Palaeontological Impact Assessment of the Cluster 9 Bulk Water supply pipeline at Tsomo, Chris Hani District Municipality, EC Province.

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Executive Summary

- Several sections of the proposed pipeline as well as the water extraction facility are located on potentially fossil-bearing Tarkastad Subgroup (*Trlk, Trlb*) strata.
- The overlying Quaternary deposits bear little palaeontological significance.
- The intrusive dolerites bear little palaeontological significance.
- There are no major palaeontological grounds to suspend the proposed development of the site.
- However, any developments that may destroy or damage subsurface fossils are of conservation and research interest.
- In such a case it is advised that newly uncovered material found during the course of excavation activities within footprint must be reported to SAHRHA, that excavations into *in situ* sedimentary bedrock should allow for inspection by a specialist at the appropriate time and that possible intact finds may require a Phase 2 rescue operation at the cost of the developer**.**

Contents

Introduction

A Phase 1 Palaeontological Impact Assessment was carried out along designated areas near the village of Tsomo in the Eastern Cape Province. Anticipated development calls for the upgrade of a bulk water supply pipeline near the village of Tsomo in the Eastern Cape Province. The assessment was carried out in accordance with National Heritage Resources Act 25 of 1999 with the aim to assess impact on potential palaeontological heritage resources. A site visit and assessment took place in June 2011.

Terms of reference

- Identification and recording of potential palaeontological heritage resources in the proposed areas of impact and;
- Recommendation of mitigation measures to minimize potential impacts associated with the proposed development.

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Description of the Affected Area

Details of area surveyed

Locality data

The 1:50 000 topographical map of the area is 3227 BB Nqamakwe.

An assessment was carried out to evaluate the palaeontology and fossil potential within the development footprint which includes the construction of an approximately 10 km pipeline within a 35m wide corridor as well as an area demarcated for infrastructural development at the current extraction point on the Tsomo River near the town of Tsomo (**Fig. 1, Table 1)**.

Table 1. General coordinates of the proposed pipeline and extraction facility.

Feature	Coordinates	
Gravity Main	32° 2'53.83"S	27°47'40.92"E
Gravity Main	32° 2'34.48"S	27°47'37.29"E
Gravity Main	32° 2'9.26"S	27°47'51.36"E
Gravity Main	32° 1'28.93"S	27°47'41.27"E

Gravity Main	32° 1'14.19"S	27°47'53.87"E
Gravity Main	32° 1'2.64"S	27°47'52.43"E
Gravity Main	32° 0'57.58"S	27°48'25.55"E
Gravity Main	32° 1'7.32"S	27°48'27.01"E
Pumping Main	32° 1'16.32"S	27°48'16.58"E
Pumping Main	32° 1'25.72"S	27°49'15.59"E
Pumping Main	32° 1'55.59"S	27°49'13.92"E
Pumping Main	32° 2'0.67"S	27°49'28.58"E
Pumping Main	32° 2'7.51"S	27°49'31.16"E
WTW	32° 2'5.84"S	27°49'32.28"E
WTW	32° 2'5.62"S	27°49'30.70"E
WTW	32° 2'8.62"S	27°49'29.57"E
WTW	32° 2'9.26"S	27°49'31.30"E

Geology

The study area is largely underlain by Palaeozoic and Mesozoic sediments of the Beaufort Group (Karoo Supergroup; see 1: 250 000 scale geological map 3226 King Williams Town, published by the Council for Geoscience, Pretoria, 1976). From oldest to youngest the sediments in the region are assigned to the Beaufort Group rocks, represented by the Late Permian Adelaide and Early Triassic Tarkastad Subgroup. The presence of upwards-fining sequences, channels, lenticular sandstone bodies characterized by flat-bedding with micro-cross lamination, mudstones and non-marine vertebrate fossils all point to a fluviatile environment for the deposition of both the Adelaide and Tarkastad Subgroups.

Locally, the underlying sedimentary rocks are made up of Early Triassic Tarkastad Subgroup sediments, which is represented by the Katberg Formation *(Trlk)* and overlying Burgersdorp Formation (*Trlb*) (**Fig. 2)**. These rocks are respectively made up of pale reddish-grey pebble-bearing fine to medium-grained sandstones and light greenish-gray fine-grained sandstone with subordinate greenish-grey mudstone. These sedimentary rocks were intruded by an interconnected network of dykes, sills and inclined sheets of dolerite (*Jd*) during the Jurassic. Quaternary river alluvium made up of semi- to well-consolidated soils and gravels blanket the older strata in places.

Methodology

Compared to the more locus-based nature of potential Quaternary palaeontological occurrences within geologically recent superficial deposits, the palaeontological footprint of Karoo sediments is, due to the lateral distribution and lithostratigraphy of the Karoo Supergroup, for the most part related to continuous sedimentary units that cover large geographical areas. A pedestrian survey was conducted along the proposed sections. The survey was kicked off at the southern part of the proposed Gravity Main and terminated at the current water extraction site (**Fig 3**). A Garmin Etrex Vista GPS hand model (set to the WGS 84 map datum) and a digital camera were used for recording purposes. Relevant geological and palaeontological information were assimilated for the report and integrated with data acquired during the on-site inspection.

Fossil potential in the area

Karoo Sediments

The area around Tsomo village is underlain by Katberg Formation strata (*Trlk*) with overlying Burgersdorp Formation mudrock exposures (*Trlb*) at the foot of the nearby mountain that is situated to the north of the town (**Fig. 4**). These rocks are assigned to the *Lystrosaurus* Assemblage Zone (AZ), which includes the Katberg Formation and the lower third part of the Burgersdorp Formation (**Table 2**). The fossil record of the *Lystrosaurus AZ* is summarized in Rubidge (1995) and MacRae (1999) and includes a variety of plants, trace fossils, invertebrates and vertebrates. The biozone is characterized by the abundance of *Lystrosaurus* in association with *Procolophon* and the absence of *Dicynodon lacerticeps. Lystrosaurus* comprises up to 95% of the vertebrate fossils, but other common genera include *Moschorhinus, Proterosuchus, Lydekkerina*, *Galesourus* and *Thrinaxodon*. Plant fossils present include *Dadoxylon* and *Glossopteris.* Vertebrate fossils are primarily found in mudrock sequences between channel sandstones and are frequently preserved as articulated skeletons. Large burrow cast have been described from several localities within the biozone.

Post-Karoo Sediments

The footprint is covered by scattered superficial deposits of Quaternary age, including valley sediments and alluvium. There is currently no record of Quaternary

palaeontological exposures in the vicinity and the likelihood of finding fossil vertebrate fauna in the geologically recent superficial deposits is low.

Table 2. Geology and potential fossil heritage in and around the affected area.

