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Bhudlu Bridge Access Road to the Umtamvuna River, KwaZulu-Natal & Eastern Cape:

Biodiversity Impact Assessment

For Royal HaskoningDHV

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1. EXECUTIVE SUMMARY

Royal HaskoningDHV appointed The Ecological Partnership to carry out a Biodiversity Impact Assessment in support of the EIA which they are conducting for the construction of a gravel access road to the proposed bridge over the Umtamvuna River in the vicinity of Bhudlu, KwaZulu-Natal on the border with the Eastern Cape (Fig. 1; Turner & Associates, 2015).

Each of the three proposed access road options to the Umtamvuna River was surveyed on 26th May, 2015 on the KwaZulu-Natal side of the river and a 100 metre length of proposed road was surveyed on the Eastern Cape side of the river (Fig. 2). Each of the surveyed road footprints included the proposed 4 metre road width together with a 20 metre wide buffer on either side of the proposed road (Fig. 2). Plant and animal species observed in the 44 metre wide footprint along each gravel road option were recorded. The whole study area was searched again for plant and animal species of conservation concern on 29th September, 2015.

Ecological impacts for each footprint are assessed according to the impact scoring system provided by Royal HaskoningDHV. The scoring system has been amended to apply to this ecological study.

No threatened plant or animal species or species of conservation concern were found in the four metre wide footprint and 20 metre wide buffer on either side of the road for each of the three alignment options when the ecological assessment was conducted towards the end of May and September, 2015 (Fig. 2). The negative ecological impacts of the proposed gravel road will be mainly in terms of the loss of the **Endangered** grassland habitat and its biodiversity with a very high significance score of -13, provided that mitigation measures are instituted to minimise grassland loss, and off-site mitigation is carried out (Table 3-5; Fig. 6). Option 2 is the preferred alignment option because it traverses an existing gravel road for over a third of its length and will involve the least destruction of **Endangered** Moist Coast Hinterland Grassland habitat and associated biodiversity and least fragmentation of grassland habitat (Fig. 6; Table 4). Option 2 does not pass through the highly **Endangered** Midlands Mistbelt Grassland as does option 1, which is the second preferred option (Fig. 6; Table 3-4). Further loss and fragmentation of this vegetation type is undesirable. Out of the three alignment options, option 2 has the lowest negative impact on the grassland and associated biodiversity in terms of significance at a local scale (Table 3-5). Option 3 is the least preferred alignment as it cuts through virgin grassland along an appreciable length, crosses a perennial stream and is the longest and least direct route (Fig. 6; Table 5).

Negative impacts on the riparian and aquatic habitats and biodiversity of the Umtamvuna River for the construction and operation of the bridge over the river are likely to be of low significance provided that mitigation measures are instituted (Table 6; Fig. 2). The same applies to the riparian, wetland and aquatic habitats and biodiversity of the stream where a culvert would have to be constructed for option 3 (Table 7; Fig. 2).

Negative ecological impacts on the grassland habitat and biodiversity, the aquatic and riparian habitats and biodiversity of the Umtamvuna River and stream and the wetland habitats and biodiversity of the stream will add to the cumulative negative ecological impacts on these natural systems. It is therefore vital that negative ecological impacts are minimised through the institution of mitigation measures and off-site mitigation.

2. INTRODUCTION

Royal HaskoningDHV appointed The Ecological Partnership to carry out a Biodiversity Impact Assessment in support of the EIA which they are conducting for the construction of a gravel access road to the proposed bridge over the Umtamvuna River in the vicinity of Bhudlu, KwaZulu-Natal on the border with the Eastern Cape (Fig. 1; Turner & Associates, 2015).

3. METHODS

Each of the three proposed access road options to the Umtamvuna River was surveyed on 26th May, 2015 on the KwaZulu-Natal side of the river and a 100 metre length of proposed road was surveyed on the Eastern Cape side of the river (Fig. 2). Each of the surveyed road footprints included the proposed 4 metre road width together with a 20 metre wide buffer on either side of the proposed road (Fig. 2). This area constitutes the study area (Fig. 2). Plant and animal species observed in the 44 metre wide footprint along each gravel road option were recorded. The whole study area was searched again for plant and animal species of conservation concern on 29th September, 2015.

Ecological impacts for each footprint are assessed according to the impact scoring system provided by Royal HaskoningDHV below. The scoring system has been amended to apply to this ecological study.

A brief written statement or description of the ecological impact being assessed is provided. For each impact, scores are shown for parameters such as extent, duration, intensity and probability. Descriptions for each score are given below.

Cumulative impacts are also identified and scored according to the parameters below. In relation to an activity, cumulative impact means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts resulting from similar or diverse activities in the area.

Criteria: Extent, Duration, Intensity and Probability (EDIP)

1. Extent (E)

Extent refers to the area which will be influenced by the impact.

- Site (1) – Within the construction area.
- Local (2) – Within a radius of 2 km of the construction area.
- Regional (3) – this applies to impacts on a provincial level and parts of neighbouring provinces.
- National (4) – this applies to impacts that will affect the whole of South Africa.

2. Duration (D)

Duration indicates what the lifetime of the impact will be.

- Short-term (1) – less than 5 years.
- Medium-term (2) – between 5 and 15 years.
- Long-term (3) – between 15 and 30 years.
- Permanent (4) – over 30 years and resulting in a permanent and lasting change that will always be there.

