identified within 5 m of the proposed construction footprints for any of the three linear routes, including Stone Age artefact scatters, graves, stone-walled structures, or buildings older than 60 years. The only identified heritage resources of note comprise the flanking dolerite stone gateway pillars located 16 m east of the Bulk pipeline footprint (Waypoint 6) and a cluster of ten historical features (Waypoints 7–16) previously recorded between approximately 50 m and 400 m from the Bulk pipeline route, located on and around a prominent dolerite kopje near the N1/R700 junction. These features include probable historical graves, stone-walled enclosures, linear stone alignments or wall remnants, and concentrations of dolerite rubble interpreted as collapsed or degraded structural remains. These features have been mapped as a localised off-footprint historical site complex and do not fall within the direct pipeline servitudes.

b) Assessment of the significance of identified heritage resources.

No heritage resources of archaeological significance were identified within the direct footprints of the proposed bulk, sewer, or water pipeline routes. From the perspective of the surveyed alignments themselves, the archaeological sensitivity of the direct impact areas is therefore considered low.

The dolerite stone gateway pillars located 16 m east of the footprint (Waypoint 6) may reflect an earlier phase of rural settlement predating the current peri-urban expansion and should be avoided by a 10 no-go buffer zone during construction phase of the project.

The previously recorded stone-built historical features on the dolerite kopje near the N1/R700 junction, although situated outside the bulk pipeline footprint, are considered to be of local historical and archaeological significance (Grade 3A, Conservation: mitigation not advised, **Table 2**). The probable graves are the most sensitive elements within this cluster due to their social and legal significance in terms of the NHRA. The associated stone-walled enclosures, alignments, and rubble concentrations appear to represent remnants of a historical farmstead, or related land-use activity, likely dating to the late nineteenth or early twentieth

century. These features contribute to the historical landscape character of the area and retain contextual significance as a clustered site complex, although their significance is assessed as local rather than of higher provincial or national order. The nearest structures are located approximately 50 m from the pipeline footprint and should be safeguarded through avoidance by means of a minimum 30 m no-go buffer zone during the construction phase of the project (**Fig. 16**).

