GOVERNMENT OF THE KINGDOM OF LESOTHO

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FEASIBILITY OF TOLLING CERTAIN CORRIDORS IN LESOTHO

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For:
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EXECUTIVE SUMMARY

1. INTRODUCTION

The Lesotho Road Fund entered into an agreement with Tolplan (Pty) Ltd to investigate the legal, economic, financial, technical and operational feasibility of tolling certain corridors in Lesotho. The results of the feasibility study are presented in this Executive Summary.

2. LEGAL AND INSTITUTIONAL FEASIBILITY

Attempts were made to collect and study all applicable legislation as well as relevant international agreements, which included–

- The Constitution
- Toll road legislation
- Roads legislation
- Road Fund legislation
- Financial legislation
- Procurement legislation
- Legislation on public-private-partnerships
- Road traffic legislation
- Road transport legislation
- Local government legislation
- Environmental legislation
- Development planning legislation (not studied at this stage)
- The SADC Transport Protocol.

The relevant institutional structures were then examined, which included–

- The Road Fund
- The Roads Branch (now incorporated into the Roads Directorate)
- The Roads Directorate (RD)
- The Department of Rural Roads (now also amalgamated with the RD)
- The Maseru City Council
- Other local authorities

- Roads Authorities (repealed and subsumed into the RD)
- The Lesotho Police

The recommendations resulting from the investigation are provided in section 9 of this Executive Summary.

3. IDENTIFICATION OF POTENTIAL TOLL CORRIDORS IN LESOTHO

The identification of potential toll corridors was approached by investigating the Lesotho primary road network, also by means of travelling along the major routes, in order to identify potential toll corridors, using the following initial criteria:

- routes with the highest traffic volumes
- routes with significant tollable distances
- routes with significant maintenance and/or upgrading needs.

After conducting traffic counts at 12 selected locations in potential corridors and after an assessment of the conditions of a part of the Lesotho primary road infrastructure, the following road sections, also shown in Figures EXEC 3-1, EXEC 3-2 and EXEC 3-3, were identified as potential toll corridors based on the average daily traffic volumes:

- Route A1 between Teya-Teyaneng and Hlotse (Leribe) - Average Daily Traffic volume (2008): 2 248 vehicles per day
- Route A1 between Maseru and Teya-Teyaneng - Average Daily Traffic volume (2008): 2 806 vehicles per day
- Route A2 between Mazenod and Morija - Average Daily Traffic volume (2008): 3 617 vehicles per day
- Route A2 between Morija and Mafeteng - Average Daily Traffic volume (2008): 1 938 vehicles per day
- Route A2 between Mafeteng and Mohale's Hoek - Average Daily Traffic volume (2008): 1 233 vehicles per day
- Route A5 between Route A2 and Roma - Average Daily Traffic volume (2008): 2 993 vehicles per day.

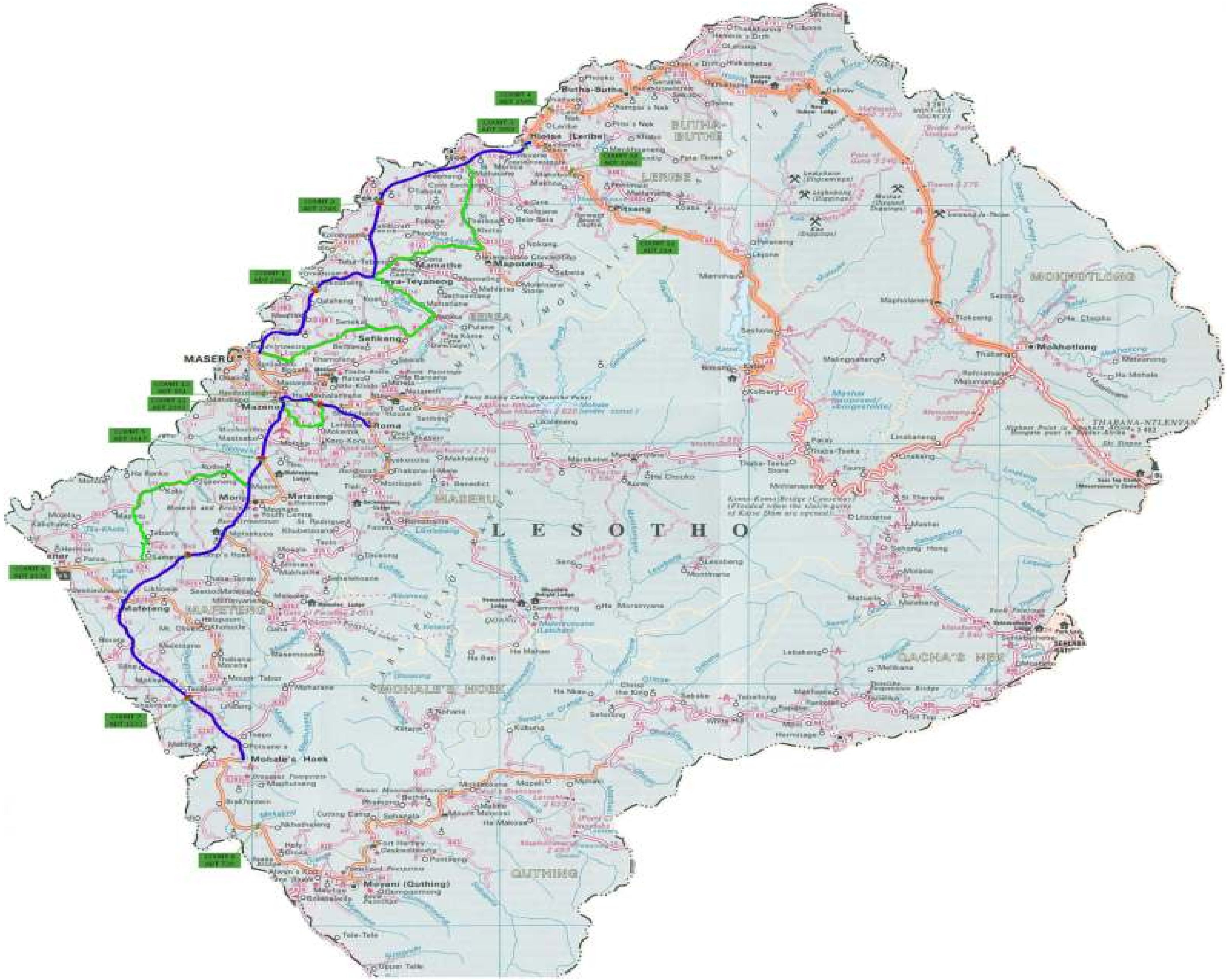


Figure EXEC 3-1: Potential Lesotho Toll Corridors: Locations of Additional 7 Day Traffic Counts (2008) - Countrywide

Figure EXEC 3-2: Potential Lesotho Toll Corridors (A1 and A8): Locations of Additional 7 Day Traffic Counts (2008)

Figure EXEC 3-3: Potential Lesotho Toll Corridors (A2 and A5): Locations of Additional 7 Day Traffic Counts

Although the study proposal referred to five potential toll corridors to be analysed, a sixth corridor was added. It has to be acknowledged that the A1 Hlotse – Butha-Buthe section has similar (or higher) volumes than the A2 Mafeteng – Mohale's Hoek section which appears on the above list as one of the six potential corridors. The A2 Mafeteng – Mohale's Hoek section was, however, selected because of its significantly longer "tollable" distance.

In order to perform a more thorough analysis of the correct definition of the above-mentioned road sections as toll corridors, roadside surveys involving, inter alia, questions regarding the origins and destinations of traffic passing at the interview locations, were carried out in each of these higher volume corridors.

4. PROPOSED TOLL STRATEGIES IN SIX CORRIDORS

4.1 Considerations in developing toll strategies

After familiarisation with the selected potential toll corridors, the development of possible toll strategy scenarios was undertaken for each corridor, taking into account, inter alia, the following major objectives:

- In view of the intrinsic controversial nature of tolling an existing major road section, it is considered important to develop a reasonable rationale for the tolling of an existing major road section. Public acceptability of the tolling of an existing major road section is significantly improved if it can be shown that road users paying toll will benefit from significant capital or maintenance expenditure that has been or will be made possible by investments to be serviced and repaid by the toll income, for example, as a result of the addition of shoulders to existing road sections and/or the rehabilitation or resealing of the pavement of a road section. Tolling usually makes such expenditure possible in the sense that the future nett toll revenue of a toll project provides the "security" for loans to fund the initial capital expenditure. Nett toll revenue is used to pay the interest in respect of such loans and also to eventually repay initial infrastructure funding loans.
- In the case of Lesotho, where the loans are obtained from development partners (for example, The World Bank) and the interest payments are not as significant as in the case of an ordinary commercial loan, the above-mentioned logic for achieving public acceptability might not be so compelling and the emphasis would be upon providing funding from nett toll revenue for rehabilitation, resealing and annual routine maintenance purposes.

- The initial and continual achievement of a significantly higher quality of road will, however, regardless of the source of the funding, remain an important characteristic of a toll corridor In order to make the tolling of the corridor acceptable to the public.
- Public acceptability of a toll strategy is usually facilitated if the toll strategy is perceived to be equitable by road users. The perception of equitability can be achieved in the following ways:
- The location of a toll plaza on an interurban road section must be such that the vast majority of toll plaza traffic uses virtually the entire road section being tolled at that location. Also, those users not using the entire toll road section should be given a discount in respect of that section of the road not used by them.
- Perceived equitability may also be achieved by charging a toll tariff lower than the perceived road user cost saving resulting from the road improvement or perceived road user cost savings relative to an alternative route.
- The minimisation of toll-related capital, operating, and maintenance costs is an important objective in order to minimise the cost of toll collection and, in so doing, possibly achieving the best financial and economic results in respect of a toll project. High toll-related costs are also often an indication of an economically inefficient toll project.
- Toll strategies should be devised that would actively promote and not negatively impact upon public transport services. This could be achieved by, for example, granting a discount to taxis and other public transport vehicles passing through a toll plaza.
- The maximisation of gross toll income is an important objective for the achievement of financial viability. In the context of the development of toll strategies, the implication is that a tolling configuration should be devised which leads to toll payments by most or all toll road users.

4.2 Specific Toll Plaza Locations in Lesotho Toll Corridors

It should be noted that, while a specific toll plaza location is indicated for every selected toll corridor, several other potential toll plaza locations have been identified in each toll corridor. A study to identify the optimal toll plaza location is usually undertaken after a decision to toll has been taken. Several toll plaza locations are usually considered in such a study which should also include public consultation and participation.

In the case of Lesotho, toll plaza location studies should take special cognisance of the reality that, if a toll plaza is not correctly located, a deviation around a toll plaza across land adjacent to the toll plaza could easily develop. In order to overcome this problem, toll plaza sites should be selected at locations where physical obstacles adjacent to a toll plaza location such as a river/stream/deep excavation occurs.

4.3 Proposed toll strategy: Route A1 between Maputsoe and Teya-Teyaneng

This possible toll section is along Route A1 between Teya-Teyaneng and Maputsoe and is approximately 38 km long (See Figure EXEC 4-1). The town of Peka is located approximately in the middle of this section. One potential toll plaza location is approximately 1km south of Peka. The roadside survey indicated that around 87% of traffic passing this location would travel the full tolling distance of 38 km with only around 13% of traffic making use of shorter distances of the toll corridor. The average daily traffic volume passing this potential toll plaza location was about 2 250 vehicles in 2008.

