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KIMBERLEY STRENGTHENING PHASE 4 PROJECT – SOIL AND AGRICULTURAL POTENTIAL BASELINE STUDY FOR THE ULCO-OLIEN-MANGANORE STUDY AREA

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BASELINE SOIL AND AGRICULTURAL POTENTIAL STUDY FOR THE PROPOSED ESKOM KIMBERLEY STRENGHTENING PHASE 4 PROJECT (ULCO-OLIEN-MANGANORE AREA)

PREPARED FOR

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1. INTRODUCTION

Terra-Africa Consult cc. was appointed by Landscape Dynamics (Pty) Ltd. to conduct a baselines soil and agricultural potential assessment report for the proposed Eskom Kimberley Strengthening Phase 4 Project situated in the Northern Cape Province. The total project area has been divided into four development areas and the third area include three substations i.e. Ulco, Olien and Manganore. The purpose of the baseline assessment is to evaluate the entire area for its suitability to the proposed project and to avoid areas with high potential agricultural soil where possible.

The objectives of this study are:

- to describe the soils present in the larger study area around the three proposed alternatives
- to determine the agricultural potential of the soil
- to determine land capabilities associated with the different soil types
- to make recommendations with regards to the most suitable alternative from the perspective of soil conservation

2. TERMS OF REFERENCE

The first part of this study consisted of a high level desktop assessment of the study area using spatial imagery on Google Earth before the site visit commenced. During this phase, the area was scanned to determine whether there are any large agricultural developments such as irrigation schemes that might be impacted upon by the construction of the power lines.

The second phase consisted of flying over the alternative routes between the Eskom Ulco, Olien and Manganore substations. In addition to flying over the area, the alternative routes were also visited by road to evaluate soil profiles and to observe any agricultural activities.

The third phase included analysis of spatial data as was obtained from the Agricultural Research Council as well as the Environmental Potential Atlas Database.

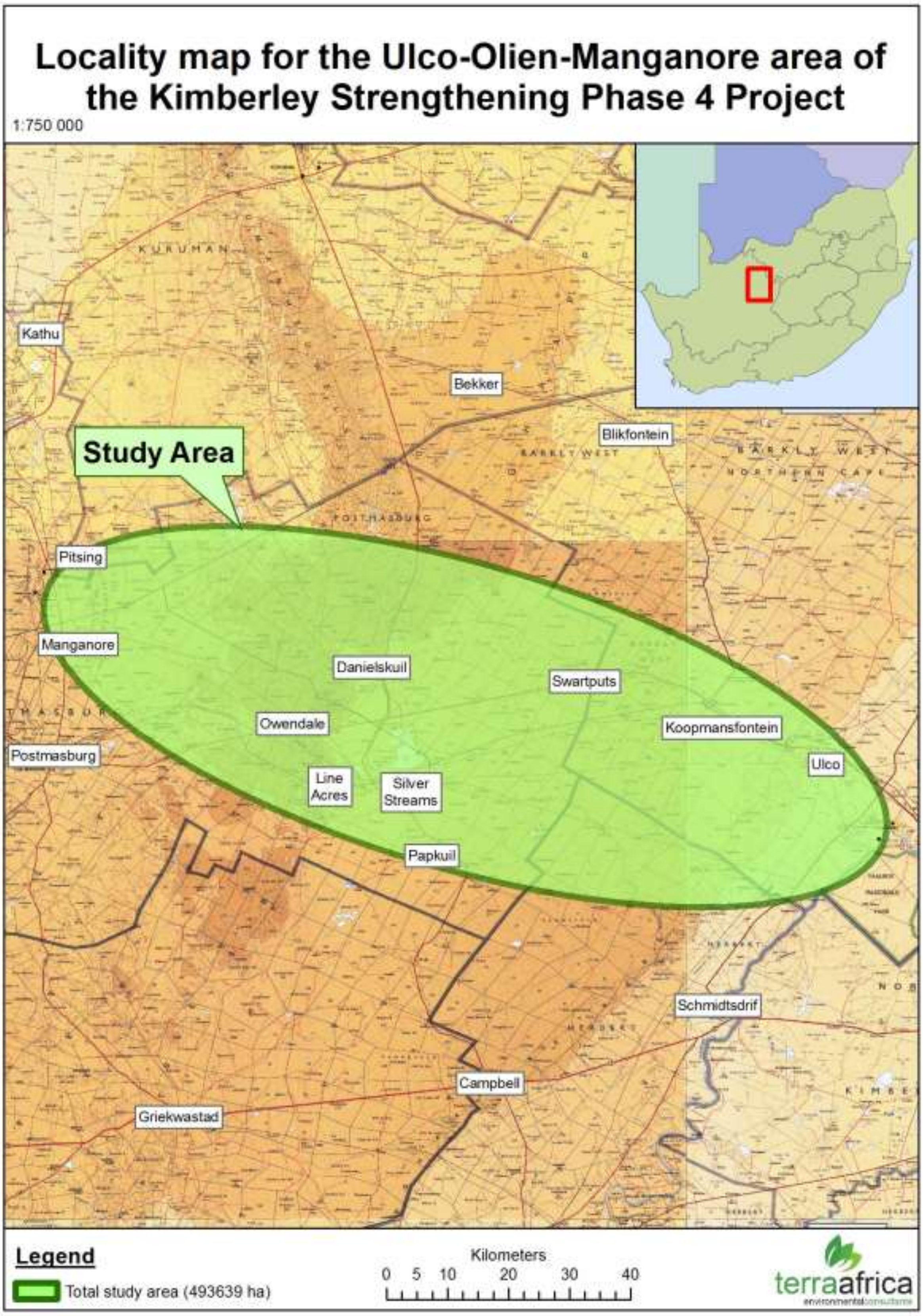

Figure 1: Locality map for the Ulco-Olien-Manganore area of the Kimberley Strengthening Phase 4 Project

3. LOCALITY OF THE ULCO-OLIEN-MANGANORE AREA OF THE KIMBERLEY STRENGTHENING PHASE 4 PROJECT

The northwestern boundary of the Ulco-Olien-Manganore line is situated between the towns of Kathu in the north and Postmasburg in the south. The southeastern boundary is north of Smithsdrift. This part of the Kimberley Strenghtening Phase 4 Project is located entirely within the Northern Cape(Figure 1). The total study area for this assessment was 493,639 hectares (ha) and included assessment of two alternatives which are the first alternative (128 km) and the second alternative (136 km) (Figure 3). All three alternatives run in an northwest to southeast direction and the first alternative aims to avoid crossing through pans and water bodies as far as possible.

4. CLIMATE OF THE STUDY AREA

The climate data was obtained from the New Local Climate Estimator, developed by the Food and Agricultural Organisation of the United Nations in 2005.

