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

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

PREPARED FOR

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1. INTRODUCTION

Terra-Africa Consult cc. was appointed by Landscape Dynamics (Pty) Ltd. to conduct a baseline 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 sections and the second of these are located between Eskom's Boundary and Ulco Substations. 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; and
- to make recommendations with regards to the most suitable alternative from the perspective of soil conservation and preservation of high potential agricultural soil.

2. TERMS OF REFERENCE

The first phase 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 is any large agricultural developments such as irrigation schemes that might be impacted upon by the construction of the powerlines.

The second phase consisted of flying along the proposed route and alternative routes between the Eskom Boundary and Ulco 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.

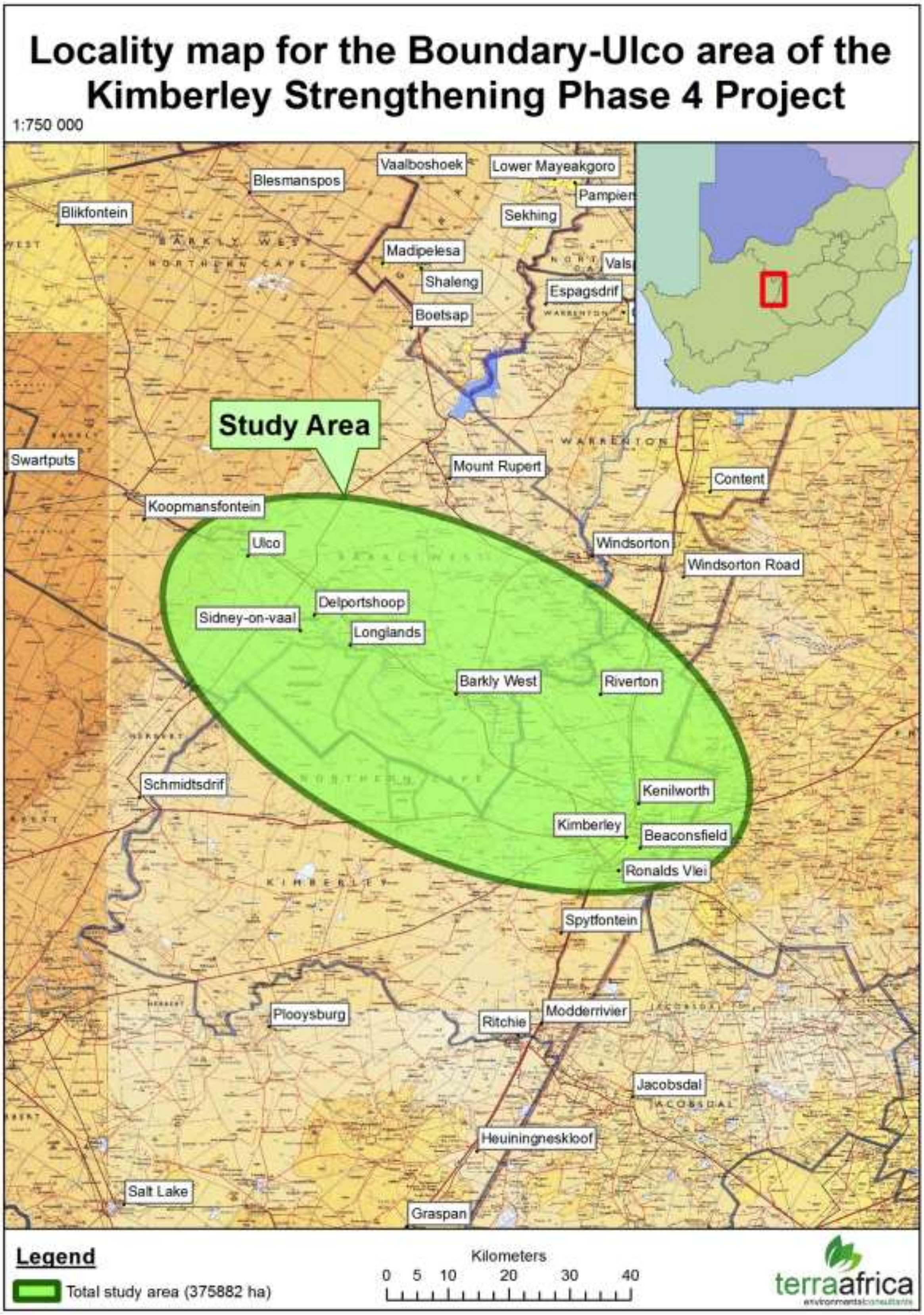

Figure 1: Locality map for the Boundary-Ulco area of the Kimberley Strengthening Phase 4 Project

3. LOCALITY OF THE BOUNDARY-ULCO AREA OF THE KIMBERLEY STRENTHENING PHASE 4 PROJECT

The Boundary-Ulco line is situated within the larger study area that includes the city of Kimberley in the southeast. The largest portion of the study area falls within the Northern Cape province with only a small section of the southeastern portion located within the Free State Province. The most northwestern town within the study area is the small town of Ulco where the Ulco Substation is located. The town of Barkley-West is located approximately in the middle of the study area (Figure 1). The total study area for this assessment was 375,882 hectares (ha) and included assessment of three alternatives which are the first alternative (98 km), second alternative (101.7 km) and a third alternative (93.5 km) (Figure 3). All three alternatives runs in a northwest-southeast direction.