Geological Unit	**Rock types and Age**	**Fossil potential / Biostratigraphy**
Superficial deposits	Valley sediments, colluvium, alluvium. Quaternary to Recent	Vertebrate skeletal remains; freshwater molluscs, coprolites, pollen and phytoliths
Karoo Dolerite (*Jd*)	Intrusive igneous bedrock. Jurassic	No fossils
Upper Beaufort Group Tarkastad Subgroup Lower 3rd of the Burgersdorp Formation (*Trlb*)	Fluvial and lacustrine mudstones and sandstones. Early Triassic	*Lystrosaurus* Assemblage Zone
Upper Beaufort Group Tarkastad Subgroup Katberg Formation (*Trlk*)	Fluvial and lacustrine mudstones and sandstones. Early Triassic	*Lystrosaurus* Assemblage Zone

Results of Survey

Impact on potential palaeontological resources within the footprint is summarized in **Table 3**. The pipeline will impact on superficial Quaternary valley sediments, potentially fossil-bearing Tarkastad Subgroup (*Trlk, Trlb*) strata and igneous dolerite intrusions (*Jd*) (**Fig. 5**).

Table 3. Assessment of impact within the footprint.

Footprint	Latitude	Geological Unit	Palaeontological significance of footprint	Extent & Duration of Impact	Potential Impact	Suggested Mitigation
Section A-B New Gravity Main	32 02 53.88 to 32 02 43.98	Superficial deposits, Alluvium, Colluvium, Karoo Dolerite (*Jd*),	low	local permanent	none	none
Section B – C New Gravity Main	32 02 43.98 to 32 01 59.41	Superficial deposits, Alluvium, Colluvium, Karoo Dolerite (*Jd*), Katberg (*Trlk*)	medium- high Katberg (*Trlk*)	local permanent	low - medium	monitoring of fresh exposures / excavations
Section C – D New Gravity Main	32 01 59.41 to 32 01 29.29	Superficial deposits, Alluvium, Karoo Dolerite (*Jd*)	low	local permanent	none	monitoring of fresh exposures / excavations
Section D – E New Gravity Main	32 01 29.29 to 32 01 18.12	Superficial deposits, Alluvium, Katberg (*Trlk*)	medium- high Katberg (*Trlk*)	local permanent	low - medium	monitoring of fresh exposures / excavations
Section E – F New Gravity Main	32 01 18.12 to 32 01 13.92	Superficial deposits, Colluvium, Karoo Dolerite (*Jd*)	low	local permanent	none	none
Section F – G	32 01 13.92	Superficial deposits, Alluvium, Colluvium,	medium – high Burgersdorp	local permanent	medium	monitoring of fresh

New Gravity Main	to 32 00 57.32	Burgersdorp (*Trlb*)	(*Trlb*)			exposures / excavations
Section G – H New Gravity & Pumping Main	32 00 57.32 to 32 01 25.72	Karoo Dolerite (*Jd*)	low	local permanent	none	none
Section H – I New Pumping Main	32 01 25.72 to 32 01 35.00	Burgersdorp (*Trlb*)	medium – high Burgersdorp (*Trlb*)	local permanent	medium	monitoring of fresh exposures / excavations
Section I – J New Pumping Main	32 01 35.00 to 32 02 07.51	Superficial deposits, Katberg (*Trlk*)	medium- high	local permanent	low - medium	monitoring of fresh exposures / excavations
Water Extraction Site (WTW)		Superficial deposits, Karoo Dolerite (*Jd*), Katberg (*Trlk*)	medium- high	local permanent	low - medium	monitoring of fresh exposures / excavations

Section A – B

The section crosses approximately 300m of interconnected dolerite intrusions underlying superficial valley deposits (**Fig. 6 & 7**). The pedestrian survey demonstrated no evidence of Quaternary fossil exposures along the section. It is not palaeontologically vulnerable and is of low palaeontological significance.

Section B - C

The section is underlain by fossil-bearing Katberg Formation sandstone (*Trlk*) and substantial superficial valley fill deposits of Quaternary age (**Fig. 8 & 9**). No evidence of fossil localities was found along the Quaternary alluvial exposures. The superficial deposits are of low palaeontological significance. The underlying Katberg Formation

rocks are palaeontologically significant and will be affected if exposed through trenching.

Section C – D

Quaternary alluvial sediments as well as dolerite bedrock (*Jd*) will be impacted along this section (**Fig. 10 & 11**). There is no evidence of Quaternary fossil material in the superficial alluvial deposits. The dolerite bedrock is not palaeontologically vulnerable and is of low palaeontological significance.

Section D – E

Extensive alluvial deposits blanket the underlying Katberg Formation (*Trlk)* bedrock along this section (**Fig. 12 & 13**). There is no evidence of Quaternary fossil material in the overlying Quaternary exposures. The underlying Katberg Formation rocks are palaeontologically significant and will be affected if exposed through trenching.

Section E – F

The section is underlain by a dolerite dyke (**Fig. 14**). Dolerite bedrock is not palaeontologically vulnerable and is of low palaeontological significance.

Section F – G

Burgersdorp Formation sandstones and mudrock (*Trlb*) are exposed along the mountainous outcrop to the north of Tsomo town (**Fig. 15**). The pedestrian survey showed no indication of fossil exposures along the surface. However, these rocks are palaeontologically significant and will be affected if exposed through trenching.

Section G - H

This section forms part of a mountain plateau that is made up of dolerite bedrock (**Fig. 16**). Dolerite is not palaeontologically vulnerable and is of low palaeontological significance.

Section H - I

Burgersdorp Formation sandstones and mudrock (*Trlb*) are exposed along the foot of the mountain to the northeast of Tsomo town (**Fig. 17**). No fossil exposures were located along the surface, but *in situ* bedrock will be affected if exposed through trenching.

Section I – J

The section is underlain by fossil-bearing Katberg Formation sandstone (*Trlk*) **(Fig. 18 & 19**). No fossil exposures were located along the surface, but *in situ* bedrock will be affected if exposed through trenching.

The Water Extraction Site (WTW).

The sedimentary bedrock in the area is made up of Katberg Formation sandstone (*Trlk*), but dolerite intrusions are also widespread along the upper terrace of the Tsomo River at the current water extraction site (**Fig. 20**). The dolerite bedrock is not palaeontologically vulnerable, but the *in situ* Katberg Formation sandstone will be affected if exposed through excavations.

Statement of Significance

The proposed pipeline and water extraction facility are located on potentially fossil-bearing Tarkastad Subgroup (*Trlk, Trlb*) strata that are frequently intruded by a system of interconnected igneous bedrock (*Jd*). The latter material as well as the overlying Quaternary deposits bear little palaeontological significance.

There are **no major palaeontological grounds to suspend the proposed development of the site**, but given the nature of fossil distribution in Karoo sedimentary rocks, it is not possible to exactly predict the buried fossil content of an area other than in general terms unless fresh exposures indicate otherwise. Also, in most cases, sampling of fossils for the purpose of palaeontological mitigation cannot usually be conducted prior to the commencement of construction / exvavation activities. Therefore, any developments that may destroy, or damage subsurface fossils are of conservation and research interest.

Recommendation

It is possible that fossil material may be uncovered in the recognized fossil-bearing strata during the construction of the pipeline and the development of the water extraction facility. Therefore, the most appropriate recommendation for mitigation in Section B - E, Section E – G and Section H – J, is monitoring of fresh exposures and bedrock excavations into potential fossil-bearing strata of the Tarkastad Subgroup (*Trlk, Trlb*).