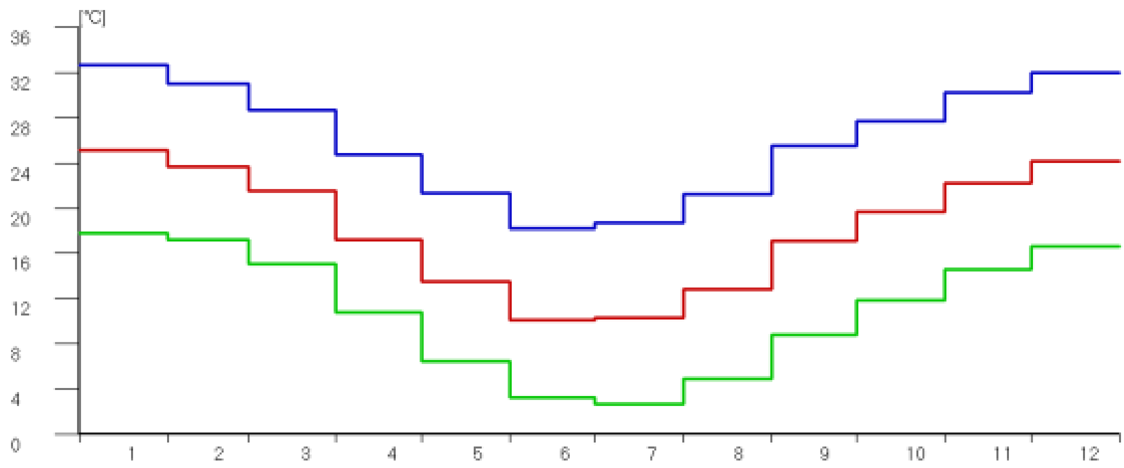

Figure 2: Average daily maximum temperature (blue), average daily mean temperature (red) and average daily minimum temperature (green) in °C from month 1 (January) to month 12 (December)

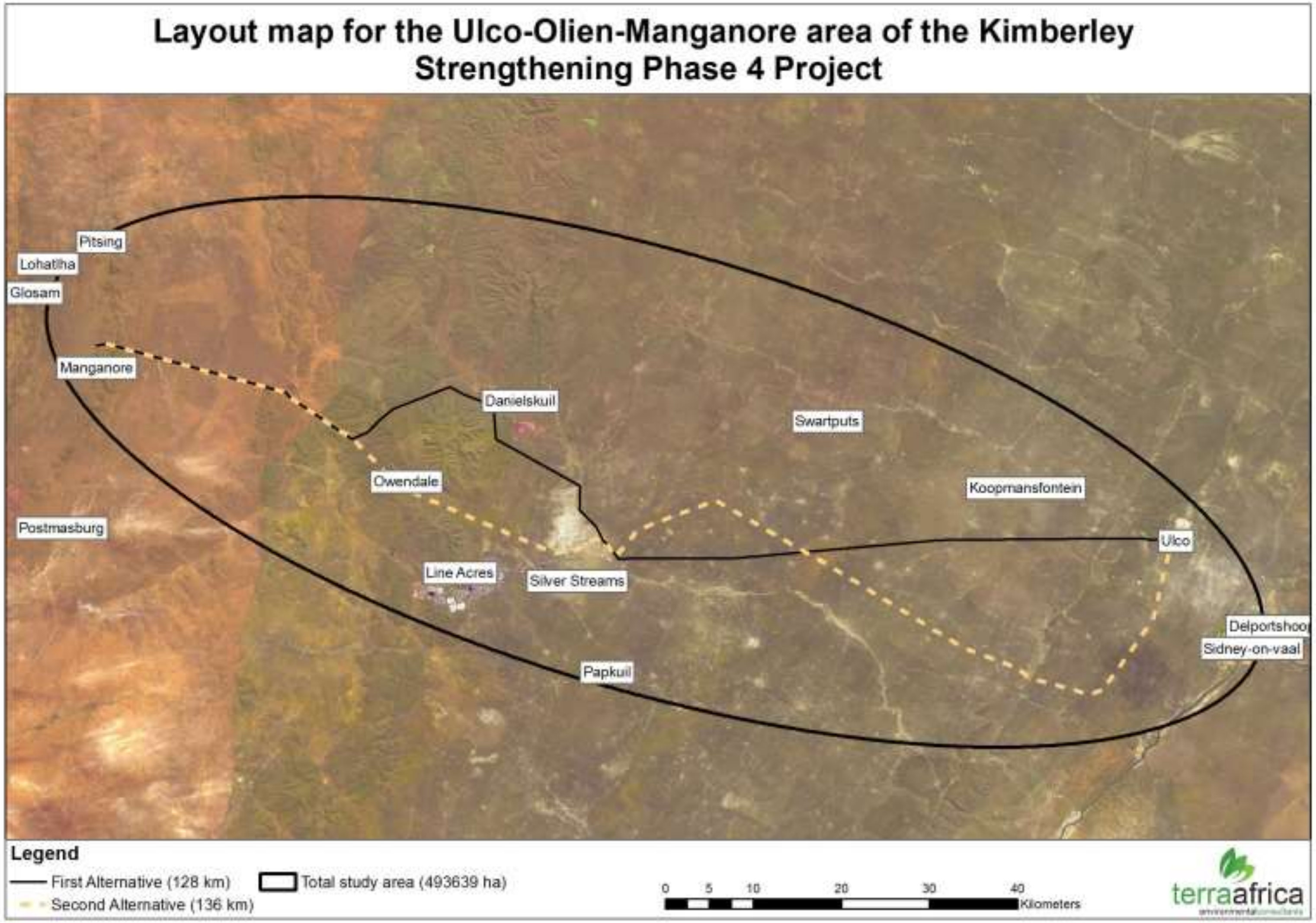

Figure 3: Layout map for the Ulco-Olien-Manganore area of the Kimberley Strengthening Phase 4 Project

The climate can be considered to be semi-arid with hot summers and cold winter temperatures. Average temperatures vary between 3°C and 33°C (Figure 2). In spring, summer and autumn months, the average rainfall varies between 33mm (October) and 70mm per month (March), while potential evapotranspiration will be between 148mm (October) and 126mm (March) per month.

Rainfall during winter months is erratic and usually no or very little rain falls between June and September, while evapotranspiration is never less than 51mm per month (Figure 4). The area has an average of 51 rainy days per year and a ground frost frequency of 5%. The effective rainfall for the area is 381mm. This implies that the area has a precipitation deficit of 1174mm per year and a moisture index of -74% and can therefore be classified as a semi-arid region for agricultural purposes.