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.

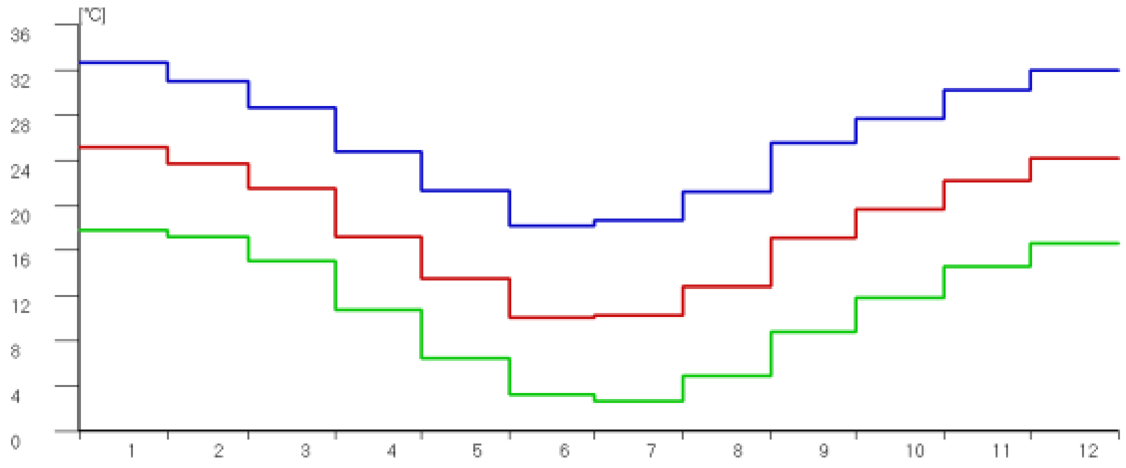

Figure 2: Average daily maximum temperature (blue), average daily mean temperature (red) and average daily minimum temperature (green) in °C from month 1 (January) to month 12 (December)