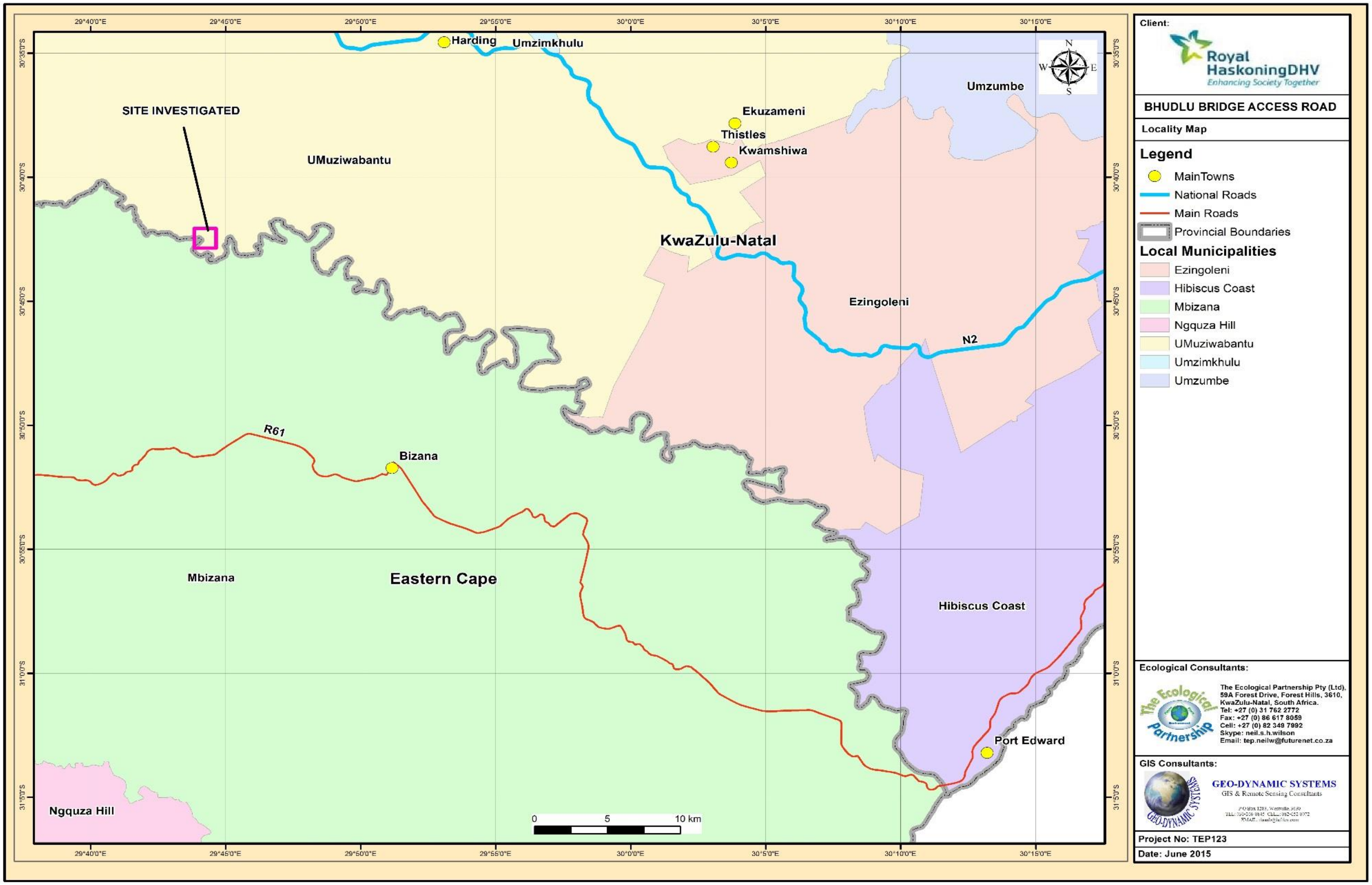

Figure 1: Locality map of the study area on the border between KwaZulu-Natal and the Eastern Cape in the vicinity of the Umtamvuna River.

3. Intensity (I)

Intensity describes whether an impact is destructive or benign.

- Very High (4) – Natural processes are altered to the extent that they permanently cease.
- High (3) – Natural processes are altered to the extent that they temporarily cease.
- Moderate (2) – The affected environment is altered, but natural functions and processes continue albeit in a modified way.
- Low (1) – The impact affects the environment in such a way that natural processes are not affected.

4. Probability (P)

Probability describes the likelihood of an impact actually occurring.

- Improbable (1) - Likelihood of the impact materialising is very low.
- Possible (2) - The impact may occur.
- Highly Probable (3) - Most likely that the impact will occur.
- Definite (4) - Impact will certainly occur.

The scores for EDIP are added to provide a significance rating, as described below:

Significance (S)

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and temporal scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Score		**Elaboration**
- (13 - 16 points)	NEGATIVE VERY HIGH	**Impacts which result in extensive or complete loss of natural habitat, biota and basic ecosystem functions. Changes maybe irreversible.** In general, these are permanent and important impacts. The design of the site is likely to be affected. Intensive remediation is needed during construction and/or operational phases. Any activity which results in a "very high impact" is likely to be a fatal flaw.
- (10 - 12 points)	NEGATIVE HIGH	**Impacts which result in a large loss of natural habitat, biota and basic ecosystem functions.** In general, these are impacts which individually or combined pose a significantly high negative risk to the quality of the receiving environment. Mitigation and possible remediation are needed during the construction and/or operational phases. The effects of these impacts may affect the broader environment.
- (7 - 9 points)	NEGATIVE MODERATE	**Impacts which result in moderate loss and change of natural habitats and biota, but basic ecosystem functions remain predominantly unchanged.** In general, these are impacts which individually or combined pose a moderate negative risk to the quality or health of the receiving environment. They include impacts which are medium term, moderate in extent, mildly intense in their effects and probable. Mitigation is possible with additional design and construction inputs.
- (4 - 6 points)	NEGATIVE LOW	**Impacts which result in a small negative change in natural habitats and biota, but ecosystem functions remain essentially unchanged.** In general, these are impacts which individually or combined pose a deleterious or adverse impact and low negative risk to the quality of the receiving environment, and may lead to potential health, safety and environmental concerns. These impacts include those which are short term, local in extent, not intense in their effects and may not be likely to occur. A low impact has no permanent affect of significance. Mitigation measures are feasible and are readily instituted as part of standing design, construction or operating procedure.
0	NEUTRAL	**Impacts which result in no change in natural habitats and biota, and ecosystem functions remain unaffected.** In general, these impacts are neither beneficial nor adverse

		and cannot be classified as either positive or negative. They include negative impacts which are adequately mitigated to a state where they no longer render a risk.
+(4 - 6 points)	POSITIVE LOW	**Impacts which result in a small positive change in natural habitats, biota and ecosystem functions.** In general, these are impacts which individually or combined pose a low positive impact to the quality of the receiving environment, and may lead to potential health, safety and environmental benefits. These impacts include those which are short term, local in extent, not intense in their effects and may not be likely to occur. A low impact has no permanent affect of significance.
+(7 - 9 points)	POSITIVE MODERATE	**Impacts which have a moderate, positive affect on natural habitats and biota with ecosystem functions remaining predominantly unchanged.** In general, these are impacts which individually or combined pose a moderate positive affect on the quality or health of the receiving environment. They include impacts which are medium term, moderate in extent, mildly intense in their effects and probable.
+(10 - 12 points)	POSITIVE HIGH	**Impacts which result in a large positive affect on natural habitat, biota and basic ecosystem functions.** In general, these are impacts which individually or combined pose a significantly high positive impact on the environment. These impacts pose a high benefit to the quality of the receiving environment and health, and may lead to potential health, safety and environmental benefits. These impacts include those which are longer term, greater in extent, intense in their effects and highly likely to occur. The effects of these impacts may affect the broader environment.
+ (13 - 16 points)	POSITIVE VERY HIGH	**Impacts which affect natural habitat, biota and basic ecosystem functions positively in an extensive way.** In general, these are permanent and important beneficial impacts which may arise. Individually or combined, these pose a significantly high positive impact on the environment. These impacts pose a very high benefit to the quality of the receiving environment, and may lead to potential health, safety and environmental benefits. These impacts include those which are long term, greater in extent, intense in their effects and highly likely or definite to occur. The effects of the impacts may affect the broader environment.