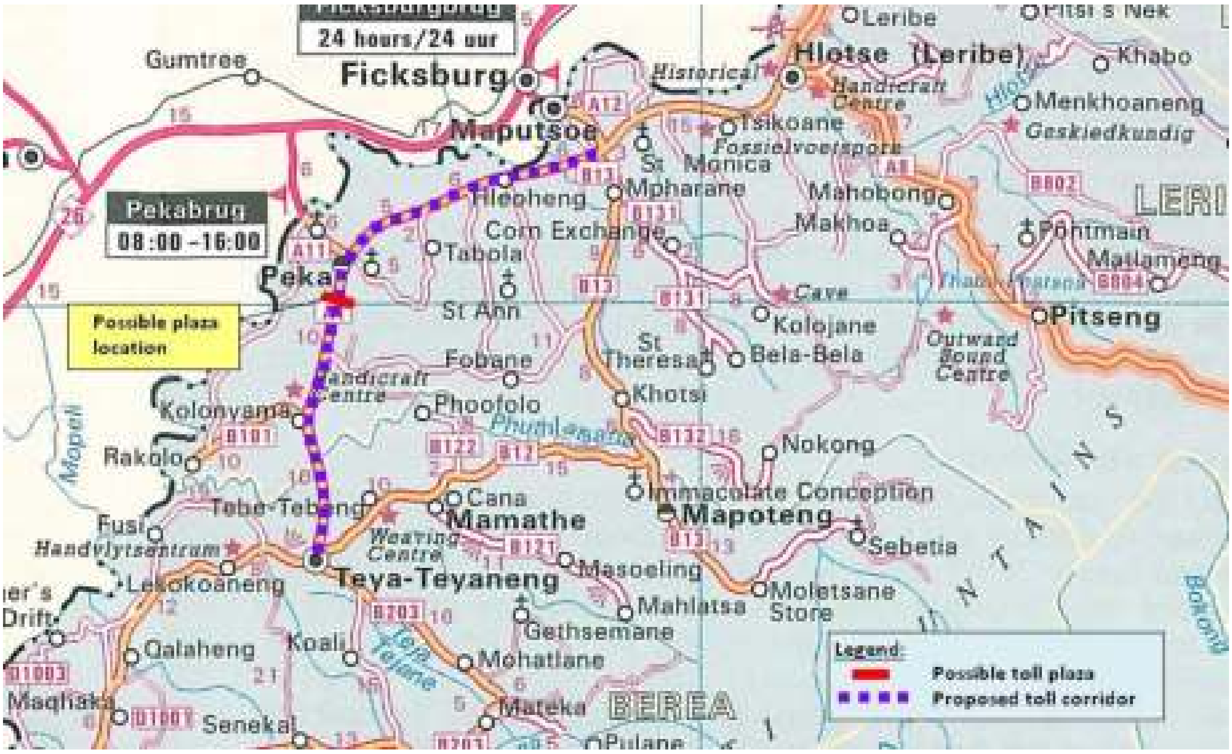


Figure EXEC 4-1: Proposed Toll Section 1: Route A1 between Maputsoe and Teya-Teyaneng

It is proposed that the following local user discounts should be granted, in the event that this road section is tolled at a location south of Peka:

- a local user discount of at least 75% to users living/working in Peka, since some of these users, when travelling to/from Kolonyama, would only be using 9 km of the 38 km toll section between Teya-Teyaneng and Maputsoe.
- a local user discount of at least 75% to users living/working in Kolonyama, since some of these users, when travelling to/from Peka, would only be using 9 kms of the 38,0 km toll section between Teya-Teyaneng and Maputsoe.

4.4 Proposed toll strategy: Route A1 between Teya-Teyaneng and Maseru

This possible toll section is along Route A1 between Maseru and Teya-Teyaneng and is approximately 40,2 km long (See Figure EXEC 4-2). There are no major towns along this section. One potential toll plaza location is about 25km north of Maseru at a location south of Lekokoaneng. The roadside survey indicated that about 98% of traffic passing this location would travel the full tolling distance of 40,2 km with only around 2% of traffic only making use of 31 4 km (8.8km less) between Maseru and Lekokoaneng. The average daily traffic volume passing the potential toll plaza location was about 2 800 vehicles in 2008.

Figure EXEC 4-2: Proposed Toll Section 2: Route A1 between Teya-Teyaneng and Maseru

The important overall conclusions regarding the definition of the toll corridor are as follows:

- The definition of the toll corridor appears to be close to perfect, since a toll tariff based on the full distance along the A1 Teya-Teyaneng and Maseru toll corridor would be equitable for 98% of the users.
- If tolling of this section takes place south of Lekokoaneng, a local user discount of about 20% would be appropriate for road users living/working in Lekokoaneng, since they would be using 31,4 km of the 40,2 km full toll section between Maseru and Teya-Teyaneng.

4.5 Proposed toll strategy: Route A5 between the A2 and Roma and Routes A5 and A3 between the A2 and Ntsi

The possible toll section was originally defined along Route A5 between Route A2, south of Mazenod, and Roma (approximately 18.5km long) - See Figure EXEC 4-3. In view of the inequitability towards the road users who turn of or get onto the toll section at St Michaels, the definition of the toll section was expanded to also include Route A3 between the A2 and Ntsi (approximately 9,9 km long), i.e. the road section indicated in green dots in Figure EXEC 4-3. The total A5/A3 toll section is 21,9 km in length. One potential toll plaza location is approximately 8km east of the A2/A5 intersection between the Ha Makhalanyana and St Michael turn-offs. The roadside survey indicated that about 78% of traffic passing this potential toll plaza location would travel the full A5 tolling distance of 18.5km while around 17% would use 11.7km of Route A5 between the A2/A5 Intersection and the St Michaels turn-off as well as 9,9 km of Route A3 between the A5 and Ntsi. The rest of the traffic would use Route A5 for shorter distances. The average daily traffic volume passing the potential toll plaza location was about 3 000 vehicles in 2008.

Figure EXEC 4-3: Expanded Proposed Toll Section 3: Route A5 between A2 and Roma and Routes A5 and A3 between the A2 and Ntsi

The remaining 3,9% local movements should be accommodated by allowing for a local user discount of 65% which is based upon that part of the total 18,3 km Mazenod – Roma section not used by local traffic between Ha Mokhalanyane and the St Michaels intersection.

4.6 Proposed toll strategy: Route A2 between Mazenod/Masianokeng and Morija

This possible toll section is along Route A2 between Mazenod and Morija and it is approximately 29,4 km long - See Figure EXEC 4-4. The town of Mantsebo and the Moshoeshoe International Airport are located along this section of Route A2. One potential toll plaza location is approximately 14km south of the A2/A5 intersection, between the Mantsebo and the Matsieng turn-off. The roadside survey indicated that about 92% of traffic passing this location would travel the full A2 tolling distance of 26.8km, while around 3,6% would use 16,5 km (Mazenod – Ha Moruthoane turn-off) and 3,1% would use 22,7 km (Mazenod – Masite) of the A2 between Mazenod and Morija. About 0,2% of the traffic would only use the 6,7 km between Mazenod and the Ha Moruthoane turn-off. The average daily traffic volume passing the potential toll plaza location was about 3 600 vehicles in 2008.

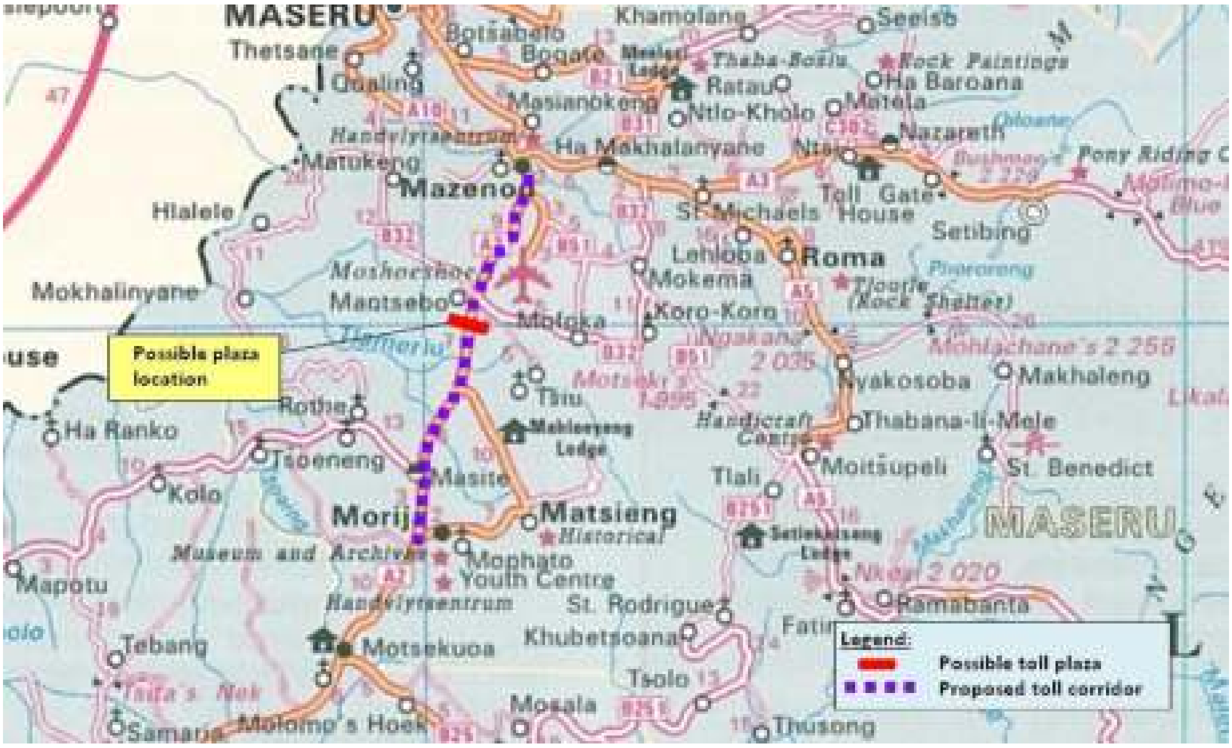


Figure EXEC 4-4: Proposed Toll Section 4: Route A2 between Mazenod and Morija

The important overall conclusion regarding the definition of the toll corridor and local user discounts are, therefore, as follows:

- The definition of the potential toll corridor appears to be very good, since a toll tariff based upon the full distance along the A2 between Mazenod and Morija would be equitable for 92% of the users.
- Road users living/working in Mantsebo, Ha Moruthoane and Masite should receive an appropriate local user discount, since they would only be using parts of the 29,4 km A2 toll section between Mazenod and Morija. Since it would not be possible to know the exact origin and destination of each local user trip, the conservative approach is to charge local users for the shortest trip that they are likely to undertake. In this case, this would appear to be the trip between Mantsebo and Ha Moruthoane which constitutes a trip of about 6,7 km on the A2. Since these local users would not be using 75% of the toll corridor when this trip is undertaken, a 75% local user discount is proposed.

4.7 Proposed toll strategy: Route A2 between Morija and Mafeteng

This possible toll section is along Road A2 between Morija and Mafeteng and it is approximately 35,6 km long - See Figure EXEC 4-5. There are no large towns located along this section of route A2. A possible toll plaza location is approximately 15 km south of the turn-off to Morija, between Motsekuao and the Ha Ramohapi turn-off. The roadside survey indicated that about 92% of traffic passing this possible toll plaza location would travel the full tolling distance of 35,6 km, while around 7% would use 25,3 km of the road to travel between Motsekuoa and Mafeteng. The average daily traffic volume passing the potential toll plaza location was about 1 900 vehicles in 2008.

