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Pave the Impenetrable?
An economic analysis of potential Ikumba - Ruhija road alternatives in and around Uganda's Bwindi Impenetrable National Park

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The International Gorilla Conservation Programme (IGCP) is a coalition programme of international conservation organizations founded in 1991, currently comprised of Fauna & Flora International and WWF. IGCP's mission is to conserve the critically endangered mountain gorillas and their habitat through partnering with key stakeholders while significantly contributing to sustainable livelihood development.

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{ Executive Summary

In July 2012, the Uganda National Road Authority (UNRA) advertised a request for expressions of interest to design and construct 1,900 kilometres (km) of strategic roads in the country. The objectives of this investment by the Ugandan government are:

1. To promote equal access to economic and social development opportunities across the country;
2. To improve the quality of the national road network and improve connectivity to all areas of the country; and
3. To promote the continual improvement of the national road sector in Uganda.

One of the proposed projects is an upgrade of the road from the Ikumba junction on the Kabale – Kisoro road, through Ndego gate, Ruhija, Kitahuriira, Hamayanja and then to Buhoma. Approximately 13 km of the Ikumba – Ruhija section of the proposed road passes through Bwindi Impenetrable National Park (BINP), a globally recognized UNESCO World Heritage Site, and a refuge for about half the world's population of the critically endangered mountain gorilla (*Gorilla beringei beringei*), one of Uganda's main tourist attractions.. Another 12 km of the road runs along the park boundary. Specific objectives for the project that includes the Ikumba – Ruhija section are:

1. To improve the performance of the tourism sector by easing access to the tourist attractions in the region;
2. To improve access to goods/passenger transport services, and reduce transport costs along the route;
3. To improve access to social and economic development opportunities along the route; and
4. To ensure no roadside communities become worse off as a result of the road upgrading works.

If the upgrade comes to fruition under the proposed plan, evidence suggests that the gorilla population will be affected in two ways: 1) gorillas will actively avoid areas of high human activity; and 2) gorilla mortality from disease, poaching, and vehicle collisions will increase. Given BINP's importance to Uganda's development and conservation objectives, the International Gorilla Conservation Programme (IGCP) and the Uganda Chapter of Poverty and Conservation Learning Group (Ug-PCLG) have proposed, in consultation with local communities and engineers, two road alternatives that would reroute the Ikumba – Ruhija road section outside of BINP.

The proposed alternatives follow the same route outside of the park except that Alternative 3 follows a mountain ridge in order to avoid steeper terrain (Figure 1). To support the decision-making process, Conservation Strategy Fund (CSF) and IGCP studied the potential economic costs and benefits associated with the proposed upgrade of the current road through BINP, and compared these with the costs and benefits of the two proposed alternative routes.

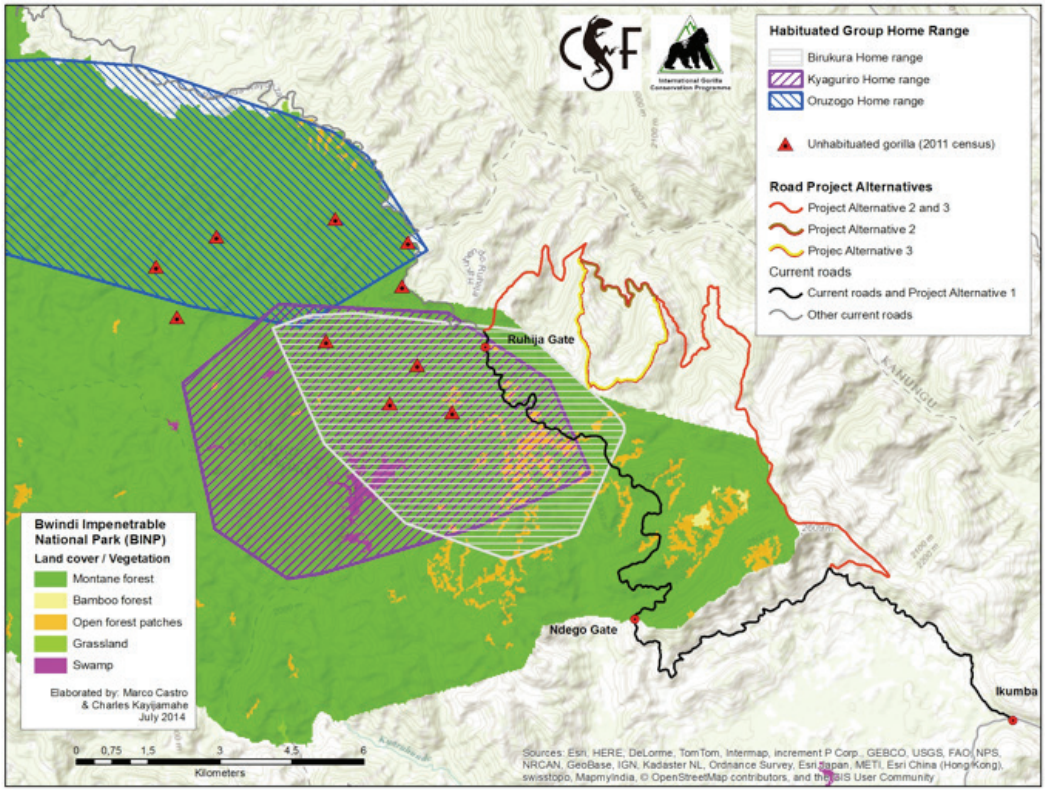


FIGURE 1 - Road project alternatives through and around BINP, habituated gorilla home ranges (2007-2012), and location of individual unhabituated gorillas discovered during census (2011)

Given the Ikumba – Ruhija road's specific objectives, we analysed road alternatives in terms of:

1. Overall economic performance;
2. Performance in reduced transport costs (benefits) versus construction and maintenance costs;
3. Effects on rural communities living around the park;
4. Impacts on tourism revenues; and
5. Ability to offset construction and maintenance costs via revenue generated by increased tourism.

Results

The results of our analysis show that both road alternatives outside BINP would have better overall economic performance than upgrading the route through the park. This conclusion rests on lowered overall risks to the gorilla population, lowered risks to specific gorilla groups upon which lucrative tourism activity depends, as well as on the greater number of people and communities who would benefit from routes outside the park. These benefits outweigh the higher construction costs of the alternative routes. When the risk to gorilla populations and associated loss of permit revenues is included, upgrading the current road option through the park is estimated to cost approximately twice as much as the alternatives. Considering impact on tourism more broadly, at the national level this translates to a possible loss of some US $214 million over the next 20 years (in Net Present Value terms - NPV). Furthermore, both the national and specific objectives under which the Ikumba – Ruhija road improvement were proposed are best met by those alternatives that divert vehicles outside of the park.

The specific findings of this report are as follows:

- For all three road options, road maintenance and construction costs outweigh benefits generated from reduced transport costs (time, vehicle operation and maintenance costs). Without the incorporation of social or environmental benefits and costs, all projects would generate a net cost ranging from US $13.7 million to US $18.4 million (NPV). Upgrading the current road through the park presents the lowest net cost with a NPV of US $13.7 million. Project Alternative 2, which circumvents the park and passes through the surrounding communities, has the next lowest cost at US $16.7 million. Alternative 3, which follows the mountain ridge, is the most expensive, at US $18.4 million.

- While the alternatives outside the park have higher construction costs than upgrading the existing road within the park, they would serve 19,000 people (6,000 more people than upgrading the current road) and deliver a greater improvement in mobility per capita, as there is currently no road serving most of the communities east of BINP. Including paving of the current road up to Mukiyorere, 3 km from the proposed point of diversion, within the construction of the project alternatives that circumvent the park would further improve road access. This addition would serve both the communities to the east and south of BINP, bringing the estimated number of people served by a paved road to 25,000 at the additional cost of only US $2.0 million.

- Tourism linked to the Ikumba – Ruhija road is centred on gorilla trekking. Upgrading the current road through BINP risks changing gorilla behavior and ranging patterns during and after construction phases. This could potentially lead to losses of US $15.7 million in permit revenue, US $26.5 million to the Bwindi-region economy, and US $214.2 million to Uganda's economy over the next 20 years (NPV). Choosing to build either of the two road project alternatives outside BINP would avoid such risks to the economy.

- The current state of the Ikumba – Ruhija road is not a limiting factor in the growth of tourism in BINP. Under current tourism growth rates in BINP, tourist numbers will have increased beyond the current maximum number of gorilla trekking permits before the completion of the new road in 2018; tourism numbers will be limited by the capacity of the habituated gorilla population (based on established best practices) and the road would be unable to further increase tourist numbers. Road-induced tourism revenues to the Ugandan economy are therefore predicted to be insufficient to offset the costs of the road upgrade project.

- Given the limited benefits to tourism from the road investment and the likely economic losses due to disruptions to gorilla behaviour and home range, the precautionary principle should be applied to ensure that the Ugandan government safeguards its tourism economy, which is currently highly dependent upon this iconic species. Any tourism investment in the area should focus on guaranteeing the protection of the current gorilla population and its potential to grow.

We recommend that only road alternatives outside the park be further explored through detailed design analysis, and that the most appropriate of the routes be developed to ensure the maximum socioeconomic return from the road investment. Such a strategy would provide the same improvement in access for the tourism industry as the upgrade of the existing road, and would more than compensate higher upfront costs by mitigating potential negative impacts on the gorilla population and tourism revenue. This strategy would also improve access to markets and important services like health and education for a total of 19,000 to 25,000 people (6,000 to 12,000 more people than would be served by the upgrade of the current road).

Introduction

In July 2012, the Ugandan government's Uganda National Road Authority (UNRA) advertised the opportunity to design and construct 1,900 km of strategic roads in the country. One of these roads is the "*Lot E.3: Hamurwa-Karere-Kanungu/Bulema-Buhoma-Butogota-Hamayanja-Ifasha-Ikumba*" road project (UNRA, 2012), as included in Annex 1. Part of this project is the upgrade of a murram road[1] between the Ikumba junction on the Kabale – Kisoro road and the town of Buhoma, the main hub for tourism in and around Bwindi Impenetrable National Park (BINP). BINP is a globally recognized UNESCO World Heritage Site, and one of the last remaining habitats of about half the world's population of the critically endangered mountain gorilla (*Gorilla beringei beringei*), one of Uganda's main tourist attractions. Approximately 13 km of the Ikumba – Buhoma road passes through the park and is currently the only access route from Kabale to the town of Ruhija. Given BINP's importance to Uganda's development and conservation objectives, the International Gorilla Conservation Programme (IGCP) and the Uganda Chapter of Poverty and Conservation Learning Group (Ug-PCLG) have proposed, in consultation with local communities and engineers, two alternative routes which bypass construction within BINP.

Due consideration of these routes is well-justified: given large investment, maintenance and environmental costs of road construction, relevant road agencies must ensure that all road construction and improvement projects are appropriately analysed and approved based on socioeconomic and environmental criteria. Without appropriate analysis and planning, road investments can result in significant permanent environmental damage and in welfare losses to society (USAID, 2009). Road development is a costly social investment and can bring considerable economic losses when environmental costs are high, accrued benefits are captured by only a few and/or do not offset the construction costs (Fleck et al., 2006). It is therefore important that the costs and benefits - economic, social and environmental - are carefully considered in the analysis of a road project and possible alternatives.

A tool commonly used for assessing the economic feasibility of infrastructure projects, such as roads, is cost-benefit analysis (CBA) (Fleck et al., 2006; Lebo and Schelling, 2001). In a CBA the flow of costs and benefits are projected over the life cycle of the project, and financially adjusted with an appropriate interest rate to reflect the opportunity cost of the capital invested. This analytical approach is widely demanded for such investments by the World Bank, governments and other funding agencies across the infrastructure sector (Fleck et al., 2006).

To support the decision-making process in Uganda, Conservation Strategy Fund (CSF) and IGCP studied the potential economic costs and benefits associated with the proposed upgrade of the current road through BINP, and compared them to the benefits and costs of the two proposed alternative routes.

[1] *Murram refers to laterite soil used to build roads*

a. Bwindi Impenetrable National Park

BINP (0°53′-1°08′S, 29°35′-29°50′E) is located in southwest Uganda. BINP has been a protected area in Uganda since 1932 and was officially gazetted as BINP in 1991. Figure 2.1 displays BINP's location and highlights primary murram roads passing through and near the protected area.

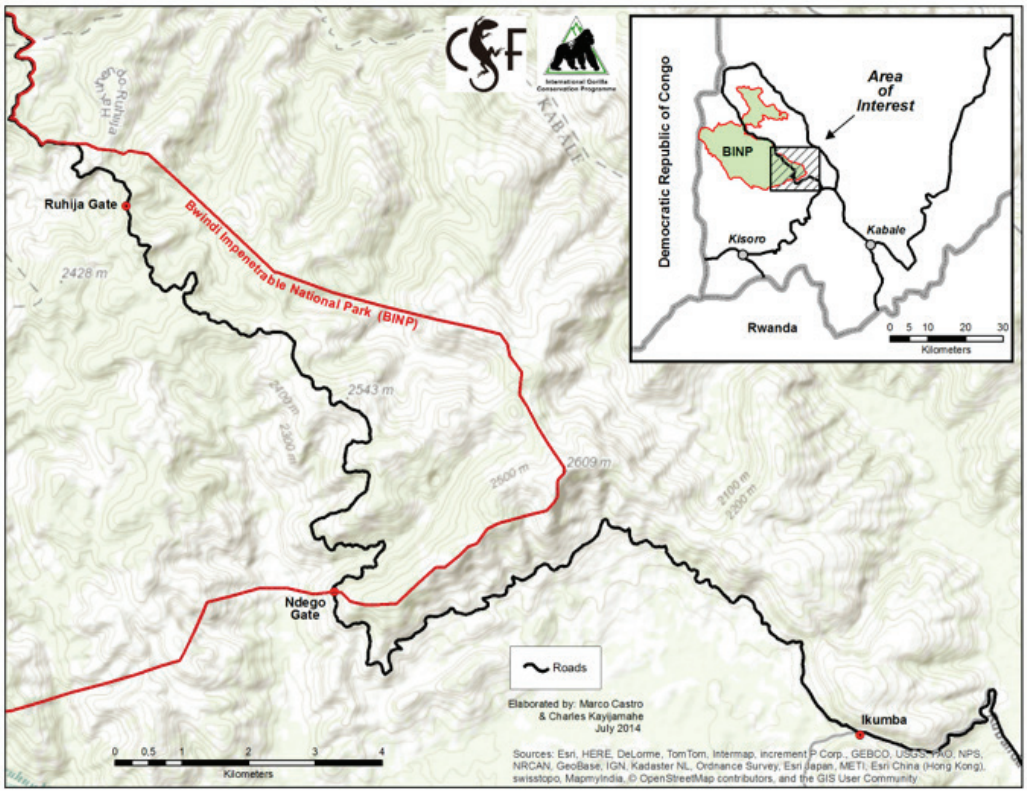


FIGURE 2.1 Study's area of focus and primary existing murram roads.

Located in the Albertine Rift, BINP is 330.8 km^2 and supports an extremely unique and diverse array of afromontane flora and fauna. The park is home to over 138 bird species and 135 mammal species, including seven diurnal primates and a small population of about 45 elephants (Olupot and Sheil, 2011; Plumptre et al., 2004). It is an enclave of critically-endangered, endangered or vulnerable species as categorized by the International Union for Conservation of Nature (IUCN). These include at least seven mammal species (mountain gorillas and chimpanzees included), six bird species, six amphibian species, and 18 plant species with these designations (Plumptre et. al. 2007). More recently, camera trap monitoring has shown BINP to be home to populations of elusive species such as the African golden cat (*Profelis aurata*), honey badger (*Mellivora capnsis*), and Sitatunga (*Tragelaphus spekii*) (Mugerwa et al. 2012). BINP is also one of the last remaining habitats of the critically endangered mountain gorilla (*Gorilla beringei beringei*), supporting one of two remaining populations.[2] BINP's estimated 400 mountain gorillas make up nearly half of the estimated remaining total of 880 mountain gorillas left in the wild. In recognition of this global significance, BINP was declared a UNESCO World Heritage Site in December 1994.

The populated areas outside of BINP are densely inhabited, with neighbouring districts having average population densities between 161 people per km^2 in Kanunugu District and 314 people per km^2 in Kisoro District (Uganda Bureau of Statistics, 2002). Kabale District, of specific focus in this assessment, has an average population density of 273 people per km^2 (Uganda Bureau of Statistics, 2002). The communities neighbouring BINP are dependent upon subsistence agriculture for their livelihood, complimented with production of cash crops including: tea, coffee and passion fruit, as well as timber production from private woodlots.

b. Roads, Development, and Biodiversity

Roads are a critical component in a country's national development. Roads – and road improvements – can generate a number of social benefits. In rural areas roads represent particularly important infrastructure by improving access to land, natural resources, markets and public services (Fleck et al., 2006; Jacoby, 2000). Newly accessible land can bring increased income from agriculture and natural resources. More readily accessible markets facilitate new opportunities for trade, increasing the availability of production inputs as well as reducing their costs, and easing access to larger markets for the sale of agricultural products. Improved links to towns and cities provide better access to public services including education and health care facilities (Fleck et al., 2006; Laurance and Balmford, 2013).

[2] *The other population being in the Virunga Massif at the intersection of the Democratic Republic of Congo, Rwanda, and Uganda.*

Although roads can deliver clear welfare benefits, their effective design and planning is critical to mitigating the potential negative impacts associated with their construction. Roads are a primary cause of deforestation, forest fragmentation and habitat modification (Alves, 2002; Cropper et al., 2001; Fearnside, 2005; Soares-Filho et al., 2004). This development transforms ecosystems, influencing hydrology, sedimentation, debris transportation as well as water, air, soil chemistry and pollution, and in turn the viability of local wildlife populations and provision of valuable ecosystem services (Amaranthus et al., 1985; Coats and Miller, 1981; Coffin, 2007; Hattinger, 1984; Hynson et al., 1982; Polak et al., 2014; Rood, 1984). Road impacts are particularly acute in pristine forested areas (Laurance and Balmford, 2013).

Roads change land use and patterns of resource exploitation, including hunting, in previously inaccessible areas. Wide asphalt roads divide animal home ranges, effectively decreasing available habitat and segmenting viable species gene pools. Heightened noise pollution disturbs animal behaviour creating avoidance features which further reduce home ranges (Leblond et al., 2013). Vehicle collisions have a significant and widespread effects on mortality rates, in which indiscriminate losses of healthy and weak individuals weakens a population's gene pool. Even minor roads show significant impacts on wildlife mortality (Polak et al., 2014). These impacts are highest for large species with low reproductive rates, large home ranges, as well as those species which require a variety of habitats (Kaphegyi et al., 2013; Polak et al., 2014; Vanthomme et al., 2013), such as the mountain gorilla. In those areas where roads already exist, road upgrades further exacerbate wildlife mortality rates as vehicle numbers and speeds increase.