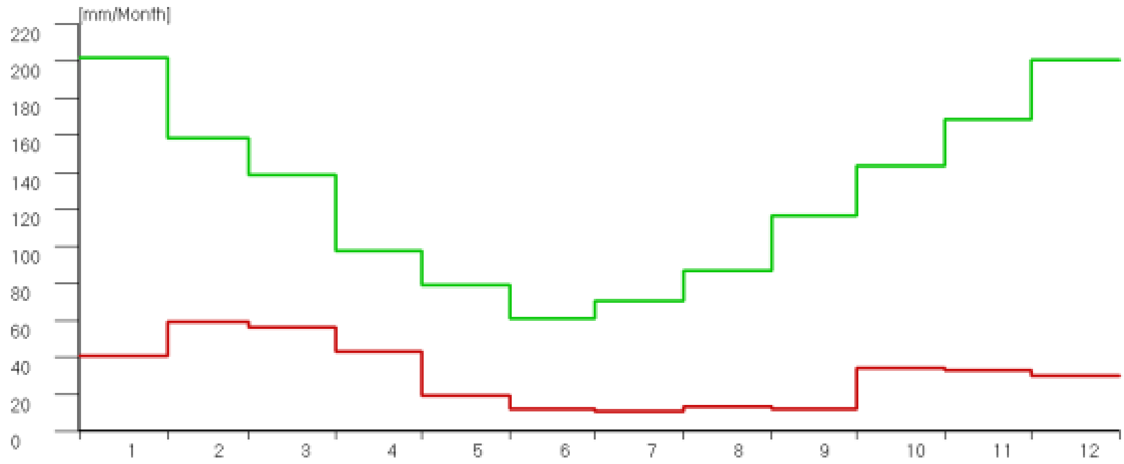

Figure 4: Annual rainfall (red) and Potential Evapotranspiration (PET) (green) in mm/Month from month 1 (January) to month 12 (December)

The weather station where this data was obtained from is the Kimberley weather station located at longitude 24.76° and latitude -28.80°. The station is located at an altitude of 1200m.

5. IDENTIFICATION OF ASSUMPTIONS AND LIMITATIONS

The study relies heavily on spatial data and imagery and has not been verified by a detailed soil survey. The photos were taken during the site visit and the purpose of this visit was to get a broad overview of the attributes of the landscape. However, taken the nature of the project into consideration and the very small areas where soil will be impacted upon, the study is sufficient to provide baseline information that can be used during the detailed planning and impact assessment phase of this project.

6. LAND TYPE DATA ASSESSMENT

7.1 Background information

The following abstract from Sililo et al. (2000) gives an introduction into the development and usefulness of a land type data system:

"In South Africa, land type maps were designed to assist in assessing agricultural potential. The procedure followed in mapping land types was described by the Institute of Soil, Climate and Water (Land type Survey Staff, 1987)."

Land type data was developed by superimposing broad soil groups developed from the Binomial Soil Classification System (MacVicar et al., 1977) with maps of climate zone. This resulted in the land type maps that indicated land type boundaries with an inventory for each land type that include clay percentage as well as other information regarding the area that can be used to interpret soil classification results more successfully.

7.2 Land type results

Seven different land types were identified on within the larger Beta-Boundary study area. These land types are Ae2, Ae124, Ae215, Ae216, Ae219, Ae7, Ae8, Ae9, Ag109, Ag110, Ag111, Ag113, Ah21, Dc5, FC4, Fc5, Fc6, Fc7, Ib236 and Ib237 (Figure 9). Below follows a description of each of the land types identified.

7.2.1 Land Type Ae2

The land type is found in landscapes where the slope is between 1% and 6% and slope length between and 800 and 4000 m for Landscape Position 4 and slope of 0 to 2% and slope length between 5 and 1000 meters for Landscape Position 5. The soil forms in this land type mainly consist of deep to medium-deep red apedal soils of the Hutton form with patches of yellow-brown apedal Clovelly soils and shallow, rocky Mispah soils dispersed in between. According to the land type chart these soils are underlain by banded ironstone and jaspillite with subordinate amphibolite and crocidolite (Asbestos Hills Formation) and fine and coarse- grained dolomite, chert and dolomitic limestone (Ghaap Plateau Formation).

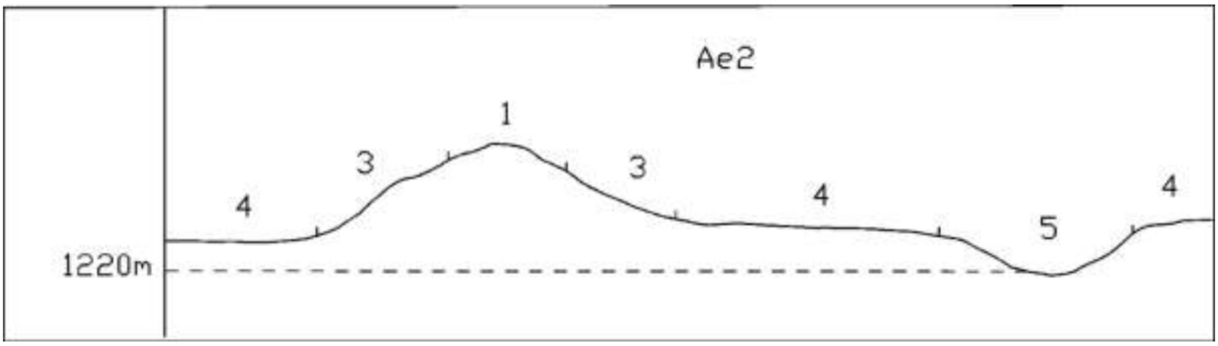

Figure 5: Terrain form sketch for Land Type Ae2

7.2.2 Land Type Ae214

This land type is found in four different landscape positions where Positions 1 and 3 are associated with areas with hilltops and steeper slopes of between 0 and 8% and slope lengths of 100 to 500m and 500m to 2000m. For the flatter landscape positions, the slope is between 0 and 2% and slope length between and 50 and 1000 m for Landscape Position 4 and slope of 0 to 2% and slope length between 50 and 200 meters for Landscape Position 5. The soil forms in this land type are dominated by red apedal Hutton soils with varying depth. The geology underlying this land type is amygdaloidal andesitic lava with interbedded tuff, agglomerate, chert and red jasper.