Figure EXEC 4-5: Proposed Toll Section 5: Route A2 between Morija and Mafeteng

The important overall conclusions regarding the definition of the toll corridor and local user discounts are, therefore, as follows;

- The definition of the potential toll corridor appears to be very good, since a toll tariff based upon the full distance between Morija and Mafeteng would be equitable for 92% of the users.
- Road users living/working at Motsekuoa should receive a local user discount of 30% at this toll plaza, since they would use 70% of the A2 toll corridor between Morija and Mafeteng.

4.8 Proposed toll strategy: Route A2 between Mafeteng and Mohale's Hoek

This possible toll section consists of Road A2 between Mafeteng and Mohale's Hoek and it is approximately 45.8km long - See Figure EXEC 4-6. There are no large towns located along this section of road. A possible toll plaza location is approximately 25km south of the A2/A21 intersection in Mafeteng, between the Tsoloane and Tsepo turn-offs. The roadside survey indicated that all traffic passing this point will travel the full tolling distance of 45.8km. The average daily traffic volume passing this point was about 1 200 vehicles in 2008.

Figure EXEC 4-6: Proposed Toll Section 6: Route A2 between Mafeteng and Mohale's Hoek

The conclusion regarding the definition of the toll corridor can, therefore, be made that this is a virtually perfect toll corridor, since very little local user traffic occur (none was picked up in the roadside interview survey). Insofar as these local users are not using the entire toll section, they should receive appropriate local user discounts. More specifically, if the final toll plaza location is between Tsoloane and Tshepo, then road users living or working in Tsoloane should receive a local user discount for the section of the road between Mafeteng and Tsoloane, i.e. 23,6 km of the 47,5 km (approximately 50%), that they would not be using when travelling between Tsoloane and Mohale's Hoek. It is, therefore, proposed that a 50% discount be granted to road users living or working in Tsoloane.

5. INVESTIGATION INTO PERCEIVED BENEFITS OF TOLL CORRIDORS AS A BASIS FOR TOLL TARIFFS

The analysis and prediction of the reaction of road users to the levying of toll in each of the six toll corridors was undertaken in order to be able to predict the potential traffic through the possible toll plaza locations at different toll tariff levels.

Since the reaction of road users to tolls is determined by the benefits a road user **perceive** if he/she uses an upgraded toll road section rather than any alternative road section that may be available, it is important for setting toll tariffs correctly to determine the perceived road user benefit for light vehicles as well as the different heavy vehicle classes. The perceived road user benefits taken into consideration in this study were the value of fuel and time savings in the case of light vehicles and the value of variable operating cost and time savings in the case of heavy vehicles.

Since the value of time is an important variable for the determination of the perceived benefit, special roadside interview surveys were performed on the A2 Masianokeng - Mafeteng road and 550 light vehicle drivers were interviewed to determine their values of time. An average value of time per light vehicle of M 89,08 (in March 2011) or M 83,62 (in June 2009 Maloti), the date of the original perceived benefit analysis, was derived from this analysis.

This confirmed the conservativeness of using a value of M 73,40 (in June 2009 Maloti) based on the Lesotho value of time being 80% of a Free State value of time used in the original perceived benefit calculations, based on the availability of such a Free State survey.

By determining the perceived road user benefits for each vehicle class in the four toll corridors with alternative routes, revenue-maximising tariffs were obtained by applying an internationally applied toll road attraction algorithm. Because of the lack of competitive alternative routes, the perceived benefit analysis showed that toll tariffs above the average South African toll tariffs could, in theory, be charged. More specifically, for light vehicles, the perceived benefit analysis in the four corridors with alternative routes indicated revenue-maximising toll tariff between 35c/km and M 1,03/km compared to the average South African light vehicle toll tariff in 2009/10 of 34c per km. It is, however, important to note that this analysis shows what a road user should be willing to pay, taking into account his/her value of time, but it does not necessarily prove that the road user would be able to afford such tariffs.

Since the above-mentioned results led to the conclusion that the revenue-maximising tariffs in the possible Lesotho toll corridors would be too high, the toll tariffs required for various funding scenarios and the resulting traffic volumes were determined in an integrated application of the toll road attraction algorithm and the financial modelling of the Lesotho toll corridors and this application yielded the gross annual revenue required for each funding scenario.

6. ROAD- AND TOLL-RELATED CAPITAL, OPERATING AND MAINTENANCE COSTS

6.1 Road-related Capital and Maintenance Costs

6.1.1 Initial Road-related Capital Costs

Only two corridors were investigated where the initial capital costs of the road upgrading was repaid from the future nett toll revenue. This particular scenario involves the repayment, to the Lesotho Government, of the initial capital cost of 19,7 million Euro for the upgrading of the A2 Mazenod – Morija and Morija – Mafeteng road sections. At an exchange rate of M9,13 = 1 Euro (November 2010), the initial capital costs of the above-mentioned two sections were as indicated in Table EXEC 6-1.

Table EXEC 6-1: Possible Lesotho Toll Corridors: Actual Upgrading Cost

Possible Toll Section	Distance (km)	Actual Road Upgrading Costs (June 2009 Maloti)
(4) Mazenod – Morija*	29,4	R81,4 million
(5) Morija – Mafeteng*	35,6	R98,5 million
TOTAL	**217,6**	**R179,9 million**

* These are the two already upgraded toll sections

6.1.2 Future Road-related Capital and Maintenance Costs

The estimated routine road maintenance, road resealing and road rehabilitation costs for each of the proposed toll sections are shown in Table EXEC 6-2.

Table EXEC 6-2: Possible Lesotho Toll Corridors: Estimated Road-related Future Capital and Maintenance Costs (June 2009 Maloti)

Possible Toll Section	Distance	Annual Routine Maintenance cost	Road Resealing Costs	Road Rehabilitation Costs
Maputsoe – Teya-Teyaneng	38,1	M 2,29 m	M 21,43 m	M 142,84 m
Teya-Teyaneng – Maseru	40,3	M 2,42 m	M 22,65 m	M 151,01 m
Mazenod - Roma	28,4*	M 1,71 m	M 15,99 m	M 106,58 m
Mazenod - Morija	29,4	M 1,76 m	M 16,54 m	M 110,25 m
Morija - Mafeteng	35,6	M 2,13 m	M 20,00 m	M 133,31 m
Mafeteng - Mohale's Hoek	45,8	M 2,75 m	M 25,74 m	M 171,60 m

* includes 18,5 km of the A5 between Mazenod and Roma and 9,9 km of the A3 between St Michaels and Ntsi

6.2 Toll-related Capital Costs

6.2.1 Initial and life-cycle capital costs of fixed and semi-fixed toll plaza assets

For the purpose of estimating toll-related capital costs, these costs were divided into the capital costs of fixed assets and of semi-fixed assets. Fixed assets are assets with a significant life such as buildings, structures, earthworks, pavement layers, etc., whereas semi-fixed assets refer to assets with a shorter life-span such as toll systems, air-conditioning, UPS units, etc.

The application of estimated unit costs for fixed and semi-fixed toll plaza assets to the numbers of required toll lanes determined in the study yielded the estimated capital costs in millions of June 2009 Maloti, as indicated in Table EXEC 6-3 below. It should be noted that the capital costs indicated in Table EXEC 6-3 will have to be incurred 8 years in advance of the design year. In the case of the 2019 design year, the cost would have to be incurred prior to the toll road opening.

Table EXEC 6-3: Possible Lesotho Toll Corridors: Toll Related Capital Cost per Toll Section (Millions of June 2009 Maloti)

Toll Section	Lane Requirement (2019 Design Year)		Lane Requirement (2027 Design Year)		Lane Requirement (2035 Design Year)		Lane Requirement (2043 Design Year)	
Cost Type	Fix	Semi-fix	Fix	Semi-fix	Fix	Semi-fix	Fix	Semi-fix
Maputsoe - Teya-Teyaneng	M 44	M 6.5	-	M 5.2	M 8	M 6.2	M 8	M 6.0
Maseru – Teya-Teyaneng	M 44	M 6.5	M 8	M 6.2	M 8	M 7.0	M 8	M 6.9
Mazenod – Roma	M 52	M 7.5	M 8	M 6.0	-	M 7.0	M 8	M 6.9
Mazenod –	M 52	M 7.5	M 8	M 7.0	M 8	M 7.8	M 8	M 7.7

Toll Section	Lane Requirement (2019 Design Year)		Lane Requirement (2027 Design Year)		Lane Requirement (2035 Design Year)		Lane Requirement (2043 Design Year)	
Cost Type	**Fix**	**Semi-fix**	**Fix**	**Semi-fix**	**Fix**	**Semi-fix**	**Fix**	**Semi-fix**
Morija								
Morija – Mafeteng	M 44	M 6.5	M 8	M 6.2	-	M 6.0	M 8	M 6.0
Mafeteng – Mohale's Hoek	M 36	M 6.0	-	M 5.3	M 8	M 5.2	-	M 5.2
TOTAL COST	M 272	M 40.5	M 32	M 35,9	M 32	M 39.2	M 40	M 38.7

6.2.2 Annual toll-related operating and maintenance costs

The annual toll-related operating and maintenance costs were estimated by using the tendered toll-related operating and maintenance costs of a comparable South African toll plaza. Table EXEC 6-4 below summarises the annual plaza operating costs (in June 2009 Maloti) for the 6 toll corridors.

Table EXEC 6-4: Possible Lesotho Toll Corridors: Estimated Plaza Operating Costs (Millions of June 2009 Maloti)

Possible Toll Section	Lane Requirement (2019 Design Year)	Lane Requirement (2027 Design Year)	Lane Requirement (2035 Design Year)	Lane Requirement (2043 Design Year)
Maputsoe - Teya-Teyaneng	M 3,0	M 3,0	M 3,3	M 3,6
Maseru – Teya-Teyaneng	M 3,0	M 3,3	M 3,6	M 3,9
Mazenod – Roma	M 3,3	M 3,6	M 3,6	M 3,9
Mazenod – Morija	M 3,3	M 3,6	M 3,9	M 4,2
Morija – Mafeteng	M 3,0	M 3,3	M 3,3	M 3,6
Mafeteng – Mohale's Hoek	M 2,7	M 2,7	M 3,0	M 3,0

7. FINANCIAL EVALUATION

7.1 Financial Feasibility Concepts : The LSR model

The primary objective of the application of the LSR (Loan Supportable by Revenue) model is to perform financial evaluations of potential and existing toll authority toll roads, i.e. toll roads for which the funding is procured directly by the toll authority in the capital and money markets or from Government.

More specifically, the financial model, inter alia, determines the so-called LSR (Loan Supportable by Revenue) of a toll project. The LSR is defined as the present value of the capital and/or money market loans or other loans that a toll project will be able to service and repay from its nett revenue during a selected evaluation period.

Other objectives of the model are:

- To provide the annual debt service cover ratios for each year of the project life, i.e. the ratio between the annual nett toll income and the required interest payments on loans. The ability of a toll project to service its loans from either its first year of operation or within its first 5 years (at the very least) is a very important test of financial viability.
- To provide the predicted capital and money market and/or other debt levels at the end of each financial year in order to put the toll authority in a position where it can predict its likely annual debt and, where necessary, can obtain authorisation for additional debt from the relevant authority.

7.2 Four Scenarios Investigated

The following scenarios were investigated from a financial feasibility point of view:

Scenario 1: The "Resealing and Initial Plaza Construction" Scenario

In this scenario, it was assumed that significant costs such as the initial road upgrading costs and subsequent road rehabilitation costs would be funded from external sources such as the Government of Lesotho and/or its development partners and that these "investments" would not have to be paid back by the projects from nett toll revenue. The implication of this approach is that the projects would have to fund the following costs from nett toll revenue (after plaza operating costs):

- Initial plaza construction costs
- Future plaza expansion costs
- Routine road maintenance costs
- Road resealing costs.