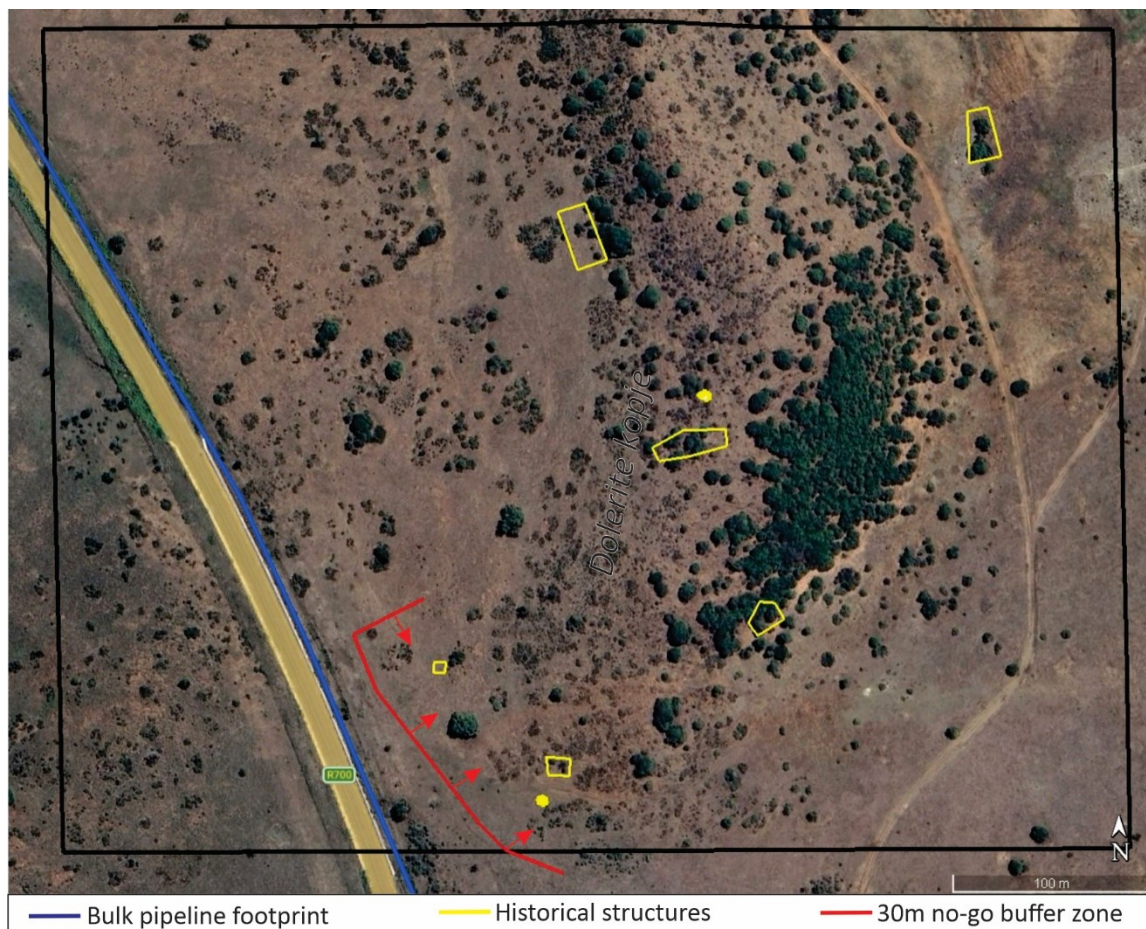


Figure 16. Spatial extent of the recommended 30 m exclusion (no-go) buffer surrounding identified stone-built historical features situated approximately 50 m from the proposed bulk pipeline footprint, implemented to avoid direct and indirect impacts.

c) Assessment of the nature and extent of potential impacts.

As no in situ heritage resources were identified within the direct footprints of the three pipeline routes, the proposed development is anticipated to have a low direct archaeological impact. The existing disturbance evident across much of the project area has already reduced

the preservation potential and visibility of surface archaeological material in many portions of the routes.

Potential direct impacts on known heritage resources are therefore not anticipated within the bulk, sewer, or water pipeline footprints. However, indirect or accidental impacts remain possible if construction-related activities extend beyond the demarcated servitudes or if ancillary infrastructure such as laydown areas, stockpiles, temporary access tracks, or service relocations encroach upon sensitive areas. This is particularly relevant to the historical feature cluster on the dolerite kopje near the N1/R700 junction, located outside but in relative proximity to the bulk pipeline corridor. Possible impacts in such a case would include physical disturbance or displacement of stone features, inadvertent damage to probable graves, and degradation of the broader historical setting. In addition, although no heritage resources were visible on the surface within the route footprints, linear trenching always carries a residual possibility of exposing previously unrecorded subsurface archaeological material, historical deposits, or unmarked graves not detectable during pedestrian survey. This residual risk remains low, but it cannot be excluded entirely, particularly in isolated pockets of relatively undisturbed ground along the northern part of the bulk pipeline route.

d) Evaluation of impacts in relation to the anticipated social and economic benefits of the proposed development.

The proposed bulk, sewer, and water pipeline infrastructure is anticipated to provide substantial social and economic benefit through improved municipal service delivery, support for residential growth and improved water supply reliability. Given that no *in situ* archaeological heritage resources were identified within the direct footprints of the three pipeline routes, and that the only recorded historical features of note are situated outside the construction servitudes and can be avoided, the social and economic benefits of the development are therefore considered to outweigh the low archaeological risks associated with the project.

e) Consultation with affected communities and other interested parties regarding potential impacts on heritage resources.

Consultation with landowners, adjacent occupiers, interested and affected parties, and other local stakeholders is undertaken through the Environmental Assessment Practitioner's broader stakeholder engagement and public participation process for the environmental authorisation application. From a heritage perspective, no site-specific concerns were raised in relation to archaeological resources within the proposed pipeline servitudes at the time of engagement.

f) Consideration of alternatives where heritage resources may be adversely affected, including alternative layouts or development options.

From an archaeological perspective, no broad alternative layout is required for the proposed bulk, sewer, or water pipeline routes, as no heritage resources were identified within the direct development footprints. The only identified heritage resources of concern occur outside the Bulk pipeline footprint on the dolerite kopje near the N1/R700 junction and can be protected through avoidance via a minimum 30m no-go buffer zone. If any previously unknown heritage resources are identified during trenching, adjustment of the alignment should be considered where practical to avoid direct impact.

g) Specification of mitigation measures to avoid, minimise, or manage adverse impacts on heritage resources during construction, operation, and operational phases of the development.

All stockpile areas and laydown areas must be clearly defined and physically demarcated prior to the commencement of construction. No unnecessary disturbance outside the approved footprint should be permitted.

The historical features recorded at Waypoints 7–16 on the dolerite kopje near the N1/R700 junction, particularly the probable graves, must be treated as no-go heritage areas. No construction activity, vehicle movement, stockpiling, dumping, or ancillary disturbance may occur within or toward these features.

All construction personnel, including contractors and machine operators, must receive heritage induction prior to the commencement of earthworks. This induction should include

guidance on the recognition of graves, stone-packed features, artefact scatters, historical walling, foundations, and other possible archaeological indicators.

A Chance Finds Procedure must be included in the Environmental Management Programme (EMPr) and implemented throughout all phases of ground disturbance. If any archaeological material, stone-packed features, foundations, human remains, or possible graves are exposed during excavation, work in the immediate vicinity must cease immediately and a qualified archaeologist and the relevant heritage authority must be notified.

Although routine archaeological monitoring is not considered necessary based on current findings, a qualified archaeologist should be consulted should any sensitive material be exposed during trenching or if construction approaches areas where unanticipated heritage risk becomes apparent.