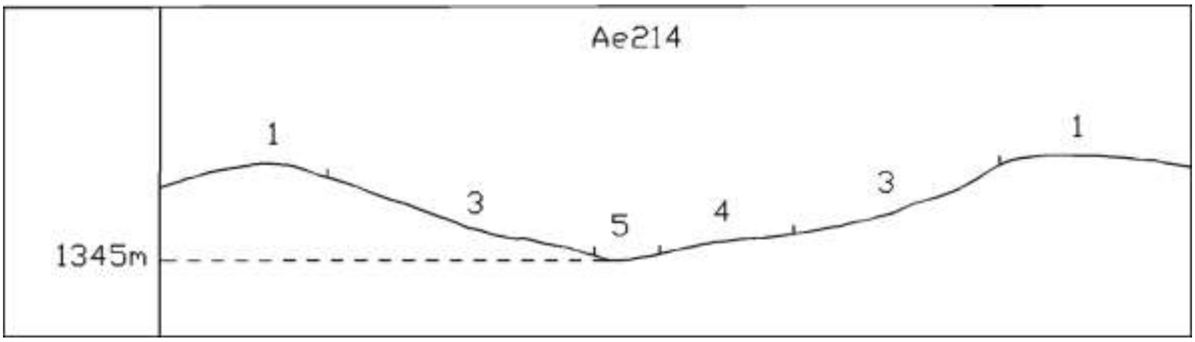

Figure 6: Terrain form sketch for Land Type Ae214

7.2.3 Land Type Ae215

This land type is associated with very shallow valley bottoms with only two landscape positions. Both of these positions (4 and 5) have very little slope (0 – 2 %) and long slope lengths. This land type is also dominated by soils of the red Hutton form but also included wetter soil of the Kroonstad form.

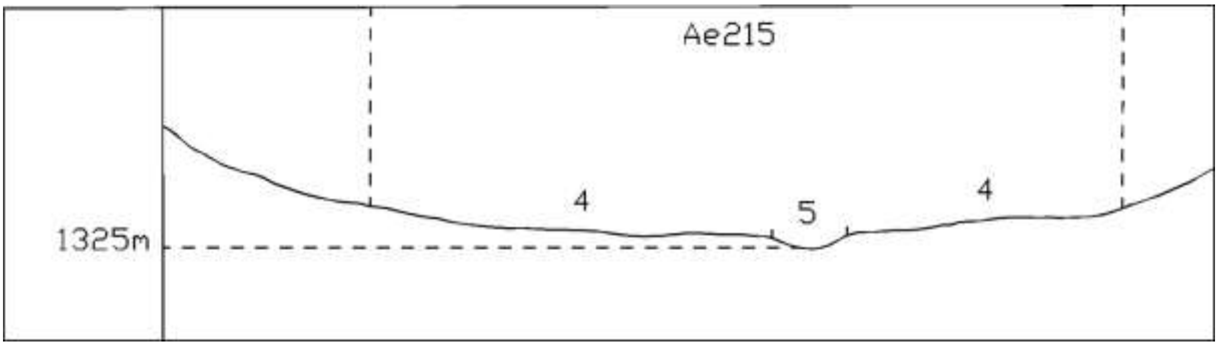

Figure 7: Terrain form sketch for Land Type Ae215

7.2.4 Land Type Ae216

This land type is very similar to land type Ae216 in that is associated with very shallow valley bottoms with only two landscape positions. Both of these positions (4 and 5) have very little slope (0 – 2 %) and long slope lengths. This land type is also dominated by soils of the red Hutton form and also include soil of the Valsrivier form and stream beds. The geology underlying is land type is amygdaloidal andesitic lava with interbeds of tuff, agglomerate, chert and red jasper of the Ongeluk Formation.

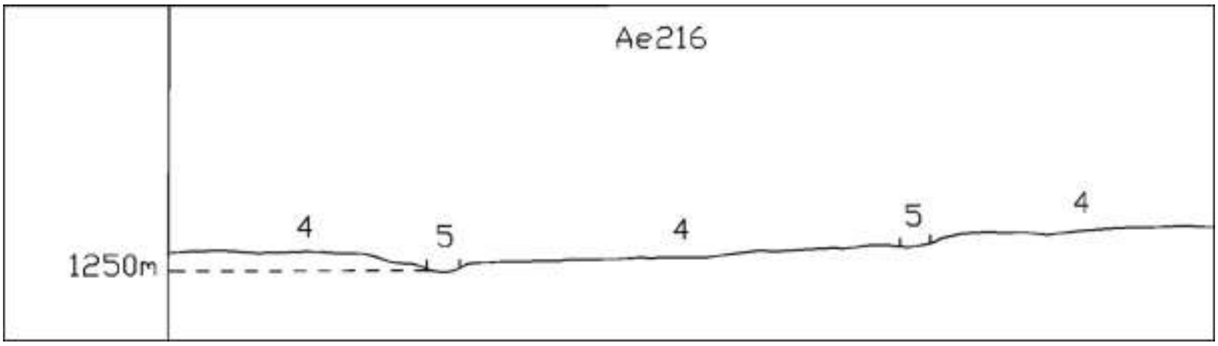

Figure 8: Terrain form sketch for Land Type Ae216

7.2.5 Land Type Ah21

The land type represents areas where duplex soils with non-red B horizons comprise more than half of the area covered by it and where the slopes are relatively flat. The soils are dominantly shallow to deep structure duplex with a limited occurrence of swelling soils in depressions. According to this classification, the land capability and land use is predominantly extensive grazing due to climatic and soil constraints. Due to the level terrain soil erosion is not a major factor but the duplex soils are very susceptible to such if the terrain is physically disturbed. The site also falls into an area with low potential due to relatively low and erratic rainfall.

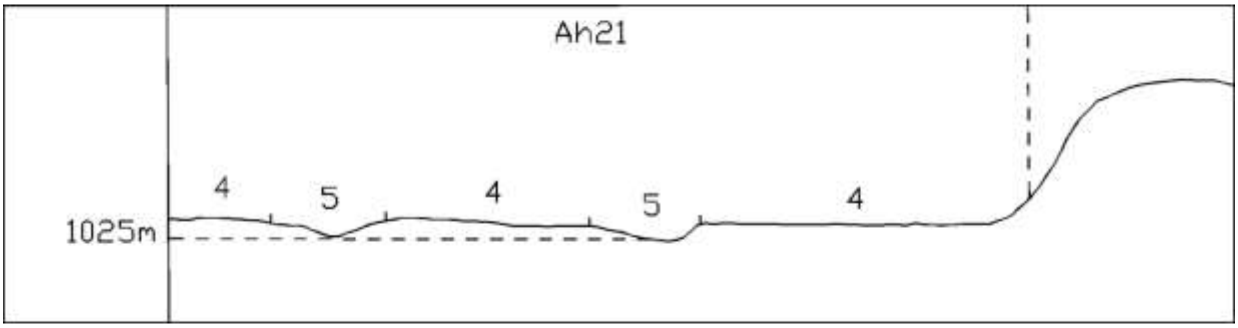

Figure 17: Terrain form sketch for land type Ah21

7.2.6 Land Type Dc5

Land type Dc5 consist of a combination of duplex soils where clay accumulation through the soil profiles have resulted in more structured soil forms such as that of the Valsrivier, Swartland and Oakleaf forms. It is found in flatter landscape positions with long slope lengths. The geology underlying this land type is shale and mudstone of the Ecca Group covered partially by surface limestone.