It is advised that newly uncovered material found during the course of excavation activities should be reported to SAHRHA, that excavations into *in situ* sedimentary bedrock should allow **for inspection by a specialist at the appropriate time** and that possible intact finds may **require a Phase 2 rescue operation at the cost of the developer.**

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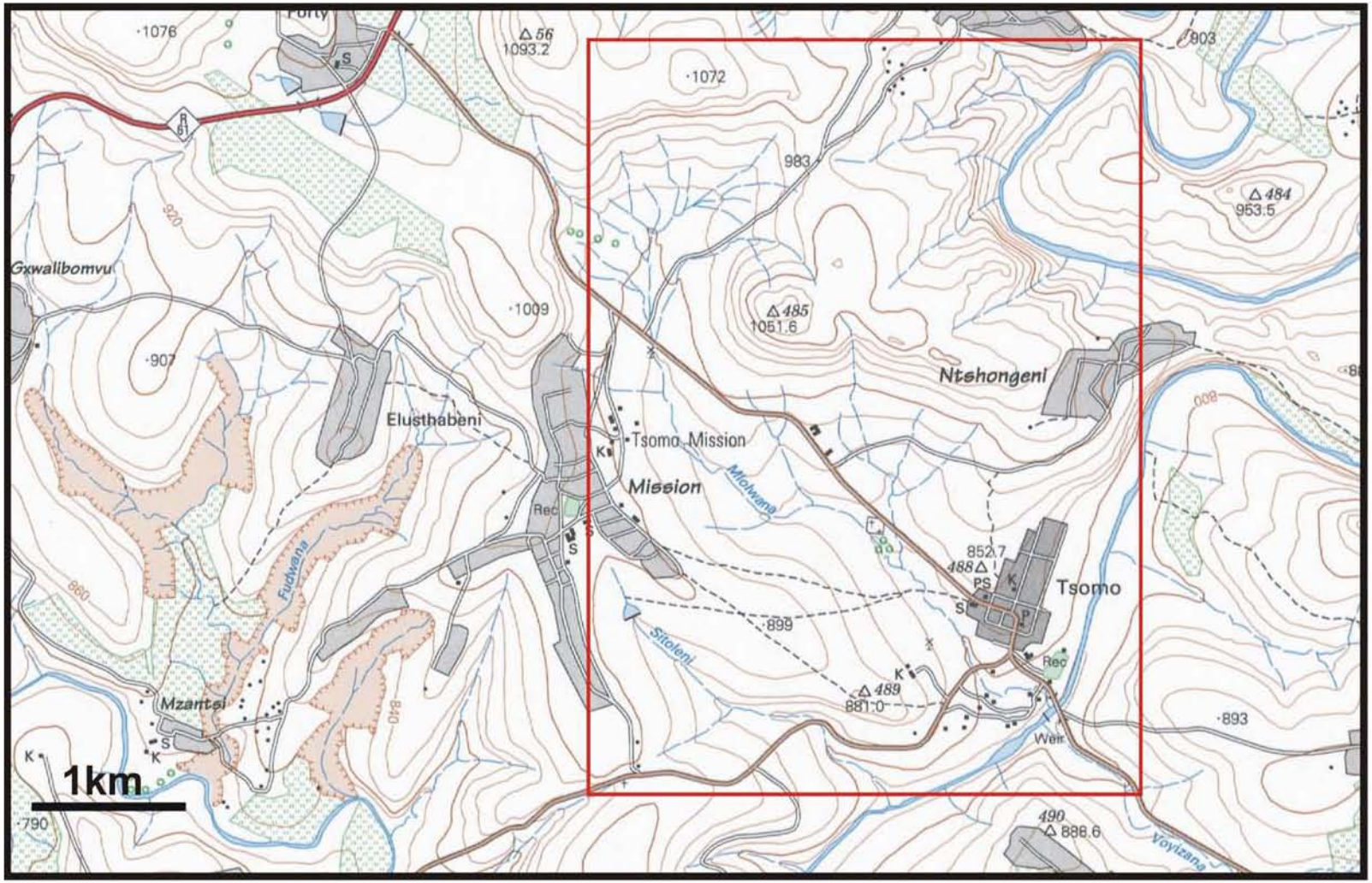

Figure 1. 1 : 50 000 scale topographic map (3227 BB Nqamakwe) of the study area.