Road construction is likely to have implications for BINP's gorilla population. Evidence suggests that the mountain gorilla population could be affected in two ways: 1) gorillas will actively avoid areas of high human activity; and 2) gorilla mortality from disease, poaching, and vehicle collisions will increase. Gorillas have demonstrated active avoidance and changes in habitat utilization due to human disturbance such as seismic and logging activities (Rabanal et al., 2010; Arnhem et al., 2008) and other types of anthropogenic disturbance (Etiendem et al, 2013; Imong et al., 2014). Even if these disturbances exist only for the short-term, their effects can lead to long-term behavioural changes and consequences (Arnhem et al., 2008). While habituated mountain gorillas exhibit a relatively high tolerance to human disturbance, it has been observed that they still avoid new phenomena or changes in their environment. Unhabituated mountain gorillas are highly wary of humans and human-disturbed areas and likely avoid roads altogether (Goldsmith et al., 2006). Within BINP itself, recent work has shown that the current murram road limits the occurrence and observation of a number of large mammal species (Olupot and Sheil, 2011).

c. Tourism in BINP and its significance to the Ugandan Economy

In 2012, nearly one million people visited Uganda, directly contributing 3.7% to Uganda's GDP (The World Bank, 2013). Of these, half spent at least one night in Uganda. Sixty-eight thousand one hundred were leisure tourists who visited with the goal of experiencing Uganda's natural places (The World Bank, 2013). The World Bank (2013) estimates leisure tourists' expenditure at US $176 per day, 30%-100% higher than that for other tourists. The higher average expenditure of this group makes them particularly valuable to Uganda. BINP attracted more than 18,000 tourists in 2012,[3] more than one quarter of all leisure tourists to Uganda. BINP is a major tourist attraction for Uganda. Tourists' desire to view and track the critically-endangered mountain gorillas is their primary motivation to visit the park.

Gorilla tourism, or "trekking" was opened in Uganda in 1993 and continues to date, playing a pivotal role in the resurgence and growth of the country's tourism industry. The existence of the gorillas in BINP, the opportunities to visit them, and tourists' willingness to pay for such visits provides the major financial foundation for the operation of Uganda's entire park system. According to the Uganda Wildlife Authority's (UWA) visitor records, the income that UWA generated from tourism in BINP between 2004 and 2012 is more than 61 billion Ugandan shillings,[4] equivalent to approximately 22.6 million USD (2012 exchange rate). In 2012, BINP's income generated over 50% of total UWA earnings from tourists' visits to all national parks in Uganda, of which 98.4% was generated from sale of gorilla permits.[4]

All money collected by UWA from BINP goes to Uganda's centralised treasury. From there, the funds are allocated according to the needs and priorities of all national parks in Uganda. In 2008 and in addition to the existing revenue sharing policy, the UWA initiated a levy (called the 'Gorilla Levy') of $5 per gorilla permit, which is shared with local communities and distributed to fund specific livelihood projects targeting marginalized people.

[3] *Bwindi Mgahinga Conservation Area (BMCA) records*
[4] *Uganda Wildlife Authority records*

Initially, authorities allowed visitation to the Mubare and Katendegyere[5] habituated gorilla groups only. In subsequent years, park managers authorized the viewing of additional habituated groups including: Habinyanja (1996), Rushegura (2002; a group split from Habinyanja), Nkuringo (2004), Bitukura (2006), Shongi (2006), Oruzogo (2010), Kahungye (2010), Mishaya[6] (2010; a group split from Shongi), Bweza (2012), and Busingye (2012; a group split from Kahungye). In addition, the Kyaguliro group was habituated in the early 1990s for research purposes and since 2012 has been visited by tourists during peak seasons. Gorilla viewing takes place in groups of no more than eight tourists and for only one hour per day. As of 2014, each permit costs US $600 per person and 29,200 permits are available annually for the 10 gorilla groups currently habituated for tourism.[4]

The number of tourists arriving in Bwindi has been growing steadily since the park opened to tourism in 1993, as shown in Figure 2.2. According to the visitor information collected by UWA, BINP has witnessed an average annual growth rate of 17.9% since opening in 1993.[4] In 2007 visitor numbers dropped, however recovery was rapid, and since 2009 visitation to gorilla groups has continued to increase at 17.3% on average per annum.[4]

In 2013, gorilla trekking within BINP was running at 70.1% capacity (up from 58.5% in 2012). However, capacity is highly dependent upon seasonality. Gorilla trekking during peak months now fluctuates near 100%; in response to this UWA has opened up a research group, Kyaguliro, to visitations during June and July. This saturation in demand also led let to an increase in permit price from $500 to $600, which became effective in January 2014. UWA has also occasionally offered promotional trekking rates in the low season (April, May, and November) to promote low-season visitation.

[5] Note: Katendegyere group is no longer a habituated mountain gorilla group, having decreased in numbers through to 1998 and moving their home range to include areas in Sarambwe Nature Reserve in DRC, continuous with Bwindi Impenetrable National Park.

[6] Note: Mishaya group, at the time of publication, is believed to have dispersed following the death of the silverback in February 2014 and is therefore no longer visited by tourists.

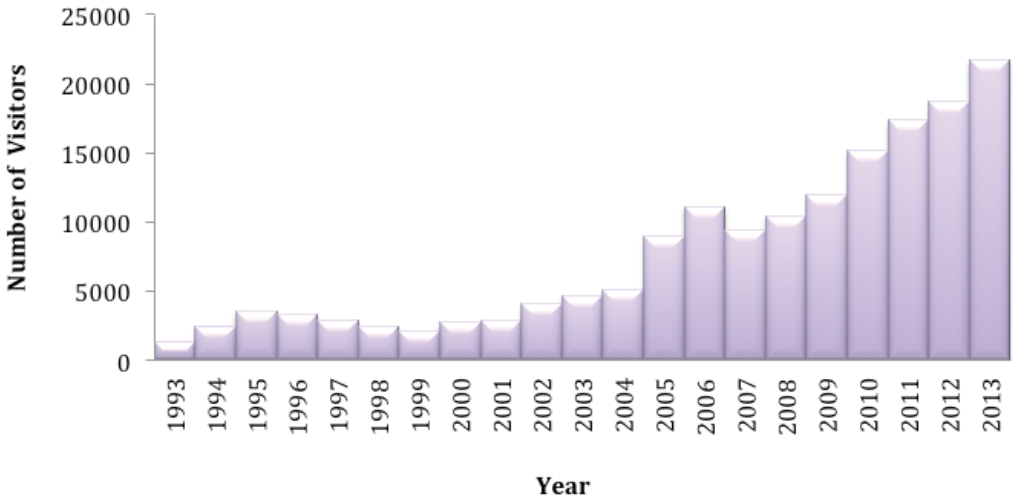


FIGURE 2.2 BINP Annual Visitation Statistics: 1993 - 2012[4]

d. The Ikumba – Ruhija road upgrade analysis

The "*Lot E.3: Hamurwa-Karere-Kanungu/Bulema-Buhoma-Butogota-Hamayanja-Ifasha-Ikumba*" road project (UNRA 2012)[7] proposes upgrading the current murram road that passes through BINP. The road upgrade was in part proposed to meet the needs of tourism in and around BINP. At the national level, the objectives of this investment in road improvement are:

1. To promote equal access to economic and social development opportunities across the country;
2. To improve the quality of the National Road Network and improve connectivity to all areas of the country; and
3. To promote the continual improvement of the National Road Sector in Uganda.

[7] *Publication included in Annex 1*

Specific objectives for the project that includes the Ikumba – Ruhija section are:

1. To improve the performance of the tourism sector by easing access to the tourist attractions in the region;
2. To improve access to goods/passenger transport services and reduce transport costs along the route;
3. To improve access to social and economic development opportunities along the route; and
4. To ensure no roadside communities become worse off as a result of the road upgrading works.

Since 2009, BINP has operated gorilla and nature-based tourism from four sites: Buhoma, Nkuringo, Rushaga/Rubuguli and Ruhija. The current access roads to the tourism sites around BINP are currently in very poor condition (Ruhija Tourism Plan 2009) leading to complaints by tourists and tour operators. One such section of road is the Ikumba – Ruhija – Buhoma road, which serves the Ruhija and Buhoma sites.

The proposed road for upgrading is the only road that passes through BINP and the only road that provides access to Ruhija. Additional roads provide access to the visitor sites in Buhoma (via Kanungu) and from Queen Elizabeth National Park.

The Ikumba – Ruhija – Buhoma road is currently a murram road (with some gravel patches), which can become impassable in the wet season; the proposed project would upgrade this road to Asphalt Concrete Standard. The current Ikumba – Ruhija road section passes through the park for approximately 12.8 km and forms the park boundary for another 12 km. The road further passes through the park for 3 km at the 'neck', also called the Kitahurira corridor,[8] and forms the park boundary for another 2 km.

[8] In order to avoid this 'neck' a much larger diversion would be necessary. Analysis of this diversion is beyond the scope of this paper. Although not discussed herein potential effects can be reduced within this area (which is also an important area for expansion) and should be considered within whichever road construction is decided upon.

In an effort to mitigate potential impacts on the gorillas and other biodiversity but still provide for the needs of people and the tourism industry, the IGCP and the Uganda Ug-PCLG have proposed, in consultation with local communities and engineers, two road alternatives which would reroute the Ikumba – Ruhija road section outside of BINP. Their alternative routes would connect a number of communities located on BINP's eastern borders. At present about 13,000 people in the area have no access to any roads.[9] Unlike the proposed upgrade through the park, the two potential alternative routes are currently undeveloped, except for a section from Ikumba to Kiyebe, and would require new construction.

Figure 2.3 shows the current road networks in and around BINP, including the current murram road between Ikumba, Ruhija, and Buhoma (in black), as well as the proposed alternatives in red.

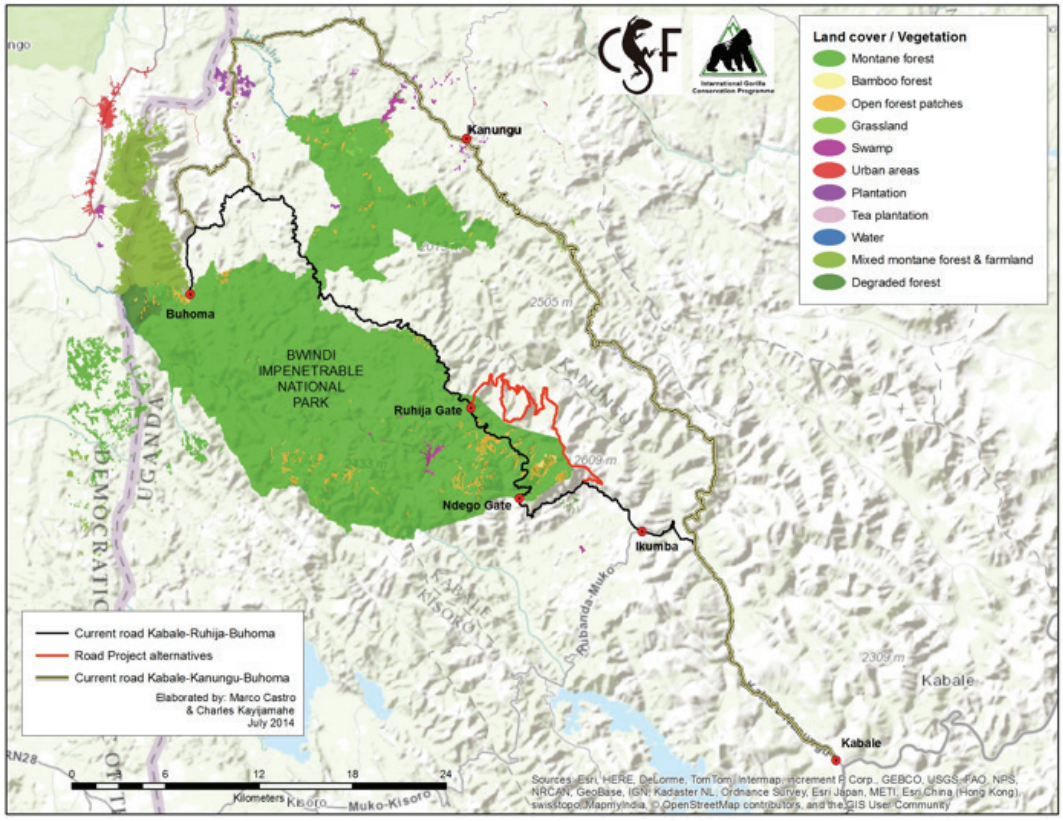
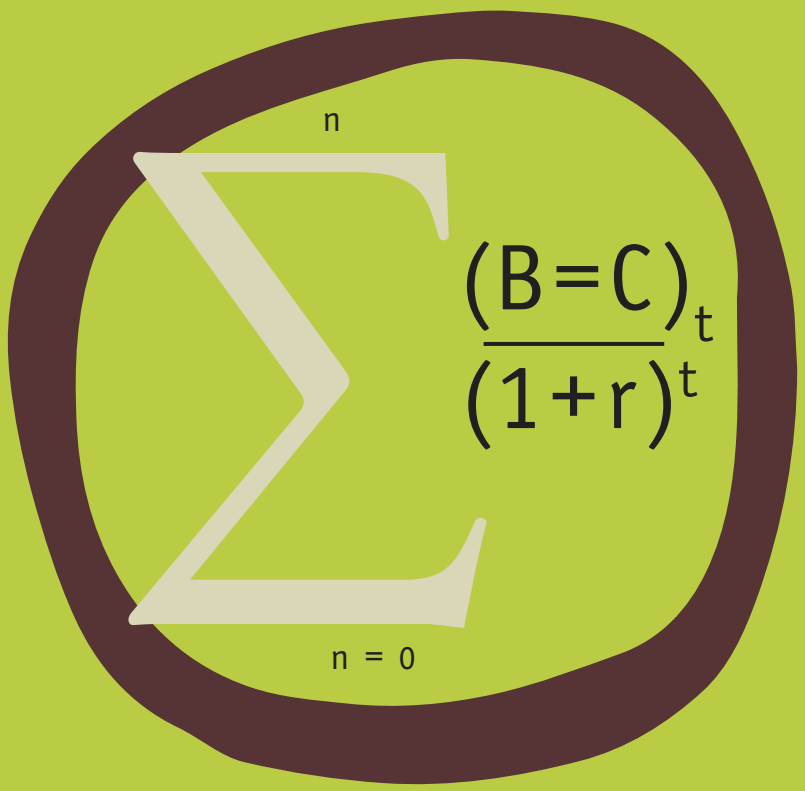


FIGURE 2.3 Current road access to Buhoma and Ruhija and proposed alternatives.

[9] *Figures from the Ruhija Sub Country Development Plan 2009-2014 and Ikumba Sub County Development Plan 2009-2014.*



Methods

We analyse three proposed road project alternatives which will connect the Ikumba – Ruhija section of the "*Hamurwa-Karere-Kanungu/Bulema-Buhoma-Butogota-Hamayanja-Ifasha-Ikumba*" road.

The purpose of the analysis is to identify which road option will have the greatest societal benefits. The analysis examines the project alternatives' impacts on society, using the whole country as the accounting entity and providing breakdowns of results where appropriate. The analysis also includes the evaluation of externalities, which are costs or benefits that affect third parties. Externalities are present in situations in which an individual or firm takes an action but does not bear all the costs (negative externality) or receive all the benefits (positive externality).

We used net present value (NPV) to define whether each alternative is economically feasible or not and to summarize the value of benefits or costs. NPV is the sum of the discounted values[10] of the expected positive and negative net returns over a project's anticipated lifetime. NPV[11] is a basic economic criterion that banks use for accepting or rejecting a project. In line with other Ugandan infrastructure project analyses, we used a 20-year lifetime and a 12% discount rate for this analysis.

Section 3.1 describes the characteristics of each project alternative. In the subsequent sections we describe the methods used to analyse the costs and benefits of project alternatives. Section 3.2 explains the RED methodology that was used to analyse the economic feasibility of the alternative road projects. In Sections 3.3 and 3.4 the methods used to analyse road project alternatives' socioeconomic implications for communities and tourism are described.

3.1 Roads Projects Analysed

The distance and routes of the road project alternatives analysed in this study are described in this section. Figure 3.1 shows a map of these alternatives and Table 3.1 summarizes the total distance and distance within BINP of each road alternative. All project alternatives under analysis have the same start and end point (labelled A and C in Figure 3.1).

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[10] *A reduced value of benefits to be received or costs to be incurred at some point in the future solely because they lie in the future is called a discounted value. Values are generally discounted by multiplying costs or benefits by a fractional number depending on how far in the future they occur. Costs or benefits occurring further in the future are usually discounted more heavily while those occurring closer to the present are usually discounted less heavily.*

[11] *Net Present Value (NPV) formula:*

$$NPV = \sum_{t=0}^{n} \frac{(\text{Benefits} - \text{Costs})_t}{(1+r)^t}$$

where:
r = discount rate
t = year
n = analytic horizon (in years)

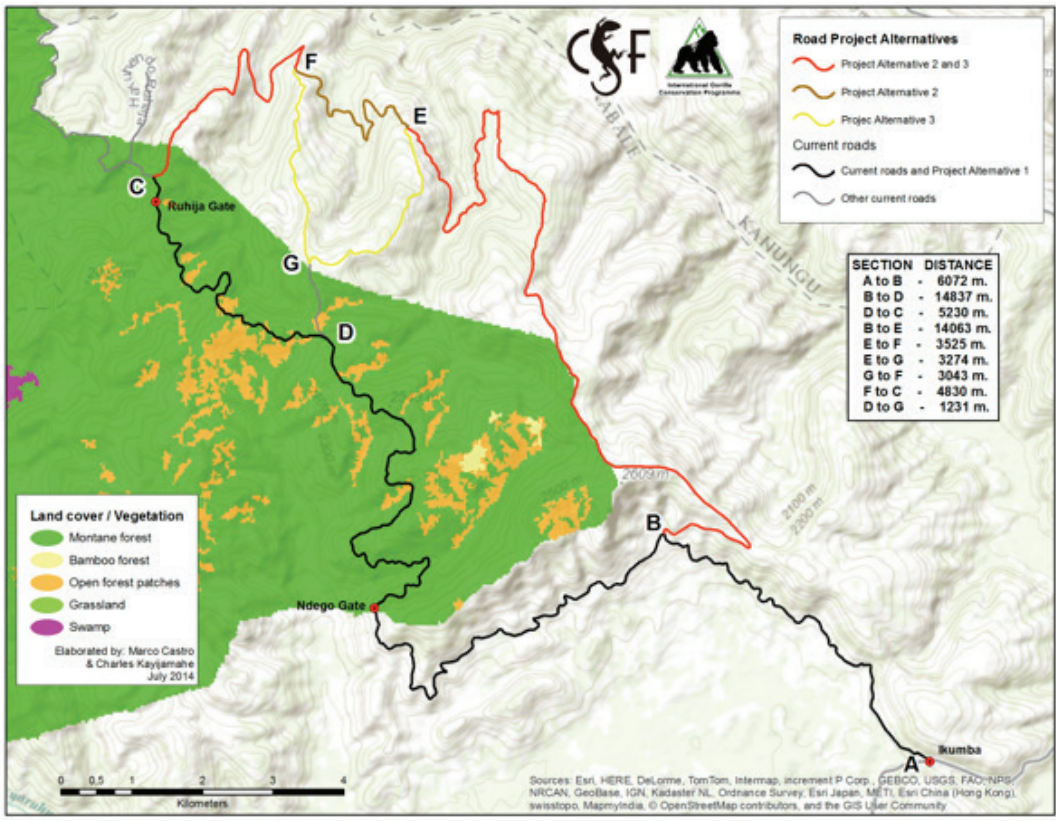

FIGURE 3.1 Road alternatives analysed in the CBA.

Project alternatives compared in the CBA are as follows:

Project Alternative 0: Without-project case

No change - keeping the current road connecting Ikumba and Ruhija (points ABDC in Figure 3.1) through BINP under the same maintenance scheme it has been under for the last 12 years, which requires mechanized maintenance of the murram road every fourth year.