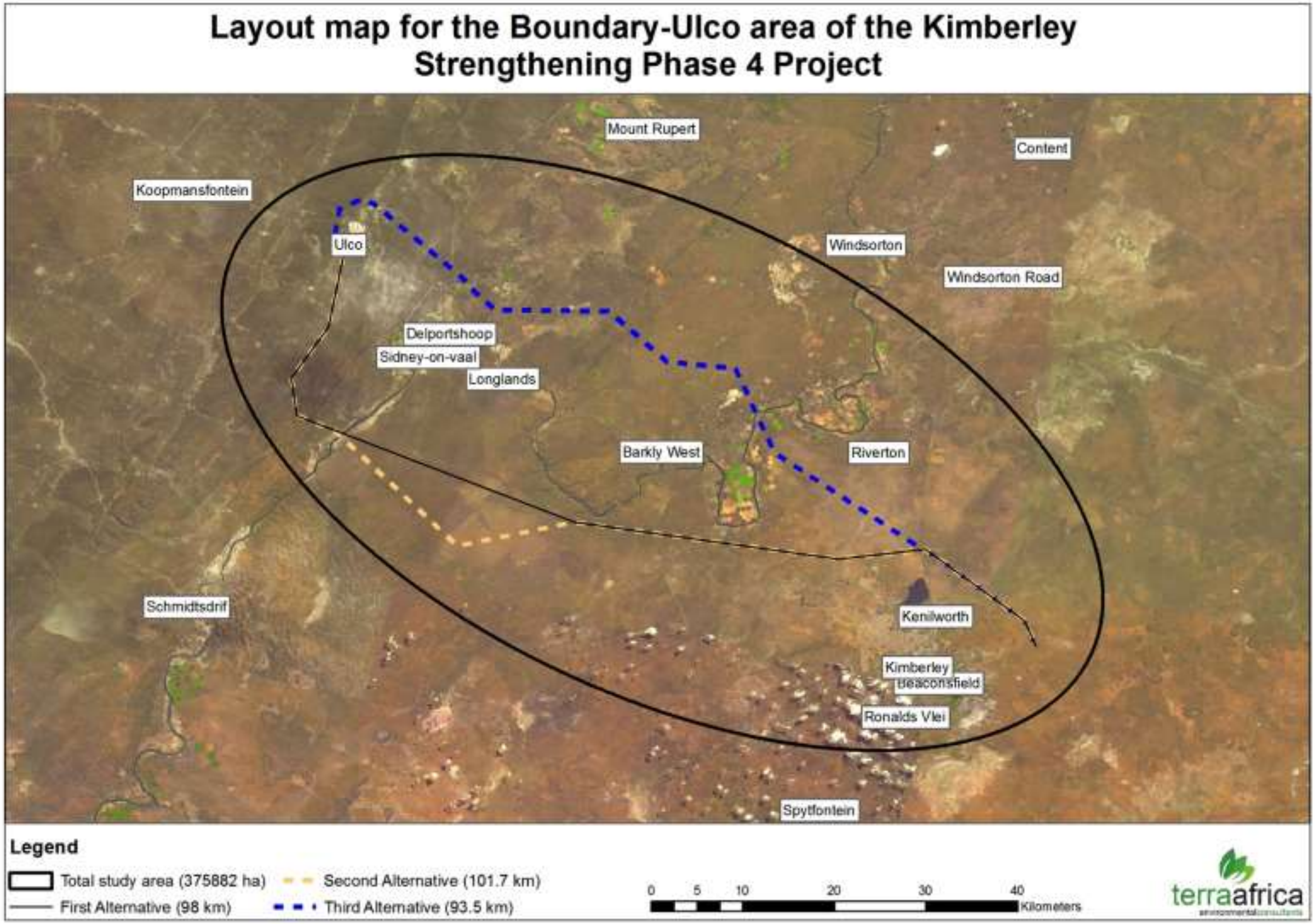

Figure 3: Layout map for the Boundary-Ulco area of the Kimberley Strengthening Phase 4 Project

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 3). 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.

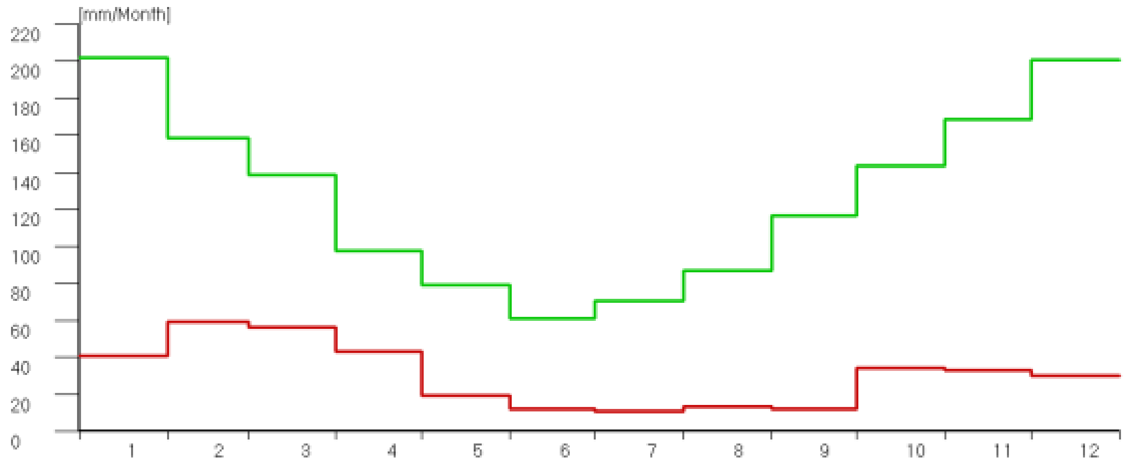

Figure 4: Annual rainfall (red) and Potential Evapotranspiration (PET) (green) in mm/Month from month 1 (January) to month 12 (December)

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

6.1 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.

6.2 Land type results

Eleven different land types were identified on within the larger Boundary-Ulco study area. These land types are Ae15, Ae44, Ae45, Ah21, Db2, Dc5, Fb1, Fc4, Fc5, Fc6 and Fc7 (Figure 9). Below follows a description of each of the land types identified.

6.2.1 Land Type Ae15

The land type is found in landscapes where the slope is between 0 and 1% and slope length between and 1000 and 5000 m for Landscape Position 4 and slope of 0 to 2% and slope length between 50 and 5000 meters for Landscape Position 5. The soil forms in this land type mainly consist of shallow, rocky and limestone rich red and yellow well drained soils. These soils in this area are derived from wind transported sands overlying hard rock with dolerite outcrops.

No terrain sketch was available for this land type.

6.2.2 Land Type Ae44

This land type is found in four different landscape positions where Positions 1 and 3 are associated with areas with slight hills and slopes of between 0 and 8% and shorter slope lengths of 75 to 200m. For the flatter landscape positions, the slope is between 0 and 2% and slope length between and 1000 and 2000 m for Landscape Position 4 and slope of 0 to 2% and slope length between 50 and 250 meters for Landscape Position 5. The soil forms in this land type mainly have high base status and are shallow, well-drained soils of red colour. The soils in this area are derived from wind transported sands overlying hard rock. The geology underlying this land type is andesitic to basaltic lavas of the Ventersdorp Supergroup sometimes overlain by calcrete. Dwyka tillite occurs in places.