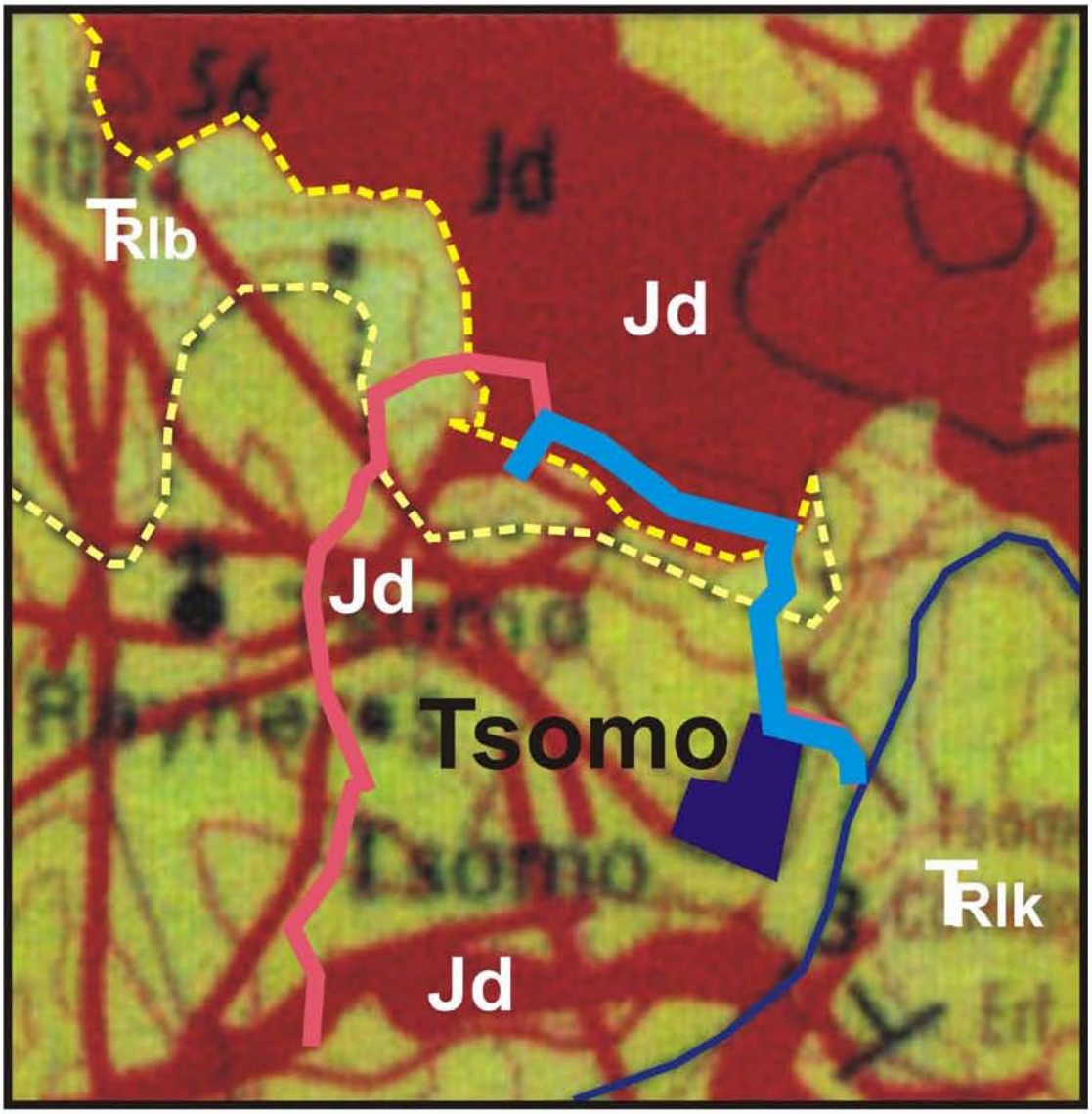

Figure 2. Portion of the 1 :250 000 scale geological map 3226 King Williams Town showing bedrock geology of the study area. Mesozoic strata consist of Tarkastad Subgroup sediments represented by the Katberg Formation *(Trlk)* and overlying Burgersdorp Formation (*Trlb*) . These sedimentary rocks were intruded by an interconnected network of dykes, sills and inclined sheets of Jurassic-age dolerite (*Jd*).

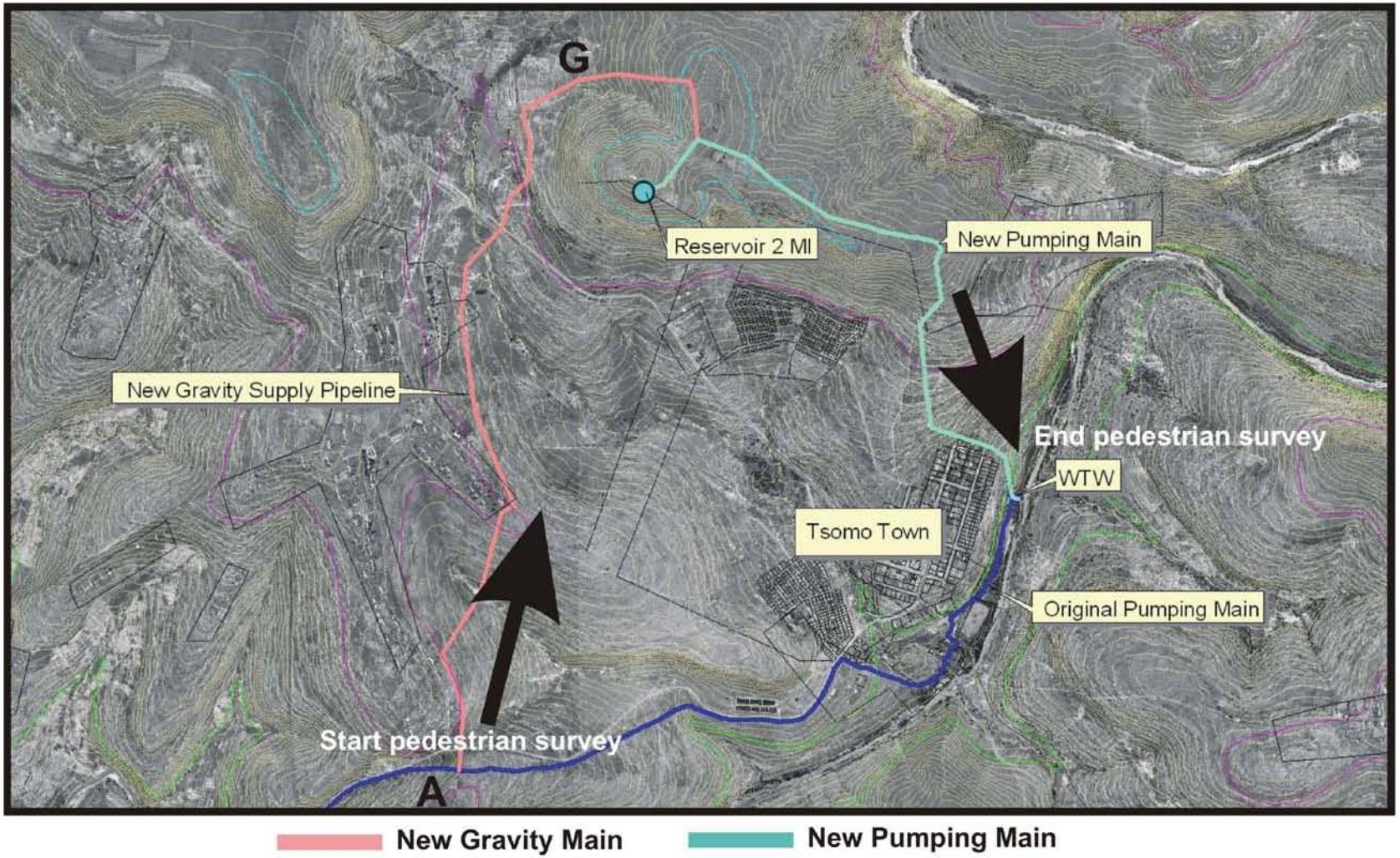

Figure 3.Map showing extent of the proposed development and subsequent pedestrian survey.