Project Alternative 1: Upgrading current road

Project Alternative 1 consists of upgrading the existing road section that connects Ikumba and Ruhija (points ABDC in Figure 3.1) to asphalt concrete standard. This section of the road measures a total of 26.2 km. The distance within BINP from the Ndego gate to Ruhija (Point C) is 12.8 km; this section within the park passes neither through any community nor service; such as a hospital, school, etc. It is also important to note that according to communications with UNRA and its preliminary design analysis, in order to complete the upgrade, this road may have to be realigned, modifying its current path within the park.

Project Alternative 2: Building alternative road outside of park and through communities

Project Alternative 2 consists of upgrading the existing road between Ikumba to Kiyebe and building a new road between Kiyebe and Ruhija in asphalt concrete standard, through points ABEFC in Figure 3.1. Project Alternative 2 includes maintaining the roads between Kacwamuhoro Junction (Point B) through BINP's Ndego gate as well as the road between Point C and BINP's Ruhija gate in their current forms. The new road (ABEFC) would have a length of 28.5 km. Between these points it only enters the park for approximately 0.6 km where it joins near Ruhija gate. According to discussions with UNRA and its preliminary design analysis, the construction of this alternative road is possible with some minor route changes to the route to avoid steep gradients.

Project Alternative 3: Building alternative road outside of park and along ridge

Project Alternative 3 consists of upgrading the existing road between Ikumba to Kiyebe and building a new road between Kiyebe and Ruhija in asphalt concrete standard, through points ABEGFC in Figure 3.1. Project Alternative 3 includes maintaining the roads between Kacwamuhoro Junction (Point B) through BINP's Ndego gate as well as the road between Point C and BINP's Ruhija gate in their current forms. This new road ABEGFC would have a length of 31.3 km. Between these points it only enters the park for approximately 0.6 km. According to discussions with UNRA and its preliminary design analysis, this alternative would pose significant design and construction challenges due to the large amount of fill that would be required.

TABLE 3.1 Road Projects Characteristics

	Base Line Alternative 0: Current road	**Road Alternative 1:** Upgrading current road	**Road Alternative 2:** Building new road through communities	**Road Alternative 3:** Building new road along mountain ridge
Points in Map 3.1	ABC	ABC	ABEFC	ABEGFC
Total Road Length (km)	26.2	26.2	28.5	31.3
Road Length within the park (km)	12.8	12.8	0.6	0.6

3.2 Road Financial Feasibility

We use the World Bank's Roads Economic Decision Model (RED) to carry out the CBA of the different road alternatives prior to incorporating any environmental externalities. Road agencies around the world, including Uganda National Road Authority (UNRA), use this model to assess road projects performance in terms of saved transport costs in relation to road construction and maintenance costs.

The RED analysis assesses benefits of road projects adopting the consumer surplus approach, which measures the benefits to road users and consumers of reduced transport costs. According to RED's User Guide (Archondo-Callao 2004): "*this approach is preferred to producer surplus approach, which measures the value added or generated benefits to productive users in the project zone of influence, e.g. agricultural producers, since the consumer surplus approach was judged to allow for a better judgment of the assumptions made and an improved assessment of the investment alternatives simulated.*"

RED evaluates road investments and maintenance options customized to the characteristics of low-volume roads with traffic volumes between around 50 to 300 vehicles per day (Archondo-Callao, 2004). The model computes benefits accruing from different types of traffic, as a function of a reduction in vehicle operating and time costs, as well as safety benefits.

The RED software evaluates one road at a time and compares project alternatives against a without-project scenario, yielding the economic indicators needed to select the more desirable option and to quantify its economic benefits (Archondo-Callao, 2004). In this CBA, we evaluate each of the three project alternatives against the without-project case. To explore consistency of this analysis, we also used RED to analyse the longer Ikumba - Buhoma road system, of which Ikumba – Ruhija is a part.

3.2.1 RED cost data

The main project costs under analysis are those related to investment, maintenance, and compensation costs under the different project alternatives. A summary of these costs is provided in Annex 2.

Investment costs are those that relate to direct construction costs to be disbursed during project construction phase. For Project Alternative 1, per km investment costs is based on: the US$ 841 thousand Fort Portal Road[12] paving costs (UNRA, 2014), plus an additional per km cost of US$ 24 thousand in opening and graveling works (Kabale District, 2014). For Project Alternative 2 and 3, per km investment costs are based on: the same US$ 841 thousand Fort Portal Road construction costs, plus a higher US$ 52.4 thousand in opening and graveling works (Kabale District, 2014). For Project Alternative 0 (the Without Project case), investment cost was assumed to be zero, given that under the current scheme only mechanized maintenance is provided.

[12] *According to UNRA (2014) Fort Portal Road costs are the most current data the institution has on upgrading roads to concrete asphalt standards in mountainous regions in Uganda.*

Maintenances costs refer to those expenditures that finance maintenance throughout the life of the project. For Project Alternatives 1, 2 and 3, a per km maintenance cost of US$ 1.5 thousand per year is assumed based on UNRA standards for asphalt concrete roads. For Project Alternative 0 a per km maintenance cost of US$ 2.3 thousand per year is assumed based on current road maintenance scheme cost (Kabale District, 2014).

In line with standards used by UNRA for road project analyses, we use an agency economic cost factor of 0.85[13] for these costs. This factor effectively discounts investment and maintenance costs by 15%.

Other costs include the compensation of land to build new roads and additional maintenance costs to BINP gate entrance (these costs are incorporated into the results as fixed costs in addition to RED model costs). Per kilometre compensation costs are estimated based on those required under the *Resettlement Action Plan (RAP) of the Proposed Upgrading Kyenjojo – Hoima – Masindi – Kigumba.*[14] The plan calls for an average per kilometre cost of US $33.9 thousand. These compensation costs are only applied to Project Alternatives 2 and 3 between Kacwamuhoro junction and point C, as these sections are new and require land for their construction.

To account for the continuing maintenance of the current road within the implementation of Project Alternatives 2 & 3 to BINP's entrance (i.e. between the Kacwamuhoro junction and BINP's Ndego gate; between Point C and BINP's Ruhija gate) additional maintenance costs are also included in the analyses of Project Alternatives 2 and 3. These annual costs are assumed to be US$ 1.5 thousand per year, equal to current per kilometre maintenance costs of the current road in that section (Kabale District, 2014).

3.2.2 RED benefits data

The main project benefits analysed by the RED tool are the reduction of vehicle operating costs (VOC[15]) and time costs, which are computed from relationships relating VOC and speeds-to-road-roughness (IRI[16]). Benefits are calculated taking into consideration traffic projections and the following road characteristics: length, condition, geometry, terrain type, accidents, and days per year when the passage of vehicles is disrupted (e.g., wet season). Please refer to Annex 3 to see the specific characteristics of the road project alternatives under analysis.

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[13] Road agency economic costs factor is the ratio of economic road agency costs (net of taxes and subsidies) divided by financial road agency costs (market values)". In this case using an agency economic cost factor of 0.85 means that any of the costs assumed by the road agency will be multiplied by a factor of 0.85 (Archondo-Callao 2004)

[14] Air Water Earth LTD (2012)

[15] Vehicle Operating Costs (VOC) are the costs those incurred by road users and road service providers (e.g. road transport firms). The principle components of road vehicle operating costs are: fuel, lubricant oil, spare parts, maintenance (labour), tyres, depreciation, and crew costs (The World Bank, 2010).

[16] Roughness (IRI, m/km), as measured in deviations of a surface from a true planar surface, according to characteristics that affect vehicle dynamics, ride quality, dynamic loads and drainage. Standardized according to the International Roughness Index (IRI, m/km) unit. (The World Bank, 2010). IRI varies from 1 to 25, 1 being best quality of road and 25 worst.

3.2.3 Savings in vehicle operating costs (VOC)

The analysis is carried out using UNRA's standard vehicle fleet characteristics and RED standard relationships between vehicle operating costs and speeds-to-roughness as used by UNRA. Based on historical information provided by the Kabale District Engineer and road observations carried out by the analysis team, we assume an IRI of 13 during the dry season and 16 for the wet season for Project Alternative 0. For Project Alternatives 1, 2, and 3, we use the default IRI of 2 for asphalt concrete standard roads, as used by UNRA, both during dry and wet season. The basic inputs used within the analysis can be seen in Annex 4.

3.2.4 Time Savings

RED also computes benefits due to reductions in passengers' time, cargo holding time, and accident costs (Archondo-Callao 2004). Time-related benefits are based on passengers per vehicle type, the value of passengers' time, the value of the cargo holding time, and distance and average speeds. These are calculated and included in the model as per UNRA specifications. Please refer to Annex 5 to view passengers per vehicle type, the value of passengers' time, the value of the cargo holding time, and Annex 6 to view average vehicle speeds as estimated by the RED model according to road characteristics.

Safety-related benefits are computed based on average cost per accident and projected number of accidents for each project alternative. In this analysis we use UNRA default average costs of US $1,000 per accident and the UNRA default of 100 accidents per 100 million vehicle/km for earth roads and 200 accidents for asphalt concrete standard roads.

3.2.5 Traffic used to estimate VOC and Time Savings

Traffic information was collected and estimated for normal, generated, induced and diverted traffic, all of which are accounted for within the RED model. These types of traffic are further described below, but in general for normal traffic, RED estimates the reduction of transport costs based on savings generated by the road project alternatives in comparison to current road (Project Alternative 0). For generated and induced traffic, RED approximates the benefits by calculating one-half the reduction of transport costs for each unit of generated or induced traffic (Archondo-Callao 2004).

Normal traffic is considered traffic which passes along the road in the absence of any new investment (Archondo-Callao 2004). Normal traffic for the Ikumba – Ruhija was determined via a vehicle count carried between July and August 2013 at Ndego Gate. The average daily traffic estimated from this count is 36.4 vehicles. Annex 7 shows daily traffic per vehicle type. In accordance with reported annual traffic growth in Uganda (NTMP, 2008)[17] normal traffic is assumed to have an annual growth rate of 8% across the analysis period and for all vehicles except tourism vehicles. For tourism related vehicles ("Bus Light" in annex 7) we used a 16% annual growth rate for the period of 2014 – 2018, in accordance with the growth in BINP visitation figures. Annual growth rate for tourism-related vehicles for the rest of the time-frame considered in our analysis is 8%, given that the available number of gorilla permits limits maximum tourism growth in BINP after this period.

Generated traffic is associated with existing users of the road driving more frequently or further than before (Archondo-Callao 2004). RED defines generated traffic by inputting a price elasticity of demand - the percent increase in traffic per each percent decrease in transport costs. In this case, the price elasticity assumed was 1 (as is the UNRA default elasticity for road analysis); therefore, a 1% decrease in transport costs will result in a 1% increase in generated traffic. For generated traffic an annual growth rate of 8% was assumed.[17]

Induced traffic is traffic attracted to the project due to local economic development (Archondo-Callao 2004). In this analysis, induced traffic was estimated as a percentage of normal traffic. For all alternatives it was assumed that induced traffic would not become a factor until construction was finished (2017). For road Alternative 1, induced traffic was estimated at 50% of current normal traffic in 2017, and 100% of current normal traffic in 2018. From year 2019 and on, it was assumed that induced traffic would increase at an 8% rate per annum, using the induced traffic in 2018 (equal to current normal traffic) as a baseline for calculation. For Project Alternatives 2 and 3, induced traffic was estimated at 100% of current normal traffic for 2017 and at 200% of current normal traffic for 2018. This increase is due to the access that these alternatives provide to surrounding communities. Beginning in 2019, we assumed that induced traffic would also increase at 8% per annum, using the induced traffic in 2018 as a baseline. Refer to Annex 8 (Alternative 1) and Annex 9 (Alternative 2 and 3) for specific induced traffic numbers. In general, these estimations were based on the maximum traffic growth that could be expected and are probably an overestimation.

[17] Based on annual traffic growth reported in Uganda National Transport Master Plan (UNRA, 2008) for areas around Kampala since 2001 at about 8 % per annum.

Diverted traffic is traffic that diverts to the project road from an alternative road with the same origin and destination as the project (Archondo-Callao 2004). For the analysis of the Ikumba – Ruhija subsection we assumed no diverted traffic as there is no other road that connects Ikumba and Ruhija other than the subsection under analysis.[18]

In the absence of information on daily traffic during the wet season, we assume the same amount of users during the wet and the dry season for all vehicle types. This is probably an overestimation as the road is difficult and occasionally impassable during the wet season due to landslides or stranded vehicles. Based on information provided by the Kabale District Engineer, we assume 150 days of wet season.

3.3 Socioeconomic implications: communities served

Rural roads can have significant benefits for adjacent communities. These benefits are underrepresented within the RED model (Van de Walle, 2002).

Each road alternative will have different socio-economic benefits depending on the communities it serves. While the RED model estimates the benefits to society through reduced VOC and time reductions it does not take into account other local tangible benefits, such as improved access to social services. We therefore present data which considers the different local benefits associated with each road alternative. We focus on improved access to: health facilities, education, and markets.

The economic values of improved education and healthcare have long been cited as extremely important components in a country's local and regional development; their long-term benefits should not be overlooked. However, such socioeconomic values associated with improved infrastructure are difficult to predict, being both non-linear and influenced by multiple factors. It is therefore not our aim within this section to quantify the benefits associated with improved access for these communities. We do however present the current trends for each village and describe how these relate to current and future road scenarios. Where possible, we value time saved by communities accessing primary services based on current and alternative road scenarios as well.

[18] We also present the specific characteristics and results for the longer Ikumba - Buhoma road system in Annex 10 of which Ikumba – Ruhija is a part; these are consistent with the methods and results herein but it is beyond the scope of this report to discuss the implications of these findings.

Forty-nine villages from eight parishes have the potential to benefit from one or all of the proposed road projects between the Ikumbu and Ruhija junctions. Villages and their proximity to project alternatives are displayed in Figure 3.2. We do not consider the additional populations which will benefit from the road upgrade located outside of our study area (i.e. further north beyond Ruhija) as these villages will benefit from all alternatives similarly.

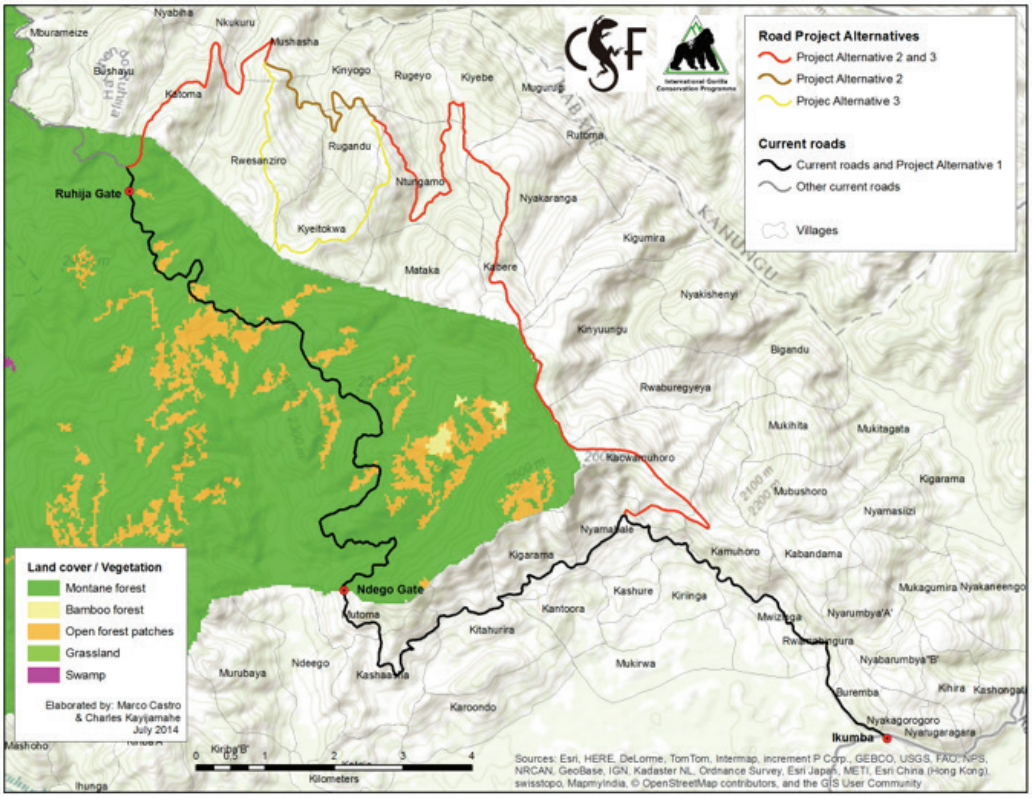

FIGURE 3.2 Location of villages related to the road alternatives between Ikumba–Ruhija

Populations that are served under the various project alternatives are projected based on the latest available census data (Uganda Bureau of Statistics, 2002). Villages located within 2 km of the proposed road alternatives are assumed to be served by that road option. Authors also recognize the localization of road accessibility due to the steep terrain.

In order to understand the current access difficulties and differences experienced by villages surrounding BINP, household questionnaires were carried out within a selection of villages over a two-week period between November 22 and December 4, 2013. Sixteen villages were randomly sampled for analysis, representing 20% of the villages within the study area. Villages were placed into one of three categories dependent upon their current access to roads: 1) villages currently transected by a murram road; 2) villages currently within 2 km of a murram road; and 3) villages currently at a distance greater than 2 km from a murram road. As reference information for the study, an additional three villages transected by a road were added to the sample. These villages are located within the Bujengwe parish, selected due to its similar cultural, social and environmental characteristics. The final number of villages sampled was 19. Sampled villages are listed in Table 3.4.

TABLE 3.4 Villages survey classified under their respective road class category

Road category 1 **Village transected by road**	**Road category 2** **Village within 2km from road**	**Road category 3** **Village over 2km from road**
Kachamohoro; Kigarama; Kinyungu; Kishanda; Mayanja; Ndego; Nyamabare; Nyamishamba; Rwamahingura	Kashure; Katojo; Kyetokwa; Mburameizi; Ntungamo; Rwesanziro	Bigandu; Kitale; Kyogo; Nyakishenyi

Eleven households were selected at random within each village, accounting for an average of 10% of the village households. Questions pertained to the personal experience of the respondent, except for questions pertaining to school, in which case respondents were asked to provide details for all members of their family considered to be residing within the household (including children currently boarding at school).

Based upon the profiles of each road category, we predicted the time savings associated with village access to healthcare and education under the various project alternatives. Time savings assumed travel times are improved from 5 km (average walking speed) to 30 km (average bus speed) per hour. Calculations and assumptions are described in more detail in the results section.

3.4 Socioeconomic implications: tourism costs and benefits

The road development plans have further implications for tourism that were not considered in the original upgrade plan, but were warned against in much of the existing road–wildlife literature (Fahrig and Rytwinski, 2009; Polak et al., 2014; Rhodes et al., 2014). As previously discussed, the mountain gorillas of Bwindi provide significant economic benefits to Uganda. Gorilla viewing tourism represents a major income-generating activity for the country. However, active avoidance behaviour of the critically endangered mountain gorilla could have serious and immediate consequences for tourism in BINP. Mountain gorillas are susceptible to human disturbance, including in terms of potentially reduced fecundity and overall viability of the population as a whole.