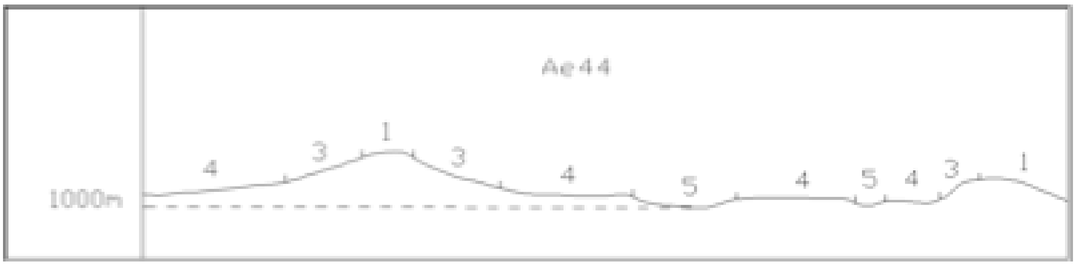

Figure 5: Terrain form sketch for Land Type Ae44

6.2.3 Land Type Ae45

This land type is found in four different landscape positions where Positions 1 and 3 are associated with areas with slight hills and slopes of between 0 and 8% and shorter slope lengths of 50 to 150m. For the flatter landscape positions, the slope is between 0 and 2% and slope length between and 800 and 2000 m for Landscape Position 4 and slope of 0 to 2% and slope length between 50 and 250 meters for Landscape Position 5. The soil forms in this land type mainly have high base status and are shallow, well-drained soils of red colour. These soils in this area are derived from wind transported sands overlying hard rock. The geology underlying this land type is tillite (Dwyka Formation), shale and mudstone (Ecca Group) covered partially by surface limestone and red wind-blown sand. Dolerite intrusions also occur.

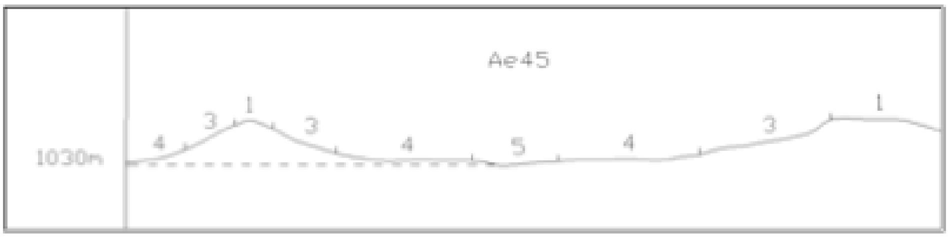

Figure 6: Terrain form sketch for Land Type Ae45

6.2.4 Land Type Db2

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.

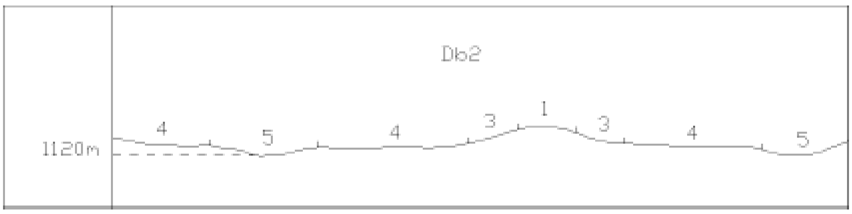

Figure 7: Terrain form sketch for Land Type Db2

6.2.5 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 Tillite of the Dwyka Formation and shale of the Prince Albert Formation.

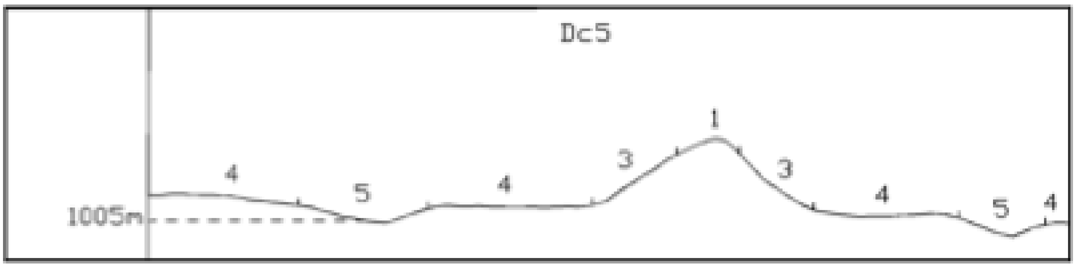

Figure 8: Terrain form sketch for Land Type Dc5

6.2.6 Land Type Fb1

The land type represents a combination of red and yellow-brown apedal soils interspersed wit duplex soils.. The soils are dominantly shallow to deep structure duplex with a limited occurrence of swelling soils in depressions. The geology of this land type is red to flesh-coloured wind-blown sand and surface limestone of Tertiary to Quaternary age and shales of the Dwyka and Ecca Groups with a few dolerite outcrops.