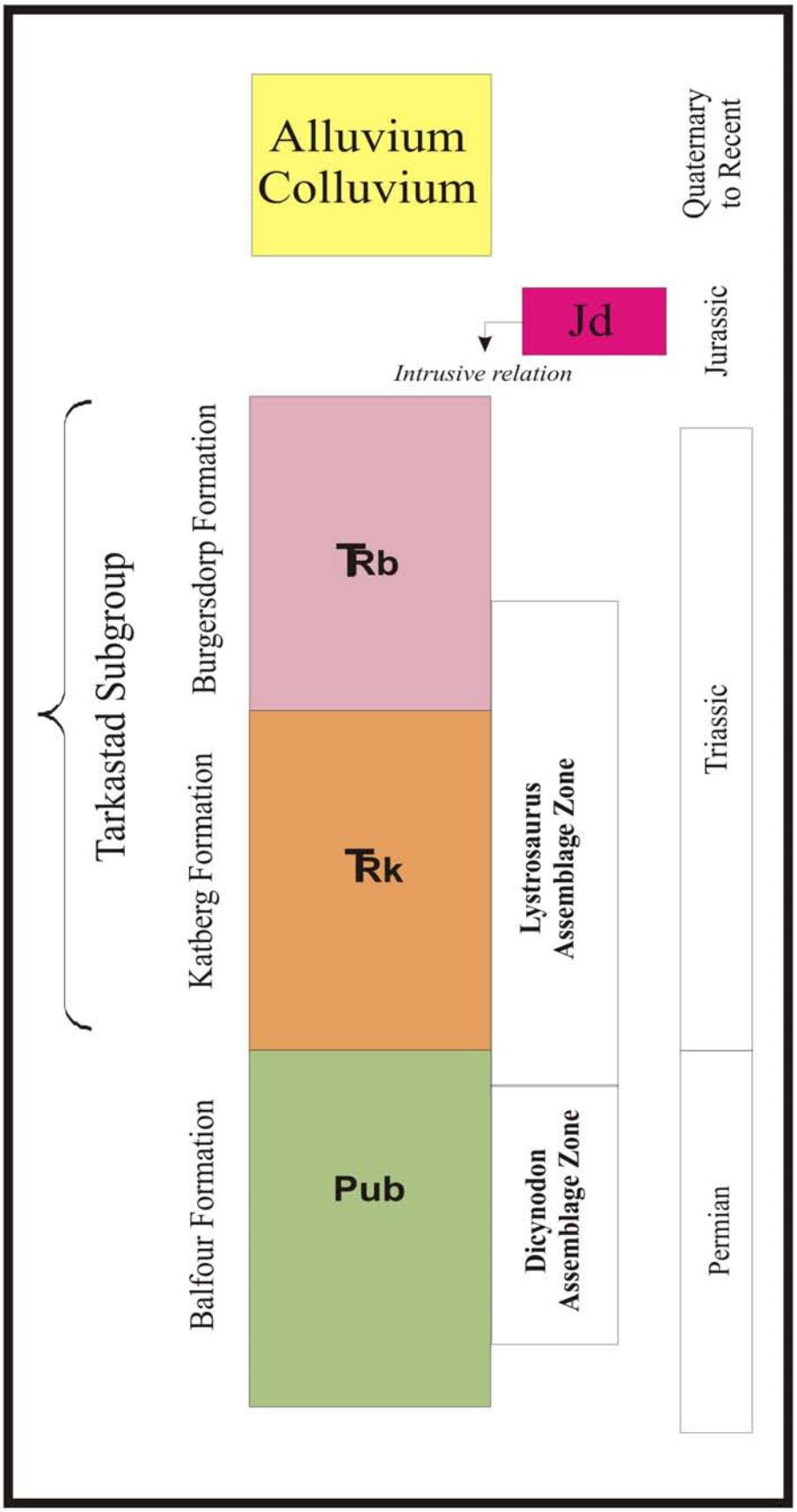

Figure 4. Stratigraphic section and schematic representation of local geology and palaeontology.

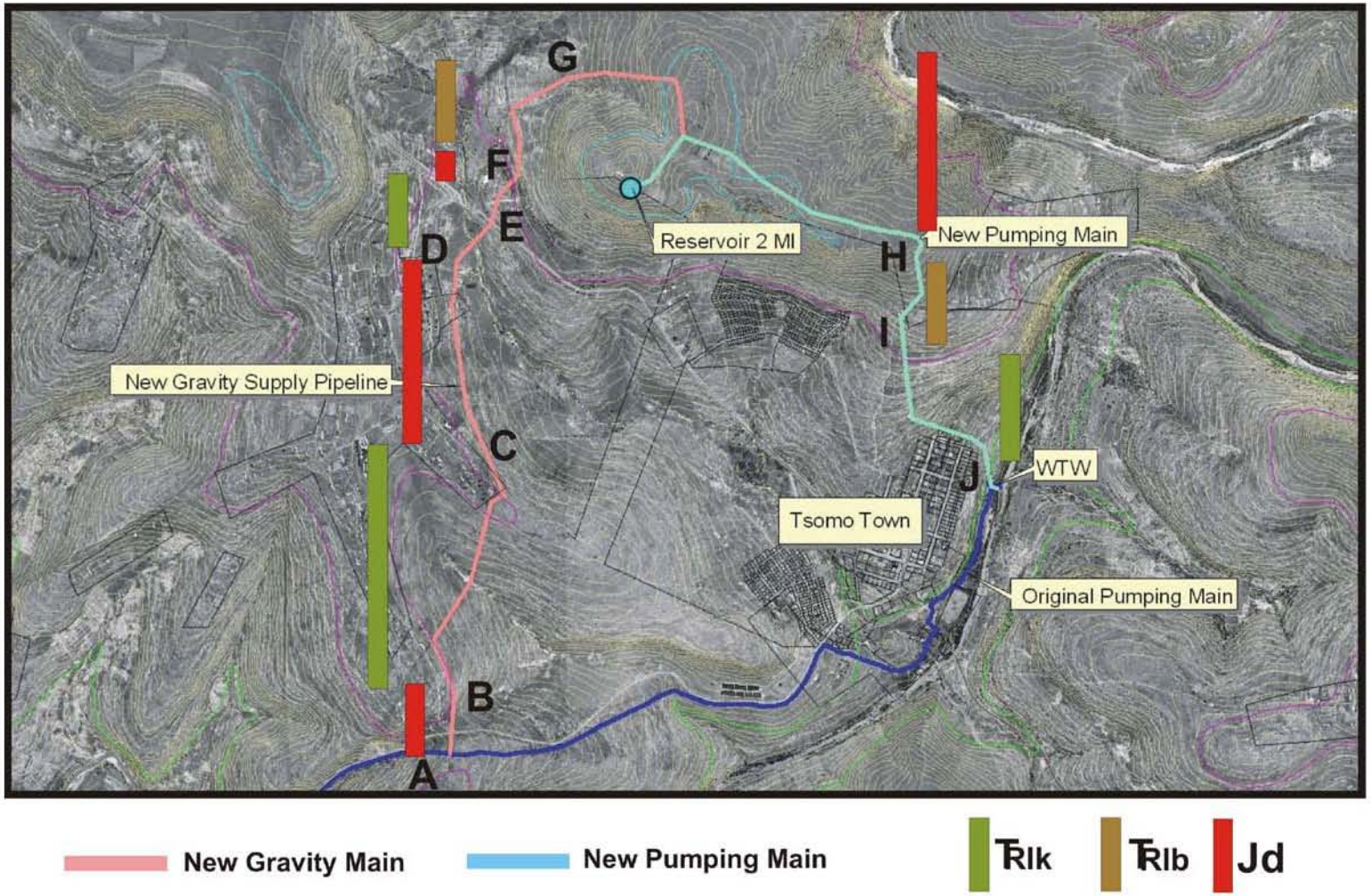

Figure 5. Schematic representation of the predominant bedrock geology along the pipeline route. The footprint is divided up into arbitrary sections from A to J.

Figure 6. Gravity Main. Aerial view of Section A - B. The section crosses approximately 300m of interconnected dolerite intrusions and superficial Quaternary-age valley deposits.

Figure 7. Area at Section A -B, looking north (32° 2'53.83"S 27°47'40.92"E).