As far as the funding of the above-mentioned costs are concerned, it was assumed that it would be possible for the Lesotho Road Fund to borrow for this purpose, and that there was no specific monetary limit for loans that has to be adhered to. The required loans would then be serviced and repaid from nett toll revenue. The financial discipline imposed in this analysis is that the debt service cover ratio should be more than 1,0 as from the first year after plaza construction, i.e. that the project should be capable of paying the interest upon its loans from the first year of operation.

Scenario 2: The "Resealing" Scenario

In this scenario, it was assumed that, apart from significant costs like the initial road upgrading costs and subsequent road rehabilitation costs, the initial toll plaza construction costs would also be funded from external sources such as the Government of Lesotho and/or its development partners in order to achieve the objective that no debt should be allowed in this scenario. This implies that a fund should be built up from nett toll revenue (after plaza operating costs) for the funding of the resealing costs when required after 9 years of operation. The objective of these changes is to create a self-funding system for the funding of the following costs from nett toll revenue (after plaza operating costs) without incurring any debt:

- Future plaza expansion costs
- Routine road maintenance costs
- Road resealing costs.

The financial discipline imposed in this analysis is that no debt will be allowed and that nett toll revenue should be "saved" in order to build up a fund to pay for road resealing when it is required.

Scenario 3: The "Rehabilitation and Resealing" Scenario

In this scenario, it was assumed that the only significant cost to be funded from external sources, i.e. the Lesotho Government and its development partners, would be initial plaza construction costs and initial road upgrading costs. It was, furthermore, considered that no debt should be allowed in this scenario, i.e. a fund should be built up from nett toll revenue (after plaza operating costs) for the funding of the resealing and rehabilitation costs when required. The objective of these measures is to create a self-funding system for the funding of the following costs from nett toll revenue (after plaza operating costs) without incurring any debt:

- Future plaza expansion costs
- Routine road maintenance costs
- Road resealing costs
- Road rehabilitation costs.

The financial discipline imposed in this analysis is that no debt will be allowed and that nett toll revenue should be "saved" in order to build up a fund to pay for road resealing and road rehabilitation when it is required.

Scenario 4: Self-funding Toll Project

The possible A2 toll road sections between Mazenod and Morija and between Morija and Mafeteng were selected as the first potential candidates for this approach in view of the significant upgrading of these sections at a cost of €19,7 million. It could be argued that these road sections are, after their upgrading, truly of "toll road standard". In this scenario, it is assumed that the possible toll sections should eventually be self-funding in that, apart from covering all other costs, it should also repay the loan incurred for its original construction, i.e. the above-mentioned €19,7 million loan. The implication of this approach is that the project would have to fund the following costs from nett toll revenue (after plaza operating costs):

- Initial road upgrading costs
- Initial plaza construction costs
- Future plaza expansion costs
- Road resealing costs
- Road rehabilitation costs
- Routine road maintenance costs.

As far as the funding of the above-mentioned costs are concerned, it was assumed that it would be possible for the Lesotho Road Fund to borrow for this purpose, and that there was no specific monetary limit for loans that has to be adhered to. The required loans would then be serviced and repaid from nett toll revenue. The financial discipline imposed in this analysis is that the debt service cover ratio should be more than 1,0 as from the first year after plaza construction, i.e. that the project should be capable of paying the interest upon its loans from the first year of operation.

Table EXEC 7-1 provides a summary of the features of the four scenarios.

Table EXEC 7-1: Scenarios Considered in Financial Evaluation

Scenario No.	External investments	Costs to cover from nett toll revenue (after plaza operating cost)	Max loan	Financial discipline
1. Resealing and Initial Plaza Construction Scenario	Road rehabilitation costs Initial road upgrading costs	• Initial plaza construction • Future plaza expansions • Routine road maintenance • Road resealing	No limit	DSCR > 1,0 year after plaza construction
2. Resealing Scenario	Initial plaza construction costs Road rehabilitation costs Initial road upgrading costs	• Future plaza expansions • Routine road maintenance • Road resealing	Zero	No debt Nett toll revenue "saved" to cover indicated costs
3. Rehabilitation and Resealing Scenario	Initial plaza construction costs Road rehabilitation costs Initial road upgrading costs	• Future plaza expansions • Routine road maintenance • Road resealing • Road rehabilitation	Zero	No debt Nett toll revenue "saved" to cover indicated costs
4. Self-funding Toll Project Scenario - Applied in respect of A2 Mazenod - Mafeteng	No external investment or External investment repaid	• Initial road upgrading • Initial plaza construction • Road resealing • Road rehabilitation • Future plaza expansions • Routine road maintenance	No limit	DSCR > 1 in year 5 of operation or DSCR >1 in year 1 of operation

7.3 Financial Results of Scenario 1: The Resealing and Initial Plaza Construction Scenario

Table EXEC 7-2 provides a summary of the financial results of Scenario 1 for the six toll sections, while Figure EXEC 7-1 provides a graphical presentation of the predicted debt levels of Scenario 1 for the six toll sections. The conclusions that may be drawn from Table EXEC 7-2 and Figure EXEC 7-1 are presented in the following sub-sections:

7.3.1 Ability to fund resealing and initial plaza construction cost

The loans supportable by revenue (LSRs) in Table EXEC 7-2 indicate the present values of future nett revenue that will be available to fund the initial plaza construction costs, after already having made provision in the LSR analysis for the subtraction of future plaza expansion costs, routine road maintenance costs and road resealing costs.

TABLE EXEC 7-2: FINANCIAL SCENARIO 1 - RESEALING AND INITIAL PLAZA CONSTRUCTION SCENARIO							
Toll Section	LSR (in June 2009 Maloti)	Year DSCR > 1	Maximum Debt	Year of maximum Debt	Year of Debt Repayment	Toll Collection Cost as % of Gross Toll Revenue	Light Vehicle Toll Tariff (c/Km)
1. Teyateyaneng - Maputsoe	M 106.40 Million	2011/2012	M 59.92 Million	2019/2020	2024/2025	38.34%	0.20
2. Maseru - Teyateyaneng	M 95.40 Million	2011/2012	M 79.40 Million	2019/2020	2025/2026	41.33%	0.15
3. Mazenod - Roma	M 122.58 Million	2011/2012	M 72.38 Million	2019/2020	2024/2025	40.90%	0.32
4. Mazenod - Morija	M 114.90 Million	2011/2012	M 75.15 Million	2019/2020	2024/2025	43.54%	0.15
5. Morija - Mafeteng	M 102.51 Million	2011/2012	M 75.30 Million	2019/2020	2025/2026	39.59%	0.23
6. Mafeteng - Mohale's Hoek	M 90.89 Million	2011/2012	M 63.40 Million	2019/2020	2024/2025	34.34%	0.25

Table EXEC 7-2: Financial Scenario 1 – Resealing and Initial Plaza Construction Scenario

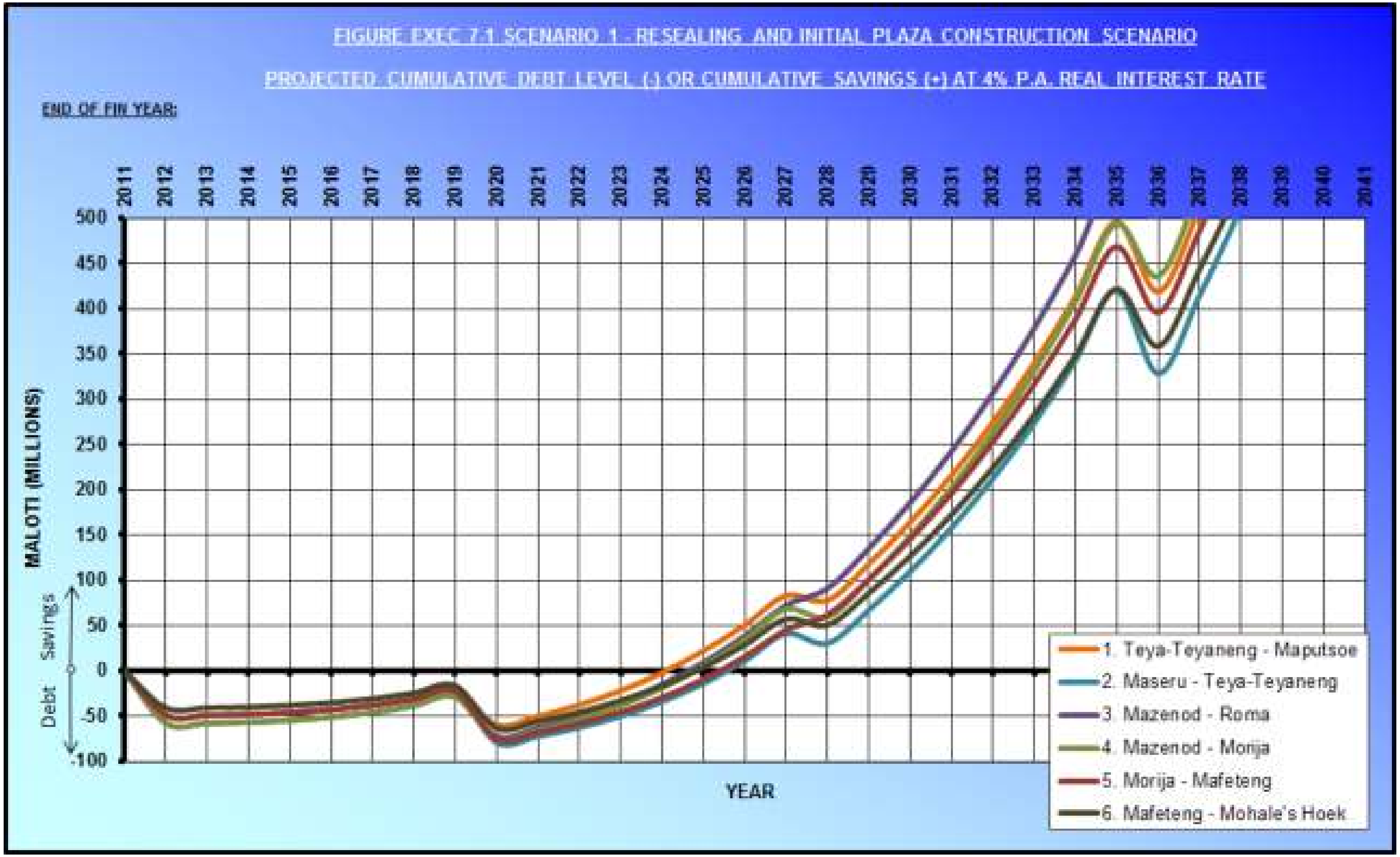


Figure EXEC 7-1: Scenario 1– Resealing and Initial Plaza Construction Scenario

Table EXEC 7-3 provides a comparison of the available LSRs and required Initial Plaza Construction Costs (IPCC) of the six potential toll sections.

Table EXEC 7-3: Scenario 1: Comparison of LSRs and Initial Plaza Construction Costs (IPCC)

Possible Toll Section	LSR	IPCC	LSR/IPCC
1. Maputsoe - Teya-Teyaneng	M106,4 m	M43,7 m	2,43
2. Teya-Teyaneng - Maseru	M95,4 m	M43,7 m	2,18
3. Mazenod – Roma	M122,6 m	M51,7 m	2,37
4. Mazenod – Morija	M114,9 m	M51,7 m	2,22
5. Morija – Mafeteng	M102,5 m	M43,7 m	2,35
6. Mafeteng – Mohale's Hoek	M90,9 m	M35,7 m	2,55

It can be concluded from Table EXEC 7-3 that the LSRs of the various toll sections (i.e. the present values of future nett revenue) are more than adequate to fund the initial plaza construction costs of the various toll sections. Please note, once again, that the LSR represents the present value of future nett revenue after provision has already been made for, inter alia, road resealing costs.