The area in the southeast corner of Bwindi currently that would be traversed by the proposed road upgrade in Alternative 1 has low gorilla density but a high-quality potential habitat for gorilla population expansion. Diverting the route outside of park would avoid fragmentation of this area, one of the last remaining viable habitats in to which the gorilla population can expand. We therefore examine the positive impact that diverting the road outside of the park could have in creating an improved environment for gorilla population growth in this area of Bwindi. In particular, we assess economic implications of an additional habituated group forming within this area, possible only if the current road upgrade is avoided.

Then, we examine the assumption that the proposed road development will negatively affect gorilla populations through changes in gorilla behaviour and/or mortality. We analyse the economic impacts under a scenario in which one group (the Bitukura) becomes unsuitable for tourist visitation due to active avoidance of road and road construction and modified ranging behaviour.

On the other side of the equation, we address the hypothesis that the proposed road upgrade will pay for itself through increasing tourism numbers. We analyse these propositions separately in Sections 3.4.1 Economic impact of road alternatives due to changes in gorilla habitat and behaviour and 3.4.2 Mitigating road costs via tourism revenues, respectively.

Given the need for a timely report and the large direct economic benefits received from current gorilla tourism, we study only benefits emerging from the direct use value of BINP's gorillas for the tourism sector. These values do not represent the total economic value of BINP as an intact ecosystem – that figure would be significantly higher. Nor do we seek to calculate the total economic value of the gorillas and biodiversity to Ugandans, tourists or a global population more generally. Accurate calculation of these values is beyond the scope of this report, although they would be substantial.

From BINP's own visitor data, gorilla visitation rates have been increasing at an average of 17.4% per annum since 2009. Uganda's overall leisure tourism, however, has increased at a much lower rate of only 3%.[19] This growth rate is included as an extremely conservative scenario. We also include a mid-range value of 10% as a more realistic conservative growth scenario. Using BINP's 2013 gorilla visitation figures, we therefore project future visitor numbers under three per annum growth rates: 3%, 10% and 17%.

For each analysis we examine three levels of economic impact:

1) Financial losses associated with permit revenues alone and their effects on revenue-sharing. This is the 'at least' scenario and represents the lowest bound of any economic effects presented within this document;

2) Changes in tourism spending in the BINP area. We consider permit fees plus additional spending visitors bring to the area from accommodation and meals, for example. We assume no leakage (that is, all spending is retained within Bwindi) which is likely to be a slight overestimate; however we consider this a reasonable allowance because we exclude all other environmental benefits from our economic valuation and the small-scale nature of the surrounding industries predicts a large proportion of income will be retained locally;

3) Wider implications on the Ugandan economy as a whole. BINP's mountain gorillas provide Uganda with a niche product which distinguishes it: Uganda provides both gorilla trekking and safari wildlife viewing. Therefore, one can assume that any effects on the gorilla population will have implications for the number of tourists visiting Uganda. Associated expenditures are calculated based on the average length of a leisure tourist visit (two-weeks); again we assume no leakage. We then calculate the implications for Ugandan society using a multiplier effect of 2.5.[20]

[19] *Figure taken from The World Bank (2012) Uganda Tourism Sector situational assessment. The World Bank Group, Washington DC.*

[20] *This multiplier effect represents the additional value of one tourism dollar spent within the country to Uganda's economy through knock-on effects such as spending by those employed in tourism industry and supplies purchased by hotels, etc. (The World Bank, 2013).*

Unless otherwise stated, each model is based on the following assumptions:

- Baseline 2013 visitor population of 20,479[21]
- Permit price constant at $600[22]
- Permit price rises to $750 after permits become saturated
- 10 active habituated gorilla groups
- 1 additional gorilla group available for viewing in July and August (research group)
- Each gorilla permit is bought by new visitor to Bwindi
- 12% discount rate (in accordance with UNRA's RED analysis standards)
- NPV calculated based on a 20 year project timeline (in accordance with RED analysis standards)
- Each tourist spends 2.17 days in Bwindi[23]
- Each tourist spends 14 days in Uganda[19]
- Each gorilla tourist is considered a leisure tourist[24]
- Daily spending of US $176 by leisure tourists[19]
- Zero leakage from Bwindi and Uganda (i.e., spending by leisure tourists remains in area. This is likely to be a slight over-representation as some spending will be captured by actors from outside of the area)
- Multiplier effect of 2.5[20]

3.4.1 Economic impact of road alternatives due to changes in gorilla habitat and behaviour

At present two habituated gorilla groups, the Bitukura and the Kyaguriro research group, have home ranges intersected by the current road in the south east of BINP. These groups are accessed from this road by park staff, researchers and tourists.[3] This area is also known to be used by unhabituated gorillas. The home ranges for habituated gorilla groups and locations of unhabituated gorillas located during the 2011 census can be seen in Figure 3.3.

[21] UWA, 2013 BMCA records

[22] http://www.ugandawildlife.org/images/pdfs/Tariffs-2014-2015.pdf

[23] Uganda Ministry of Tourism, Wildlife, and Antiquities (MTWA), pers comm. Feb 2014.

[24] 97% of interviewees from IGCP surveys (2013) were from overseas; 98.5% were non-Eastern African citizens from BINP figures (2009-2012).

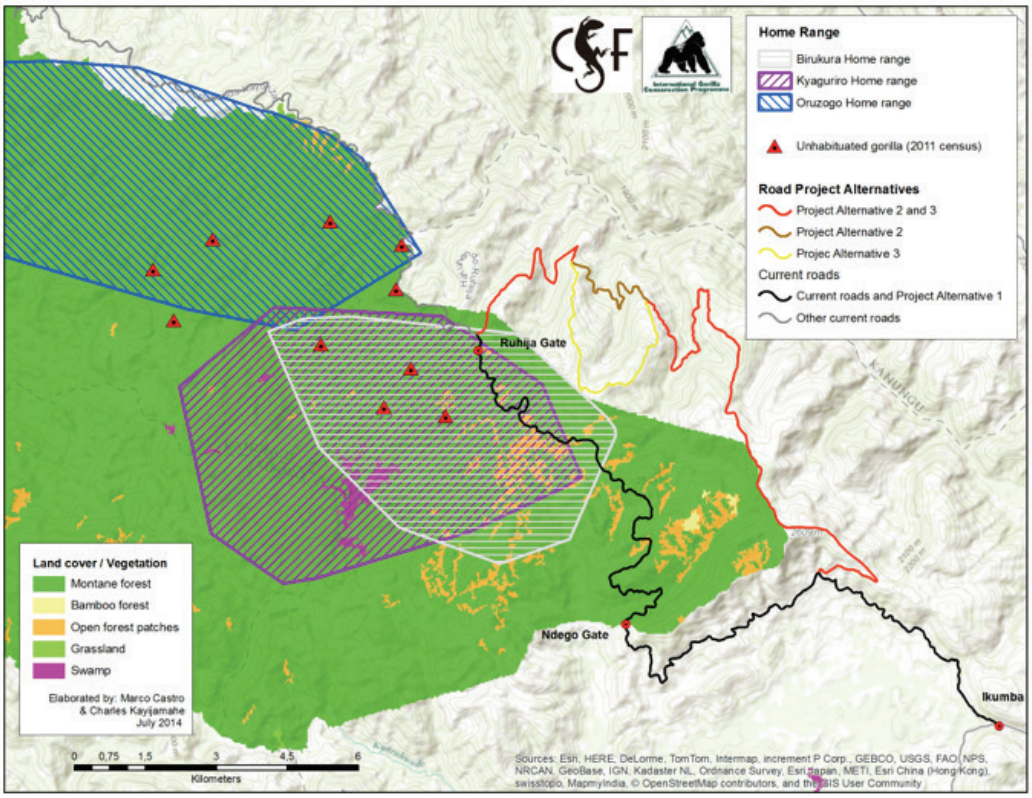

FIGURE 3.3 Gorilla home ranges for habituated gorillas along the proposed Ikumba – Rujiha upgrade (2007-2012) shown alongside proposed road developments. Red triangles also represent location of unhabituated gorillas during the routine census of 2011.

The construction of Project Alternative 1 is therefore likely to disrupt the home ranges of two of Bwindi's habituated gorilla groups, as well unhabituated gorilla populations. It is not possible to know exactly how the gorilla populations will react to the disturbances caused by the road and its construction, but from the literature on the topic, evidence suggests the following:

First, gorilla populations tend to avoid areas of high human activity. At the present time, the Bitukura and Kyaguriro groups are accessed from a starting trail along the existing jungle road. On average, trail trekking times are between 1.5 and 6 hours. Road development activities have the potential to push gorilla groups further away from these starting points, thus increasing trail trekking times and terrain difficulty. In the worst-case scenario, habituated groups may move too far for tourists to even access. The viability BINP's southeast corner as an area of growth is also affected by the presence of the present and upgraded road.

Second, gorilla mortality from disease, poaching, and vehicle collisions may increase. Increased traffic volume and speeds are likely to increase potential mortality from vehicle strikes. UWA records from 2012 and 2013 note that vehicle collisions killed a total of 35 animals, representing 12 species, including leopards, hyenas, and baboons.[4] Vehicle-related mortality can have dramatic effects on population dynamics as it results in the deaths of both weak and healthy individuals. Whereas all injury to the critically-endangered mountain gorilla is of great concern, possible injury and/or death to any silverback gorilla can result in the destabilization and possible dissolution of the entire group, with the remaining gorillas joining existing groups and/or branching out alone. Any road mortality will also likely increase the probability of road avoidance by group members in the future.

We analyse two possible scenarios and their potential to influence and disrupt tourism revenue due to changes in gorilla behaviour and/or mortality. One scenario addresses the possible addition of one new habituated group to BINP if road construction avoids BINP's southeast corner. In the other scenario, one gorilla group – the Bitukura – is lost due to the road upgrade through the park. Further detail on these scenarios is as follows:

3.4.1.1 Economic effects of road alternatives associated with habitat viability for gorilla population expansion

The growth of BINP's gorilla population and future increase in habituated groups depends on the preservation of intact viable habitat. The area of BINP, east of the current road in the southeast, is approximately 11.5 km^2 or 3.5% of the area of the park and represents an area of the park available for the growing gorilla population to expand into. Mountain gorillas have a low level of feeding competition, which enables the same habitat area to be used by multiple groups. Expansion of utilized habitat in a growing population of mountain gorillas has been documented in the Virunga Massif. This population demonstrated a 75% increase in the range area of a subset of the population, and experienced a 50% growth in population and a threefold increase in the number of groups over the same time period (Caillaud et al., 2014). Further, similar behaviour has been observed in the Bwindi population of mountain gorillas; routinely collected ranger-based monitoring data and population censuses have shown that in recent years, gorilla groups have expanded into entirely new areas most notably the Kitahurira corridor area and the southeast corner of Bwindi.

Under this scenario, we explore potential revenues associated with the formation of a new habituated gorilla group in this area: either a new group that has split from a currently habituated group or the formation or relocation of a group of non-habituated gorillas that becomes suitable for habituation.

The future revenues from gorilla tourism under this scenario are calculated as the difference between the status quo (10 groups open for visitation including the research group for 2 months of the year) and the status quo plus the addition of one viable gorilla group for visitation in 2020 (i.e., 11 groups year round). For Project Alternatives 2 and 3, the calculation is made assuming the formation of a group viable for visitation in 2020. For Alternative 1, this calculation is made assuming no new group becomes viable for visitation in 2020.

Visitor numbers are projected from 2013 BINP figures under the three defined growth rates, and annual visitor numbers are calculated on a monthly basis to account for seasonality, whereby visitors are unable to substitute across months. Visitation rates vary throughout the year, with much higher visitation rates during February, July, and September. July and September are well-known peak travel times due to global factors such as school holidays. These months also fall within the dry season in BINP, which provides more favourable trekking conditions. February is also the start/mid-point of the second dry season. We have therefore estimated visitor numbers on a monthly basis from which we calculated annual numbers, i.e. once peak months reach maximum capacity, no more tourism is possible for these months. We assume no substitution of visitor numbers across months, as this would overestimate the potential number of tourists able to visit under both the status quo and projected scenarios. Annual visitor numbers are a summation of monthly figures.

A visitation permit price is $600 (price as of January 2014), until maximum capacity is reached after which permit prices is assumed to rise to $750 (based on the response to saturation in the past both within BINP and neighbouring Rwandan gorilla sites). The rise in permit price is calculated as relevant for both the status quo and the 'lost group' scenario.

3.4.1.2 Economic effects of roads associated with loss of one habituated gorilla group

Under this scenario, we explore the implications of the loss of one gorilla group. These changes could include the group ranging too far to be viable for tourism, or group dissolution due to disturbance.

The status quo is modeled as in the previous section and contrasted with a model in which the potential permits (hence visitor numbers) are decreased to account for the loss of one habituated group. The loss of the habituated group for visitation is assumed to occur at the initiation of road construction (2017).

3.4.2 Mitigating road costs via tourism revenues

If roads are the limiting factor of gorilla tourism in the area, tourism would be expected to increase due to the road investment. However, accurately forecasting the changes in tourism attributable directly to improvement in access is difficult. Instead, we look at the degree to which tourism must increase in order to compensate society for the costs of road construction under each alternative. If road development is to be economically viable, one should expect that increased tourist revenues would – at least for the greater part[25] – cover these expenses. The increase needed is projected against current trends of growth in the region. We refer to this additional growth in tourism above and beyond predicted tourism growth under current growth trends as 'induced tourism' from here onwards. The required level of induced tourism is calculated based on the tourist numbers projected under the previously described growth rates.

We first model visitation numbers over the next 20-year time period under a no-project scenario (Alternative 0). Assuming the majority of tourists visit BINP to view the gorillas, visitor numbers are limited by available permits. The number of tourists visiting BINP will equal that predicted by the trend data only up to the point where permits become exhausted; that is, gorilla trekking is at full capacity, at which point visitor numbers will equal available permits.

If road construction is completed on schedule, the upgraded or new road between Ikumba Junction and Ruhija will provide access as of 2017. At this point the presence of the new road can improve tourism experience and favour the choice to visit BINP. Induced tourism is therefore set to start from 2017 within the model. This is an optimistic scenario as most road projects over-run their projected timeline and it is likely that the benefits of the road for tourism would take a couple of years to take effect based on the time needed for information to be widely available to tourists. Induced tourism is considered for all road improvement scenarios, including the proposed upgrade of the existing road, and potential alternatives outside of the park.

We assume no changes in tourism behaviour during construction phase. However, it is possible that the disturbance to the access road could deter visitors and lead to a decrease in numbers. We also ignore the possibility that tourists show opposition to any infrastructure development within a designated UNESCO World Heritage Site (in particular that they do not choose to visit the gorillas elsewhere), as well as the potential decrease in scenic quality and wildlife sightings, which could negatively affect tourism and cause further economic losses (USAID 2003 in Brunger 2003).

We examine the required induced growth from road construction at the three economic impact levels described above. Results are presented in the next section.

[25] It is anticipated that some benefits will be transferred to communities by the alternative 0 development but these under the justification of the tourism sector as a beneficiary.

Results

4.1 RED Analysis of the three alternatives

Results of the CBA calculated using the RED model (i.e., benefits in terms of users' and consumers' reduced transport costs, no information on other social or environmental impacts) indicate that all three proposed Project Alternatives have a negative NPV. In other words, discounted returns are less than costs in all cases (Table 4.1). We present a breakdown of the costs and benefits in Annex 11. In Annex 12, we present the specific characteristics and results for the longer Ikumba - Buhoma road system, of which Ikumba – Ruhija is a part. These are consistent with the results for Ikumba – Ruhija, but it is beyond the scope of this report to discuss further implications.

TABLE 4.1 Summary Preliminary Results from the RED model

	Project Alternative 1: Upgrading current road (US$ million)	**Project Alternative 2:** Building new road through communities (US$ million)	**Project Alternative 3:** Building new road along mountain ridge (US$ million)
Points in Map 1	**ABC**	**ADEC**	**ADFEC**
NPV without consideration of effects on habitat degradation and other social impacts	-13.7	-16.7	-18.4

Without the incorporation of non-consumer social and environmental impacts, Project Alternative 1 presents the lowest cost to society with a NPV of US $-13.7 million. Project Alternative 2, which circumvents the park and passes through the communities, has the next lowest cost to society at US $-16.7 million. Project Alternative 3, which circumvents the park and passes along the mountain ridge between Ikumba and Ruhija, has the highest cost to society at US $-18.4 million, US $4.7 million greater than Project Alternative 1. The higher costs associated with Project Alternatives 2 and 3 are mainly due to higher costs related to building new roads versus improving existing ones, and the greater length of Project Alternative 3. Actual NPV values for the three alternatives may vary slightly once detailed engineering is designed.

In order to further facilitate access to surrounding communities and to the southern entrance of BINP, as serviced within Project Alternative 1's design, Project Alternatives 2 and 3 could additionally incorporate the upgrading of the current road from the Kacwamuhoro Junction until Mukiyorere or the entire road section until Ndego Gate to asphalt concrete standard; this would add an additional US $-2.0 million or US $-4.5 million to their reported NPVs, respectively.

4.2 Access to Services

Due to numerous and confounding determinants, quantifying the monetary value of improved access to services is a complex, imperfect, and evolving science. We therefore attempt no causal calculations. Instead, based on the clear link between roads and time savings associated with travel, we calculate the approximate value of time saved as an indicator of benefits. We do this for several major areas of benefit described as significant within the road literature. It should be noted that this time saved is a large underrepresentation of the additional socioeconomic benefits which might accrue from improved access and should be viewed as an 'at least' value. We provide some discussion of the further values that could be expected as well.

4.2.1 Populations to be served

Currently about 170,000 people live in the 18 parishes surrounding BINP. The communities to the east have limited access options. Those villages located between the Kacwamuhoro Junction and Ruhija currently have no access road at all, and must on average travel between 18 to 69 km to reach the nearest town, Kabale. Kabale offers secondary schools and the only hospital facility. The existing murram road under analysis is primarily used for tourists to access BINP but also currently connects four parishes south of BINP to the Ikumba junction and Kabale.

Villages and populations served under the various project alternatives are presented in Table 4.2. Project Alternatives 2 and 3 will serve about 40 villages along the Ikumbu – Ruhija stretch, almost double the 22 villages served under the current plan (Project Alternative 1). Project Alternatives 2 and 3 therefore provide improved access for an additional 5,907 people compared to Project Alternative 1. Italicised villages in Table 4.2 are villages which are currently not served by any road and would benefit from the entirely new access route provided by Project Alternatives 2 and 3.

It is worth noting that the current RED NPV calculations for Project Alternatives 2 and 3 include continued maintenance costs associated with the current stretch of road extending from the Ikumba junction to Ndego gate; hence those villages south of the park will not lose access to Kabale and surrounding areas under these project alternatives. They would however forgo those benefits associated with the upgrade to asphalt such as improvements associated with increased vehicle access. Paving the additional road section from Kacwamuhoro Junction to Mukiyorere (at an additional cost of US $2.0 million) would increase the population served by the asphalt road to around 25,000 individuals – an additional 12,000 people more than the originally proposed Project Alternative 1 upgrade.