4. RESULTS & DISCUSSION

a) Study Area

Each of the three gravel road options traverses steep, moderately steep and gently sloping terrain on its path to the Umtamvuna River (Fig. 3 & 4). Option 1 starts at waypoint 40 just off the main gravel road and descends a relatively steep hill along an existing gravel track through grassland that becomes a deep erosion donga (Fig. 2; Plate 1). It joins option 2 at the bottom of this hill at waypoint 50 and both alignments proceed together along a track through grassland down a second hill where they join option 3 at waypoint 69 (Fig. 2). All three options then proceed along the same alignment through grassland to the proposed bridge site on the Umtamvuna River at waypoint 63 (Fig. 2; Plate 2). The 100 metre section of proposed road on the Eastern Cape side of the river traverses the gently and moderately sloping floodplain which is covered by grassland (Fig. 2; waypoint 64-67; Plate 2). Option 3 branches off from option 1 and 2 at waypoint 69 and descends a short stretch of hill along a track through grassland after which it cuts across the hill through virgin grassland to a moderately incised perennial stream at waypoint 75 (Fig. 2; Plate 3). A culvert would have to be built here for the proposed road to cross this stream. Across the stream, option 3's alignment continues up the side of a hill through grassland along a narrow footpath to waypoint 79, after which it cuts through a short section of virgin grassland and joins a footpath to a homestead at waypoint 80 (Fig. 2). Option 3 follows this footpath and joins an existing gravel road at waypoint 82 and then another gravel road at waypoint 85 (Fig. 2). Option 3 continues along this gravel road to waypoint 91 where it meets option 2 (Fig. 2). Option 2 proceeds along a track through a short stretch of grassland to join option 1 at waypoint 50 (Fig. 2). From waypoint 91, option 2 and 3 proceed together along an existing gravel road to waypoint 100 where they join the main gravel road (Fig. 2).

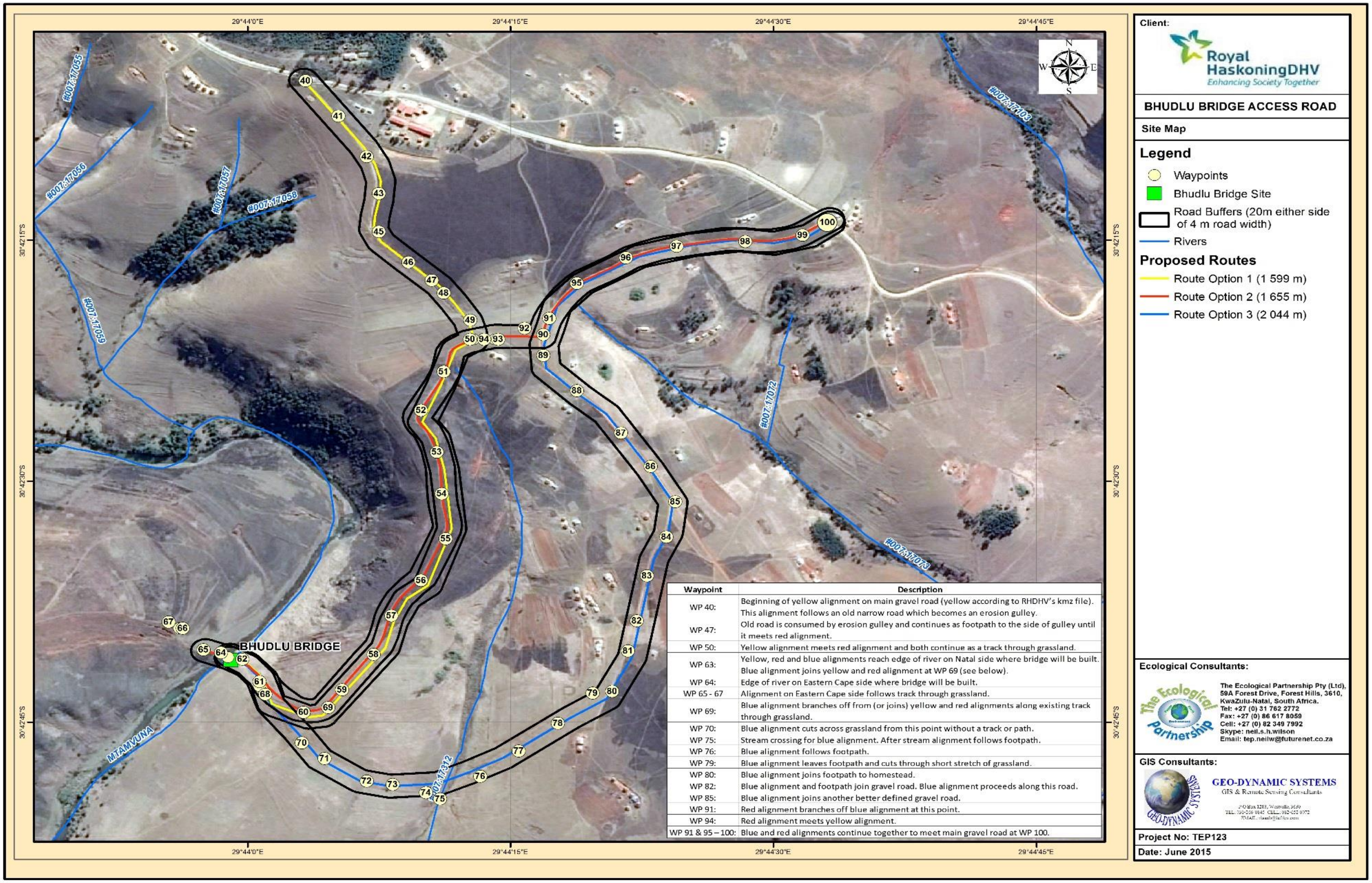

Figure 2: The study area showing the four metre wide footprints and 40 metre wide buffers of the three gravel road alignment options on the KwaZulu-Natal side of the Umtamvuna River and along the four metre wide footprint and 40 metre wide buffer of the alignment on the Eastern Cape side of the river.

Figure 3: Topography of the study area with 5 metre contour intervals.