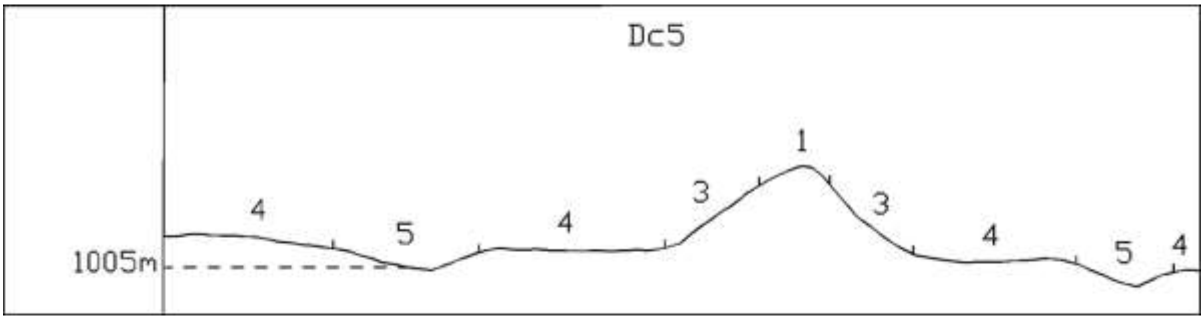

Figure 18: Terrain form sketch for land type Dc5

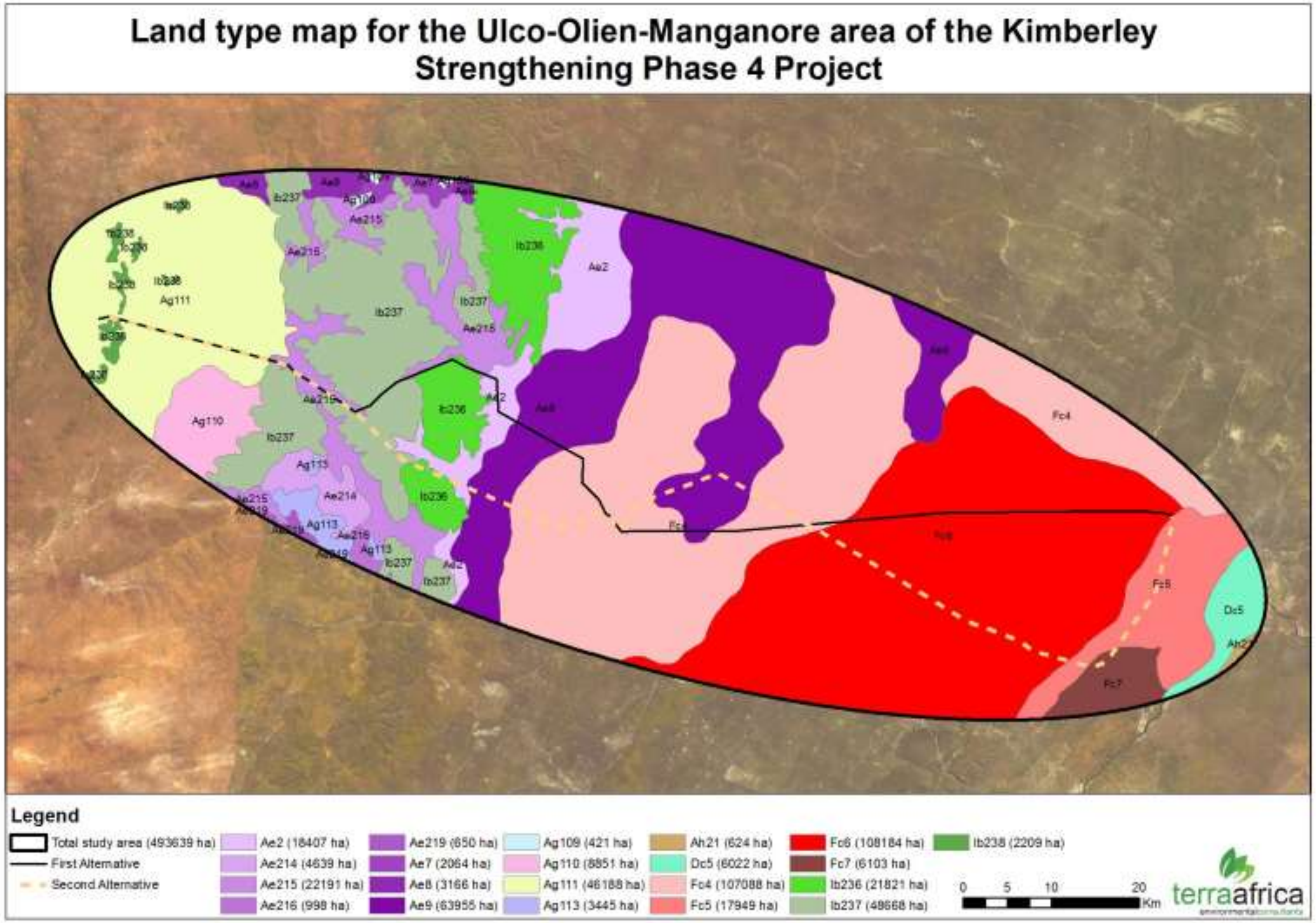

Figure 24: Land type map for the Beta-Boundary area of the Kimberley Strengthening Phase 4 Project

7. SOIL CLASSIFICATION

As the entire Kimberley Strengthening Phase 4 Project consist of four phases that are described in four different reports, soil description has been approached to be clear within each individual report as well as when all soil data are combined. Soils were classified into groups for the entire Phase 4 project area and only those relevant for each phase described within the phase's soil report.

Five different main soil groups are present in the entire Ulco-Olien-Manganore baseline area as well as in the areas currently indicated as the proposed alternative corridors for the project. Table 3 summarises the approximate lengths of each proposed alternative corridor that falls within the different soil groups.

8.1 Lithic soils (Group 2)

This group include shallow, rocky soils that are considered rather young in pedogenesis (soil formation processes). The lithic group is dominated by soils of the Mispah and Glenrosa forms and also include rocky outcrops (in this area more specifically dolerite outcrops). These soils have sandy texture, while topsoil structure is apedal and the profiles are very shallow (as shallow as 0.10 m of soil on a rocky layer). The orthic A-horizon of the lithic soil group is unsuitable for annual cropping or forage plants (poor rooting medium since the low total available moisture causes the soil to be drought prone). This soil group covers the smallest area of the three groups within the study area and is limited to the south-western part of the study site. Only alternative three has 4.2 kilometres of the proposed corridor that falls within the lithic soils.