TABLE 4.2 Villages and populations served by current murram road (status quo) and proposed project alternatives

Villages served	Parish	Estimated Population (2014)
Status Quo and Project Alternative 1		
Kitahurira, Karoondo, Kashasha, Katojo, Mutoma, Mawefuzo, Ndego	Kashasha	4684
Bisanyu	Kitojo	375
Mubushoro	Mushanje	641
Buremba, Kacwamuhoro, Kamuhoro, Kantoora, Kashure, Kigarama, Kiriinga, Mukirwa, Mwizinga, Nyamabale, Nyakagorogoro, Nyarugarara, Rwamahingura	Nyamabale	7367
Total Population Served under Project Alternative 1		**13,067**
Project Alternatives 2 and 3		
Bugongi, Buzanyiro, Nyabiha	Buhumuriro	1125
Kitaba, Inywero	Kashekyera	750
Bisanyu, Katooma, Mushasha, Nkukuru, Rwensanziro	Kitojo	1876
Kabare, Kiyebe, Mataka, Mugurante, Nyakaranga, Rutooma	Kiyebe	2251
Kigumira, Kinyuungu, Mubushoro, *Mukihita, Mukitagata, Nyakishenyi, Rwaburegyeya*	Mushanje	4487
Kashogati, Kinyogo, Kyetokwa, Ntugamo, Rugandu, Rugyeyo	Ntungamo	2251
Buremba, Kacwamuhoro, Kamuhoro, Kashure, Kiriinga, Mukirwa, Mwizinga, Nyamabale, Nyakagorogoro, Nyarugarara, Rwamahingura	Nyamabale	6234
Total Population Served under Project Alternatives 2 and 3		**18,974**
Total Population Served with additional paving under Project Alternatives 2 and 3		**24,792**

4.2.2 Access to healthcare

Physical access to healthcare has been shown to be a leading determinant to healthcare facility visitations and healthcare outcomes (Tanser et al., 2006). Increasing travel times and distances to healthcare centres have been demonstrated to negatively affect healthcare visitation rates in rural areas (Buor, 2003; Kowalewski et al., 2002; Stock, 1983; Tanser et al., 2006). For rural families, travel costs can represent a large proportion of hospital visit costs (Kowalewski et al., 2002).

As one might expect, surveys found that for villages surrounding BINP the average distance and cost of hospital visits was higher for those located further from the current road, as is seen in Table 4.3. The average number of household hospital visits made annually was also seen to be higher in those Road Category 1 villages, i.e., those villages currently traversed by a road.

TABLE 4.3 Hospital visitation profile across village categories

Village category	Average distance to hospital (km)	Average cost of travel to hospital (US$)	Average number of hospital visits per year
Road Category 1 Village transected by road	34.3	13.7	2.2
Road Category 2 Village within 2km from road	42.5	19.0	1.2
Road Category 3 Village over 2km from road	46.8	31.7	0.6

As can be seen from the table, the average visitation for those villages traversed by a road was higher than in those further away, 2.2 household visits per year vs. 1.2 and 0.6 for villages located within and further than 2 km from the current road network, respectively. A simple linear regression indicates that this correlation is still significant once both distance to the hospital and cost are controlled for ($t=-2.7$, $p<0.001$). Travel cost was also seen to be significantly correlated ($t=2.3$, $p<0.05$) with hospital visits whereas distance to hospital showed no such relationship.

Improving the health of a population should be an end-goal in its own right but is also associated with improved economic development. Improvements in healthcare lead to greater farm and business income, accessibility of higher education, and improvements in long-term investment decisions both at the household and country level (Bloom and Canning, 2008). Investment in children's health has been shown to be an effective mechanism by which to break the cycle of self-perpetuating poverty (Belli et al., 2005). Therefore any returns on improved access to health care will have profound implications – including economic – beyond those time savings demonstrated here. Decreasing the time to medical help will also directly decrease local mortality rates.

The construction of Project Alternative 2 or 3 will significantly improve access to health facilities for an additional 1206 households (some 5907 individuals), saving on average 6.5 hours per hospital visit (the difference between walking and motorised transport). Assuming two hospital visits per year per household, the current average of those villages with good road access (Road Category 1), access to motorised transport to healthcare facilities represents time savings of 7,885 hours a year. If we were to value this at the minimum wage for Ugandan labour (US $0.6) this represents a NPV of US $79,225 over the course of the project. It should be noted however that this calculation does not include any deductions based on travel costs such as bus fares. It is also assumed that households would be able to afford transport and/or have access to motorised and/or non-motorised vehicles.

With the additional paving of the Kacwamuhoro Junction – Mukiyorere, Project Alternatives 2 and 3 would improve access for approximately 25,000 people living in the areas to the south and east of BINP. This would represent, on average, time savings of 5.6 hours per healthcare facility visit, savings equal to US $333,504 over the lifetime of the project.

4.2.3 Access to education

The relationship between education and road access is also influenced by multiple factors. That said, data suggests a relationship between distance travelled to school and enrolment (Burde and Linden, 2009). A study of villages surrounding BINP by Plumptre et al. (2004) found a significant positive relationship between distance to primary and secondary education and the percentage of households with members attending primary or secondary school, respectively. Results collected for this analysis are in line with these findings.

The distribution of children of schooling age (ages 4 to 18) was consistent across all road categories, accounting for approximately 50% of the population. However, the percentage of those children attending school varied as can be seen in Table 4.4. Close to 90% of the children of school age currently attend school in those villages crossed by roads, but this number is closer to 75% in villages located away from the road. This result becomes more profound when examining only secondary school attendance, where almost 30% of children between 13 and 18 attend secondary school in Road Category 1 villages but less than 10% and 3% in Road Categories 2 and 3, respectively.

The reported education levels across the entire population show a similar pattern. As shown in Table 4.5, the number of individuals reporting to have attended secondary school is once again much higher in Road Category 1 villages. Likewise, the percentage of individuals who reported never having attended school at all is approximately 10% higher in those villages over 2 km from any access road. No obvious differences were seen when results were disaggregated by gender.

TABLE 4.4 Schooling profiles across village categories

Village category	Children of school age attending school (%)	13-18 year olds attending secondary school (%)	Adults having completed secondary school (%)
Road Category 1	87.0	27.8	12.5
Road Category 2	76.4	8.2	7.2
Road Category 3	76.3	3.1	7.1

TABLE 4.5 Reported education levels across village categories (having once attended or attending but not necessarily completed)

Village category	No education (%)	Primary (%)	Secondary (%)	Tertiary (%)
Road Category 1	11.6	69.1	15.7	3.6
Road Category 2	13.9	78.0	6.4	1.7
Road Category 3	20.1	75.3	4.0	0.6

Evidence from elsewhere suggests high returns on investment into education.The highest returns are generally seen for low and middle-income countries and have been estimated to be as high as 20% in sub-Saharan African countries (Psacharopoulos and Patrinos, 2004). These calculations also ignore the positive externalities associated with higher levels of education such as improvements in sexual health and reproduction, and reduced crime (Colclough et al., 2010).

At present, distance to school limits participation; under Project Alternatives 2 and 3 daily trips for those children east of BINP become more realistic; children would have previously needed to board. Assuming road access will enable more children to attend secondary schools located within Kabale and Rubanda, we estimate time savings associated with a daily round trip to the nearest secondary school facility. Enabling access to motorised transport for those villages located to the east of BINP would improve access for some additional 1046 children of school age. If improving access were to increase secondary school attendance to the current average of Road Category 1 villages (27.8%), an additional 291 children would attend secondary school. Taking the average distance to secondary school (18.4 km) time per round-trip visit is reduced from 7.4 hours to 1.2 hours. Over the course of a Ugandan school calendar of 236 days, this would represent some 420,154 hours over the course of one year. If school attendance were to grow to 100%, this number would be as high as 1,511,343 hours. If we were to value this time at the minimum wage for Ugandan labour (US $0.6)[26] this represents a NPV of US $2.5 million and US $9.1 million over the course of the project respectively.

4.2.4 Access to markets

Roads reduce input costs and increase access to markets through decreased transportation costs (Bryceson et al., 2008; Jacoby, 2000; Van de Walle, 2002). The lack of quality roads has been deemed as one, if not the major constraint to agricultural markets and, as a result, improvements in productivity and poverty alleviation (DeGrassi, 2005).

As can be seen in Table 4.6, households located within those villages transected by a road show a higher proportion of high-value crops, such as tea and Irish potatoes, as their primary crop, suggesting that market access in this context does provide economic opportunities related to agriculture.

[26] *For want of a more realistic value, time saved is valued in line with the minimum wage.*

TABLE 4.6 Primary source of household income broken down across road categories

	Households' primary income source (% of all households surveyed)							
	Tea	Irish potato	Beans	Passion fruit	Live stock	Other	Labour	No income
Road category 1	27.7	42.6	8.9			5.0	7.9	4.0
Road category 2		43.6	25.8	8.1	3.2	1.6		6.5
Road category 3	4.7	27.9	20.9	20.9		4.7	4.7	2.3

Given the dispersed nature of the smaller markets in and around the BINP villages, it was not possible to conclude the degree of time savings associated with the road construction projects; it is likely that the road will transect a few of these markets although not all. However, one possible benefit to smallholders of the road construction, as previously mentioned, will be the reduced cost of inputs as well as improved access to larger, more profitable markets.

More generally, tea and Irish potato are considered higher value crops. The growth of tea has been promoted as a high value buffer crop around BINP borders. Profitable cultivation, however, relies on good access from the farms to the processing plants in the surrounding areas (e.g. the Kanungu area). The results above clearly show tea cultivation as a more common primary income source by those households in villages crossed by a murram road. In other road categories fewer than 5% indicate growing tea as a primary income crop.

4.3 Implications for BINP Tourism

This section presents results on the economic costs of environmental impact on gorilla groups, considering in particular the impacts on tourism revenues. The full results can be seen in Annex 13. These are conservative values, which considerably underestimate the total economic value of BINP's habitat and gorilla population both locally and globally. The section also includes summary results combining environmental costs with standard road CBA costs from the RED model. We also include results related to the potential for increased tourism flows to pay for road costs.

4.3.1 Economic effects related to gorilla population expansion

Gorilla growth in BINP will ultimately be limited by the availability of habitat into which emerging gorilla groups can expand. As described in methods, we assume the formation of a new habituated gorilla group would only occur if the current expansion area experienced reduced traffic due to alternatives around the park. Therefore, additional revenues associated with this scenario are generated only under Project Alternatives 2 and 3. The NPVs of forgone revenues for Project Alternative 1 and the associated losses to neighbouring communities based on a US $5 levy from each permit that is allocated to these communities are presented in Table 4.7.

TABLE 4.7 NPV of forgone future revenues from new habituated gorilla group (losses shown as negative numbers).

	Growth scenario	NPV of forgone revenues associated with Project Alternative 1 *(US$ million)*	NPV of forgone revenues associated with Project Alternative 1 to local communities *(US$ thousand)*
Permit revenue	3	-2.4	-20.1
	10	-4.8	-45.6
	17	-4.9	-47.5
Total spending in Bwindi	3	-3.9	
	10	-8.3	
	17	-8.5	
Revenues to Uganda	3	-30.7	
	10	-68.2	
	17	-70.8	

Under the current tourism growth rate of 17%, Project Alternative 1 has the potential to cost UWA US $4.9 million (NPV) in forgone permit revenues from the non-formation of the additional gorilla group. This would lead to losses of US $47,500 in tourism levy fees distributed among local communities. Possible losses to the Ugandan economy could be as high as US $70.8 million over the course of the 20 years. Under Project Alternatives 2 and 3, Uganda would not incur these losses.

These figures are lower for the more conservative growth rates of 3% and 10% but still represent substantial additional losses compared with the road alternatives which circumvent BINP.

4.3.2 Economic effects of the loss of one habituated gorilla group

The loss of one habituated gorilla group due to road improvements will again only have a negative impact under Project Alternative 1, as this is the only road which has the potential to disturb current gorilla groups. The economic losses and NPV of the road alternatives associated with the loss of one habituated gorilla group are presented in Table 4.8. Detailed results can be seen in Annex 14.

TABLE 4.8 NPV associated with the loss of one habituated gorilla group under road Project Alternative 1

	Growth scenario	NPV of lost group revenues under Project Alternative 1 *(US$ million)*	NPV of lost group revenues under Project Alternative 1 to local communities *(US$ thousand)*
Permit revenue	3	-4.7	-38.9
	10	-7.8	-81.6
	17	-10.7	-94.6
Total spending in Bwindi	3	-7.6	
	10	-14.0	
	17	-18.0	
Revenues to Uganda	3	-59.6	
	10	-120.0	
	17	-143.4	

Under the current tourism growth rate of 17%, Project Alternative 1 has the potential to cost UWA US $10.7 million (NPV) in lost permit revenues over the 20 year lifetime of the project. This would lead to losses of US $94,600 in tourism levy fees distributed among local communities. Possible losses to the Ugandan economy could be as high as US $143.4 million over the course of the 20 years. Under Project Alternatives 2 and 3 these revenues losses would not be incurred.

Again these figures are lower for the more conservative growth rates of 3% and 10%, but still represent substantial additional costs compared with the road alternatives which circumvent BINP.

4.3.3 Combined results

Considering both potential changes in gorilla group behaviour together, the NPV of forgone revenues associated with Project Alternative 1 could be as high as US $15.7, 26.5 and 214.2 in terms of permit revenues, total spending in Bwindi and revenues to the Ugandan national economy, respectively. Full results are shown in Table 4.9.

TABLE 4.9 NPV of forgone revenues from one habituated gorilla group plus gorilla group loss.

	Growth scenario	NVP of forgone future revenues Project Alternative 1 *(US$ million)*	NVP of group lost revenue under Project Alternative 1 *(US$ million)*	NVP forgone & lost revenues under Project Alternative 1 *(US$ million)*
Permit revenue	3	-2.4	-4.7	-7.1
	10	-4.8	-7.8	-12.6
	17	-4.9	-10.7	-15.7
Total spending in Bwindi	3	-3.9	-7.6	-11.6
	10	-8.3	-14.0	-22.3
	17	-8.5	-18.0	-26.5
Revenue Uganda	3	-30.7	-59.6	-90.4
	10	-68.2	-120.0	-188.2
	17	-70.8	-143.4	-214.2

Combining these values with the results of the RED analysis suggests that the realised cost of Project Alternative 1 is likely much higher than that for Project Alternatives 2 and 3. Under a 17% growth rate, Project Alternative 1 could generate costs as high as US $227.9 million for Uganda's national economy. At the local level, tourism expenditure in Bwindi could experience a NPV loss of some US $26.5 million. In permit revenues, it would generate losses for UWA as high as US $15.7. Building Project Alternatives 2 and 3 would not incur these additional losses and their respective societal costs remain at US $16.7 and US $18.4 million respectively, in present value terms, only several million dollars higher than the cost of Alternative 1. The costs and benefits of each Project Alternative under the current growth rate are summarised in Table 4.10.

TABLE 4.10 Summary of costs and benefits of Project Alternatives under current growth scenario.

Growth scenario (rate)	Project Alternative	Costs and Benefits							
		Base route Without additional paving		*Base route With additional paving between* Kacwamuhoro Junction until Mukiyorere		*Tourism Revenue*			
		RED (US$million)	**Access to paved road** (people, thousands) {no access currently }	**RED** (US $million)	**Access to paved road** (people, thousands) {no access currently }	**Permits** (US $million)	**Community levy** (US $ thousand)	**Bwindi spending** (US $million)	**Uganda** (US $million)
17	1 (compared to no project)	-13.7	+13.1	-13.7	+13.1	-10.7	-94.6	-18.0	-143.4
	2 & 3 (compared to no project)	-16.7/-18.4	+19.0 {9.5}	-18.7/20.4	+24.8 {9.5}	+4.9	+47.5	+8.5	+70.8
Project Alternative 1 compared against Project Alternatives 2 & 3		**+2.9/4.7**	**-5.9**	**+5.0/6.7**	**-11.7**	**-15.7**	**-142.1**	**-26.5**	**-214.2**

4.3.4 Mitigating costs via tourism revenues

The road upgrade's primary function is to improve the tourist experience and increase tourism within the region; it follows then that this increase in tourism should be able to offset the costs to society of road construction.

The NPV of benefits associated with additional growth in tourism from 1% to 5% ('induced tourism') are presented in Table 4.11.[27] As can be seen, only under the most conservative background tourism growth scenario of 3% would any of the projects alternatives be able to recoup any of their costs via additional tourism growth induced by road improvements.

Under the more realistic growth scenarios of 10% and 17%, road-induced tourism would be unable to mitigate the costs of road construction no matter the level of tourism it can induce. This is because under these growth rates, tourism numbers will have increased beyond the maximum capacity of BINP before the construction of the new road; tourism will be limited by the available permits before the road would be able to entice new visitors in 2018.

TABLE 4.11 NPV from induced tourism under the various growth scenarios

	Growth rate	NPV of induced tourism (US $million)				
		Induced tourism growth				
		+1%	+2%	+3%	+4%	+5%
Permit revenue	3	7.7	13.6	17.4	20.8	24.1
	10	0.0	0.0	0.0	0.0	0.0
	17	0.0	0.0	0.0	0.0	0.0
Total spending in Bwindi	3	10.1	17.7	22.5	26.6	30.5
	10	0.0	0.0	0.0	0.0	0.0
	17	0.0	0.0	0.0	0.0	0.0
Revenue to Uganda	3	58.7	99.6	126. 5	146.7	163.3
	10	0.0	0.0	0.0	0.0	0.0
	17	0.0	0.0	0.0	0.0	0.0

After combining these results with the cost of road construction, Table 4.12 displays the NPVs of the cheapest road alternative (Project Alternative 1) for the various induced-tourism scenarios. Results for all project alternatives can be seen in Annex 15.

[27] *I.e. The 10% growth rate scenario refers to baseline growth rate modeled under a 'no improvement scenario'. Induced tourism in Table 3.11 refers to the addition of 1/2/3/4 or 5% to the baseline growth rate, e.g. 11/12/13/14 or 15%. Numbers displayed within the cells represent the difference in NPV for 'induced tourism growth rate and the 'no improvement scenario'.*

TABLE 4.12 NPV of Project Alternative 1 under various induced tourism scenarios

	Growth rate	NPV of Project Alternative 1 under induced tourism rates (US $million)				
		Induced tourism growth				
		+1%	+2%	+3%	+4%	+5%
Permit revenue	3	-6.0	-0.0	3.7	7.1	10.4
	10	-13.7	-13.7	-13.7	-13.7	-13.7
	17	-13.7	-13.7	-13.7	-13.7	-13.7
Total spending in Bwindi	3	-3.5	4.0	8.9	13.0	16.8
	10	-13.7	-13.7	-13.7	-13.7	-13.7
	17	-13.7	-13.7	-13.7	-13.7	-13.7
Revenue to Uganda	3	45.0	85.9	112.8	133.1	149.7
	10	-13.7	-13.7	-13.7	-13.7	-13.7
	17	-13.7	-13.7	-13.7	-13.7	-13.7

In order for Project Alternative 1 to recoup its costs from permit revenues alone it would need to induce at least a 2% growth in tourism over and above the 3% predicted in this conservative scenario- almost a doubling in tourism; the same is true when examining revenues to Bwindi. This value is smaller (less than 1%) when looking at the revenues to Uganda more broadly. We must keep in mind, however, that current growth to BINP is much higher than 3% (17%), that induced growth would be required to occur mostly within the off seasons, and that these results are based on the assumption that information about the road upgrade influences tourists' choices.

More importantly, only under this extremely conservative growth scenario is any recuperation of costs possible; under the more realistic conservative assumption of a 10% growth rate, induced tourism would fail to repay any of the road construction costs and the NPV of all road alternatives will remain negative. The same result is seen for the 17% historical growth rate, providing strong evidence that current road quality is not a limiting factor to tourism in BINP.