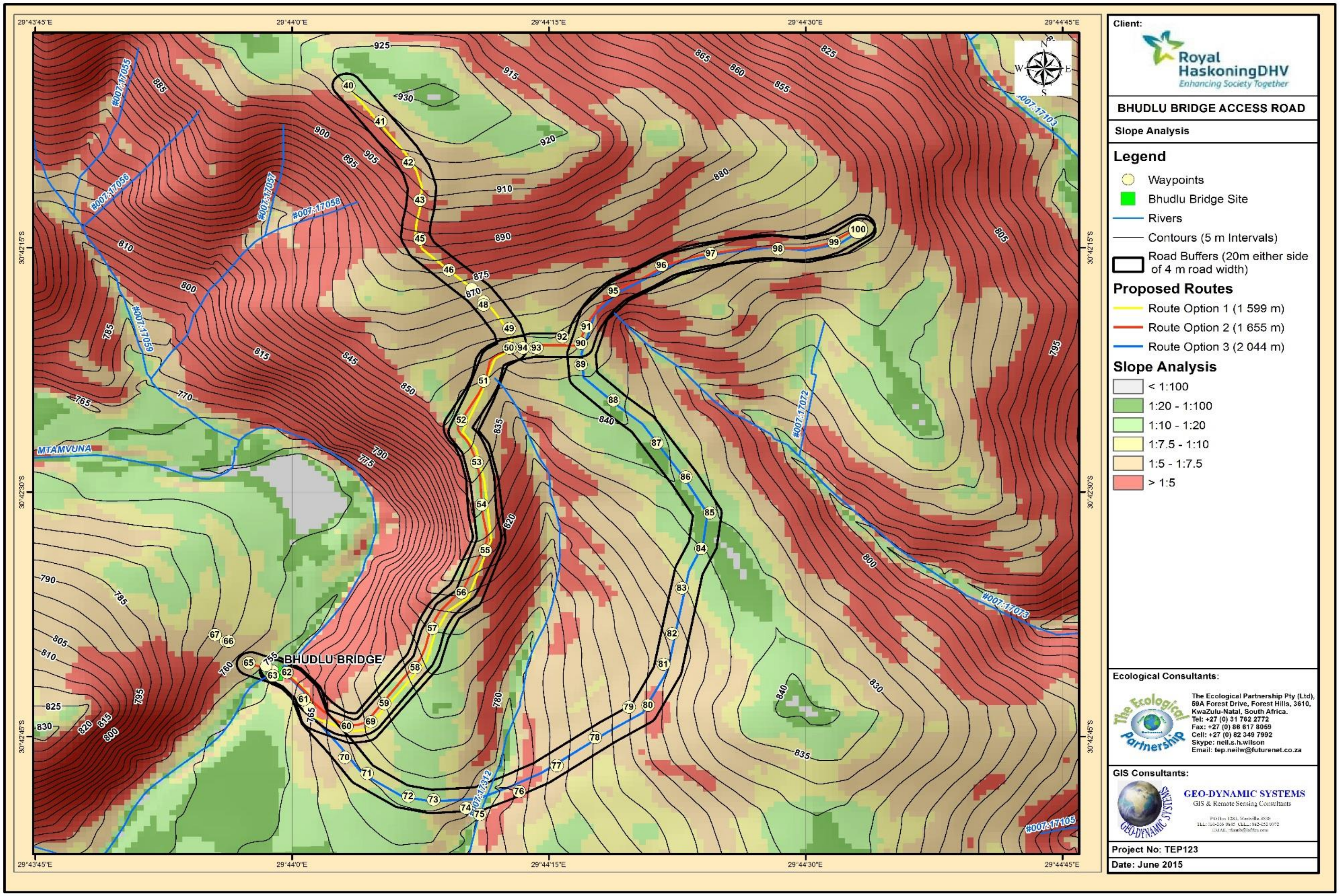

Figure 4: Slope analysis of the study area.

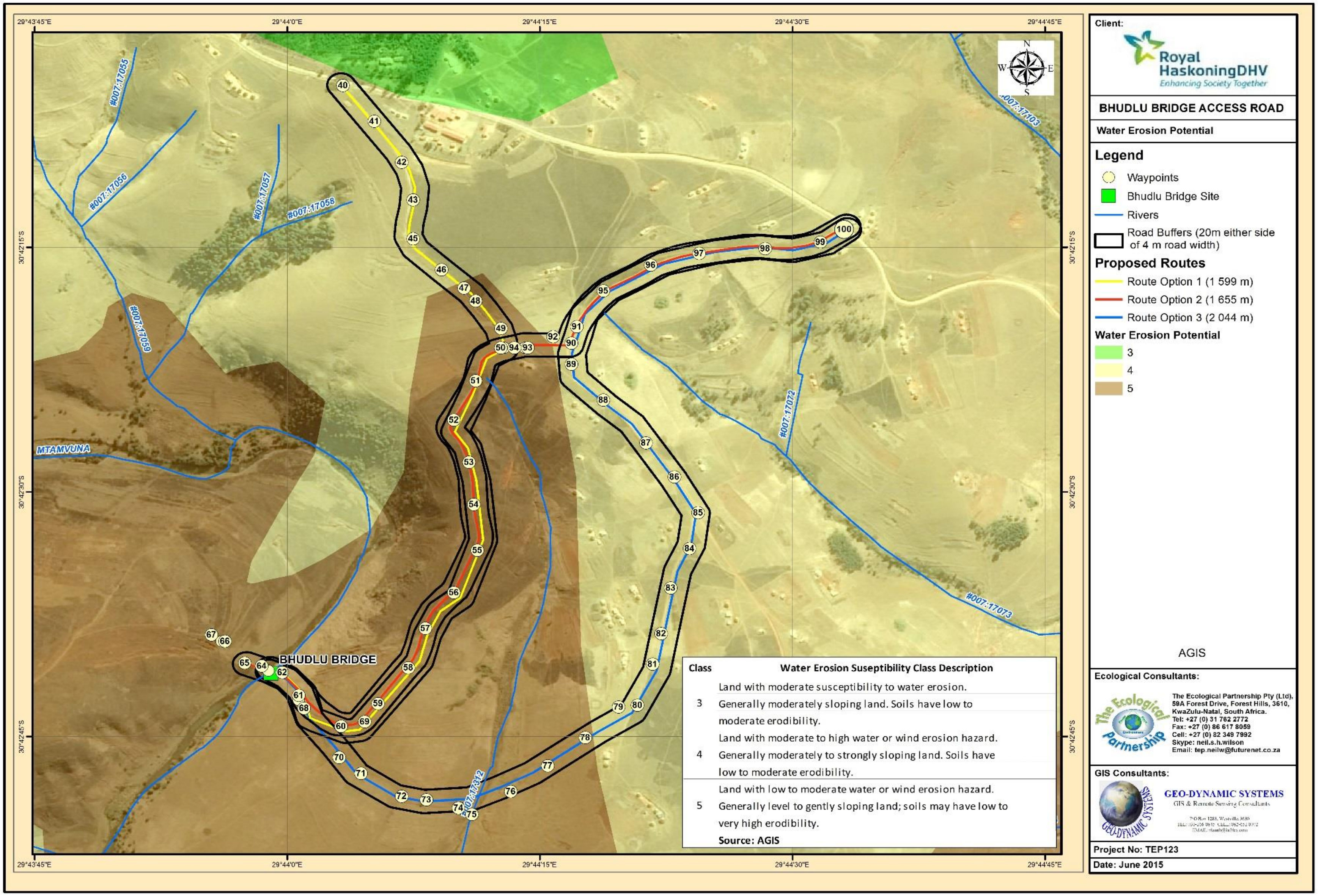

Figure 5: Erosion potential in the study area.