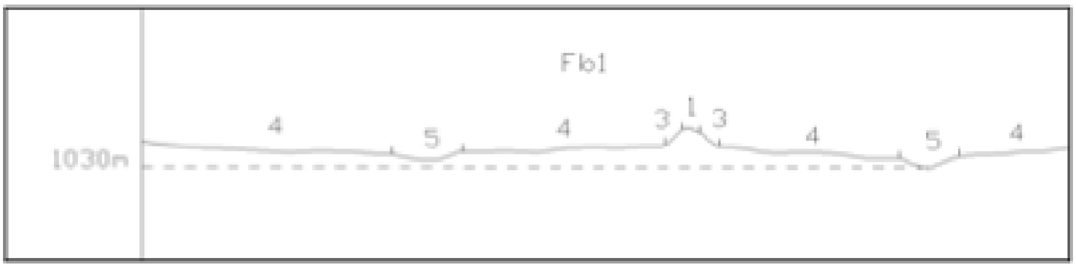

Figure 9: Terrain form sketch for Land Type Fb1

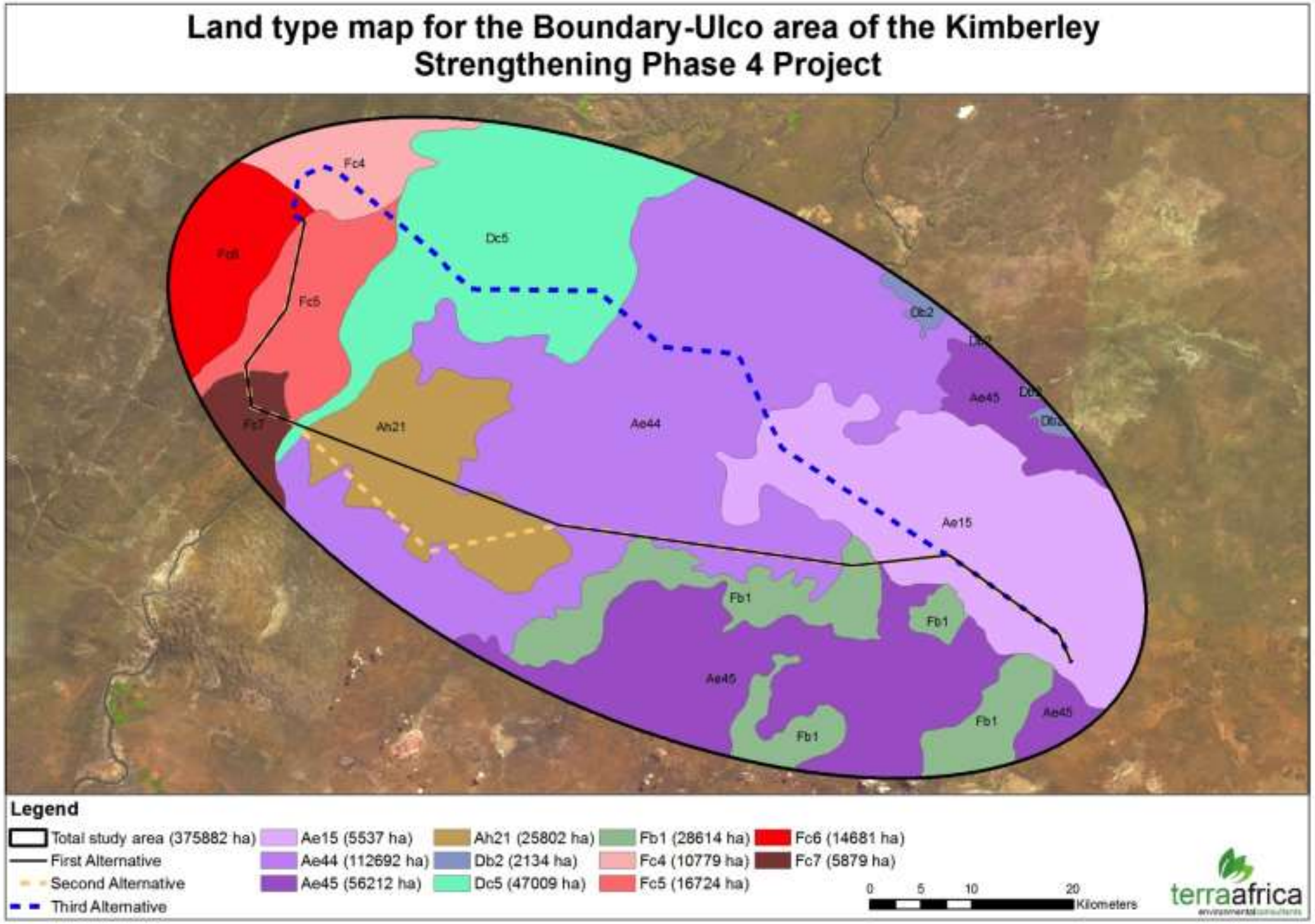

Figure 10: Land type map for the Boundary-Ulco area of the Kimberley Strengthening Phase 4 Project

7. SOIL CLASSIFICATION

Six different main soil groups are present in the entire baseline area as well as in the areas currently indicated as the proposed alternative sites for the project. Below follows a description of each of the groups:

7.1 Lithic soil

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.

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.

7.2 Red-yellow apedal freely drained soil

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).

7.3 Duplex soils (prismacutanic and pedocutanic soils)

Duplex 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.Duplex soils dominate the eastern half of the site and the clay content ranges between 15 and 35% (Figures 11 and 12).

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 red and yellow apedal soils as well as the lithic soil group.