The pans identified on site are endorheic pans that formed as a result of low infiltration rate of the soils present on site. These pans are underlain by rock and hardpan carbonate horizons where water accumulates during thunderstorms during the summer months. The water in the pans remains present until the high evaporation rate resulted in all the water evaporating. This leaves the soil surface barren and the lack vegetation on the soil surface cause sand to erode away as a result of wind erosion. The rock and/or carbonate horizon does not function as a conventional wetland and therefore the soils present in the pans are not considered sensitive. Sensitivity of these pans is more related to the ecosystems that are supported by the temporary water supply in the summer months.

8.2 Oxidic soils (Groups 1, 2 and 3)

The soil group consists of an orthic A horizon on a red or yellow-brown apedal B horizon overlying unspecified material. The B1-horizon has more or less uniform "red" or “yellow” soil colours in both the moist and dry states and has weak structure or is structureless in the moist state. The red and yellow apedal horizons are per definition non-calcareous within 1500mm of the soil surface, but may contain small lime nodules as was the case on site. Textures are coarse to medium sand to sandy-loam in the topsoil and medium to fine sandy-loam in the subsoil. Structure is weak blocky (dominant) or apedal in all horizons. These red-yellow apedal soils dominate the western half of the entire study area. The clay content for this soil group is less than 15% (Figures 11 and 12).

8.3 Prismacutanic and/or pedocutanic soils (Group 1)

Prismacutanic and/or pedocutanic soils have strong B horizon structure and a marked increase in clay content down the soil profile, compared to the overlying horizon, from which it is separated by a clear or abrupt boundary. This clear change between adjacent horizons has resulted in the term “duplex soils” being given to this group. The soils have high erosion susceptibility and the B horizon is often sufficiently hard to be an impediment to both root growth and water movement.

The marked enrichment with clay in the subsoil results in strong blocky structure and cutanic character (clay skins). The cutans give the peds shiny surfaces that reflect the light and are often a different colour to the interior of the peds. The orthic A horizon often has a weak structure and when it contains sufficient clay it may become hard or very hard when dry (a feature known as ‘hard-setting’).

Amounts of organic matter are low giving their (orthic) top soils a grey or brown colour. Base status varies from low to high, a range directly correlated to the amount of clay in either the overlying horizon or the B horizon itself. The soils have a low phosphate (P) fixing ability and often have moderate reserves of plant nutrients.

Prismacutanic and/or pedocunatic soils dominate the eastern half of the site and the clay content ranges between 15% and 35% (Figures 11 and 12). All three corridor alternatives occur within this soil grouping.

8. SOIL DEPTH

The Environmental Potential Atlas indicated that soil depths in the study area are divided into two groups i.e. soils shallower than 450mm and soils between 450 and 750mm (Figure 13). Deeper soils are present on the eastern portion of the study area and are associated with the pedocutanic and prismacutanic soil forms. The shallower soils are present on the western part of the side and are found in the areas associated with the oxidic soils as well as the lithic soil group.

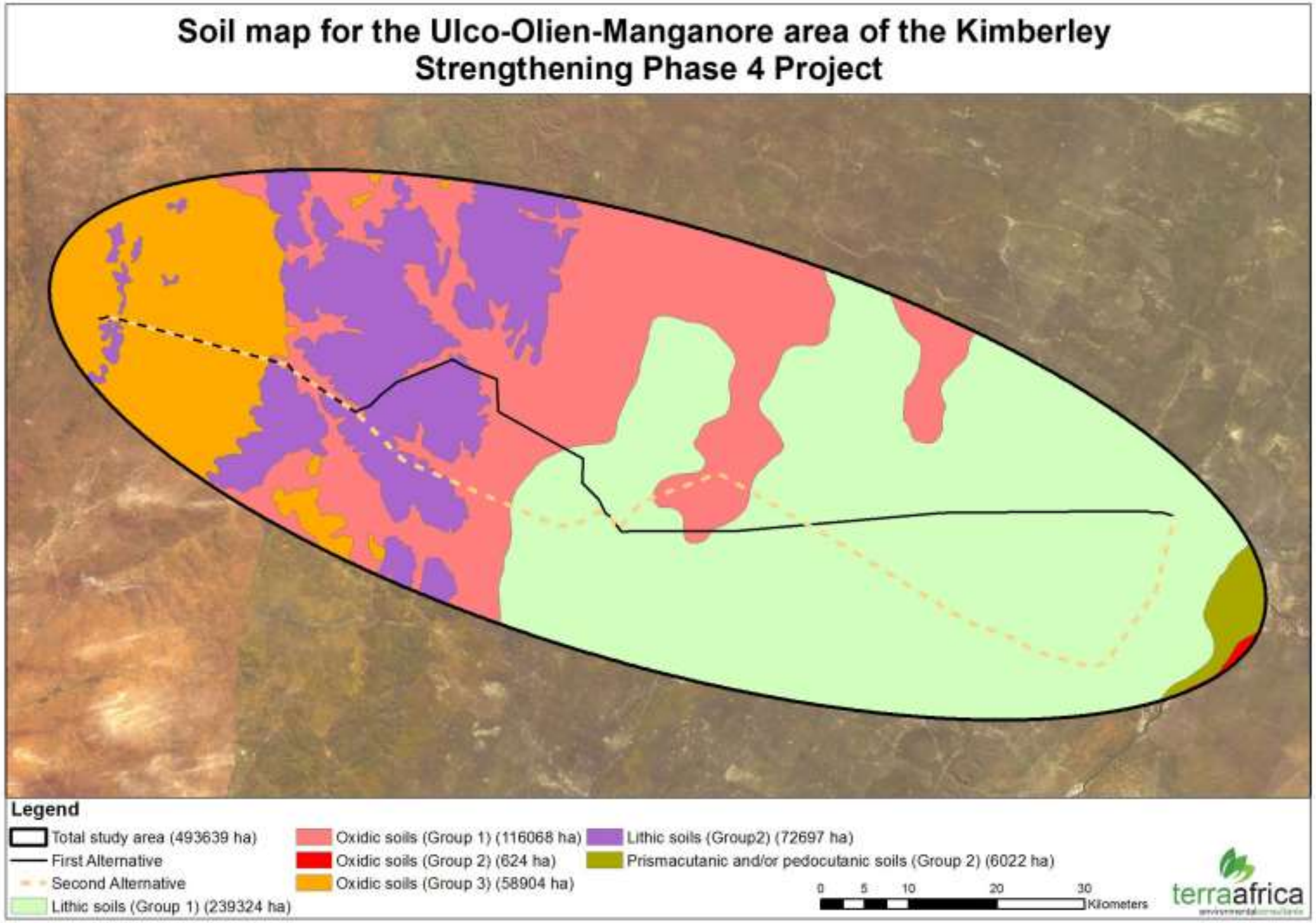

Figure 26: Soil map for the Ulco-Olien-Manganore area of the Kimberley Strengthening Phase 4 Project