Plate 1: Erosion donga along an old gravel track from waypoint 42 to 48 in option 1 (Fig. 5).

Plate 2: Site of the proposed bridge on the Umtamvuna River where drilling has started. Donga erosion can be seen on the Eastern Cape side of the river.

Plate 3: Perennial stream at waypoint 75 along option 3.

b) Erosion Potential

Land with moderate to high erosion potential is present along option 1 from waypoint 40 to 47 and along option 3 from waypoint 78 to 100, excluding the short section from waypoint 92 to 94 (Fig. 5). Along option 1 from waypoint 42 to 48, deep donga erosion is present (Fig. 5; Plate 1). The remaining study area comprises land with a low to moderate erosion potential (Fig. 5). Serious, extensive erosion is present in this area on the Eastern Cape side of the Umtamvuna River in the vicinity of the proposed bridge site near waypoints 66 and 67 (Fig. 5; Plate 2).

c) Vegetation Types & Flora

Midlands Mistbelt Grassland is recorded in the literature as occurring along option 1 from waypoint 40 to 42 (Fig. 6; Plate 4; Mucina & Rutherford, 2006). The rest of the study area along option 1, 2 and 3 is covered by Moist Coast Hinterland Grassland, including the section on the Eastern Cape side of the Umtamvuna River, according to the literature (Fig. 6; Plate 5; Scott-Shaw & Escott, 2011).

Midlands Mistbelt Grassland is **Endangered** and is one of the most threatened vegetation types in KwaZulu-Natal (Mucina & Rutherford, 2006; Jewitt, 2011). Only 0.5% is statutorily conserved in Protected Areas and the conservation target is 23% (Mucina & Rutherford, 2006). This vegetation and habitat type typically is dominated by forb rich, tall, sour *Themeda triandra* grassland which is often invaded by Ngongoni grass, *Aristida junciformis* subsp. *junciformis* which is typically the dominant species in Moist Coast Hinterland Grassland.

The herb, *Anisopappus smutsii* and the succulent herb, *Aloe kniphofioides*, are two biogeographically important taxa that are found in Midlands Mistbelt Grassland (Mucina & Rutherford, 2006). Endemic taxa which feature in this vegetation type are the herbs, *Acalypha entumenica* and *Selago longiflora,* the geophytic herbs, *Asclepias woodii*, *Albuca xanthocodon*, *Dierama luteoalbidum*, *Kniphofia latifolia*, *Pachycarpus rostratus* and *Watsonia canaliculata*, and the low shrubs, *Helichrysum citricephalum* and *Syncolostemon latidens* (Mucina & Rutherford, 2006). None of these important taxa were found in the study area.

Moist Coast Hinterland Grassland is also **Endangered** (Jewitt, 2011). This vegetation and habitat type is usually composed of dense, tall, sour grassland dominated by unpalatable Ngongoni grass, *Aristida junciformis*. Due to the dominance of this species, Moist Coast Hinterland Grassland has low plant species diversity. When in good condition, this grassland is dominated by the grasses, *Themeda triandra* and *Tristachya leucothrix*. Less than one percent is statutorily conserved in Protected Areas and the conservation target is 25% (Mucina & Rutherford, 2006).

In the field the two **Endangered** grasslands are difficult to distinguish and the whole study area is covered by grassland which is totally dominated by the widespread occurrence of the grass, *Aristida transvaalensis* (Table 1; Plate 1-5). Along options 1, 2 and 3, the grassland has a high cover and abundance value which ranges from 80 to 100%. The grasses, *Eragrostis curvula, Sporobolus africanus* and *Monocymbium ceresiiforme* which are present along all three options are important species in Midlands Mistbelt Grassland, while the former two species are important taxa in Moist Coast Hinterland Grassland (Table 1; Mucina & Rutherford, 2006).

Figure 6: Vegetation types of the study area comprising highly **Endangered** Midlands Mistbelt Grassland and **Endangered** Moist Coast Hinterland Grassland. The latter vegetation type occurs on the Eastern Cape side of the Umtamvuna River as well along the alignment from waypoint 64 to 67.

Plate 4: Highly **Endangered** Midlands Mistbelt Grassland occurs along option 1 from waypoint 40 to 42 (Fig. 6).

Plate 5: Endangered Moist Coast Hinterland Grassland occurs in most of the study area. This is the track through the grassland along option 1 and 2 viewed from waypoint 53 (Fig. 6).

In the study area, the sub-dominance and widespread presence of *Sporobolus africanus* tends to indicate disturbed conditions and maybe due to overgrazing, although only a few cattle were seen (Table 1; van Oudtshoorn, 1999). The presence of *Eragrostis plana* also indicates overgrazing and/or overburning of the veld, while *Eragrostis curvula* usually grows in disturbed areas and may indicate overgrazing (Table 1; van Oudtshoorn, 1999).

Two **Threatened** plant species which may occur in the study area were revealed by querying Ezemvelo KZN Wildlife's SEA database. *Asclepias schlechteri* is **Endangered** and is a South African endemic, while *Stachys comosa* is **Threatened** and is also a South African endemic (Raimondo, von Staden, Foden, Victor, Helme, Turner, Kamundi & Manyama 2009). Both species have been recorded in Midlands Mistbelt Grassland and Moist Coast Hinterland Grassland, which are the **Threatened** grassland vegetation types occurring in the study area. However, neither species was found during an intensive search of the study area in late September on the second site visit.

d) Fauna

Very few indigenous animals were found or evidence of them was observed in the study area (Table 2). The call of an unidentified species of frog was heard along option 1 from waypoint 41 to 48 and many tadpoles were observed in the perennial stream along option 3 at waypoint 75 (Fig. 2). The frog call did not match any of the calls of frogs which may occur in the area, notably the Sharp-nosed Grass Frog, *Ptychadena oxyrhynchus* and the Striped Grass Frog, *Ptychadena porosissima* (du Preez & Carruthers, 2009). Small mounds of sand were seen along option 3 from waypoint 70 to 74 that are likely to be those of the Hottentot Golden Mole, *Amblysomus hottentotus* (Fig. 2; Apps, 2000). No threatened animal species or animal species of conservation concern were revealed by querying Ezemvelo KZN Wildlife's SEA database and none were found in the study area during the two site visits in late May and late September.