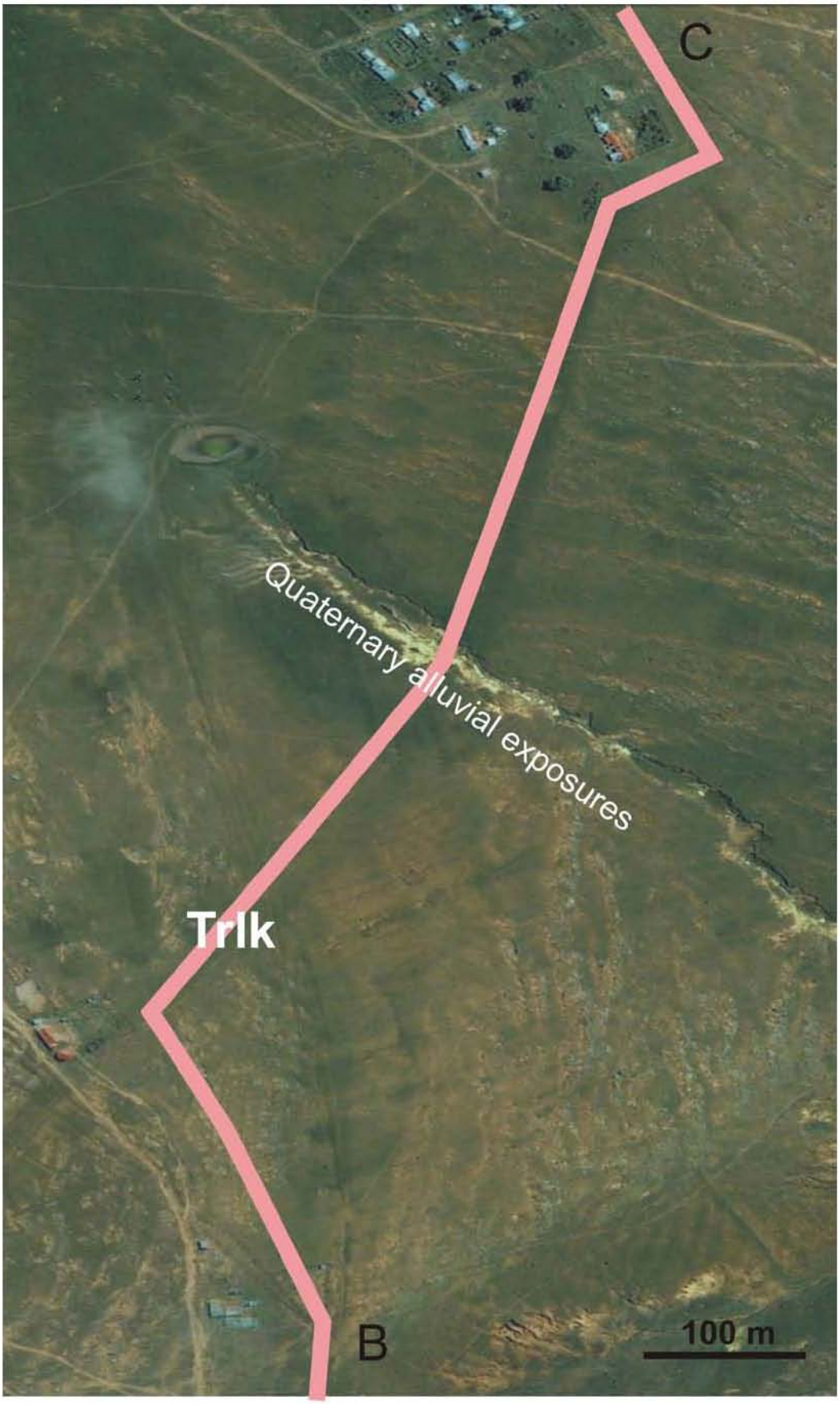

Figure 8. Gravity Main. Aerial view of Section B - C. The section is underlain by fossil-bearing Katberg Formation sandstone (*Trlk*) and substantial superficial valley fill deposits of Quaternary age.

Figure 9. Katberg Formation (*Trlk*) sandstone outcrop (above) and Quaternary-age colluvial deposits (below) along Section B - C.

Figure 10. Gravity Main. Aerial view of Section C - D. The underlying geology is mostly made up of dolerite bedrock (*Jd*) and Quaternary alluvial sediments.

Figure 11. Section C -D, looking south (32° 2'34.48"S 27°47'37.29"E).