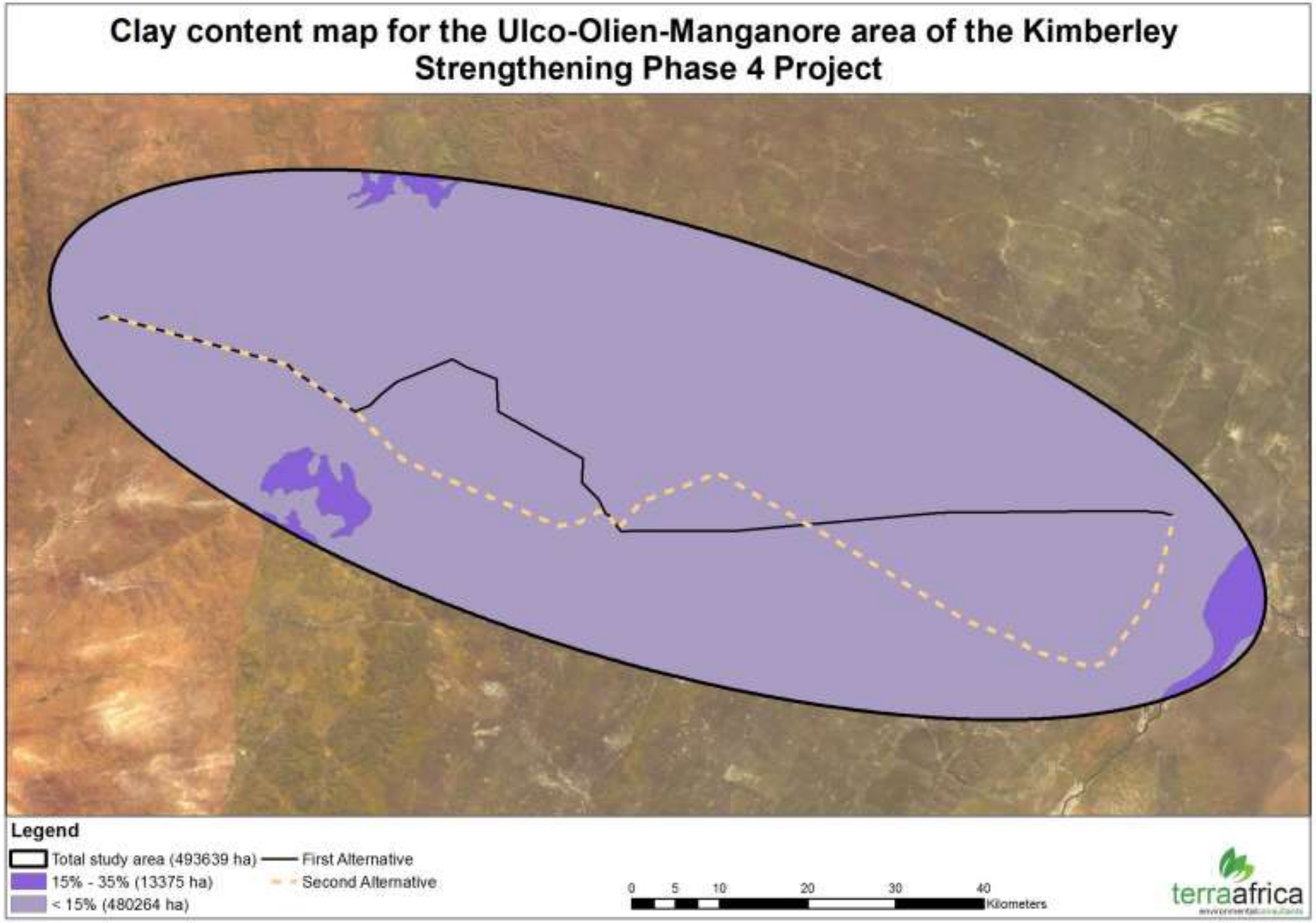

Figure 27: Clay content map for the Ulco-Olien-Manganore area of the Kimberley Strengthening Phase 4 Project