This study presents the potential economic costs and benefits associated with the proposed

Discussion & Conclusion

upgrade of the current road through BINP compared to two proposed alternative routes outside the park, with the aim of supporting the decision-making process. These alternatives outside the park were proposed to avoid impacts that are likely to negatively impact gorilla populations and therefore the Ugandan tourism economy, which is highly dependent upon the presence of this iconic species within BINP.

For all three road options, road maintenance and construction costs outweigh benefits generated from reduced transport costs (time, vehicle operation and maintenance costs). Therefore, without the incorporation of other social or environmental benefits and costs, all projects' net costs range from US $ -13.7 million to US $-18.4 million (in present value terms). Upgrading the current road through the park presents the lowest net cost with a NPV of US $-13.7 million.

However, social and environmental costs and benefits must be taken into account. Once these are included, even very conservatively, the road alternatives around the park appear to be more beneficial to society than paving the current road through the BINP. The additional construction costs, which range from US $2.9 to US $6.7 million, are almost insignificant when compared to potential losses that paving the current road through BINP could cause to the Ugandan economy. Limiting gorilla population growth and accessibility are projected to generate losses as high as US $15.7, US $26.5 and $214.2 million over the next 20 years (NPV) in lost UWA permit revenues, impacts on spending in Bwindi and impacts on the greater Ugandan economy, respectively. In addition, route alternatives around the park would serve an additional population of 6,000 to 12,000 people, giving access to 9,500 people currently with no road access, and improving local communities' access to health care, education and markets.

Results of the analysis also call into question the assumptions on which the road upgrade was based. The road upgrade (Project Alternative 1) was initially requested as a means to increase tourism revenues to Uganda, with a lack of decent infrastructure being cited as one of the main limitations to BINP's visitation numbers. Yet the reality presents a different picture. Visitor growth to BINP has been increasing at an average of 18% since it was opened in 1993; gorilla trekking has continued to be the main source of tourism to BINP and rates have continued to grow at average of 17% since 2010. In 2013, over 20,000 people visited BINP's gorillas, up from around 18,000 in the previous year. BINP's growth rate is many times higher than that for overall leisure tourism in Uganda (3%) and while larger improvements in Uganda's infrastructure are likely to prove positive for Uganda's tourism sector, the evidence suggests that BINP's visitation numbers and its associated tourism revenues are independent of this. The Ikumba – Ruhija road upgrade will have minimal effect in attracting additional tourists to the area, and under current growth rates any increase in road-induced tourism is unlikely to be able to offset construction costs.

At the current growth rate, BINP will reach its maximum gorilla tourist capacity by 2016, or 2017 under the more conservative rate of 10%, the same year the road is expected to be

operational. Therefore, given that the most important factor limiting tourism growth in Bwindi is the number of gorilla groups that can be visited, we recommend that any investment related to increasing the number of visitors to BINP focuses on guaranteeing the viability of the current gorilla population and its potential to grow.

While beyond the scope of the present analysis, this focus also has implications for the design of the road through the Kitahurira corridor (BINP's 'neck'), which provides access to at least one gorilla group. While it is unlikely that this section of road will be bypassed without a significant road construction, measures can be taken to reduce road impacts. Leaving this 3 km section of road unpaved would continue to facilitate gorilla crossing between the north and south of BINP and reduce vehicle-related mortality. Large economic benefits could be realised from relatively low-impact mitigation instruments due to the short nature of the road though this section. For example - as previously demonstrated with regards to the lower section of road - if a new group were to form in 2020 in the northern block, this would result in an additional US$ 4.9 million in permit revenues for UWA over the 20 years, or some US$ 70.8 million to the Ugandan economy if these represented new leisure tourists visiting Uganda.

While we believe results are robust, some caveats should be made explicit. The purpose of this report was to inform the decision-making process around the construction of three road alternatives connecting Ikumba and Ruhija. All efforts were made to use information as per local conditions and according to UNRA figures and standards; nevertheless, the construction costs assumed for all road project alternatives can change once more detailed construction plans are designed. Environmental and social costs and benefits described within this document represent what we believe to be the most pertinent, but represent a conservative value. For example, we focused on the primary risk of the road to tourism and have not valued the more extensive environmental impacts and costs associated with the widening of any road construction. We have assumed no leakage from Uganda associated with visitor expenditure; we feel this is justified as no other environmental impacts are valued. The socioeconomic benefits associated with the road alternatives which bypass the park and connect the communities are also not calculated in a comprehensive way in this analysis – their mention was indicative only. Benefits are likely to be much higher than we note, as farm and household income has long been shown to be correlated with education and health; improved access to larger markets will likely change productivity and crop choice.

This report highlights the need for a further discussion around the construction of the Ikumba –

Ruhija road section based upon its primary objectives as laid out in in the introduction of this document. The Ikumba – Ruhija road project aims improve the performance of the tourism sector by easing access to the tourist attractions in the region; to improve access to goods/ passenger transport services, and reduce transport costs along the route access to social and economic development opportunities along the route; while ensuring no roadside communities become worse off as a result of the road upgrading works. The results from the analyses conducted demonstrate that these objectives are more effectively met by the alternative road projects that circumvent the park. Further work is therefore recommended on the design of specific alternatives around the park.

References

Air Water Earth LTD, 2012. Resettlement Action Plan (RAP) of Proposed Upgrading of Kigumba--Masindi-Hoima- Kabwoya Road to Bituminous Standards. Prepared for Ugandan National Road Authority. Available at: http://www.afdb.org/fileadmin/uploads/afdb/Documents/Environmental-and-Social-Assessments/Uganda%20-%20Resettlement%20action%20plan%20(RAP)%20of%20proposed%20upgrading%20of%20Kigumba-Masindi-Hoima--Kabwoya%20road%20to%20bituminous%20standards%20-%20RAP%20Summary.pdf

Alves, D.S., 2002. Space-time dynamics of deforestation in Brazilian Amazonia. Int. J. Remote Sens. 23, 2903–2908.

Amaranthus, M.P., Rice, R.M., Barr, N.R., Ziemer, R.R., 1985. Logging and forest roads related to increased debris slides in southwestern Oregon. J. For. 83, 229–233.

Archondo-Callao, R. 2004. Sub-Saharan Africa Transport Policy Program SSATP Working Paper No. 78. Roads Economic Decision Model. Software User Guide & Case Studies. African Region. The World Bank.

Arnhem, E., Dupain, J., Vercauteren Drubbel, R., Devos, C., and Vercauteren, M., 2008. Selective logging, habitat quality and home range use by sympatric gorillas and chimpanzees: a case study from an active logging concession in Southeast Cameroon. *Folia Primatol* 79,1-14.

Belli, P.C., Bustreo, F., Preker, A., 2005. Investing in children's health: what are the economic benefits? Bull. World Health Organ. 83, 777–784.

Bloom, D.E., Canning, D., 2008. Population health and economic growth. Health Growth 53.

Bryceson, D.F., Bradbury, A., Bradbury, T., 2008. Roads to poverty reduction? Exploring rural roads' impact on mobility in Africa and Asia. Dev. Policy Rev. 26, 459–482.

Buor, D., 2003. Analysing the primacy of distance in the utilization of health services in the Ahafo--Ano South district, Ghana. Int. J. Health Plann. Manage. 18, 293–311. doi:10.1002/hpm.729

Burde, D., Linden, L.L., 2009. The Effect of Proximity on School Enrollment: Evidence from a randomized controlled trial in Afghanistan. N. Y. Univ. Steinhardt Columbia Univ. IZA BREAD.

Caillaud, D., Ndagijimana, F., Giarrusso, A.J., Vecellio, V., and Stoinski, T.S., 2014. Mountain gorilla ranging patters: Influence of group size and group dynamics. American Journal of Primatology.

Coats, R.N., Miller, T.O., 1981. Cumulative silvicultural impacts on watersheds: a hydrologic and regulatory dilemma. Environ. Manage. 5, 147–160.

Coffin, A.W., 2007. From roadkill to road ecology: A review of the ecological effects of roads. J. Transp. Geogr. 15, 396–406. doi:10.1016/j.jtrangeo.2006.11.006

Colclough, C., Kingdon, G., Patrinos, H., 2010. The Changing Pattern of Wage Returns to Education and its Implications. Dev. Policy Rev. 28, 733–747. doi:10.1111/j.1467-7679.2010.00507.x

Cropper, M., Puri, J., Griffiths, C., 2001. Predicting the Location of Deforestation: The Role of Roads and Protected Areas in North Thailand. Land Econ. 77, 172–186. doi:10.3368/le.77.2.172

DeGrassi, A., 2005. Transport, poverty and agrarian change in Africa: models, mechanisms and new ways forward. IDS Bull. 36, 52–57.

Etiendem, D.N., Funwi-Gabga, N., Tagg, N., Hens, L., Indah, E.K., 2013. The Cross River gorillas (Gorilla gorilla diehli) at Mawambi Hills, south-west Cameroon: habitat suitability and vulnerability to anthropogenic disturbance. Folia Primatol. (Basel) 84, 18–31.

Fahrig, L., Rytwinski, T., 2009. Effects of roads on animal abundance: an empirical review and synthesis. Ecol. Soc. 14.

Fearnside, P.M., 2005. Deforestation in Brazilian Amazonia: History, Rates, and Consequences. Conserv. Biol. 19, 680–688. doi:10.1111/j.1523-1739.2005.00697.x

Fleck, L.C., Painter, L., Reid, J., Amend, M., 2006. A road through Madidi: a environmental-economic analysis, Technical Series. Conservation Strategy Fund.

Goldsmith, M.L., Glick, J. & Ngabirano, E., 2006. Gorillas living on the edge: literally and figuratively. In: Primates of Western Uganda (Eds N.E. Newton-Fisher, H. Notman, J.D. Paterson and V. Reynolds). Springer, New York, pp. 405–422.

Hattinger, H., 1984. Influence of forest roads on water runoff, sediment yield and landslides. Etude FAO Forets no. 33, 1982, (Heinrich R., editor), "Exploitation des forets de montagne".

Hynson, J., Adamus, P., Tibbetts, S., Darnell, R., 1982. Handbook for protection of fish and wildlife from construction of farm and forest roads; best management practices for building activities associated with the discharge of dredged or fill material. USDA Fish and Wildlife Service, Eastern Energy and Land Use Team, 1982, No. FWS/OBS-82/18.

Imong, I., Robbins, M.M., Mundry, R., Bergl, R., Kühl, H.S., 2014. Distinguishing ecological constraints from human activity in species range fragmentation: the case of Cross River gorillas. Anim. Conserv.

Jacoby, H.G., 2000. Access to Markets and the Benefits of Rural Roads. Econ. J. 110, 713–737. doi:10.1111/1468-0297.00562

Kabale District, 2014. Information Facilitated by District Engineer.

Kaphegyi, T.A.M., Dees, M., Zlatanova, D., Ueffing, C., Dutsov, A., Kaphegyi, U., 2013. Rapid assessment of linear transport infrastructure in relation to the impact on landscape continuity for large ranging mammals. Biodivers. Conserv. 22, 153–168. doi:10.1007/s10531-012-0409-9

Kowalewski, M., Mujinja, P., Jahn, A., 2002. Can Mothers Afford Maternal Health Care Costs? User Costs of Maternity Services in Rural Tanzania. Afr. J. Reprod. Health Rev. Afr. Santé Reprod. 6, 65–73. doi:10.2307/3583147

Laurance, W.F., Balmford, A., 2013. Land use: A global map for road building. Nature 495, 308–309. doi:10.1038/495308a

Leblond, M., Dussault, C., Ouellet, J. P., 2013. Avoidance of roads by large herbivores and its relation to disturbance intensity. J. Zool. 289, 32–40. doi:10.1111/j.1469-7998.2012.00959.x

Lebo, J., Schelling, D., 2001. Design and Appraisal of Rural Transport Infrastructure: Ensuring Basic Access for Rural Communities. World Bank Publications.

Mugerwa, B., Sheil, D., Ssekiranda, P., van Heist, M., and Ezuma, P. 2012. A camera trap assessment of terrestrial vertebrates in Bwindi Impenetrable National Park, Uganda. African Journal of Ecology.

Olupot, W., Sheil, D., 2011. A preliminary assessment of large mammal and bird use of different habitats in Bwindi Impenetrable National Park. Afr. J. Ecol. 49, 21–30.

Plumptre, A.., Kayitare, A., Rainer, H., Gray, M., Munanura, I., Barakabuye, N., Asuma, S., Sivha, M., Namara, A., 2004. The Socio-economic Status of People Living Near Protected Areas in the Central Albertine Rift, Albertine Rift Technical Reports.

Plumptre, A.J., Davenport, T.R.B., Behangana, M., Kityo, R., Eilu, G., Ssegawa, P., Ewango, C., Meirte, D., Kahindo, C., Herremans, M., Kerbis Peterhans, J., Pilgrim, J., Wilson, M., Languy, M. and Moyer, D., 2007. The Biodiversity of the Albertine Rift. *Biological Conservation* 134: 178-194.

Polak, T., Rhodes, J.R., Jones, D., Possingham, H.P., 2014. Optimal planning for mitigating the impacts of roads on wildlife. J. Appl. Ecol. 51, 726-734.

Psacharopoulos, G., Patrinos, H.A., 2004. Returns to investment in education: a further update. Educ. Econ. 12, 111–134.

Rabanal L. I., Kuehl, H. S., Mundry, R., Robbins, M. M., and Boesch, C., 2010. Oil prospecting and its impact on large rainforest mammals in Loango National Park, Gabon. *Biological Conservation* 143:1017–1024.

Rhodes, J.R., Lunney, D., Callaghan, J., McAlpine, C.A., 2014. A Few Large Roads or Many Small Ones? How to Accommodate Growth in Vehicle Numbers to Minimise Impacts on Wildlife. PLoS ONE 9, e91093. doi:10.1371/journal.pone.0091093

Rood, K., 1984. An aerial photograph inventory of the frequency and yield mass wasting on the Queen Charlotte Islands. Land Management Report. Ministry of Forests, British Columbia.

Soares-Filho, B., Alencar, A., Nepstad, D., Cerqueira, G., Vera Diaz, M. del C., Rivero, S., Solórzano, L., Voll, E., 2004. Simulating the response of land-cover changes to road paving and governance along a major Amazon highway: the Santarém–Cuiabá corridor. Glob. Change Biol. 10, 745–764. doi:10.1111/j.1529-8817.2003.00769.x

Stock, R., 1983. Distance and the utilization of health facilities in rural Nigeria. Soc. Sci. Med. 1982 17, 563–570.

Tanser, F., Gijsbertsen, B., Herbst, K., 2006. Modelling and understanding primary health care accessibility and utilization in rural South Africa: an exploration using a geographical information system. Soc. Sci. Med. 63, 691–705.

The World Bank, 2010. Technical Documentation. HDM-4 Road Use Costs Model Version 2.00 Documentation, available at: moodle.stoa.usp.br/mod/resource/view.php?id=45012

The World Bank, 2013. Economic and statistical analysis of tourism in Uganda. The World Bank Group, Washington DC.

Uganda Bureau of Statistics (UBOS), 2002. The 2002 Uganda Population and Housing Census, Population Size and Distribution. October 2006, Kampala, Uganda.

Uganda National Road Authority, 2008. Uganda National Transport Master Plan. Available at: https://www.unra.go.ug/images/stories/assets/transport_master_plan_main_report_doc.pdf

Uganda National Road Authority, 2012. Request for Expression of Interest For the Development of 1900 Km of Roads Supporting Primary Growth Sectors Through Contractor Facilitated Financing Mechanism, Procurement Reference Number: UNRA/ Works/2011-2012/00002/02/01-05.Daily Monitor, pp. 29. Lote E.3)

Uganda National Road Authority, 2014. Information Facilitated by Planning Department.

USAID 2003 in Brunger, C. 2003. Indirect Impacts of Road Building in Developing Countries. The Road RIPorter. Quarterly Newsletter of Wildlands CPR. Winter Solstice 2003. Volume 8(4): 16-18.

USAID, 2009. Chapter 14: Rural roads, in: Environmental Guidelines for Small-Scale Actvities in Africa (EGSSAA).

Van de Walle, D., 2002. Choosing rural road investments to help reduce poverty. World Dev. 30, 575–589.

Vanthomme, H., Kolowski, J., Korte, L., Alonso, A., 2013. Distribution of a community of mammals in relation to roads and other human disturbances in Gabon, Central Africa. Conserv. Biol. 27, 281–291.

Annexes

ANNEX 1: Request for Expression of Interest For the Development of 1900 Km of Roads Supporting Primary Growth Sectors Through Contractor Facilitated Financing Mechanism, Procurement Reference Number: UNRA/Works/2011-2012/00002/02/01-05.