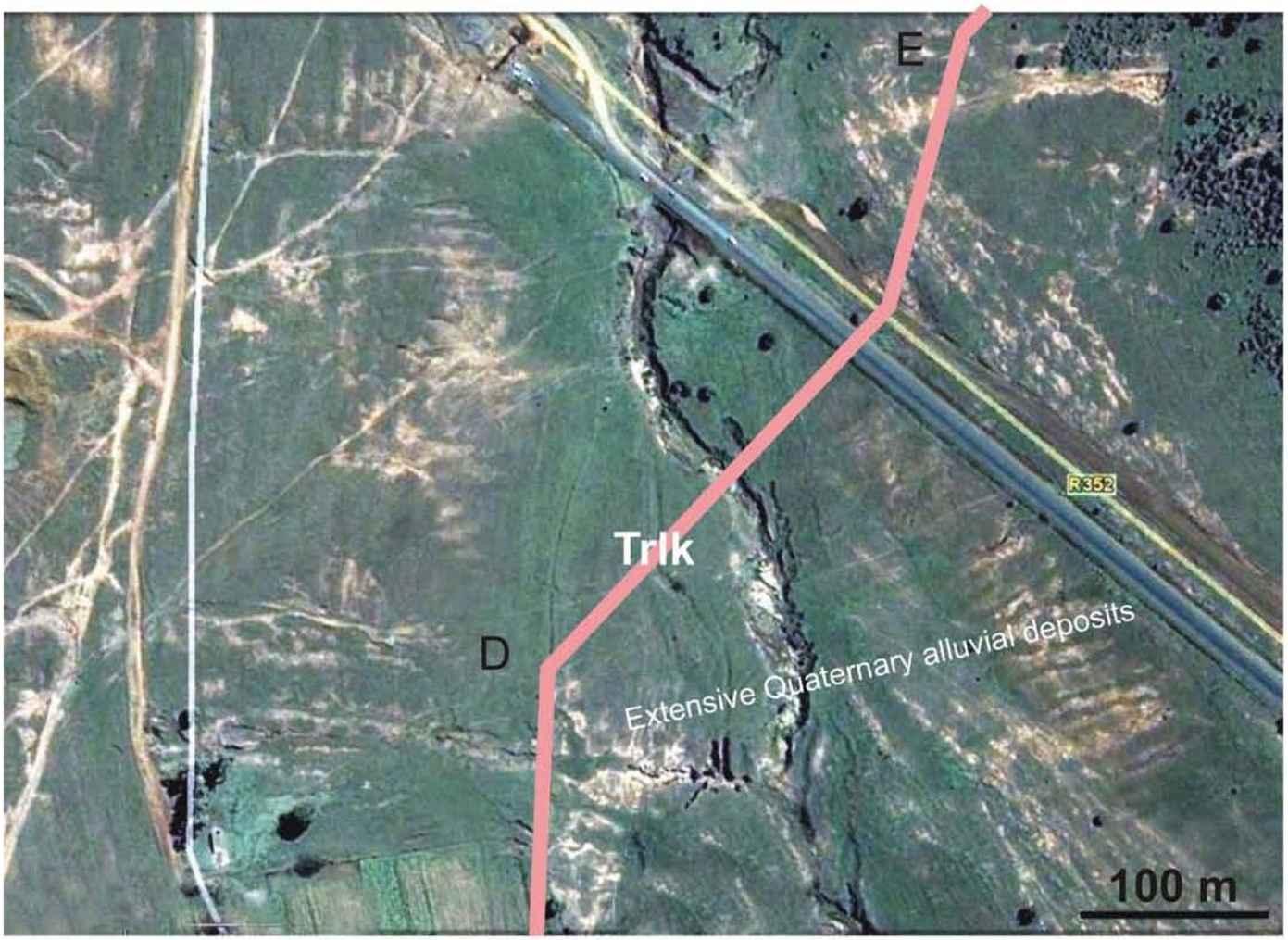

Figure 12. Gravity Main. Aerial view of Section D - E. Extensive alluvial deposits blanket the underlying Katberg Formation (*Trlk)* sandstones along this section.

Figure 13. Section D - E, looking northeast (32° 1'29.98"S 27°47'37.21”E).

Figure 14. Gravity Main. Aerial view of Section E - F. The section is underlain by a dolerite dyke. Colluvium make up the superficial component.

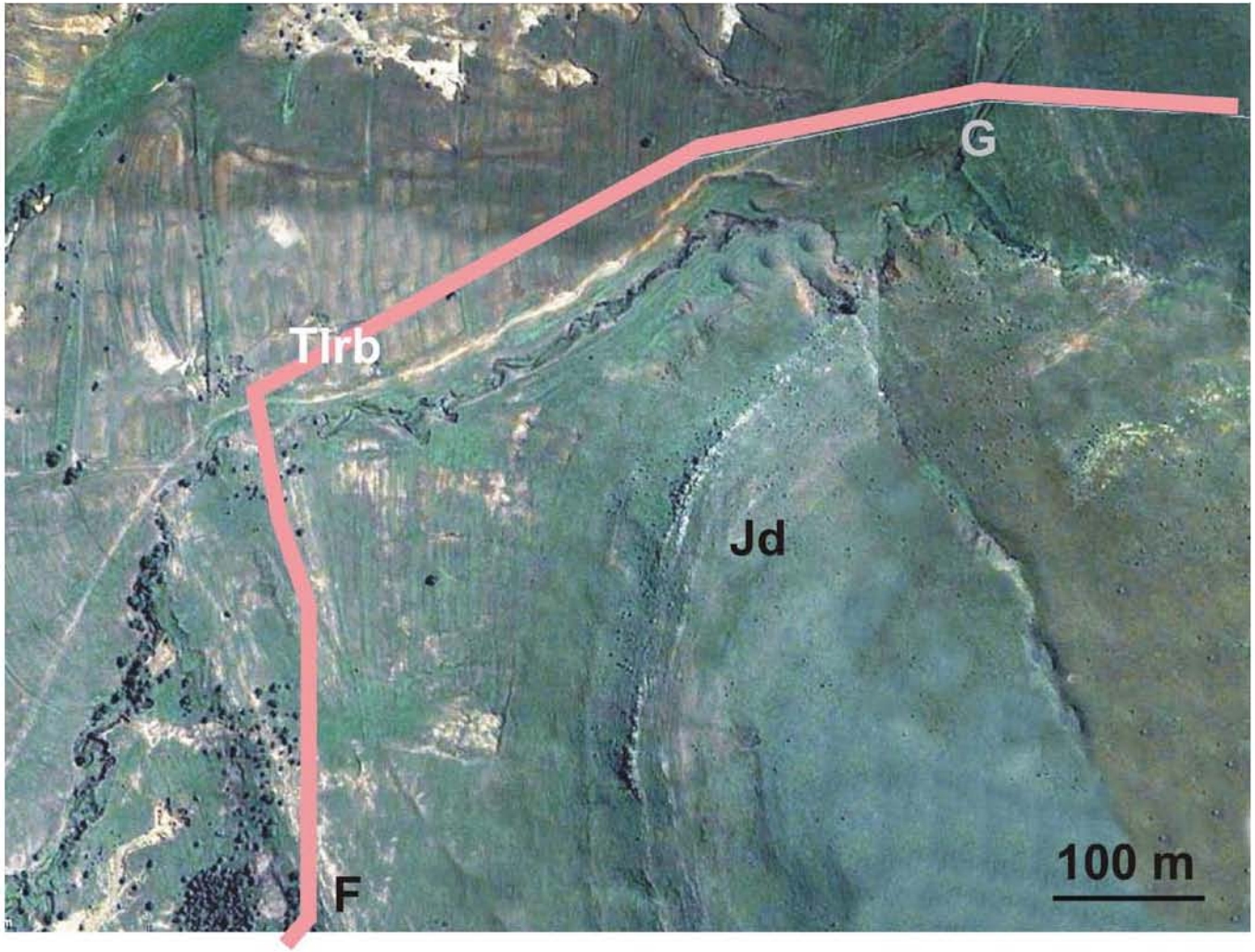

Figure 15. Gravity Main. Aerial view of Section F - G. Burgersdorp Formation sandstones and mudrock (*Trlb*) are exposed along a prominent mountainous outcrop of dolerite (*Jd*).