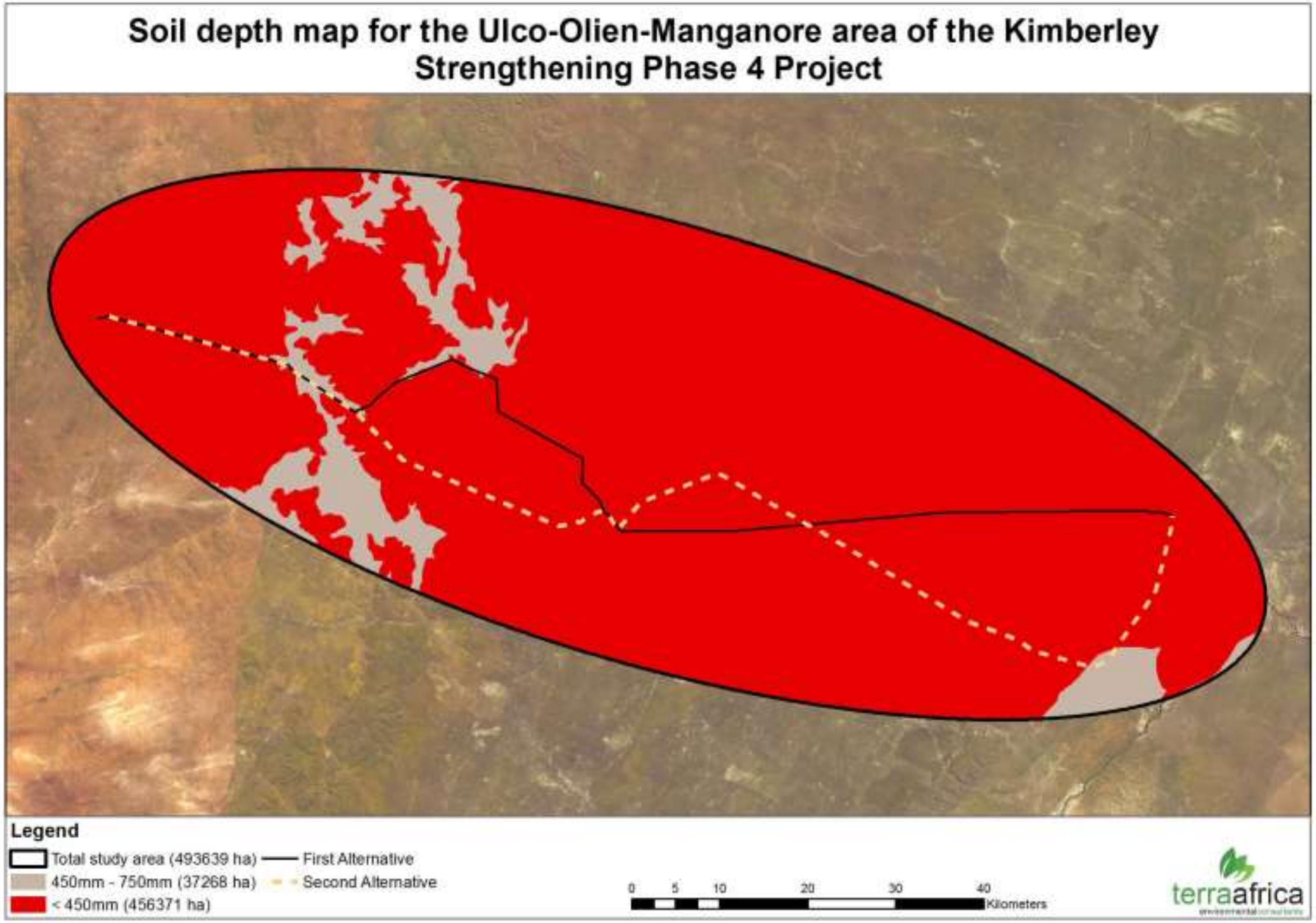

Figure 5: Soil depth map for the Ulco-Olien-Manganore area of the Kimberley Strengthening Phase 4 Project

9. AGRICULTURAL POTENTIAL

The dominant land-use in the larger study area prior is cattle and small livestock farming. This included the commercial farming of cattle, goats and sheep. The average carrying capacity of the veldt is 14 ha per unit of large stock. Game farming is also present in the study area. This region is not suited to the production of dryland arable agricultural owing to the low rainfall. Irrigated crop production is practiced in very small areas that are limited by the availability of irrigation water and proximity to the water resource.

According to the ENPAT data, the western portion of the study area is dominated by land with no or very low arable agricultural potential due to the shallow nature of the topsoil present. The eastern portion is considered to have intermediate suitability as a result of the deeper soil profiles however the climate only permits successful production in the presence of irrigation systems as a result of the erratic rainfall and high evaporation rate that results in soilwater losses.

10. CONCLUSION

Based on the baseline soil and agricultural potential data gather for this study, it is the opinion of the soil scientist, from a soil conservation and land capability point of view, that the first alternative for the proposed development be considered favourably. Although the first alternative has a longer footprint than all other alternatives considered, it will avoid cutting through areas with endorheic pans that may have ecological value. However, it is not anticipated that the first alternative will have any detrimental impact on the crop production ability of the region or result in soil degradation. It is still important that due care is taken to minimise impacts on soils and land capability through good soil management principles.

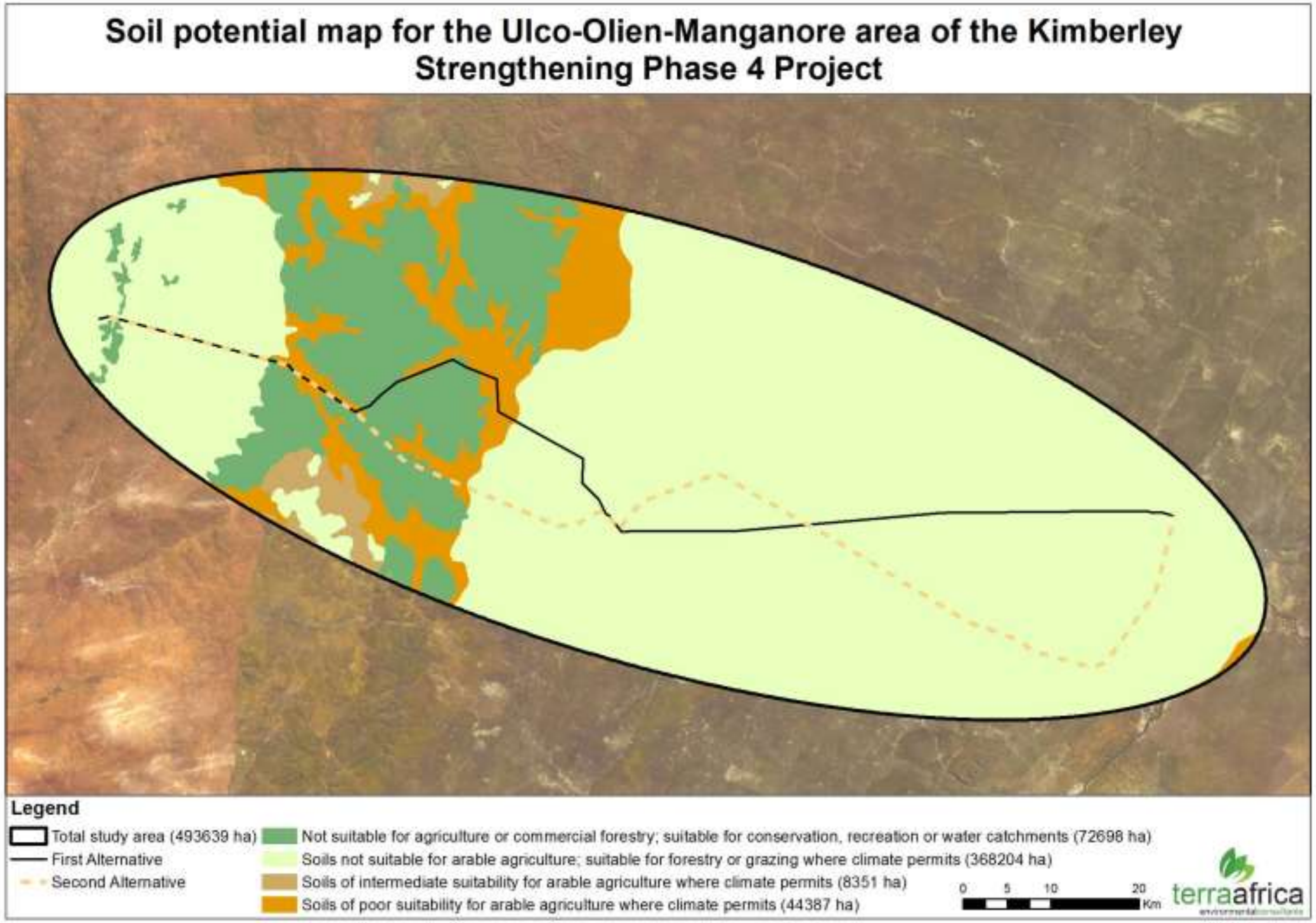

Figure 29: Soil potential map for the Ulco-Olien-Manganore area of the Kimberley Strengthening Phase 4 Project