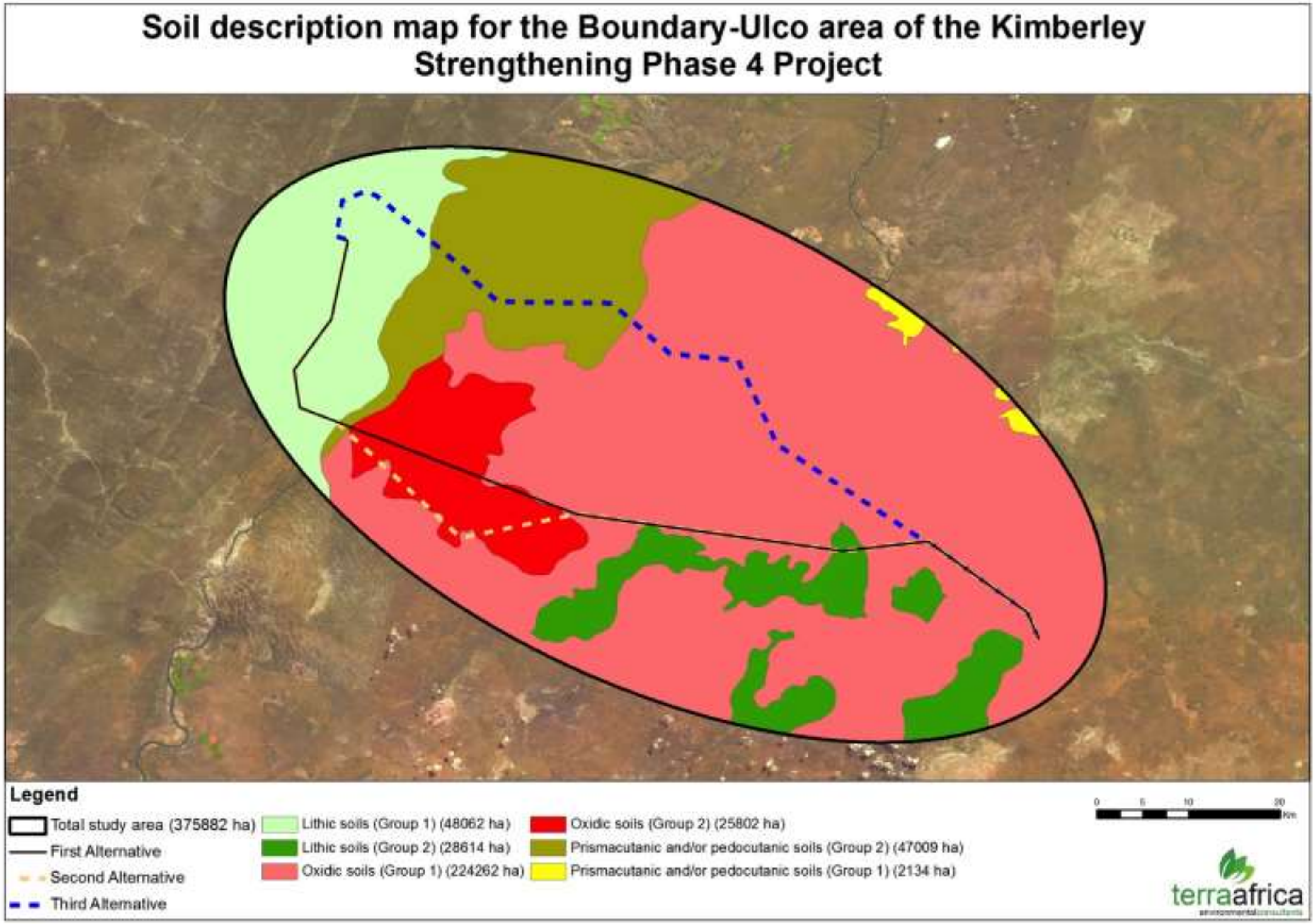

Figure 11: Soil map for the Boundary-Ulco project of the Kimberley Strengthening Phase 4 Project