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UGANDA NATIONAL ROADS AUTHORITY

Plot 5, Lourdel Road, Nakasero
P.O. Box 28487 Kampala, Uganda

REQUEST FOR EXPRESSION OF INTEREST

FOR

THE DEVELOPMENT OF 1900 KM OF ROADS SUPPORTING PRIMARY GROWTH SECTORS THROUGH CONTRACTOR FACILITATED FINANCING MECHANISM

Procurement Reference Number: UNRA/WORKS/2011-12/00001/02/01-05

1. The Government of the Republic of Uganda represented by the Uganda National Roads Authority (UNRA) has identified the need to upgrade from gravel to paved standard of approximately 1900km of roads supporting the primary growth sectors of Tourism, Agriculture, and Oil & Gas Sectors;
2. UNRA therefore seeks to procure contractors with the capability to organise funding for road development projects supporting the primary growth sectors that have been packaged into five (5) lots as shown in the table below:

ITEM		Project Length (km)	Status of design	Construction Period
LOT A		271.0		
A.1	Otwiyo-Gulu-Kitgum	167.0	Complete	36 Months
A.2	Atiak-Adjumani-Moyo-Afoji	104.0	Complete	36 months
LOT B		519.0		
B.1	Kapchorwa-Suam	77.0	Complete	36 Months
?	Mbale-Bubulo-Lwakhakha	41.0	Complete	24 Months
;	Muyembe-Nakapiripirit/ Moroto-Kotido	193.0	Complete	36 months
B.4	Soroti-Katakwi-Moroto-Loktanyala	208.0	Complete	36 months
LOT C		361.9		
C.1	Mukono – Kyetume - Katosi	74.0	Complete	36 months
C.2	Mpigi - Maddu - Ssembabule	135.0	Complete	36 Months
C.3	Villa Maria Ssembabule	48.0	Complete	24 Months
C.4	Musiita-Lumino-Busia/Majanji	104.0	Complete	36 Months
LOT D				
D.1	Hoima-Butiaba-Wanseko	111.0	Complete	36 Months
D.2	Rukungiri-Kihihi-Kanungu-Ishasha	74.0	Complete	36 Months
D.3	Kyenjojo-Kabwoya	105	Complete	36 Months
LOT E (Design and Build)		477.5		
E.1	Kayunga-Bbaale - Galiraya	88.5	Not ready	36 Months
E.2	Buwaya-Kasanje-Mpigi-Kibibi-Mityana	90.0	Not ready	36 Months
E.3	Hamurwa-Kerere-Kanungu/ Bulema-Buhoma-Butogota-Hamayanja-Ifasha-Ikumba	149.0	Not ready	36 Months
E.4	Ishasha-Katunguru	88.0	Not ready	36 Months
E.5	Kabale-Bunyonyi	8.0	Not ready	6 Months
E.6	Kisoro-Mgahinga Gate	14.0	Not ready	6 Months
E.7	Kisoro-Nkuringo/Bwindi	40.0	Not ready	24 Months
GRAND TOTAL		1,918.5		

3. The Design-Bid-Build project delivery strategy will be adopted for road projects for which designs are ready whereas the Design and Build approach will be adopted for road projects where designs are not yet ready.
4. The roads are to be upgraded from gravel to paved bituminous standard with an asphaltic or Double Bituminous Surface Treatment wearing course on granular base course and cemented or granular subbase;
5. The short-listed firms shall be responsible for organizing funding for the construction works for the roads in the Lot for which the company is short listed and for execution of construction works based on the agreed design and within the stipulated time for the respective projects. To aid the lobbying of finances by the short listed firms, the Government of Uganda will enter into Memorandum of Understanding with the short listed firms to confirm the relationship in respect of financing and implementation of the works;
6. For all roads, construction is expected to be completed within a period of 3 to 5 years from commencement. This implies that the selected contractor will have to undertake the works on the different roads within a lot concurrently;
7. The short-listing criteria will include the following:

i. **The Applicants' Information:**
The following attachments shall be enclosed to provide the required information:-
(a) Copy of Certificate of Registration/ Incorporation;
(b) Articles of Association/ documents of constitution and registration to demonstrate legal capacity;
(c) In case of Joint Venture (JV), letter of intent to form JV or JV agreement;
(d) In case of Government Owned Entity, documents establishing legal and financial autonomy and compliance with commercial law.

ii. **Historical Contract Non-Performance:**
The applicant shall list the Non-performing contracts it has had in the last five years (including the total Contract Amount in US$) while indicating the full details of the employer, reasons for non-performance and whether they have been resolved or still pending. All pending litigations shall in total not represent more than 50% of the applicant's net worth and shall be treated as resolved against the applicant.

iii. **Financial Situation:**
(a) The applicant shall submit audited balance sheets or if not required by the law of the Applicant's country, other financial statements acceptable to the Employer, for the last five (5) years to demonstrate the current soundness of the applicant's financial position and its prospective long term profitability and capacity to have a cash flow amount of US$ 15 million;
(b) The applicant shall demonstrate a minimum average annual construction Turnover of US$200 million over the last 5 years;

iv. **Capacity to Mobilise Project Financing**
(a) The applicant shall demonstrate its ability to mobilise the required financing by indicating the following:
- Magnitude of financing to be raised by the applicant; and
- Commitment letters/ reference from the probable financier of the project;
- Proven experience in organising this type of financing;
- References/ recommendation for firms from lenders or potential financiers;

(b) Acceptability of loan terms that shall include the following information:-
- Terms of financing, (Concessional or Commercial loan);
- Interest rates;
- Grace and repayment period; and
- Any other requirements of the potential financier.

v. **Contractor's Strategy for supporting Economic Growth**
The applicant shall provide the proposed strategy to support Government of Uganda's aspirations of stimulating economic growth through job creation resulting from investment in large scale infrastructure projects. The strategy shall be examined to ascertain the following:
- Proposed interaction with local contractors;
- Percentage of locals (skilled and others) to be employed on the project; and
- Inputs to be procured locally, and;
- any other proposal considered critical for stimulating Economic Growth;

vi. **Contractor's experience:**
a) Experience under construction contracts in the role of contractor, subcontractor, or management contractor for at least the last five (5) years prior to the application submission deadline, and with activity in at least nine (9) months in each year;
b) Participation as contractor, management contractor or subcontractor, in at least three (03) contracts within the last five (05) years, each with a value of US$100 million, that have been successfully and substantially completed and that are similar to the proposed works;
Evidence for the stated experience shall be completion certificate or any other acceptable form detailing the Contract, date of award, date of completion, amount of Contract, role played by applicant, scope of work (including physical size, complexity and methodology/ technology used) as well as full details of the Employer.
8. During the bidding stage, shortlisted firms will be required to prepare and submit in a single stage, three separate envelopes which will be opened at different stages - the first for the technical bid, the second for the financial bid and the third for the financing terms. The envelope for the technical bid will be opened first followed by the envelope for the financial bid and finally the envelope for the financing terms. Only the financial bids for the technically responsive bidders will be opened for consideration. Thereafter, the Lowest Eligible and Responsive Bidder in respect of the bid price as well as the acceptable financing terms will be awarded the tender.
9. Government will then enter into a conditional commercial contract with the winning tenderer conditioned on loan agreements being signed between Government and the winning contractor's financiers. The process up to signature of the loan agreement will involve negotiations, cabinet approval, parliamentary Approval and Attorney General's Legal Opinion of the Loan. This will be followed by signature of the loan agreement between Government and the Contractor's financiers;
10. For each lot, two separate contract agreements will be signed as follows:
i. The financing/ loan agreement which will be signed between the contractor's financier and Ministry of Finance, Planning and Economic Development representing the Government of Uganda; and
ii. The Works Contract Agreement which will be signed between the contractor and the Uganda National Roads Authority (the Employer);
11. The project works will then commence immediately after the loan becomes effective following signature of the loan agreement and commercial agreement;
12. The short listing of firms for the works under this invitation will be conducted in accordance with the public procurement procedures contained in the Government of Uganda's Public Procurement and Disposal of Public Assets Act, 2003, and will be open to all bidders from eligible source countries.
13. Interested eligible applicants may obtain further information from the Procurement and Disposal Unit at the address below during office hours from 0900 to 1600 hours (Local time), on working days.
14. Applications for short listing should be submitted in sealed envelopes, delivered to the address below by 1700 hours (Local time) on 08th October 2012 and the Envelope must be clearly marked "Application to Short listing for the Development of 1900km of Roads Supporting Primary Growth Sectors through Contractor Facilitated Financing Mechanism (Lots A, B, C, D and E)" as applicable. Late applications will be rejected.
15. Firms must submit separate envelopes for the respective lots and in addition to the original, the number of copies to be submitted with the application is: Four (4) copies for each lot.

The Head of Procurement and Disposal Unit
Uganda National Roads Authority (UNRA) Plot 5, Lourdel Road, Nakasero
Ground Floor, Room GA/002 P.O. Box 28487, Kampala, Uganda Tel: +256-312-233 100,
+ 256-414-318 000 Fax: +256-414-232807 E-mail: procurement@unra.go.ug

MANAGEMENT

ANNEX 2: Project Costs per Kilometre

TABLE A2.1: Project Costs per Kilometre

	Base Line Alternative 0: Current road (US $thousand)	**Road Alternative 1:** Upgrading current road (US $thousand)	**Road A lternative 2:** Building new road through communities (US $thousand)	**Road Alternative 3:** Building new road along mountain ridge (US $thousand)
Total Investment	**0**	**865.0**[1]	**927.38**[2]	**927.38**[2]
Total Compensation	0	0	33.9	33.9
Maintenance Per year	2.3[3]	1.5[4]	1.5[4]	1.5[4]
Maintenance to gates per year	0	0	2.3[3]	2.33

Table A.2.1 summarises per kilometre investment and maintenance costs of each project alternative. Investment costs are total costs throughout the project's lifetime, whereas maintenance costs are per year.

[1] *US$ 841,000 Fort Portal Road construction costs provided by UNRA, plus US$ 24,000 in opening and graveling works estimated by Kabale District Engineer.*

[2] *US$ 841,000 Fort Portal Road construction costs provided by UNRA, plus US$ 52,400 in opening and graveling works estimated by Kabale District Engineer.*

[3] *According to Kabale District Engineer: current road maintenance scheme cost.*

[4] *According to UNRA guidelines, maintenance costs of $1,500 per year for asphalt concrete.*

ANNEX 3: Road Characteristics and Vehicle Fleet Characteristics (Information used HDM4 VOC module of RED)

TABLE A3.1: Road Characteristics (All alternatives)

Altitude (m)	2250.0
Percent Time Driven on Water	40.1
Percent Time Driven on Snow	0.0
Paved Roads Texture Depth (mm)	0.69

Source: GIS from the area of study and Kablale District Engineer

TABLE A3.2: Project Alternatives Terrain Types

Project Alternatives	**Rise & Fall (m/km)**	**Horizontal Curvature (deg/km)**	***Number of Rises & Falls (#)***	***Super elevation (%)***
Alternative 0 (no project)	120	150	34	2
Alternative 1:	120	150	34	2
Alternative 2:	100	150	14	2
Alternative 3:	80	150	11	2

Source: these variables were estimated for each road alternative using GIS software

TABLE A3.3: Road Types

	Surface Type	Carriageway width (m)	Speed Limit (km/hour)	Speed Limit Enforcement (#)	*Roadside Friction (#)*	*NMT Friction (#)*
Paved (Alternative 1,2,3)	1- Bitumunous	7.0	120.0	1.1	1.0	1.0
Gravel	3-Unsealed	6.0	80.0	1.1	1.0	1.0
Earth (Alternative 0)	3- Unsealed	5.0	70.0	1.1	1.0	1.0

Source: Default RED UNRA 2009

TABLE A3.4 : Vehicle Fleet Characteristics

	Car Medium	Goods Vehicle	Bus Light	Bus Medium	Motorcycle	Truck Light	Truck Medium	Truck Heavy	Truck Articulated
Economic Unit Costs									
New Vehicle Cost ($/vehicle)	40300	45000	50500	75000	6000	50000	130000	130000	6000
Fuel Cost ($/liter for MT, $/MJ for NMT)	1.42	1.42	1.42	1.25	1.42	1.25	1.25	1.25	1.42
Lubricant Cost ($/liter)	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90
New Tire Cost ($/tire)	75.00	112.00	150.00	330.00	15.00	300.00	450.00	450.00	15.00
Maintenance Labor Cost ($/hour)	1.73	1.92	2.60	6.02	1.73	6.02	6.02	6.02	1.73
Crew Cost ($/hour)	1.65	1.07	1.75	1.75	0.24	1.11	1.90	1.90	0.24
Interest Rate (%)	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
Utilization and Loading									
Kilometers Driven per Year (km)	20000	20000	40000	40000	10000	40000	55000	55000	10000
Hours Driven per Year (hr)	600	600	2500	2500	600	1200	1500	1500	600
Service Life (years)	10	10	10	10	10	10	10	10	10
Percent of Time for Private Use (%)	100.00	100.00	0.00	0.00	100.00	0.00	0.00	0.00	100.00
Gross Vehicle Weight (tons)	1.45	2.50	2.60	6.00	0.20	4.00	22.60	22.60	0.20

Source: Default RED Analysis 2009 (UNRA, 2013)

ANNEX 4: Basic Input Data to Run RED Analysis

TABLE A4: Basic Input Data to Run RED Analysis

	Without Project Alternative	Project Alternatives		
	Alternative 0	Alternative 1	Alternative 2	Alternative 3
Alternative Description	Mechanized Maintenance Every Four Years	Upgrade to Asphalt Concrete Standard	Upgrade to Asphalt Concrete Standard	Upgrade to Asphalt Concrete Standard
Terrain Type (A/B/C)	Mountainous C	Mountainous C	Mountainous B	Mountainous A
Road Type	Earth	Paved	Paved	Paved
Dry Season				
Road Length (km)	26.2	26.2	28.5	31.3
Roughness (IRI)	13.0	2.0	2.0	2.0
Wet Season				
Road Length (km)	26.2	26.2	28.5	31.3
Roughness (IRI)	16.0	2.0	2.0	2.0
Investment Duration in Years (0/1/2/3)	0	2	2	2
Investment Costs in Year 1 (%)	0%	50%	50%	50%
Investment Costs in Year 2 (%)	0%	50%	50%	50%
Investment Costs in Year 3 (%)	0%	0%	0%	0%
Financial Investment Costs ('000$/km)	0.00	865.00[1]	927.38[2]	927.38[2]
Fixed Financial Maintenance Costs ('000$/km/year)	2.30[3]	1.50[4]	1.50[4]	1.50[4]

[1] *US$ 841,000 Fort Portal Road construction costs provided by UNRA, plus US$ 24,000 in opening and graveling works estimated by Kabale District Engineer.*

[2] *US$ 841,000 Fort Portal Road construction costs provided by UNRA, plus US$ 52,400 in opening and graveling works estimated by Kabale District Engineer.*

[3] *According to Kabale District Engineer: current road maintenance scheme cost.*

[4] *According to UNRA guidelines, maintenance costs of $1,500 per year for asphalt concrete.*

ANNEX 5: Travel Time Costs

TABLE A5.1: Number of Passengers per Vehicle and Time Costs per Passenger and Cargo Holding

	Number of Passengers (#)	Passengers' Time Cost ($/pas-hr)	Cargo Holding Time Cost ($/veh-hr)
Car Medium	4.00	1.00	0.00
Goods Vehicle	1.00	0.50	0.00
Bus Light	10.00	0.50	0.00
Bus Medium	20.00	0.50	0.00
Motorcycle	1.00	0.50	0.00
Truck Light	0.00	0.00	0.00
Truck Medium	20.00	0.00	0.00
Truck Heavy	0.00	0.00	0.00
Truck Articulated	0.00	0.00	0.00

ANNEX 6: Vehicle Fleet Speeds

TABLE A6: Vehicle Fleet Speeds

	Without Project Alternative	Project Alternatives		
	Alternative 0	Alternative 1	Alternative 2	Alternative 3
Alternative Description	Mechanized Maintenance every 4 Years	Upgrade to Asphalt Concrete Standard	Upgrade to Asphalt Concrete Standard	Upgrade to Asphalt Concrete Standard
Terrain Type (A/B/C)	C: Mountainous C	C: Mountainous C	B: Mountainous B	A: Mountainous A
Road Type (X/Y/Z)	Earth	Paved	Paved	Paved
Dry Season				
Road Length (km)	26.2	26.2	28.5	31.3
Roughness (IRI)	13.0	2.0	2.0	2.0
Vehicle Fleet Speeds (km/hr):				
Car Medium	46.0	71.8	78.3	85.1
Goods Vehicle	40.4	58.8	63.3	71.1
Bus Light	42.6	61.6	67.6	73.6
Bus Medium	33.5	44.7	50.2	57.0
Motorcycle	49.1	89.0	90.8	92.5
Truck Light	35.8	48.9	54.5	59.7
Truck Medium	27.8	32.3	32.3	32.3
Truck Heavy	32.1	41.6	46.8	53.3
Truck Articulated	40.5	77.8	77.8	77.8
Wet Season				
Road Length (km)	26.2	26.2	28.5	31.3
Roughness (IRI)	16.0	2.0	2.0	2.0
Vehicle Fleet Speeds (km/hr):				
Car Medium	38.7	71.8	78.3	85.1
Goods Vehicle	35.4	58.8	63.3	71.1
Bus Light	36.7	61.6	67.6	73.6
Bus Medium	30.3	44.7	50.2	57.0
Motorcycle	39.7	89.0	90.8	92.5
Truck Light	32.1	48.9	54.5	59.7
Truck Medium	26.1	32.3	32.3	32.3
Truck Heavy	28.9	41.6	46.8	53.3
Truck Articulated	31.1	77.8	77.8	77.8

ANNEX 7: Normal Traffic (Dry and Wet Season)

TABLE A7.1 Normal traffic for the road calculations used in the RED analysis.

Type of Vehicle	Daily Traffic 2015 (vehicles/day)
Car Medium	3.2
Goods Vehicle	12.9
Bus Light	4.6
Bus Medium	0.2
Motorcycle	7
Truck Light	0
Truck Medium	8.4
Truck Heavy	0.1
Truck Articulated	0
Total	36.4

ANNEX 8: Induced Traffic Alternative 1 (Dry and Wet Season)

TABLE A8.1: Induced Traffic Alternative 1 (Dry and Wet Season)

Year	Car Medium	Goods Vehicle	Bus Light	Bus Medium	Motorcycle	Truck Light	Truck Medium	Truck Heavy	Truck Articulated
2014	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0	0	0
2017	2	6	2	0	4	0	4	0	0
2018	3	13	5	0	7	0	8	0	0
2019	3	14	5	0	8	0	9	0	0
2020	4	15	5	0	8	0	10	0	0
2021	4	16	6	0	9	0	11	0	0
2022	4	18	6	0	10	0	11	0	0
2023	5	19	7	0	10	0	12	0	0
2024	5	20	7	0	11	0	13	0	0
2025	5	22	8	0	12	0	14	0	0
2026	6	24	9	0	13	0	16	0	0
2027	6	26	9	0	14	0	17	0	0
2028	7	28	10	0	15	0	18	0	0
2029	7	30	11	0	16	0	20	0	0
2030	8	32	12	1	18	0	21	0	0
2031	9	35	13	1	19	0	23	0	0
2032	9	38	14	1	21	0	25	0	0
2033	10	41	15	1	22	0	27	0	0

ANNEX 9: Induced Traffic Alternative 2 and 3 (Dry and Wet Season)

TABLE A9.1: Induced Traffic Alternative 2 and 3 (Dry and Wet Season)

Year	Car Medium	Goods Vehicle	Bus Light	Bus Medium	Motorcycle	Truck Light	Truck Medium	Truck Heavy	Truck Articulated
2014	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0	0	0
2017	3	13	5	0	7	0	8	0	0
2018	5	19	7	0	11	0	13	0	0
2019	5	21	7	0	11	0	14	0	0
2020	6	23	8	0	12	0	15	0	0
2021	6	24	9	0	13	0	16	0	0
2022	7	26	9	0	14	0	17	0	0
2023	7	28	10	0	15	0	19	0	0
2024	8	31	11	0	17	0	20	0	0
2025	8	33	12	1	18	0	22	0	0
2026	9	36	13	1	19	0	23	0	0
2027	10	39	14	1	21	0	25	0	0
2028	10	42	15	1	23	0	27	0	0
2029	11	45	16	1	24	0	29	0	0
2030	12	49	17	1	26	0	32	0	0
2031	13	53	19	1	29	0	34	0	0
2032	14	57	20	1	31	0	37	0	0
2033	15	61	22	1	33	0	40	0	0

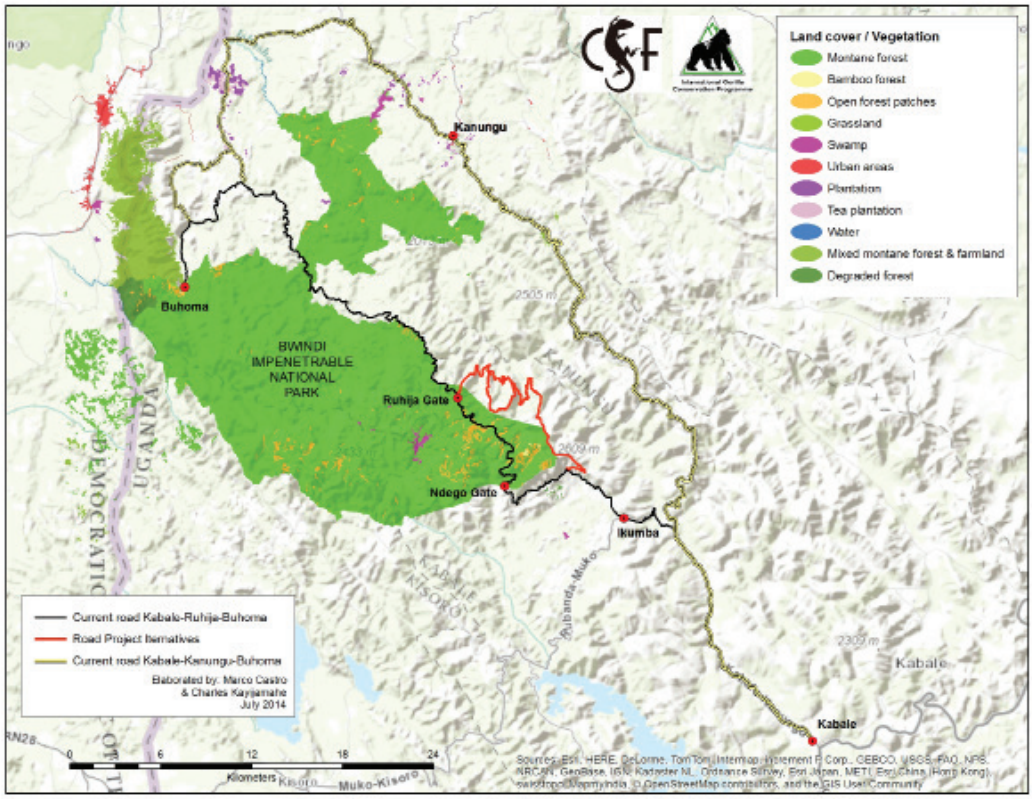
ANNEX 10: General Characteristics Ikumba-Buhoma Road Alternatives