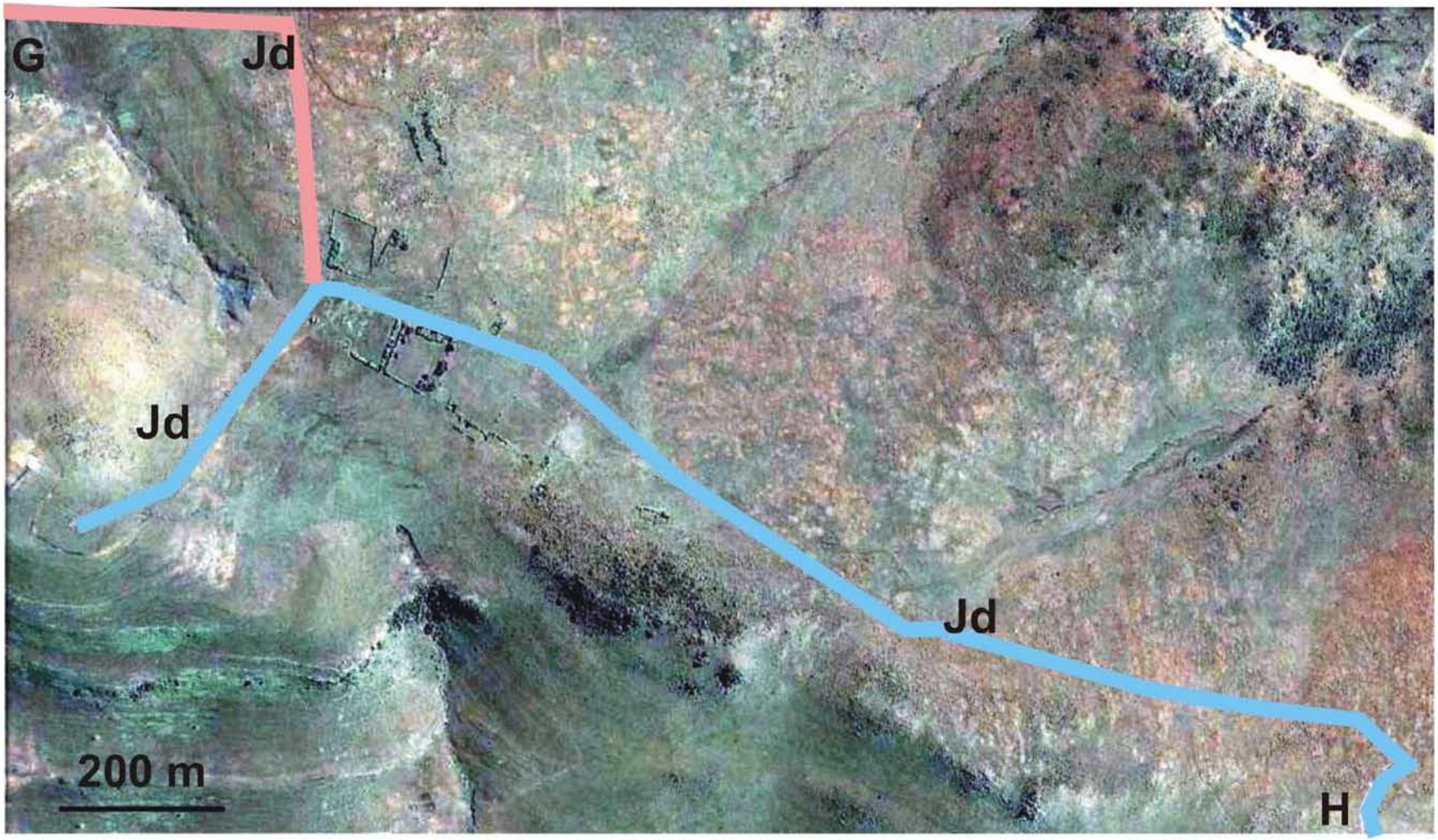

Figure 16. Gravity Main and Pumping Main. Aerial view of Section G - H. This section forms part of a mountain plateau that is made up of dolerite bedrock (*Jd*).

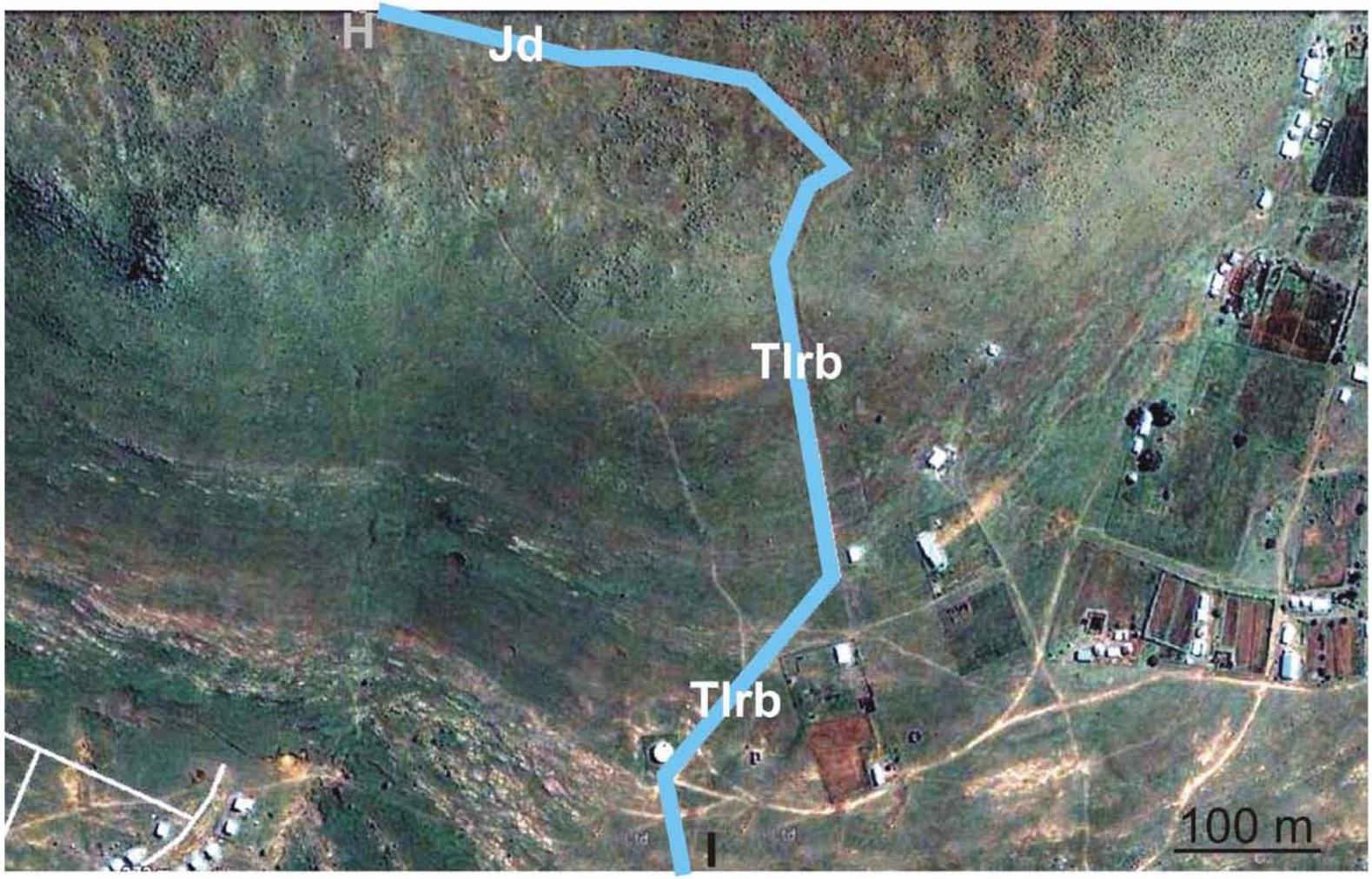

Figure 17. Pumping Main. Aerial view of Section H - I. Burgersdorp Formation sandstones and mudrock (*Trlb*) are exposed along the foot of the mountain to the northeast of Tsomo town.

Figure 17. Pumping Main. Aerial view of Section I - J. The section is underlain by fossil-bearing Katberg Formation sandstone (*Trlk*). Dolerite intrusions are also widespread along the upper terrace of the Tsomo River at the current water extraction site.

Figure 19. Katberg Formation (*Trlk*) outcrop, looking north along Section I - J (32° 1'57.61"S 27°49'18.33”E).

Figure 20. The current water extraction site (above). The area is located on Katberg Formation sediments intruded by interconnected dolerite bedrock (below).