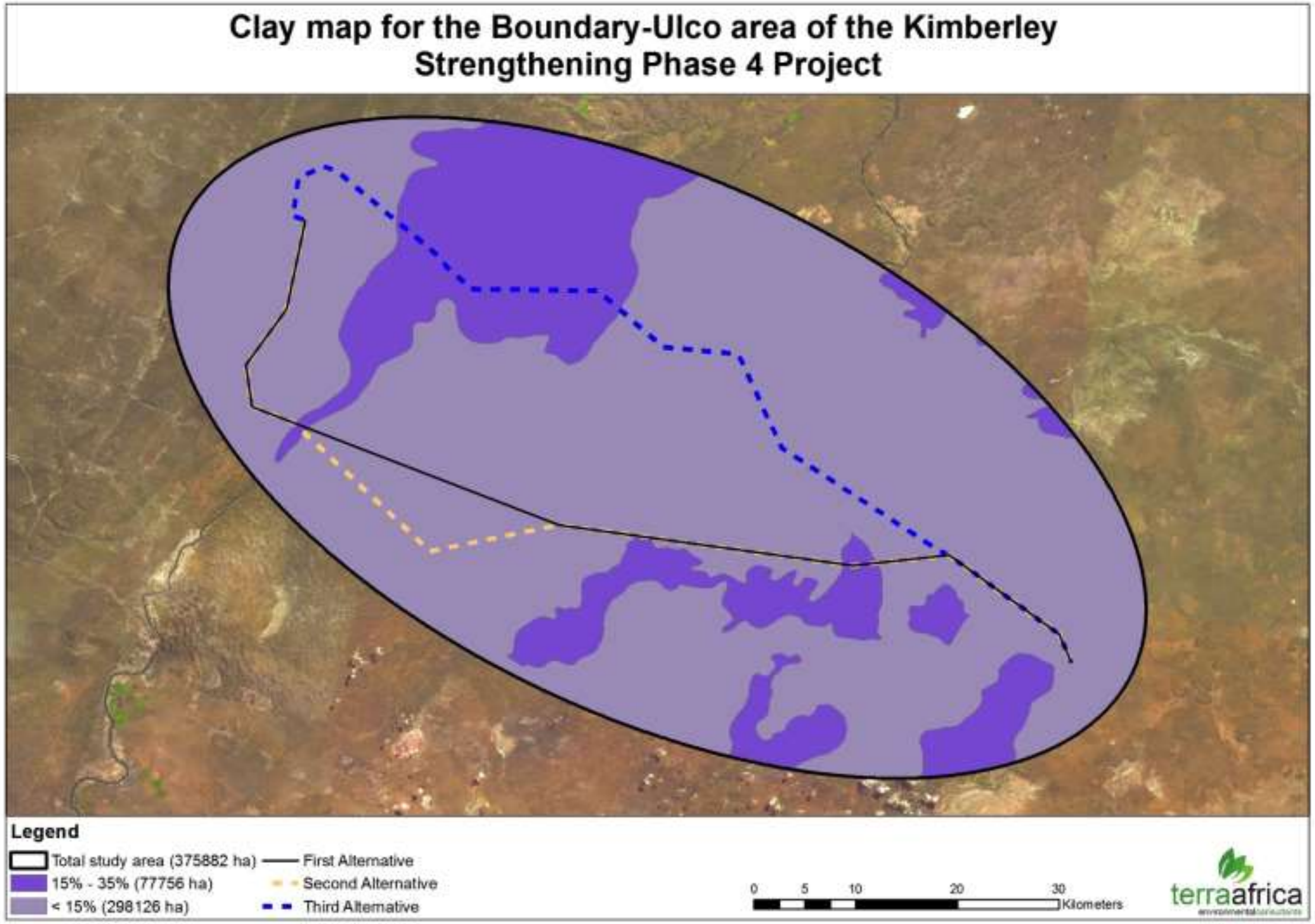

Figure 12: Clay content map for the Boundary-Ulco area of the Kimberley Strengthening Phase 4 Project