TABLE A10.1: Road alternative Characteristics: Ikumba - Buhoma Road (US$ reported in Million)

	Alternative 0	Alternative 1	Alternative 2	Alternative 3
Terrain Type (A/B/C)	Mountainous C	Mountainous C	Mountainous B	Mountainous A
Road Type	Earth	Paved	Paved	Paved
Dry Season				
Road Length (km)	71.2	71.2	73.5	76.3
Roughness (IRI)	13.0	2.0	2.0	2.0
Wet Season				
Road Length (km)	71.2	71.2	73.5	76.3
Roughness (IRI)	16.0	2.0	2.0	2.0
Diverted Traffic from Alternative Road** (veh/day):				
Car Medium		3.2	3.2	3.2
Goods Vehicle		12.9	12.9	12.9
Bus Light		4.6	4.6	4.6
Bus Medium		0.2	0.2	0.2
Motorcycle		7	7	7
Truck Light		0	0	0
Truck Medium		8.4	8.4	8.4
Truck Heavy		0.1	0.1	0.1
Truck Articulated		0	0	0
Alternative Road Characteristics**:				
Road Terrain Type (A/B/C)		C	C	C
Road Type (X/Y/Z)		Z	Z	Z
Road Length (km)		109.0	109.0	109.0
Road Roughness (IRI)		13.0	13.0	13.0

** *Alternative Road is Diverted Traffic Kabale-Kanungu-Buhoma. The reference point is not Kabale rather the diversion point to Ikumba in the Kabale-Kanungu Road (as shown in Figure A10.1).*

FIGURE A10.1: Ikumba - Buhoma Road Project Alternatives and Current Existing Roads



ANNEX 11: Net Present Costs and Benefits associated with the Project Alternatives (Ikumba-Ruhija)

TABLE A11: Net Present Costs and Benefits associated with the Project Alternatives (US$ reported in Million)

	Agency Benefits (US$ million)				User Benefits (US$ million) (US$ million)					Total (US$ million)
	Investment	Maintenance	Maintenance to Gates	Compensation	Normal Traffic		Generated Traffic		Road	
	Costs	Costs	Costs	Costs	VOC	Time	VOC	Time	Safety	
Alternative 1	($16.28)	$0.13	$0.00	$0.00	$1.54	$0.06	$0.82	$0.03	$0.04	($13.66)
Alternative 2	($18.98)	$0.11	($0.13)	($0.68)	$1.68	$0.06	$1.22	$0.04	$0.04	($16.65)
Alternative 3	($20.85)	$0.09	($0.13)	($0.76)	$1.80	$0.06	$1.33	$0.04	$0.03	($18.40)

Table A7 shows the distribution of costs and benefits from the different projects. All projects costs and benefits are estimated taking as a base the current roads costs and benefits. As in all Cost-Benefit Analysis, projects are compared to a base scenario (in this case the base scenario is the current earth road with it's related management costs and benefits)

ANNEX 12: Net Present Value of Road Alternatives Ikumba-Buhoma (Ikumba-Ruhija-Buhoma)

TABLE A12: NPV of road alternatives: Ikumba - Buhoma Road (US$ reported in Million)

	Road Alternative 1: Upgrading Current Road	**Road Alternative 2:** Building New Road through communities	**Road Alternative 3:** Building New Road along mountain ridge
Points in Map 3.1	Ikumba-Buhoma through points ABC	Ikumba-Buhoma through points ADEC	Ikumba-Buhoma through points ADFEC
NPV without consideration of effects on habitat degradation	US$ **-27.78**	US$ **-30.74**	US$ **-30.99**

Note: Includes benefits from diverted traffic Kabale-Kanungu-Buhoma

ANNEX 13: Forgone revenues: Breakdown of analysis results

Fixed	
Gorilla permits sold 2013	20479
Total number of permits available	29696
Total number permits available after new group introduced	32616
Initial permit price	600
Permit price at saturation	750
Daily expenditure_Leisure tourist	176
Average length of stay Bwindi	2.17
Average length of stay Uganda	14
Mutliplier effect	2.5
Variable	
Annual visitor growth rate	3/10/17%

TABLE A13.1 Breakdown 3% growth

		Current: Without Gain				Gain of 1 group			
Year	Year of project	Permits sold (#)	Revenue Permits (M$/year)	Revenue Bwindi (M$/year)	Revenue Uganda (M$/year)	Permits sold (#)	Revenue Permits (M$/year)	Revenue Bwindi (M$/year)	Revenue Uganda (M$/year)
2014	1	21093.37	12.66	20.71	161.58	21093.37	12.66	20.71	161.58
2015	2	21717.05	13.03	21.32	166.35	21717.05	13.03	21.32	166.35
2016	3	22286.72	13.37	21.88	170.72	22286.72	13.37	21.88	170.72
2017	4	22866.50	13.72	22.45	175.16	22866.50	13.72	22.45	175.16
2018	5	23388.81	14.03	22.97	179.16	23388.81	14.03	22.97	179.16
2019	6	23926.79	14.36	23.49	183.28	23926.79	14.36	23.49	183.28
2020	7	24480.92	14.69	24.04	187.52	24480.92	14.69	24.04	187.52
2021	8	24922.66	14.95	24.47	190.91	25547.67	15.33	25.09	195.70
2022	9	25362.66	15.22	24.90	194.28	26135.54	15.68	25.66	200.20
2023	10	25815.86	15.49	25.35	197.75	26741.04	16.04	26.26	204.84
2024	11	26282.66	15.77	25.81	201.33	27258.66	16.36	26.77	208.80
2025	12	26763.46	16.06	26.28	205.01	27739.46	16.64	27.24	212.48
2026	13	27173.64	16.30	26.68	208.15	28234.68	16.94	27.72	216.28
2027	14	27426.51	16.46	26.93	210.09	28744.76	17.25	28.23	220.18
2028	15	27592.58	16.56	27.09	211.36	29270.15	17.56	28.74	224.21
2029	16	27750.28	16.65	27.25	212.57	29748.71	17.85	29.21	227.88
2030	17	27912.71	16.75	27.41	213.81	30064.50	18.04	29.52	230.29
2031	18	28080.01	16.85	27.57	215.09	30264.01	18.16	29.72	231.82
2032	19	28252.33	16.95	27.74	216.41	30436.33	18.26	29.89	233.14
2033	20	28429.82	17.06	27.92	217.77	30613.82	18.37	30.06	234.50
			$121.17	198.30	1546.91		123.58	202.24	1577.65
				Difference in NPV:			$2.41	$3.94	$30.74

TABLE A13.2 Breakdown 10%

		Current: Without Gain				Gain of 1 group			
Year	Year of project	Permits sold (#)	Revenue Permits (M$/year)	Revenue Bwindi (M$/year)	Revenue Uganda (M$/year)	Permits sold (#)	Revenue Permits (M$/year)	Revenue Bwindi (M$/year)	Revenue Uganda (M$/year)
2014	1	22416.90	13.45	22.01	171.71	22416.90	13.45	22.01	171.71
2015	2	24173.49	14.50	23.74	185.17	24173.49	14.50	23.74	185.17
2016	3	25666.32	15.40	25.20	196.60	25666.32	15.40	25.20	196.60
2017	4	27136.81	16.28	26.65	207.87	27136.81	16.28	26.65	207.87
2018	5	23388.81	16.66	27.27	212.72	27769.86	16.66	27.27	212.72
2019	6	27769.86	16.99	27.80	216.88	28313.25	16.99	27.80	216.88
2020	7	28313.25	17.35	28.39	221.46	28910.97	17.35	28.39	221.46
2021	8	29276.68	17.57	28.75	224.26	31752.47	19.05	31.18	243.22
2022	9	29474.74	17.68	28.94	225.78	32154.74	19.29	31.57	246.31
2023	10	29692.62	17.82	29.16	227.45	32372.62	19.42	31.79	247.97
2024	11	29696.00	17.82	29.16	227.47	32612.28	19.57	32.02	249.81
2025	12	29696.00	22.27	33.61	238.61	32616.00	19.57	32.03	249.84
2026	13	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2027	14	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2028	15	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2029	16	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2030	17	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2031	18	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2032	19	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2033	20	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
			$144.74	232.01	1769.41		149.56	240.31	1937.61
				Difference in NPV:			$4.82	$8.30	$68.61

TABLE A13.3 Breakdown 17%

		Current: Without Gain				Gain of 1 group			
Year	Year of project	Permits sold (#)	Revenue Permits (M$/year)	Revenue Bwindi (M$/year)	Revenue Uganda (M$/year)	Permits sold (#)	Revenue Permits (M$/year)	Revenue Bwindi (M$/year)	Revenue Uganda (M$/year)
2014	1	23554.73	14.13	23.13	180.43	23554.73	14.13	23.13	180.43
2015	2	26105.12	15.66	25.63	199.97	26105.12	15.66	25.63	199.97
2016	3	27739.84	16.64	27.24	212.49	27739.84	16.64	27.24	212.49
2017	4	28658.50	17.20	28.14	219.52	28658.50	17.20	28.14	219.52
2018	5	29321.82	17.59	28.79	224.61	29321.82	17.59	28.79	224.61
2019	6	29666.21	17.80	29.13	227.24	29666.21	17.80	29.13	227.24
2020	7	29696.00	17.82	29.16	227.47	29696.00	17.82	29.16	227.47
2021	8	29696.00	22.27	33.61	238.61	32616.00	19.57	32.03	249.84
2022	9	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2023	10	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2024	11	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2025	12	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2026	13	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2027	14	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2028	15	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2029	16	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2030	17	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2031	18	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2032	19	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
2033	20	29696.00	22.27	33.61	238.61	32616.00	24.46	36.92	262.07
			$156.41	246.75	1848.06		161.33	255.29	1918.88
				Difference in NPV:			$4.82	$8.30	$68.61

ANNEX 14: Lost revenues: Breakdown of analysis results

Fixed	
Gorilla permits sold 2013	20479
Total number of permits available	29696
Total number permits available after new group introduced	32616
Initial permit price	600
Permit price at saturation	750
Daily expenditure_Leisure tourist	176
Average length of stay Bwindi	2.17
Average length of stay Uganda	14
Mutliplier effect	2.5
Variable	
Annual visitor growth rate	3/10/17%

TABLE A14.1 Breakdown 3% growth

		Current: Without Loss				Loss of 1 group			
Year	Year of project	Permits sold (#)	Revenue Permits (M$/year)	Revenue Bwindi (M$/year)	Revenue Uganda (M$/year)	Permits sold (#)	Revenue Permits (M$/year)	Revenue Bwindi (M$/year)	Revenue Uganda (M$/year)
2014	1	21093.37	12.66	20.71	161.58	21093.37	12.66	20.71	161.58
2015	2	21717.05	13.03	21.32	166.35	21371.06	12.82	20.98	163.70
2016	3	22286.72	13.37	21.88	170.72	21863.39	13.12	21.47	167.47
2017	4	22866.50	13.72	22.45	175.16	22311.14	13.39	21.91	170.90
2018	5	23388.81	14.03	22.97	179.16	22702.08	13.62	22.29	173.90
2019	6	23926.79	14.36	23.49	183.28	23104.74	13.86	22.69	176.98
2020	7	24480.92	14.69	24.04	187.52	23519.48	14.11	23.09	180.16
2021	8	24922.66	14.95	24.47	190.91	23946.66	14.37	23.51	183.43
2022	9	25362.66	15.22	24.90	194.28	24349.66	14.61	23.91	186.52
2023	10	25815.86	15.49	25.35	197.75	24646.30	14.79	24.20	188.79
2024	11	26282.66	15.77	25.81	201.33	24822.41	14.89	24.37	190.14
2025	12	26763.46	16.06	26.28	205.01	24962.52	14.98	24.51	191.21
2026	13	27173.64	16.30	26.68	208.15	25106.83	15.06	24.65	192.32
2027	14	27426.51	16.46	26.93	210.09	25255.48	15.15	24.80	193.46
2028	15	27592.58	16.56	27.09	211.36	25408.58	15.25	24.95	194.63
2029	16	27750.28	16.65	27.25	212.57	25566.28	15.34	25.10	195.84
2030	17	27912.71	16.75	27.41	213.81	25728.71	15.44	25.26	197.08
2031	18	28080.01	16.85	27.57	215.09	25896.01	15.54	25.43	198.36
2032	19	28252.33	16.95	27.74	216.41	26068.33	15.64	25.60	199.68
2033	20	28429.82	17.06	27.92	217.77	26187.67	15.71	25.71	200.60
			$121.17	198.30	1546.91		116.50	190.65	1487.28
				Difference in NPV:			$4.67	$7.61	$59.63

TABLE A14.2 Breakdown 10%

		Current: Without Loss				Loss of 1 group			
Year	Year of project	Permits sold (#)	Revenue Permits (M$/year)	Revenue Bwindi (M$/year)	Revenue Uganda (M$/year)	Permits sold (#)	Revenue Permits (M$/year)	Revenue Bwindi (M$/year)	Revenue Uganda (M$/year)
2014	1	22416.90	13.45	22.01	171.71	22416.90	13.45	22.01	171.71
2015	2	24173.49	14.50	23.74	185.17	23289.38	13.97	22.87	178.40
2016	3	25666.32	15.40	25.20	196.60	24571.09	14.74	24.13	188.21
2017	4	27136.81	16.28	26.65	207.87	25091.87	15.06	24.64	192.20
2018	5	27769.86	16.66	27.27	212.72	25585.86	15.35	25.12	195.99
2019	6	28313.25	16.99	27.80	216.88	26114.91	15.67	25.64	200.04
2020	7	28910.97	17.35	28.39	221.46	26416.61	15.85	25.94	202.35
2021	8	29276.68	17.57	28.75	224.26	26596.68	15.96	26.12	203.73
2022	9	29474.74	17.68	28.94	225.78	26776.00	16.07	26.29	205.10
2023	10	29692.62	17.82	29.16	227.45	26776.00	20.08	30.31	215.15
2024	11	29696.00	17.82	29.16	227.47	26776.00	20.08	30.31	215.15
2025	12	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2026	13	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2027	14	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2028	15	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2029	16	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2030	17	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2031	18	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2032	19	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2033	20	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
			$144.74	232.01	1769.41		136.94	217.97	1649.37
				Difference in NPV:			$7.80	$14.04	$120.04

TABLE A14.3 Breakdown 17%

		Current: Without Loss				Loss of 1 group			
Year	Year of project	Permits sold (#)	Revenue Permits (M$/year)	Revenue Bwindi (M$/year)	Revenue Uganda (M$/year)	Permits sold (#)	Revenue Permits (M$/year)	Revenue Bwindi (M$/year)	Revenue Uganda (M$/year)
2014	1	23554.73	14.13	23.13	180.43	23554.73	14.13	23.13	180.43
2015	2	26105.12	15.66	25.63	199.97	24770.67	14.86	24.32	189.74
2016	3	27739.84	16.64	27.24	212.49	25555.84	15.33	25.09	195.76
2017	4	28658.50	17.20	28.14	219.52	26330.41	15.80	25.85	201.69
2018	5	29321.82	17.59	28.79	224.61	26641.82	15.99	26.16	204.08
2019	6	29666.21	17.80	29.13	227.24	26776.00	16.07	26.29	205.10
2020	7	29696.00	17.82	29.16	227.47	26776.00	20.08	30.31	215.15
2021	8	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2022	9	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2023	10	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2024	11	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2025	12	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2026	13	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2027	14	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2028	15	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2029	16	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2030	17	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2031	18	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2032	19	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
2033	20	29696.00	22.27	33.61	238.61	26776.00	20.08	30.31	215.15
			$156.41	246.75	1848.06		145.67	228.79	1704.70
				Difference in NPV:			$10.74	$17.96	$143.36

ANNEX 15: Induced traffic: All Project Alternatives

TABLE A15.1 NPV of Project Alternative 1 under various induced tourism scenarios

	Growth rate	NPV of Project Alternative 1 under an induced tourism rate of:				
		+1	+2	+3	+4	+5
Permit revenue	3	-5.96	-0.02	3.71	7.11	10.44
	10	-13.66	-13.66	-13.66	-13.66	-13.66
	17	-13.66	-13.66	-13.66	-13.66	-13.66
Revenue to Bwindi	3	-3.52	4.04	8.85	12.98	16.83
	10	-13.66	-13.66	-13.66	-13.66	-13.66
	17	-13.66	-13.66	-13.66	-13.66	-13.66
Revenue to Uganda	3	45.00	85.94	112.79	133.05	149.65
	10	-13.66	-13.66	-13.66	-13.66	-13.66
	17	-13.66	-13.66	-13.66	-13.66	-13.66

TABLE A15.2 NPV of Project Alternative 2 under various induced tourism scenarios

	Growth rate	NPV of Project Alternative 2 under an induced tourism rate of:				
		+1	+2	+3	+4	+5
Permit revenue	3	-8.95	-3.01	0.72	4.12	7.45
	10	-16.65	-16.65	-16.65	-16.65	-16.65
	17	-16.65	-16.65	-16.65	-16.65	-16.65
Revenue to Bwindi	3	-6.51	1.05	5.87	10.00	13.84
	10	-16.65	-16.65	-16.65	-16.65	-16.65
	17	-16.65	-16.65	-16.65	-16.65	-16.65
Revenue to Uganda	3	42.01	82.95	109.80	130.06	146.66
	10	-16.65	-16.65	-16.65	-16.65	-16.65
	17	-16.65	-16.65	-16.65	-16.65	-16.65

TABLE A15.3 NPV of Project Alternative 3 under various induced tourism scenarios

	Growth rate	NPV of Project Alternative 3 under an induced tourism rate of:				
		+1	+2	+3	+4	+5
Permit revenue	3	-10.70	-4.75	-1.03	2.37	5.71
	10	-18.40	-18.40	-18.40	-18.40	-18.40
	17	-18.40	-18.40	-18.40	-18.40	-18.40
Revenue to Bwindi	3	-8.25	-0.69	4.12	8.25	12.10
	10	-18.40	-18.40	-18.40	-18.40	-18.40
	17	-18.40	-18.40	-18.40	-18.40	-18.40
Revenue to Uganda	3	40.27	81.20	108.05	128.31	144.92
	10	-18.40	-18.40	-18.40	-18.40	-18.40
	17	-18.40	-18.40	-18.40	-18.40	-18.40

International Gorilla
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