During operation and future maintenance, all excavation should, as far as possible, remain confined to the already disturbed trench footprint. Any proposed maintenance works extending beyond the original disturbance envelope into undisturbed ground should be subject to prior heritage screening.

Recommendation

The only heritage resources of note are: (1) two stone-built gateway pillars near an unpaved access track linking a homestead to the R700 public road, which may predate the current peri-urban landscape; and (2) a localised cluster of probable historical graves and associated stone-built features situated outside the bulk pipeline footprint on a dolerite kopje near the N1/R700 junction.

Provided that the identified off-footprint historical features are protected as no-go areas, that all construction remains confined to the approved pipeline servitudes, and that a Chance Finds Procedure is implemented during all ground disturbance, the proposed development is considered acceptable from an archaeological perspective.

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APPENDIX 1 - CHANCE FINDS PROTOCOL FOR DEVELOPER

Palaeontology - Easily noticeable fossil remains from freshly exposed sedimentary rocks in the region may resemble petrified wood fragments of variable size that usually exhibit concentric ring-like structures or bones resembling odd shaped, nodular or cylindrical, stone-like objects (**Fig. 17**).



Figure 17. Easily recognizable features likely indicative of fossil remains within Adelaide Subgroup sedimentary rocks may include fragmentary silicified wood resembling stone-like objects of variable size exhibiting concentric ring-like structures in distal or proximal view (far left) and fossil bones resembling odd shaped, nodular or cylindrical, stone-like objects.

Archaeology - Archaeological remains that may be encountered in the project area include, but are not limited to, the following (**Fig. 18**): Stone Age lithic artefacts — typically presenting as concentrations of knapped debitage, retouched flakes and convergent points consistent with reduction or knapping sites — may occur on older, stable land surfaces beneath the aeolian sand cover and eluvial mantles, particularly in proximity to contact metamorphic zones where hornfels and indurated shale provided suitable raw material for stone tool manufacture. Surface scatters of glass, fragmented bone and corroded ferrous metal are diagnostic of late 19th- to early 20th-century refuse middens associated with historical-period farmstead occupation. Unmarked burial sites, which may lack formal headstones, are typically identified by low, tightly packed stone cairns or domed cobble coverings consistent with vernacular grave-marking traditions in the region.



Figure 18. Surface concentrations of knapped lithic debitage and retouched flake-tools (A) — including convergent flake-blades consistent with MSA typologies (B) — may signal deflated or shallowly capped in situ Stone Age occurrences. Localised surface scatters of glass, fragmented bone and corroded metal artefacts are diagnostic of late 19th- to early 20th-century refuse middens associated with historical-period occupation (C). In the absence of formal headstones, unmarked burial sites are typically identified by low, tightly packed stone cairns or domed cobble coverings — surface features consistent with historically vernacular grave-marking traditions (D, E).

Procedural Steps:

1. If potential fossil material, stone artefacts, historical-period objects (e.g., glass, ceramics, metal), human skeletal remains or unmarked grave features are encountered during construction, all activity within the immediate vicinity of the find must cease immediately.
2. The Environmental Control Officer (ECO) or Site Manager must demarcate a no-go buffer zone of at least 15 m around the find to prevent further disturbance by personnel, vehicles or machinery. No material may be removed, washed, cleaned or otherwise handled. should photograph the remains, note GPS coordinates.
3. The ECO or Site Manager must photograph the remains *in situ* from multiple angles (including a scale reference where possible), record GPS coordinates, and compile a brief written description noting the nature of the material, its stratigraphic context and associated surface features.
4. Portable finds that have already been dislodged must be placed in a clearly labelled container and stored in a secure location on site. Intact or *in situ* remains must be left in place and protected from further exposure or damage by covering them with a light but rigid object such as a box, bucket or metal sheet.
5. The ECO or Site Manager must notify the South African Heritage Resources Agency (SAHRA) (Tel. 21 462 4502, Email info@sahra.org.za) as well as a professional palaeontologist and/or archaeologist as soon as practicably possible to arrange confirmation of the find. In the case of human skeletal remains or suspected burial features, the South African Police Service (SAPS) must also be notified in terms of applicable legislation.
6. No construction activity may resume within the demarcated buffer zone until the specialist has inspected the find, assessed its significance and provided written clearance or further instructions.
7. Should the material prove to be of archaeological or palaeontological significance, a Phase 2 rescue excavation or systematic collection may be required subject to permits issued by the South African Heritage Resources Agency (SAHRA) or the relevant

Provincial Heritage Resources Authority (PHRA). In such cases, the developer must, upon permit approval, appoint a suitably qualified professional archaeologist or palaeontologist to excavate, remove and curate the material in accordance with the conditions of the permit.

8. The specialist must submit a Chance Find Report to SAHRA or the relevant PHRA documenting the nature, significance and disposition of the material. Construction within the affected area may only resume once written authorisation has been received from the heritage authority or the appointed specialist.