Table 1: Plant species identified in the 4 metre wide footprints and 40 metre wide buffers of the three gravel road alignments on the KwaZulu-Natal side of the Umtamvuna River and along the 4 metre wide footprint and 40 metre wide buffer of the alignment on the Eastern Cape side of the river. Declared plant invaders are indicated with a double asterisk**. Category 1b plant invaders are prohibited according to the National Environmental Management Biodiversity Act and must be removed, while Category 2 plant invaders require a permit to be retained (Government Gazette, 2014).

PLANT SPECIES	PLANT TYPE & LOCATION
*Acacia mearnsii***	Tree; Category 2 invader; Umtamvuna river bank; occasional pockets along option 1 & 2.
*Agave sisalana***	Shrub; Category 2 invader; occasional plants along option 1, 2 & 3.
Aristida transvaalensis	Grass; dominant and widespread species along all alignments.
Crassula vaginata subsp. vaginata	Perennial herb; present along option 1, 2 & 3.
Eragrostis curvula	Grass; present along option 1, 2 & 3.
Eragrostis plana	Grass; present along option 1, 2 & 3.
Hyparrhenia anamesa	Grass; present along option 1, 2 & 3.
Helichrysum simillimum	Perennial herb; common along all options.
Leonotis leonurus	Shrub; occasional patches along option 1, 2 & 3.
Lobelia erinus	Annual herb; present along option 1, 2 & 3.
Monocymbium ceresiiforme	Grass; present along option 1, 2 & 3.
Pteridium aquilinum	Fern; occasional pockets along option 1 & 2.
*Rubus cuneifolius***	Shrub; Category 1b invader; present along option 3.
*Solanum mauritianum***	Shrub; Category 1b invader; occasional presence along option 1 & 2.
Sporobolus africanus	Grass; sub-dominant species & widespread along all options particularly next to existing gravel roads, footpaths & near homesteads.

Table 2: Animal species identified in the 4 metre wide footprints and 40 metre wide buffers of the three gravel road alignments on the KwaZulu-Natal side of the Umtamvuna River and along the 4 metre wide footprint and 40 metre wide buffer of the alignment on the Eastern Cape side of the river.

ANIMAL SPECIES	LOCATION
Belenois creona severina (African Common White; butterfly)	Along options 1, 2 & 3.
Danaus chrysippus aegyptius (African Monarch; butterfly)	Along options 1, 2 & 3.
Eyprepocnemis plorans (grasshopper)	Along options 1, 2 & 3.

Lanius collaris (Common Fiscal; bird)	Along options 1, 2 & 3.
Mirafra africana (Rufous-naped Lark; bird)	Along options 1, 2 & 3.
Passer domesticus (House Sparrow; bird)	Along options 1, 2 & 3.
Serinus canicollis (Cape Canary; bird)	Along options 1, 2 & 3.

e) Conservation Corridors

A critical linkage conservation corridor is present north-east and south-west of the study area (Fig. 7). These corridors are rather anomolous as the whole Umtamvuna River Valley should be a conservation corridor as well as other stream areas and not just limited sections of these areas.

f) Ecological Impacts & Mitigation Measures

Along each of the three options, grassland habitat will be removed and lost to accommodate the four metre wide gravel road. There will be edge effects as well during the construction and operational phases that probably will result in at least another metre of grassland habitat being damaged or lost on either side of the road. No threatened plant or animal species or species of conservation concern were found in the four metre wide footprint and 20 metre wide buffer on either side of the road for each option when the ecological assessment was conducted in the winter month of May, 2015. A further search was conducted in late September, 2015, but none were found. The negative ecological impacts of the proposed gravel road therefore will be mainly in terms of the loss of the two **Endangered** grassland habitats and their biodiversity. The high negative score of -13 obtained for each of the three route options applies to the construction area (Table 3-5). If however the ecological impacts are assessed at a local scale within a radius of 2 km of the construction area, the significance scores would range from -7 to -9 indicating moderate negative levels of significance, reflecting moderate loss and change of natural habitats and biota, with basic ecosystem functions remaining predominantly unchanged (Table 3-5). This less severe ecological assessment can change radically with rampant negative cumulative ecological impacts (see section 4g below).

Option 2 is the preferred option because it traverses an existing gravel road for over a third of its length and will involve the least destruction of **Endangered** Moist Coast Hinterland Grassland habitat and associated biodiversity (Fig. 6). More than a third of its total length from waypoint 90 to 100 traverses land with a moderate to high erosion potential, but this path is along an existing gravel road with level and gently sloping gradients (Fig. 5). Therefore, the potential for erosion is minimised together with its secondary negative ecological impacts on the adjacent Moist Coast Hinterland Grassland habitat and associated biodiversity (Fig. 5). Option 2 has the lowest negative impact on the grassland and associated biodiversity in terms of significance (Table 4). Option 1 is the second preferred option because it will involve the second greatest loss of grassland habitat and biodiversity in terms of significance (Table 3). Option 1 passes through the highly **Endangered** Midlands Mistbelt Grassland from waypoint 40 to 42 which is undesirable (Fig. 6; Plate 4). It will also involve further unnecessary fragmentation of the two **Endangered** grasslands when an existing gravel road route is already present from waypoint 90 to 100 in option 2 (Fig. 6). Option 1's path from waypoint 40 to 47 traverses land with a moderate to high erosion potential, and from waypoint 42 to 48 a steep gradient is present where two metre deep donga erosion already has taken hold (Fig. 3-5; Plate 1). Option 3 is the third preferred option because it has the longest path through virgin grassland and will involve the greatest loss of Moist Coast Hinterland Grassland habitat and associated biodiversity (Fig. 6). Option 3 also crosses a perennial stream where a culvert will have to be built (Fig. 2; Plate 3). The culvert may have negative ecological impacts on the stream, nearby wetlands and associated biodiversity during the construction and operational phases (Table 7). Option 3 constitutes the longest and least direct route (Fig. 2).

No mitigation measures are going to be able to prevent the loss of the grassland and its biodiversity for each of the three options, but they will help in minimising grassland loss and preventing unnecessary damage to the grassland. One such measure is to ensure that construction related activities remain within the four metre wide footprint of the road. Without this mitigation measure, the negative ecological impacts would extend beyond the construction area or site resulting in an increased significance score of -14, since extent would increase to -2, with duration, intensity and probability remaining the same at -4 (Table 3-5).