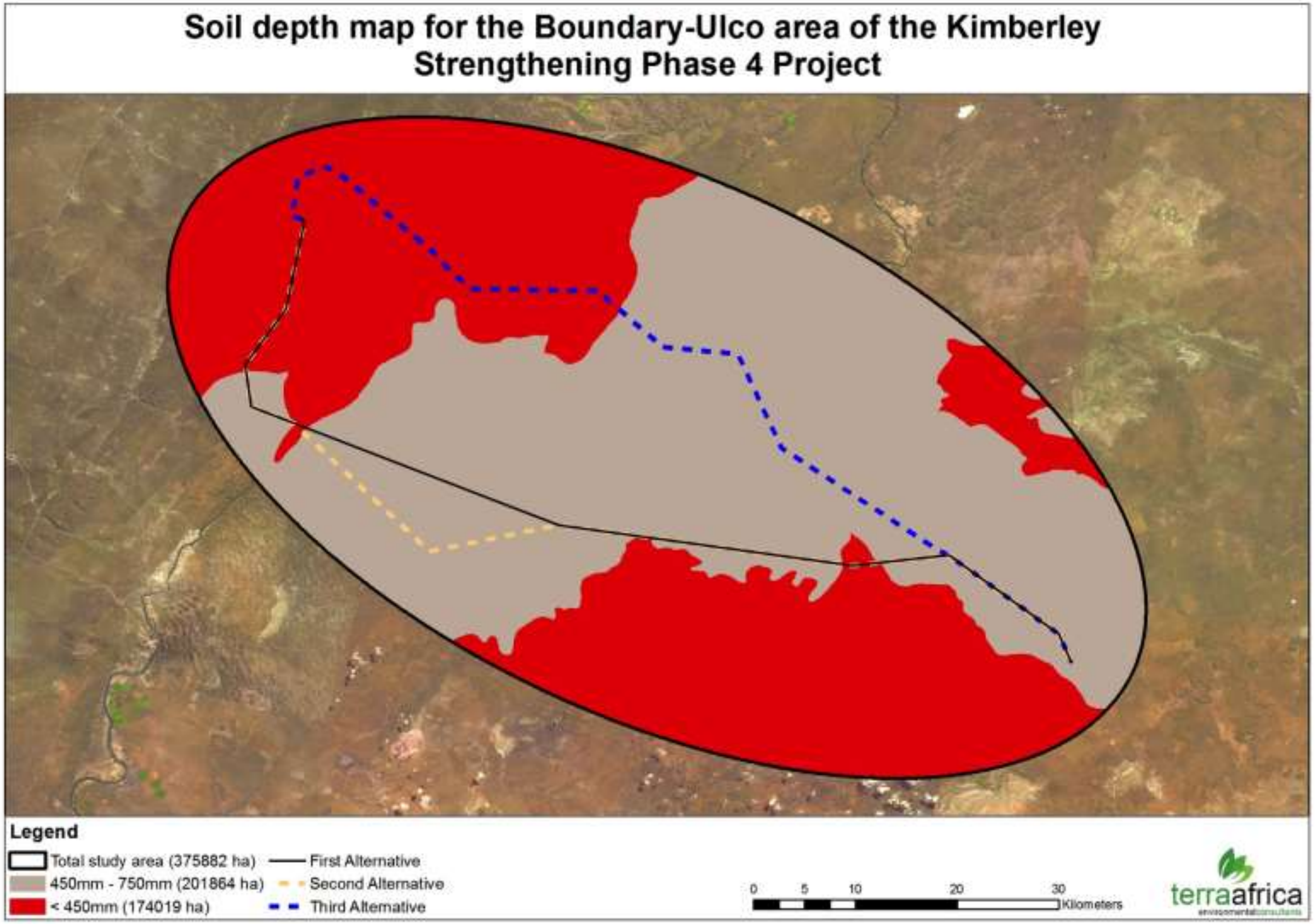

Figure 13: Soil depth map for the Boundary-Ulco area of the Kimberley Strengthening Phase 4 Project

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. The reason for this is that the first alternative does not cut through a pivot irrigation area like the third alternative and is shorter than the second alternative which means it has impact on a smaller portion of land than the second alternative. Power line construction has a negative impact on centre pivot irrigation as it is not possible to continue with this practise directly underneath these power lines.

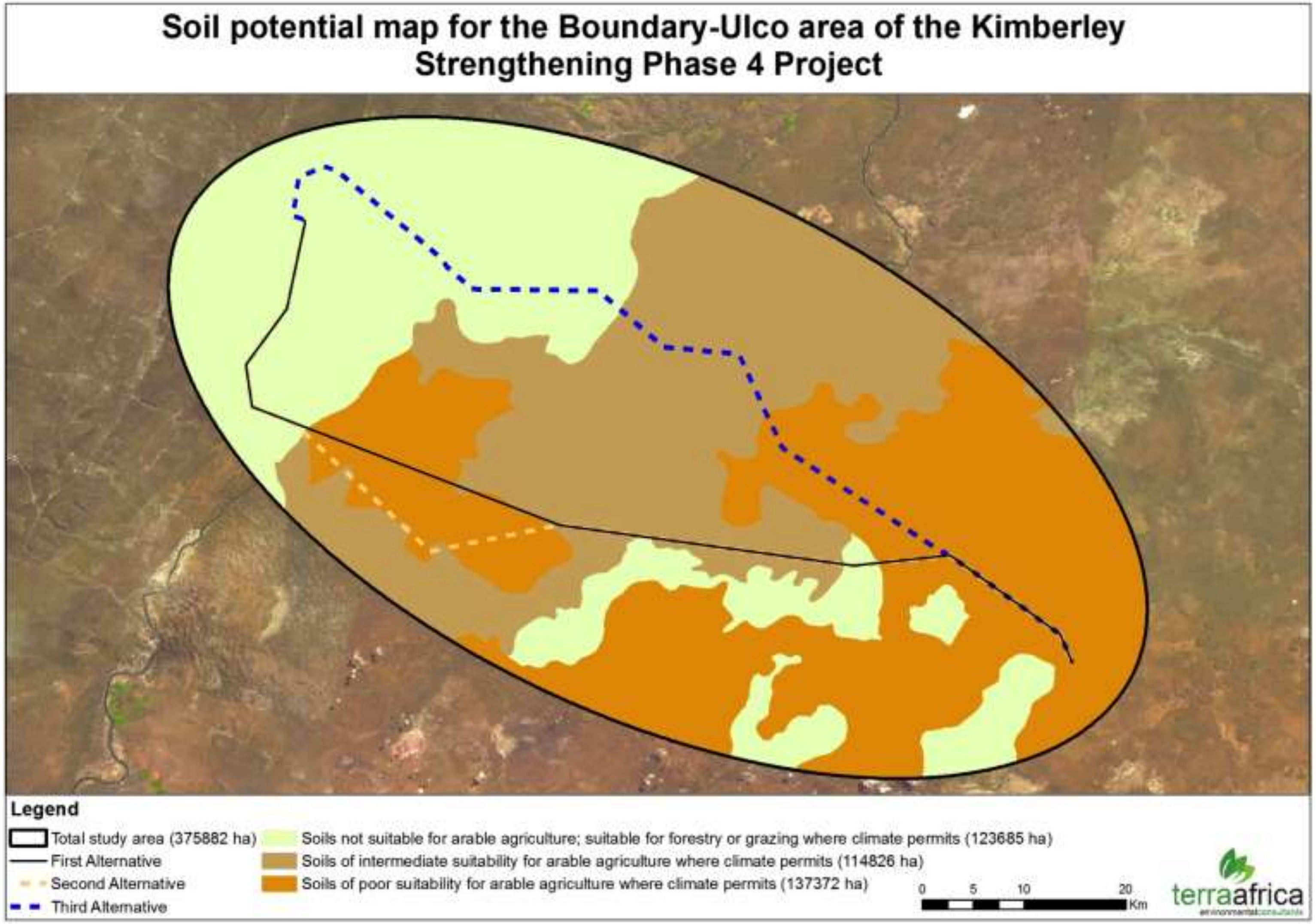

Figure 14: Soil potential map for the Boundary-Ulco area of the Kimberley Strengthening Phase 4 Project