7.3.2 Debt levels and debt repayment

As far as the debt levels and repayment of debt are concerned, it can be concluded (from Table EXEC 7-2 and Figure EXEC 7-1) that the maximum debt levels will be reached in 2019/20, i.e. during the year when all the resealing is allowed for in the financial model and that the maximum debt level per toll section would amount to about M60 million to M80 million with a total maximum debt for all 6 potential toll sections together of about M425 million in 2019/20. This debt is, however, predicted to then be repaid by 2025/26.

7.3.3 Toll tariffs

The proposed unrounded full toll tariffs (i.e. before any local user discount) for Scenario 1 are summarised in Table EXEC 7-4 below. In practice, these tariffs would be rounded to, for example, the nearest full Maloti. The tariffs for the three heavy vehicle classes are 2, 3 and 4 times the light vehicle tariff for classes 2, 3 and 4 respectively.

Table EXEC 7-4: Scenario 1 – Resealing and Initial Plaza Construction Scenario : Proposed Toll Tariffs (in 2009 Maloti)

Possible Toll Section	Proposed Toll Tariffs			
	Class 1	Class 2	Class 3	Class 4
Maputsoe - Teya-Teyaneng	M7,67	M15,35	M23,02	M30,69
Teya-Teyaneng - Maseru	M6,20	M12,40	M18,60	M24,80
Mazenod – Roma	M5,88	M11,76	M17,64	M23,52
Mazenod – Morija	M4,46	M8,91	M13,37	M17,83
Morija – Mafeteng	M8,02	M16,03	M24,05	M32,07
Mafeteng – Mohale's Hoek	M11,55	M23,10	M34,65	M46,21

The above-mentioned proposed light vehicle toll tariffs for Scenario 1 for the six possible toll sections vary between 15c and 25c per km with the A5 Mazenod – Roma Section being an outlier at 32c per km (See Table EXEC 7-2). These light vehicle toll tariffs are still significantly below the average light vehicle tariffs of about 35c per km on South African toll roads in 2009 which is considered as a kind of a benchmark that should not be exceeded.

7.3.4 The cost of toll collection

Table EXEC 7-2 also indicates the toll collection cost as a percentage of gross toll revenue for Scenario 1 for each possible toll section. More specifically, this represents the present value of all toll-related capital, operating and maintenance costs (i.e. including initial plaza construction costs, future plaza expansion costs, semi-fixed toll plaza asset costs and toll plaza operating and maintenance costs) as a percentage of the present value of gross toll revenue, with all present values being determined by the predicted inflation rate being applied as a discount rate to the nominal future revenue and expenditure figures.

As can be concluded from Table EXEC 7-2, the present values of toll collection costs as percentages of the present values of gross revenues vary between about 34% and 44% for Scenario 1 which are quite high percentages.

7.3.5 Conclusions

Since the cash flow of each of the toll sections after 2024/25 or 2025/26, the years of debt repayment, is predicted to become very positive, it would appear to be an under-utilisation of the potential revenue of the toll sections at the tariff levels in sub-section 7.3.3 above to only fund the cost items included in Scenario 1.

It is, therefore, considered that more expenditure such as rehabilitation expenditure should be funded by the toll revenue in order to fully explore the potential of tolling and this alternative is further explored in Scenario 3. This funding will require higher toll tariffs than those determined for Scenario 1, but as is indicated in sub-section 7.3.3 above, the Scenario 1 tariffs are still significantly below the average South African light vehicle tariffs.

7.4 Financial Results of Scenario 2: The Resealing Scenario

It should be noted, once again, that the financial discipline imposed in Scenario 2 is that no debt whatsoever will be incurred and that all nett toll revenue after toll-related semi-fixed asset costs and annual operating costs will be "saved" to cover future resealing costs.

Table EXEC 7-5 provides a summary of the financial results of Scenario 2 for the six toll sections, while Figure EXEC 7-2 provides a graphical presentation of the predicted debt levels of Scenario 2 for the six toll sections. The conclusions that may be drawn from Table EXEC 7-5 and Figure EXEC 7-2 are presented in the following sub-sections:

7.4.1 Ability to fund resealing costs

The loans supportable by revenue (LSRs) in Table EXEC 7-5 indicate the present values of future nett revenue that will be available, after already having made provision in the LSR analysis for the subtraction of future plaza expansion costs, routine road maintenance costs and road resealing costs.

7.4.2 Positive cash flow

Since the semi-fixed toll plaza assets to be supplied require expenditure of M6,5 million – M7,5 million (in 2009 Maloti) per toll plaza over and above the plaza operating costs during the first year of operation, toll tariffs have to be set at levels a bit higher than those required to fund only toll operations and routine road maintenance in order not to incur any debt. With the underlying assumption that these tariffs would increase at the inflation rate, the predicted cash flows grow by so much that the resealing expenditure in 2019/20 can easily be funded from the built-up positive cash flow (See Figure EXEC 7-2).

TABLE EXEC 7-5: FINANCIAL SCENARIO 2 - RESEALING SCENARIO							
Toll Section	**LSR (in June 2009 Maloti)**	**Year DSCR > 1**	**Maximum Debt**	**Year of maximum Debt**	**Year of Debt Repayment**	**Toll Collection Cost as % of Gross Toll Revenue**	**Light Vehicle Toll Tariff (c/Km)**
1. Teyateyaneng - Maputsoe	M 182.86 Million	N/A	N/A	N/A	N/A	24.17%	0.26
2. Maseru - Teyateyaneng	M 172.01 Million	N/A	N/A	N/A	N/A	26.60%	0.20
3. Mazenod - Roma	M 207.72 Million	N/A	N/A	N/A	N/A	25.11%	0.42
4. Mazenod - Morija	M 200.10 Million	N/A	N/A	N/A	N/A	27.19%	0.20
5. Morija - Mafeteng	M 178.79 Million	N/A	N/A	N/A	N/A	24.97%	0.29
6. Mafeteng - Mohale's Hoek	M 171.50 Million	N/A	N/A	N/A	N/A	21.22%	0.34

N/A - Not Applicable.

Table EXEC 7-5: Financial Scenario 2 – Resealing Scenario

Figure EXEC 7-2: **Scenario 2 – Resealing Scenario**

As far as the positive cash flow levels are concerned, it can therefore be concluded (from Figure EXEC 7-2) that no debt will be incurred and that the surplus (savings) will reach about R500 million for each toll section within 18-20 year after the start of operation, if toll tariffs are increased annually at the inflation rate, even after having funded the required resealing of the toll sections in 2019/20.

7.4.3 Toll tariffs

The proposed unrounded full toll tariffs (i.e. before any local user discount) for Scenario 2 are summarised in Table EXEC 7-6 below. In practice, these tariffs would be rounded to, for example, the nearest full Maloti. The tariffs for the three heavy vehicle classes are 2, 3 and 4 times the light vehicle tariff for classes 2, 3 and 4 respectively.

Table EXEC 7-6: Scenario 2 – Resealing Scenario : Proposed Toll Tariffs (in 2009 Rand)

Possible Toll Section	Proposed Toll Tariffs			
	Class 1	Class 2	Class 3	Class 4
Maputsoe - Teya-Teyaneng	M10,00	M20,00	M30,00	M40,00
Teya-Teyaneng - Maseru	M8,05	M16,10	M24,15	M32,20
Mazenod – Roma	M7,74	M15,49	M23,23	M30,98
Mazenod – Morija	M5,86	M11,73	M17,59	M23,45
Morija – Mafeteng	M10,45	M20,90	M31,34	M41,79
Mafeteng – Mohale's Hoek	M15,41	M30,82	M46,23	M61,64

The above-mentioned proposed light vehicle toll tariffs for Scenario 2 for the six possible toll sections vary between 20c and 34c per km with the A5 Mazenod – Roma Section being an outlier at 42c per km (See Table EXEC 7-5). Except for Mazenod – Roma, these light vehicle toll tariffs are still below the average light vehicle tariffs of about 35c per km on South African toll roads (in 2009).

7.4.4 The cost of toll collection

Table EXEC 7-5 also indicates the toll collection cost as a percentage of gross toll revenue for Scenario 2 for each possible toll section. More specifically, this represents the present value of all toll-related capital, operating and maintenance costs (i.e. including initial plaza construction costs, future plaza expansion costs, semi-fixed toll plaza asset costs and toll plaza operating and maintenance costs) as a percentage of the present value of gross toll revenue, with all present values being determined by the predicted inflation rate being applied as a discount rate to the nominal future revenue and expenditure figures.

As can be concluded from Table EXEC 7-5, the present values of toll collection costs as percentages of the present values of gross revenues vary between about 21% and 27% for Scenario 2 which are in line with the higher percentages of some South African toll roads.

7.4.5 Conclusion

Since the cash flow of each of the toll sections after 2019/20, the years of funding resealing, is predicted to become very positive, it would appear to be an under-utilisation of the potential revenue of the toll sections at the tariff levels in sub-section 7.4.3 above to only fund the cost items included in Scenario 2.

It is, therefore, considered that more expenditure such as rehabilitation expenditure should be funded by the toll revenue in order to fully explore the potential of tolling and this alternative is further explored in Scenario 3. This funding will require similar or slightly higher toll tariffs than those determined for Scenario 2, but as is indicated in sub-section 7.4.3 above, the Scenario 2 tariffs are still mostly somewhat below the average South African light vehicle tariffs.

7.5 Financial Results of Scenario 3: The Rehabilitation and Resealing Scenario

Table EXEC 7-7 provides a summary of the financial results of Scenario 3 for the six toll sections, while Figure EXEC 7-3 provides a graphical presentation of the predicted debt levels of Scenario 3 for the six toll sections. The conclusions that may be drawn from Table EXEC 7-7 and Figure EXEC 7-3 are presented in the following sub-sections:

7.5.1 Ability to fund resealing and rehabilitation costs

The loans supportable by revenue (LSRs) in Table EXEC 7-7 indicate the present values of future nett revenue that will be available to fund the initial plaza construction costs, after already having made provision in the LSR analysis for the subtraction of future plaza expansion costs, routine road maintenance costs, road resealing costs and road rehabilitation costs.