If option 1 is not chosen as the preferred alignment, off-site mitigation should be conducted to fill the serious erosion donga which has developed along the gravel track from waypoint 42 to 49 (Fig. 5; Plate 1). Topsoil and grassland which are removed from the preferred option should be used to rehabilitate the gravel track and erosion donga from waypoint 42 to 49 (Fig. 5). Other areas which are eroded or denuded of vegetation should receive topsoil and transplanted grassland sods such as those badly eroded areas on the Eastern Cape side of the Umtamvuna River on the steep slopes in the vicinity of the proposed bridge (Fig. 5; Plate 2). Eroded areas would first have to be filled with soil before grassland sods are transplanted. Removed topsoil and grassland sods should also be used to rehabilitate sections along the chosen alignment where construction activities have extended beyond the four metre wide construction width of the proposed gravel road resulting in damage to or destruction of the grassland. With this recommended on-site and off-site rehabilitation, top-soils, sub-soils and grassland sods would have to be conserved and protected in a nursery area where the grassland sods would have to be watered to keep the plants alive. *Eragrostis curvula* which is one of the grasses that is present in the study area, is one of the best grasses to stabilise exposed soil as it establishes easily (Table 1; van Oudtshoorn, 1999).

Negative ecological impacts may result from the construction of the bridge over the Umtamvuna River for all three road alignment options and from the construction of the culvert over the stream at waypoint 75 for option 3 (Table 6 & 7; Fig. 2; Plate 2 & 3). Negative impacts on the aquatic and wetland habitats and biodiversity include pollution due to spillage of toxic fluids or substances and agitation or disturbance of the river and stream beds causing siltation downstream during the construction phase. Erosion in the vicinity of the bridge and culvert due to damage or destruction of grassland resulting from road, bridge and culvert construction activities will add to the siltation impact. Siltation may result in secondary negative ecological impacts on aquatic and wetland habitat and biodiversity. Negative impacts on the riparian habitat and biodiversity include disturbed river bank conditions resulting in the spread of nearby alien plant invaders such as Black Wattle (*Acacia mearnsii*) at the Umtamvuna site and American Bramble (*Rubus cuneifolius*) and Black Wattle at the stream site (Table 1). Mitigation measures involve preventing toxic spillages and severe disturbance to the bed of the river and stream and confining any impacts to the four metre wide construction footprint. Damage or destruction of protective grassland beyond this footprint that may lead to erosion should be avoided. Mitigation measures are likely to result in negative low levels of significance where impacts cause small negative changes in natural habitats and biota, but ecosystem functions remain essentially unchanged (Table 6 & 7). Off-site mitigation is strongly recommended and would involve removing all the alien invader trees along the left and right banks of the Umtamvuna River downstream and upstream of the proposed bridge site over a 1 km distance from the bridge site and destruction of invasive American Bramble and Sisal (*Agave sisalana*) along option 3 from waypoint 70 to 74 (Fig. 2).

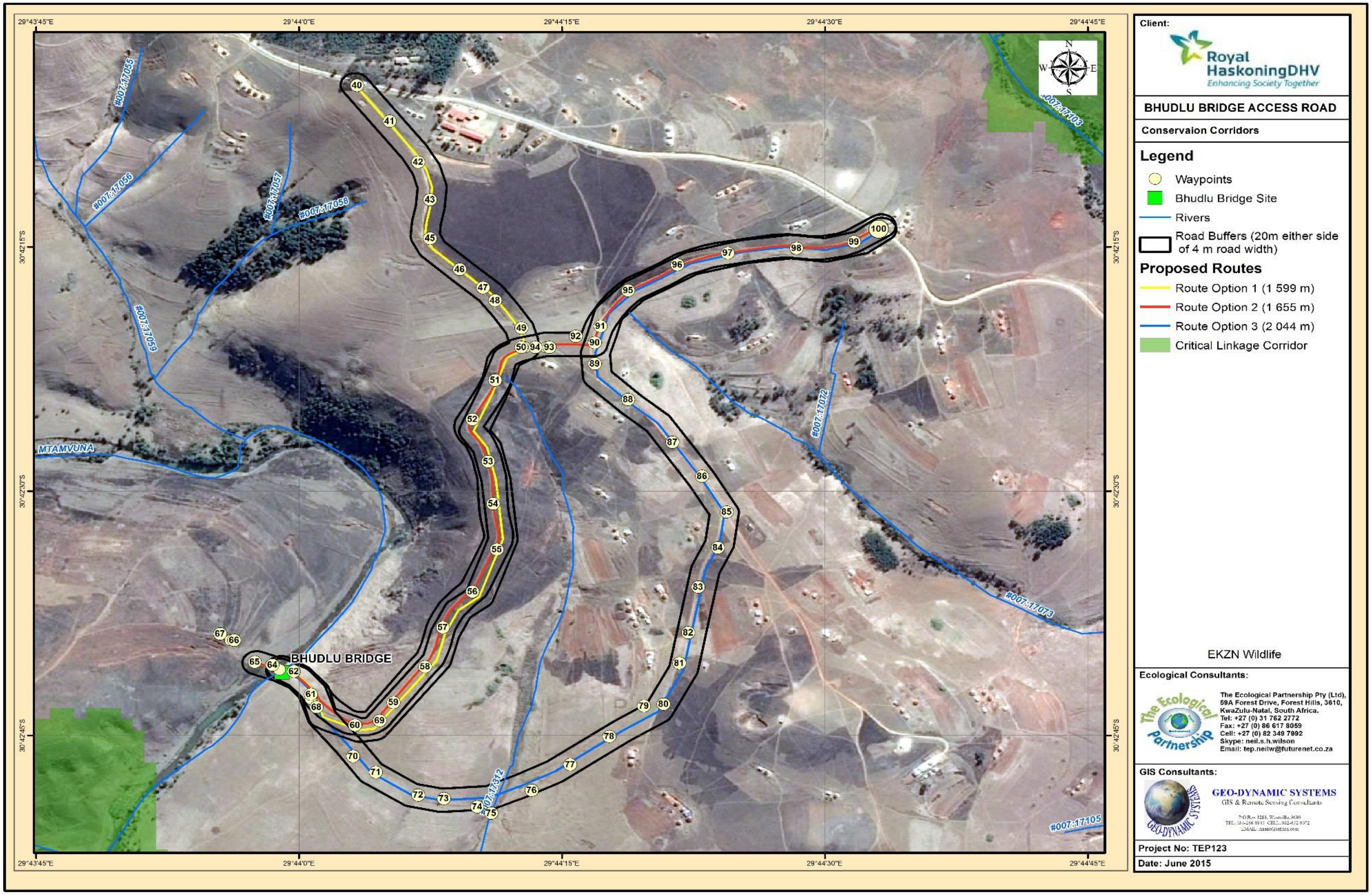

Figure 7: Critical linkage conservation corridors are present near the study area.

g) Cumulative Impacts

Loss of the grassland in each of the three options will add to the cumulative loss of grassland in the area due to various factors including creation of new umuzis and expansion of the residential area, planting of crops, soil erosion, expansion of areas occupied by alien plant invaders and fragmentation of the veld through the creation of numerous informal vehicle tracks and footpaths. Grassland degradation caused by overgrazing and over-burning will also contribute to the negative cumulative impacts on the grassland.