TABLE EXEC 7-7: FINANCIAL SCENARIO 3 - REHABILITATION AND RESEALING SCENARIO							
Toll Section	LSR (in June 2009 Maloti)	Year DSCR > 1	Maximum Debt	Year of maximum Debt	Year of Debt Repayment	Toll Collection Cost as % of Gross Toll Revenue	Light Vehicle Toll Tariff (c/Km)
1. Teyateyaneng - Maputsoe	M 127.08 Million	N/A	N/A	N/A	N/A	23.14%	0.27
2. Maseru - Teyateyaneng	M 137.84 Million	N/A	N/A	N/A	N/A	23.75%	0.22
3. Mazenod - Roma	M 155.11 Million	N/A	N/A	N/A	N/A	25.11%	0.42
4. Mazenod - Morija	M 145.68 Million	N/A	N/A	N/A	N/A	27.19%	0.20
5. Morija - Mafeteng	M 118.72 Million	N/A	N/A	N/A	N/A	24.54%	0.30
6. Mafeteng - Mohale's Hoek	M 153.08 Million	N/A	N/A	N/A	N/A	17.59%	0.41

N/A - Not Applicable

Table EXEC 7-7: Financial Scenario 3 – Rehabilitation and Resealing Scenario

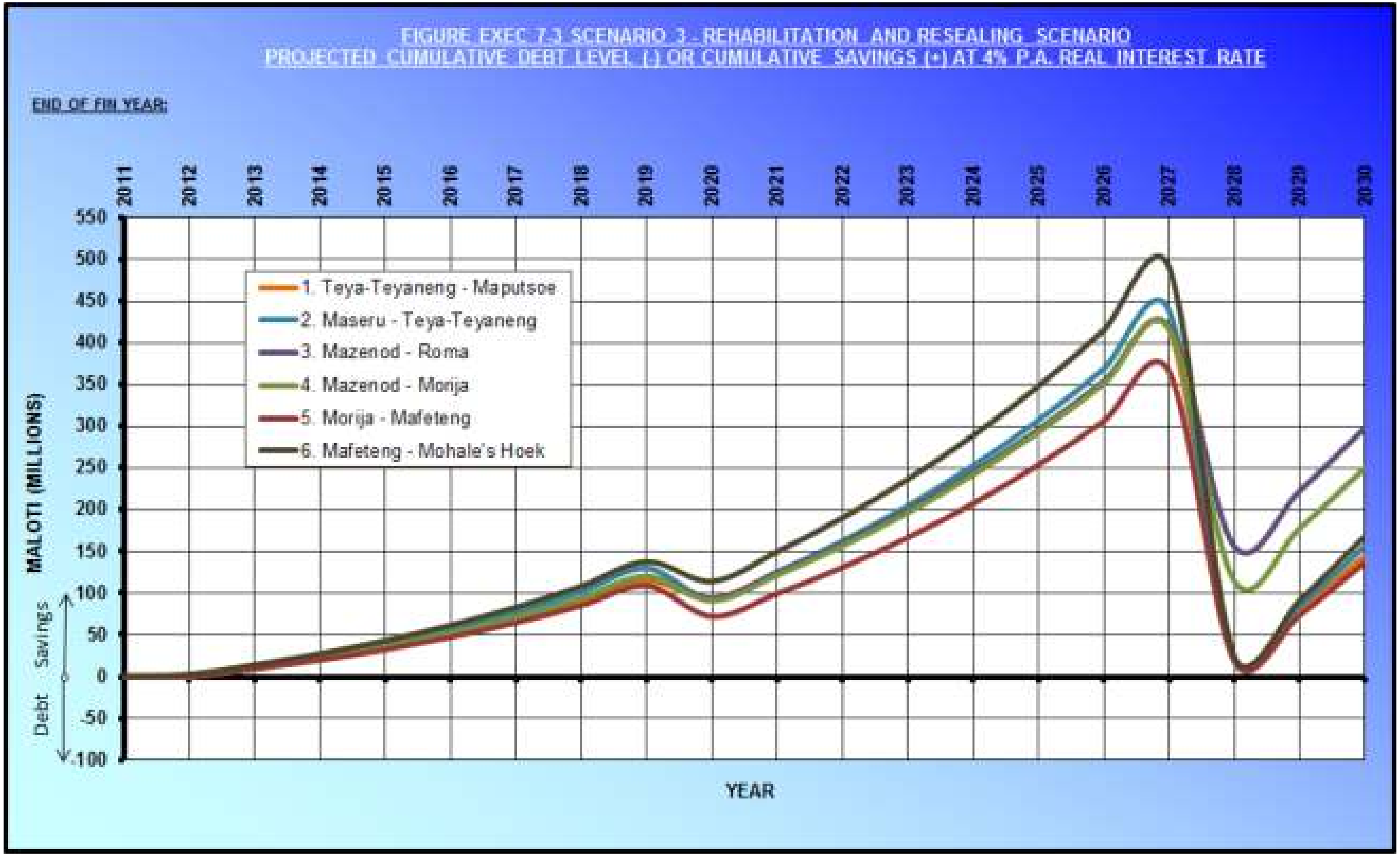


Figure EXEC 7-3: **Scenario 3 – Rehabilitation and Resealing Scenario**

7.5.2 Application of Positive Cash Flow

As can be observed in Figure EXEC 7-3, the build-up of positive cash flow for all six toll sections is such with this scenario that it can actually fund both its predicted resealing costs and its predicted rehabilitation costs over a 17 year period. After this period, a new build-up of cash would occur.

7.5.3 Toll tariffs

The proposed unrounded full toll tariffs (i.e. before any local user discount) for Scenario 3 are summarised in Table EXEC 7-8 below. In practice, these tariffs would be rounded to, for example, the nearest full Maloti. The tariffs for the three heavy vehicle classes are 2, 3 and 4 times the light vehicle tariff for classes 2, 3 and 4 respectively.

Table EXEC 7-8: Scenario 3 – Rehabilitation and Resealing Scenario : Proposed Toll Tariffs (in 2009 Maloti)

Possible Toll Section	Proposed Toll Tariffs			
	Class 1	Class 2	Class 3	Class 4
1. Maputsoe - Teya-Teyaneng	M10,46	M20,91	M31,37	M41,83
2. Teya-Teyaneng - Maseru	M9,05	M18,10	M27,14	M36,19
3. Mazenod – Roma	M7,74	M15,49	M23,23	M30,98
4. Mazenod – Morija	M5,86	M11,72	M17,57	M23,43
5. Morija – Mafeteng	M10,63	M21,26	M31,89	M42,52
6. Mafeteng – Mohale's Hoek	M18,58	M37,17	M55,75	M74,33

The above-mentioned proposed light vehicle toll tariffs for Scenario 3 for the six possible toll sections vary between 20c and 30c per km with the A5 Mazenod – Roma Section and the A2 Mafeteng – Mohale's Hoek Sections being outliers at 42c and 41c per km respectively (See Table EXEC 7-7). Except for these two sections, these light vehicle toll tariffs are still somewhat below the average light vehicle tariffs of about 35c per km on South African toll roads (in 2009).

7.5.4 The cost of toll collection

Table EXEC 7-7 also indicates the toll collection cost as a percentage of gross toll revenue for Scenario 3 for each possible toll section. More specifically, this represents the present value of all toll-related capital, operating and maintenance costs (i.e. including initial plaza construction costs, future plaza expansion costs, semi-fixed toll plaza asset costs and toll plaza operating and maintenance costs) as a percentage of the present value of gross toll revenue, with all present values being determined by the predicted inflation rate being applied as a discount rate to the nominal future revenue and expenditure figures.

As can be concluded from Table EXEC 7-7, the present values of toll collection costs as percentages of the present values of gross revenues vary between about 18% and 27% for Scenario 3 which are in line with the more expensive South African toll roads.

7.5.5 Conclusion

This scenario is a classic example of how toll financing could be applied without incurring debt to provide for ("save for") future road resealing and rehabilitation expenditure. The most significant challenge will probably be to ensure that the nett toll revenue being saved could be safeguarded against other applications prior to its application for resealing and rehabilitation respectively.

7.6 Financial Results of Scenario 4: The Self-funding Toll Project Scenario

This scenario was only investigated for the two recently upgraded sections on the A2, i.e. Mazenod – Morija and Morija – Mafeteng in respect of which €19,7 million was spent on the upgrading of these road sections.

Table EXEC 7-9 provides a summary of the financial results of Scenario 4 for the two toll sections, while Figure EXEC 7-4 provides a graphical presentation of the predicted debt levels of Scenario 4 for the two toll sections. The conclusions that may be drawn from Table EXEC 7-9 and Figure EXEC 7-4 are presented in the following sub-sections:

7.6.1 Ability to fund all project costs

The loans supportable by revenue (LSRs) in Table EXEC 7-9 indicate the present values of future nett revenue that will be available to fund all project costs, after already having made provision in the LSR analysis for the subtraction of future plaza expansion costs, routine road maintenance costs, road resealing costs and road rehabilitation costs.

TABLE EXEC 7-9: FINANCIAL SCENARIO 4 - SELF-FUNDING TOLL PROJECT SCENARIO							
Toll Section	LSR (in Millions of June 2009 Maloti)	Year DSCR > 1	Maximum Debt	Year of maximum Debt	Year of Debt Repayment	Toll Collection Cost as % of Gross Toll Revenue	Light Vehicle Toll Tariff (c/Km)
4. Mazenod - Morija	M 307.60 Million	2011/2012	M 148.02 Million	2010/2011	2022/2023	23.07%	0.28
5. Morija - Mafeteng	M 323.04 Million	2011/2012	M 156.51 Million	2010/2011	2022/2023	18.75%	0.48

Table EXEC 7-9: Financial Scenario 4 – Self-Funding Toll Project Scenario

Figure EXEC 7-4: **Scenario 4 – Self-Funding Toll Project Scenario**

Table EXEC 7-10 provides a comparison of the available LSRs and required Initial Capital Costs (ICC) of the two potential toll sections.

Table EXEC 7-10: Scenario 4: Comparison of LSRs and Initial Capital Costs (ICC)

Possible Toll Section	LSR	IPCC	LSR/ICC
Mazenod – Morija	M307,6 m	M140,9 m	2,18
Morija – Mafeteng	M323,0 m	M149,0 m	2,17

It can be concluded from Table EXEC 7-10 that the LSRs of the two toll sections (i.e. the present values of future nett revenue) are more than adequate to fund all the project costs of the two toll sections. Please note, once again, that the LSR represents the present value of future nett revenue after provision has already been made for, inter alia, road rehabilitation and resealing costs.

7.6.2 Debt levels and debt repayment

As far as the debt levels and repayment of debt is concerned, it can be concluded (from Table EXEC 7-9 and Figure EXEC 7-4) that the maximum debt levels will be reached in 2010/11, i.e. at the end of the year before toll collection starts and that the maximum debt level would amount to about M148 million for the A2 Mazenod – Morija section and to M157 million for the A2 Morija – Mafeteng section. This debt is, however, predicted to then be repaid by 2022/23.

7.6.3 Toll tariffs

The proposed unrounded full toll tariffs (i.e. before any local user discount) for Scenario 4 are summarised in Table EXEC 7-11 below. In practice, these tariffs would be rounded to, for example, the nearest full Maloti. The tariffs for the three heavy vehicle classes are 2, 3 and 4 times the light vehicle tariff for classes 2, 3 and 4 respectively.

Table EXEC 7-11: Scenario 4 – Self-funding Toll Project Scenario : Proposed Toll Tariffs (in 2009 Rand)

Possible Toll Section	Proposed Toll Tariffs			
	Class 1	Class 2	Class 3	Class 4
1. Mazenod – Morija	M8,36	M16,72	M25,08	M33,44
2. Morija – Mafeteng	M17,15	M34,30	M51,45	M68,60

The above-mentioned proposed light vehicle toll tariffs for Scenario 4 for the two possible toll sections amount to 28c per km for the A2 Mazenod – Morija section and to 48c per km for the A2 Morija – Mafeteng section. In order to bring these tariffs in line with the light vehicle tariffs of about 35c per km on South African toll roads in 2009, it may be advisable to decrease the A2 Morija - Mafeteng tariffs and to increase the A2 Mazenod – Morija tariffs to an equal tariff per km.

7.6.4 The cost of toll collection

Table EXEC 7-9 also indicates the toll collection cost as a percentage of gross toll revenue for Scenario 4 for each of the two toll sections. More specifically, this represents the present value of all toll-related capital, operating and maintenance costs (i.e. including initial plaza construction costs, future plaza expansion costs, semi-fixed toll plaza asset costs and toll plaza operating and maintenance costs) as a percentage of the present value of gross toll revenue, with all present values being determined by the predicted inflation rate being applied as a discount rate to the nominal future revenue and expenditure figures.

As can be concluded from Table EXEC 7-9, the present values of toll collection costs as percentages of the present values of gross revenues are about 19% and 23% respectively for Scenario 4. These percentages are in line with those of the more expensive South African toll roads.

7.6.5 Conclusion

It is clear from the above analysis that it would be possible for the A2 Mazenod – Morija and the A2 Morija – Mafeteng road sections to be self-funding, including servicing and repaying the "loans" to the projects by the Lesotho Government for the upgrading of the projects.

8. ECONOMIC EVALUATION

8.1 Alternatives

The 62,3 km of the A2 from Masianokeng to Mafeteng was selected for an economic evaluation, since these two toll corridors have been upgraded to the level of service of a toll road. The road consists of a single lane in each direction and has surfaced shoulders and there are passing lanes in strategic places. The speed limit on the road varies between 50 kilometres per hour and 80 kilometres per hour, with the speed limit being 50 kilometres per hour for long stretches.

Four alternatives were evaluated from an economic evaluation perspective, namely:

- The 'do-nothing' alternative where the road is not tolled but is also not maintained. The verges are not cleared, road markings are not painted and pot holes are left unattended.
- The road could be tolled purely for routine maintenance. The maintenance includes ensuring that the verges are cut on a regular basis, painted markings on the road are kept in good condition and pot holes are filled.
- The road could be tolled for maintenance, resealing and rehabilitation. The resealing and rehabilitation would consist of one resealing and one rehabilitation during a 20 year life-cycle.
- A further case was also evaluated where the road could be tolled for maintenance, resealing and rehabilitation as well as paying off the cost of the Initial Capital Works (ICW) which was funded by the Lesotho Government.

8.2 Limitations and Assumptions

The analysis was subject to a number of limitations and as a result a variety of assumptions had to be made. Some of the assumptions are based on experience in Southern Africa and it is considered that these assumptions can be used in the Lesotho context. There are, however, some assumptions that are project and context specific. The two most important of these are travelling speeds and trip suppression. Travelling speeds are a function of road quality and congestion and will be lower if the road quality is allowed to decline but the exact extent to which this will occur is a matter of judgement. Trip suppression is a function of the toll charged and measuring trip suppression requires an extremely detailed traffic model. The higher the toll charged, the greater will be the trip suppression.

8.3 Results

The results of the cost benefit analysis are provided in Table EXEC 8-1.

Table EXEC 8-1: Results of the Cost Benefit Analysis

	Maintenance tolling	Maintenance, Resealing and Rehabilitation tolling	ICW, Maintenance, Resealing and Rehabilitation tolling
PV Costs (Mm)	197.5	269.6	434.9
PV Benefits (Mm)	213.4	500.4	1 761.5
NPV (Mm)	15.9	230.8	1 326.6
BCR	1.08	1.86	4.05
IRR	9%	17%	47%

It was found that the maintenance only alternative is likely to have a present value (PV) of costs equal to M197.5m and of benefits of M213.4m. It, therefore, returns a net present value (NPV) of M15.9m. This alternative has a benefit cost ratio (BCR) of 1.08 and an internal rate of return (IRR) of 9% per annum. The fact that the BCR is only slightly larger than 1 means that this alternative is at breakeven point. Any marginal increase in costs would quickly make it economically inefficient.

The maintenance, resealing and rehabilitation alternative has an estimated PV of costs equal to M269.6m and of benefits of M500.4m. It, therefore, returns a NPV of M230.8m. This alternative has a BCR of 1.86 and an IRR of 17% per annum. The fact that the BCR is greater than one makes this an economically efficient alternative.

Finally the ICW, maintenance, resealing and rehabilitation tolling alternative has a PV of costs equal to M434.9m and benefits of M1 761.5m. It, therefore, returns a significant NPV of M1 326.6m. This alternative has a BCR of 4.05 and an IRR of 47% p.a. The fact that the BCR is greater than one makes this an economically very efficient alternative and the high BCR reinforces this conclusion.

The ICW, maintenance, resealing and rehabilitation alternative is clearly the most desirable of the three alternatives. It has the highest BCR, IRR and NPV. If it can correctly be argued that the funds used for the upgrading of the A2 were effectively a loan from the Lesotho Government to be serviced and repaid from the nett toll revenue (after operating costs) of the A2, then the ICW, maintenance. resealing and rehabilitation alternative could be regarded as economically the most efficient alternative. If the ICW, maintenance, resealing and rehabilitation alternative is not selected and a decision has to be made between the maintenance only alternative or the maintenance, resealing, rehabilitation & upgrade alternative, then the latter is the better choice.

8.4 Sensitivity Analysis

A sensitivity analysis was performed on five key components of the analysis:

8.4.1 Reduction in travelling speeds

One of the key assumptions in the analysis is the degree to which travelling speeds are reduced if the road is not maintained. Travelling speeds are currently estimated to be 61 kilometres per hour for light vehicles and 45 kilometres per hour for heavy vehicles. The assumption was made that speeds for light vehicles would be 20 kilometres per hour slower and for heavy vehicles would be 15 kilometres per hour slower by 2030 if the road is not maintained. It was found that:

- For maintenance tolling a slower travelling speed immediately makes the BCR less than one and renders that alternative economically undesirable. Higher travelling speeds increase the BCR but not by enough for this alternative to be anything but economically marginal.
- For maintenance, resealing and rehabilitation tolling it was found that while the results did vary with slower travelling speeds, this alternative did not switch from being economically efficient to inefficient.
- The same result holds for the alternative of having planned to toll for the ICW in addition to maintenance and rehabilitation.

The conclusion that is drawn from this sensitivity analysis is that the maintenance tolling alternative is very sensitive to changes in travelling speeds, whereas the other two alternatives are not.

8.4.2 Maintenance, resealing and rehabilitation costs

Changes in maintenance, resealing and rehabilitation costs were tested in the range for a level of cost which is 25% below the expected amount and up to one and a half times the expected amount. It was found that the maintenance tolling alternative is sensitive to small increases in the cost of maintenance while the other two alternatives remain economically efficient for as much as a 50% increase in costs.

8.4.3 Trip suppression

Trip suppression was varied from zero to a 15% trip suppression. The maintenance tolling alternative was sensitive to these changes. The results did not switch from being economically efficient to inefficient for the other two alternatives.

The conclusion that is drawn is that only the maintenance tolling alternative is sensitive to marginal changes in trip suppression.

8.4.4 Traffic Diversion

There is always some concern when roads are being considered for tolling that this might result in diversion off the tolled roads onto the rest of the road network. In this case it is considered unlikely that traffic would divert onto alternative routes purely because of the length of these alternative routes. The additional fuel cost alone would be more than the proposed toll tariffs. For the sake of completeness an analysis was, however, done on the potential impact of some of the traffic diverting onto the alternative routes. The range of traffic diversions that was tested in the sensitivity analysis was up to a maximum of a 5% diversion.

The analysis showed that although the results are sensitive to traffic diversion, the only option that became economically inefficient was the maintenance tolling option. This was an option that has always been marginal. The maintenance, resealing and rehabilitation tolling and ICW, maintenance, resealing and rehabilitation tolling options remain economically efficient with up to a 5% traffic diversion.

8.4.5 The Cost of Time

The cost of time was varied from M50 per hour to M200. It was found that the only case where the results changed from being economically efficient to inefficient was for the maintenance tolling alternative at a M100 per hour cost of time. The other two cases remained economically efficient.

The conclusion that is drawn is that, apart from the case mentioned above, the results of the analysis are not sensitive to marginal changes in the cost of time.

8.5 Overall Conclusion

The following conclusions for the tolling of the A2 between Masianokeng and Mafeteng are drawn from the analysis:

The maintenance tolling alternative is economically marginal and extremely sensitive to changes in key assumptions. This alternative should not be adopted.

The maintenance, resealing and rehabilitation alternative is economically efficient and is not particularly sensitive to reasonable changes in key assumptions.

The ICW, maintenance, resealing and rehabilitation alternative is economically extremely efficient since it yields very good economic results and is not sensitive to reasonable changes in key assumptions. If it can correctly be argued that the funds used for the upgrading of the A2 were effectively a loan to the A2 project from the Lesotho Government to be serviced and repaid from the nett toll revenue (after operating costs) of the A2, then the ICW, maintenance, resealing and rehabilitation alternative could be regarded as economically the most efficient alternative.

8.6 Recommendations

As a result of the conclusions drawn above and additional socio-economic considerations, two recommendations are made:

- Before a final decision about tolling is taken, there needs to be an investigation into the affordability of tolling in these main road corridors of Lesotho.
- Depending upon an acceptable outcome of the investigation into the affordability of tolling in the main road corridors of Lesotho, it is recommended that, from an economic efficiency point of view, the following tolling options be implemented:
- as the most economically efficient option, the ICW, maintenance, resealing and rehabilitation tolling option should be the first choice purely from an economic efficiency point of view.
- if the toll tariffs associated with the previous option are not regarded as affordable, then it would still be economically efficient to implement the tolling option involving maintenance, resealing and rehabilitation.

9. PUBLIC SUPPORT FOR TOLLING AN UPGRADED ROAD

The roadside interviews in 2008 included a question to road users regarding whether they would support the tolling of the road that they were driving on, provided that the toll money is applied towards upgrading the road. Table EXEC 9-1 provides a summary of the responses from the roadside interviews in the various corridors.

Table EXEC 9-1: Responses to question regarding support for tolling an upgraded road

	Yes	No
A1 Maputsoe - Teya-Teyaneng	64,0%	36,0%
A1 Teya-Teyaneng - Maseru	50,1%	49,9%
A5 Mazenod - Roma	52,0%	48,0%
A2 Mazenod - Morija	63,5%	36,5%
A2 Morija - Mafeteng	62,8%	37,2%
A2 Mafeteng - Mohale's Hoek	69,2%	30,8%
TOTAL	**60,0%**	**40,0%**

As can be concluded from Table EXEC 9-1, 60% of road users interviewed supported tolling the roads, with slightly higher percentages south of Maseru where the roads had already been upgraded.

It can be concluded from the above-mentioned information that the public is likely to be very divided on the issue of tolling upgraded roads. It is, therefore, very important that a road should be upgraded prior to its tolling to demonstrate to the public the benefits made possible by tolling.

10. POTENTIAL FUNDING SOLUTION

Since the publication of the final draft of this report, it has become known that the Lesotho Government is not, at this time, inclined to fund the construction costs of the required toll facilities on the A2 Mazenod/Masianokeng - Mafeteng road sections where the upgrade of the road sections has already taken place and the road sections could, therefore, in theory be tolled in order to recover the initial upgrading costs and/or to provide funding for the future road rehabilitation, resurfacing and routine maintenance costs.

A possible solution in this situation is to outsource all the following functions to a single private sector consortium:

- funding of the initial capital costs for the construction of toll plazas and the procurement of a toll system
- construction of toll plazas
- procurement and installation of a toll system
- toll operations, including the collection and transfer of toll revenue to the Lesotho Road Fund/Roads Directorate
- repair and maintenance of the toll infrastructure and the toll system
- transfer of all the toll infrastructure and the toll system to the Lesotho Road Fund in good condition after 8-10 years.

Since the Lesotho Road Fund/Roads Directorate would want the toll infrastructure/toll system to be of a required standard at the time of transfer or in the event that a contractor/operator should become insolvent and withdraw from the project, it is recommended that the Lesotho Road Fund/Roads Directorate should appoint consultants to specify and design the required toll infrastructure and the toll system as well as prepare the required tender documentation and adjudicate the tender submissions.

The likely success of this proposed FUND-BUILD-OPERATE-TRANSFER (F-BOT) approach will be very dependent upon the following factors:

- the degree of assurance that the Lesotho Government could provide to the potential F-BOT consortium that all legal and public participation processes to facilitate tolling have been completed and that tolling of the project is, therefore, irreversible
- an acceptable guarantee of re-imbursement for costs incurred to construct a toll plaza/procure a toll system in the event of the toll project being terminated by the Lesotho Government
- the right should ideally be given to the consortium to subtract the monthly interest and repayment in respect of the toll infrastructure and toll system loans funded by them from the monthly gross revenue payable to the Lesotho Road Fund
- payment to the consortium for toll collection services should, however, not be subtracted by the consortium and should be subject to performance penalties before payment by the Lesotho Road Fund/Roads Directorate for these services takes place.