Where negative ecological impacts increase in extent to become local and regional due to cumulative impacts, resulting in increased significance scores of -14 and -15 respectively, the ecological situation becomes critical as extensive or complete loss of natural habitat, biota and basic ecosystem functions occurs locally and regionally. Ecological impacts at a national scale may ensue as a result of the demise or extinction of threatened plant and animal species or vegetation types (i.e., habitat types), for example the highly **Endangered** Midlands Mistbelt Grassland.

The off-site grassland mitigation measures strongly recommended in section 4(f) above would help reduce significant negative cumulative ecological impacts.

Table 3: Negative impacts on the grassland habitat and its biodiversity resulting from using option 1 for the proposed gravel road with (scores without brackets) and without (scores in brackets) mitigation measures. Local scale refers to a radius of 2 km from the construction area.

Impact Parameter	Score	Description
Extent	-1 (-2)	Site (Local)
Duration	-4 (-4)	Permanent
Intensity	-4 (-4)	Very high
Probability	-4 (-4)	Definite
Significance in construction area	-13 (-14)	Negative very high
Significance at local scale	-8 (-9)	Negative moderate

Table 4: Negative impacts on the grassland habitat and its biodiversity resulting from using option 2 for the proposed gravel road with (scores without brackets) and without (scores in brackets) mitigation measures. Local scale refers to a radius of 2 km from the construction area.

Impact Parameter	Score	Description
Extent	-1 (-2)	Site (Local)
Duration	-4 (-4)	Permanent
Intensity	-4 (-4)	Very high
Probability	-4 (-4)	Definite
Significance in construction area	-13 (-14)	Negative very high
Significance at local scale	-7 (-8)	Negative moderate

Table 5: Negative impacts on the grassland habitat and its biodiversity resulting from using option 3 for the proposed gravel road with (scores without brackets) and without (scores in brackets) mitigation measures. Local scale refers to a radius of 2 km from the construction area.

Impact Parameter	Score	Description
Extent	-1 (-2)	Site
Duration	-4 (-4)	Permanent
Intensity	-4 (-4)	Very high
Probability	-4 (-4)	Definite
Significance in construction area	-13 (-14)	Negative very high
Significance at local scale	-9 (-10)	Negative moderate (Negative high)

Table 6: Negative impacts on the riparian and aquatic habitats and their biodiversity of the Umtamvuna River resulting from the proposed bridge for option 1, 2 and 3 with (scores without brackets) and without (scores in brackets) mitigation measures.

Impact Parameter	Score	Description
Extent	-1 (-2)	Site (Local)
Duration	-1 (-1)	Short-term
Intensity	-2 (-2)	Moderate
Probability	-2 (-2)	Possible
Significance	-6 (-7)	Negative low (Negative moderate)

Table 7: Negative impacts on the riparian, aquatic and wetland habitats and their biodiversity of the stream resulting from the culvert which would have to be built for option 3 with (scores without brackets) and without (scores in brackets) mitigation measures.

Impact Parameter	Score	Description
Extent	-1 (-2)	Site (Local)
Duration	-1 (-1)	Short-term
Intensity	-2 (-2)	Moderate
Probability	-2 (-2)	Possible
Significance	-6 (-7)	Negative low (Negative moderate)

Negative impacts on the aquatic habitat and associated biodiversity of the Umtamvuna River and stream and on the wetlands and associated biodiversity of the stream resulting from the construction of the proposed bridge and culvert respectively will add to the existing negative impacts on these natural systems in terms of siltation through the disturbance of the river and stream beds and siltation from possible erosion due to damage or destruction of the grassland in the vicinity of the crossings. Negative impacts on the riparian habitat and associated biodiversity of both watecourses will add to existing negative impacts on those natural systems in terms of creating disturbed conditions suitable for the spread of alien plant invaders such as Black Wattle (*Acacia mearnsii*) and American Bramble (*Rubus* *cuneifolius*) which are already present in the area (Table 1). Cumulative negative impacts may increase the significance scores for the river and stream to -8 or -9 in the negative moderate range (Table 6 & 7).

Off-site mitigation mentioned in section 4(f) above involving the removal of all alien invader trees along the left and right banks of the Umtamvuna River over a 1 km distance downstream and upstream of the proposed bridge site and the eradication of invasive American Bramble and Sisal along option 3 from waypoint 70 to 74 would help reduce the negative cumulative ecological impacts (Fig. 2).

5. CONCLUSION

No threatened plant or animal species or species of conservation concern were found in the four metre wide footprint and 20 metre wide buffer on either side of the road for each of the three alignment options when the ecological assessment was conducted towards the end of May and September, 2015. The negative ecological impacts of the proposed gravel road will be in terms of the loss of the **Endangered** grassland habitat and its biodiversity with a very high score of -13 for significance, provided that mitigation measures are instituted to minimise grassland loss, and off-site mitigation is carried out. Option 2 is the preferred alignment option because it traverses an existing gravel road for over a third of its length and will involve the least destruction of **Endangered** Moist Coast Hinterland Grassland habitat and associated biodiversity and the least fragmentation of grassland habitat. Option 2 does not pass through the highly **Endangered** Midlands Mistbelt Grassland as does option 1, which is the second preferred option. Further loss and fragmentation of this vegetation type is undesirable. Out of the three alignment options, option 2 has the lowest negative impact on the grassland and associated biodiversity in terms of significance at a local scale. Option 3 is the least preferred alignment as it cuts through virgin grassland along an appreciable length, crosses a perennial stream and is the longest and least direct route.

Negative impacts on the riparian and aquatic habitats and biodiversity of the Umtamvuna River are likely to be of low significance provided that mitigation measures are instituted. The same applies to the riparian, wetland and aquatic habitats and biodiversity of the stream.

Negative ecological impacts on the grassland habitat and biodiversity, the aquatic and riparian habitats and biodiversity of the Umtamvuna River and stream and the wetland habitats and biodiversity of the stream will add to the cumulative negative ecological impacts on these natural systems. It is therefore vital that negative ecological impacts are minimised through the institution of mitigation measures and off-site mitigation.

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