11. CONCLUSIONS AND RECOMMENDATIONS

11.1 Legal/Institutional Recommendations

The following recommendations are made:

11.1.1 It is recommended that legislation be amended so that only one functionary will have the power to declare toll roads. In order to ensure political accountability, it is recommended that this power should rest with the Minister of Finance who would do so either at the joint recommendation of the Road Fund and the Roads Directorate or at the recommendation of the Road Fund only, bearing in mind that the Fund is responsible for funding matters.

11.1.2 The Road Fund Board should create special accounts within the Road Fund for the purpose of ring-fencing the toll funds related to a specific toll corridor and these funds should be managed in terms of a tri-partite agreement between the Road Fund, the Roads Directorate and the Minister of Finance. The agreement should provide for the saving of the net toll revenue in each toll corridor account for the future rehabilitation or resealing of the relevant toll corridor. The toll revenue would then be transferred to the Roads Directorate as and when the funds are required for the specific toll project.

11.1.3 It is recommended that provision be made that funds in these special toll corridor accounts that are being saved for future periodic road maintenance or rehabilitation or for toll-related infrastructure or system procurement, replacement or expansion purposes, should not be allowed to be removed from such a fund, but should be invested conservatively on behalf of the toll corridor. In order to create flexibility amongst toll corridors, it is recommended that toll corridors be allowed to borrow funds from each other, provided that these funds can be repaid when required by the toll corridor to which the funds belong, all subject to the approval of the Minister of Finance.

11.1.4 The fine of M50 for non-payment of toll should be revised. If the Act is amended, it would be advisable to provide that the maximum fine will be stipulated in regulations from time to time, to avoid having to amend the Act each time the fine is revised.

11.1.5 Since the study recommends that electronic toll collection (ETC) should be used, amending legislation or just regulations will be needed for this purpose.

11.2 Recommendations related to Toll Strategy, the Definition of Toll Corridors and Local User Discounts

11.2.1 Before commencement of tolling, a toll corridor should be upgraded, ideally to the standard achieved in the two A2 Masianokeng - Mafeteng toll corridors in order to achieve public acceptance of the introduction of tolling.

11.2.2 It is recommended that, if it is decided to implement the toll corridors, the following definition of toll corridors be accepted:

- Route A1 between Maputsoe and Teya-Teyaneng.
- Route A1 between Teya-Teyaneng and Maseru.
- Route A5 between A2 and Roma and Routes A5 and A3 between the A2 and Ntsi (tolled at the same mainline toll plaza).
- Route A2 between Mazenod/Masianokeng and Morija.
- Route A2 between Morija and Mafeteng.
- Route A2 between Mafeteng and Mohale's Hoek.

11.2.3 It is also recommended that local user discounts should be provided to communities (traffic streams) not using the full distance of the defined toll sections, as detailed in the following sub-sections of the Executive Summary: 4.3, 4.4, 4.5, 4.6, 4.7 and 4.8. In the event that different toll plaza locations are selected, the required local user discounts should be redefined.

11.3 Toll Infrastructure and Equipment

It is recommended that:

- Once a decision is taken to proceed with tolling, a toll plaza location study should be undertaken for each selected toll corridor. Such a study should compare alternative locations from a geometric, operational, tolling equitability and financial point of view.
- In view of the importance of minimising travel delays, Electronic Toll Collection (ETC) should be introduced into the payment methods available in toll plaza lanes. Once the ETC market share has built up adequately, a non-stop ETC lane in a direction of travel could be introduced in order to delay/prevent the need for future toll plaza expansion.

11.4 Financial/Economic Recommendations

The most important conclusion that may be drawn is that, from both a financial and an economic point of view, the funding by means of tolls of maintenance and resealing only is significantly less efficient than the funding by means of tolls of maintenance, resealing, rehabilitation and upgrading. This conclusion is based upon the relatively high cost of toll collection as a percentage of toll revenue (financial analysis) and the relatively lower benefit-cost ratio of the alternative involving maintenance only compared to the alternative involving maintenance, resealing, rehabilitation and upgrading (economic analysis).

It is, therefore, recommended that, in order to efficiently explore the financial and economic potential of toll financing whilst still charging toll tariffs that are lower than or in line with those charged in South Africa, toll financing should ideally fund routine road maintenance, resealing, rehabilitation and road upgrading costs, since such options yield the best financial and economic results.

As a second best option from the point of view of optimally exploring the financial and economic potential of toll financing, toll financing should at least fund routine road maintenance, resealing and rehabilitation in the identified toll corridors which have been shown to be economically and financially viable.

11.5 Need for Affordability and Macro-Economic Studies

As was identified at the Stakeholders' Workshop in March 2011, studies should be undertaken into the affordability of the proposed toll tariffs and also into the macro-economic impact of the planned tolling in order for the Lesotho Government to be able to better motivate the possible tolling decisions from a social and a macro-economic point of view.

11.6 Potential funding solution

In view of the likely non-availability of funds from the Lesotho Government at this time for the funding of toll plazas/toll systems on the A2 Masianokeng - Mafeteng road sections, it is recommended that the implementation of this toll project be undertaken by means of a FUND-BUILD-OPERATE-TRANSFER (F-BOT) contract in terms of which the contractor/operator undertakes the following functions:

- funding of the initial capital costs for the construction of toll plazas and the procurement of a toll system
- construction of toll plazas
- procurement and installation of a toll system
- toll operations, including the collection and transfer of toll revenue to the Lesotho Road Fund/Roads Directorate
- repair and maintenance of the toll infrastructure and the toll system
- transfer of all the toll infrastructure and the toll system to the Lesotho Road Fund in good condition after 8-10 years.

The above-mentioned approach could also be applied to the other potential toll corridors, provided that the funding of the road upgrading is available from other sources such as the Lesotho Government or development partner funding or a combination thereof.

11.7 Possible Need for Public-Private Partnership Study Extension

If there is an interest in the Road Fund or Lesotho Government to execute the development of the toll corridors by means of public-private partnerships (PPP) such as the one described in sub-section 11.6, a limited expansion of the study should be undertaken to define the work to be performed and the required contractual mechanisms as well as to indicate the financial (tariff) and other implications for each toll corridor of a PPP approach. The changes in toll tariffs compared to the current study would result from the required return on investment of private sector companies for the funding risk that they would be required to take.

1. INTRODUCTION

1.1 Scope of Services

The Lesotho Road Fund entered into an agreement with Tolplan (Pty) Ltd to investigate the legal, economic, financial, technical and operational feasibility of tolling certain corridors in Lesotho.

More specifically, the following scope of services was required by the Lesotho Road Fund in the "Request for Proposals":

"4 SCOPE OF SERVICES

4.1 Review of Road Pricing Structure

(i) Review current legislative/regulatory environment for charging usage of roads in Lesotho and assess their suitability for operation of toll roads in the interior of the country;

(ii) Review the current road pricing structure in Lesotho and make appropriate recommendations;

(iii) Review existing schemes in the world more specifically in developing countries;

(iv) Review the attitudes to road pricing for road maintenance cost recovery. This will involve some qualitative and quantitative research into attitudes;

(v) Review of potential impacts of road pricing on different social groups and the environment; and

(vi) Make recommendation on the most appropriate road pricing structure that will be transparent and easily understood by the road users and the general public.

4.2 Economic Feasibility

(i) Carry out traffic studies/forecast of selected corridors to assess the feasibility of tolling them;

(ii) To carry out a cost and benefit analysis of tolling the selected corridors;

(iii) To carry out an opinion survey to promote social inclusion and accessibility; and

(iv) Review the legislative and devolution issues to which tolling would impact on.

4.3 Financial Feasibility

(i) Explore different tolling strategies and scenarios and the potential cost of implementing a range of tolling schemes on selected corridors; These will include:

(a) Capital cost;

(b) Operational costs;

(c) Maintenance costs; and

(d) Replacement costs.

(ii) Examine the capability of the domestic financial markets for financing toll roads and suggest various measures to develop potential investments for the private sector; and

(iii) Develop a financing model.

4.4 Technical Feasibility

(i) Review the existing technologies and assess the direction and pace to technological developments;

(ii) Assess land acquisition requirements

(iii) Assess infrastructure and equipment requirements; and

(iv) Assess hardware and software requirements.

4.5 Operational Feasibility

(i) Review the operational requirements of different tolling schemes, these will include but not be limited to:

(a) Security requirements; and

(b) Logistics requirements;

(ii) Review the feasibility of outsourcing the operations of the schemes;

(iii) Make recommendation for the most cost effective mode of operating the scheme e.g. if it should be operated in-house or outsourced; and

(iv) Recollect the above results for a preliminary risk analysis.

4.6 Stakeholder Participation

GoL is in the process of decentralising governance to the local level. As a result, planning and administration of national roads shall be the responsibility of the Roads Directorate and for tertiary and feeder road the local authorities. In undertaking this assignment, the Consultant will be expected to liaise with the Ministry of Finance and Development Planning, Ministry of Local Government, Ministry of Natural Resources, Ministry of Public Works and Transport, Local Authorities, Road Users, Non Governmental Organizations and the public at large.

4.7 Result

Output of the consultancy service will be:

(i) Recommendations on the tolling of selected corridors in the country;

(ii) Recommendations on the appropriate tolling pricing structure for the recommended toll gates."

1.2 Outcome of Investigation

The outcome of the investigation into the feasibility of six possible toll corridors in Lesotho is presented in the following chapters:

CHAPTER 1 – INTRODUCTION: This chapter provides the terms and reference a brief overview of the presentation of the outcome of the investigation.

CHAPTER 2 – STUDY OBJECTIVES AND METHODOLOGY: This chapter uses the services required in respect of the study to derive the study objectives and supplies summaries of the methodologies applied in respect of each objective.

CHAPTER 3 – REVIEW OF LEGAL AND INSTITUTIONAL FRAMEWORK: This chapter provides an inventory and analysis of relevant portions of Lesotho legislation, including regulations, that could have an impact upon the possible tolling of the identified six corridors.

CHAPTER 4 – INITIAL IDENTIFICATION OF POTENTIAL TOLL CORRIDORS IN LESOTHO: The initial identification of the potential toll corridors was embarked upon by considering the Lesotho primary road network from the points of view of identifying the routes with the highest traffic volumes and identifying the routes with significant maintenance and/or upgrading needs by investigating the condition of the primary routes.

CHAPTER 5 – INTERIM IDENTIFICATION OF SIX POTENTIAL TOLL CORRIDORS: This chapter describes the analysis of additional traffic counts in respect of potential toll corridors in order to derive and motivate the selection of six potential toll corridors for this study.

CHAPTER 6 – ROADSIDE SURVEYS: This chapter provides an overview of the roadside surveys undertaken in the six potential toll corridors and present the results of these surveys in respect of the frequency of trips and the trip purposes.

CHAPTER 7 – TOLL STRATEGY: This chapter describes the objectives of toll strategies as well as the approaches that are followed to achieve equitable open tolling strategies. The traffic streams as indicated by the origin-destination surveys are then analysed for each corridor to test the equitability of the possible toll strategy and, in some cases, the tolling section definitions are adjusted to achieve tolling equitability.

CHAPTER 8 – DETERMINATION OF PERCEIVED BENEFITS AND TOLL TARIFFS AND PREDICTION OF TOLL TRAFFIC AND GROSS REVENUE FOR THE SIX TOLL CORRIDORS: This chapter describes the methodology to achieve the traffic and gross revenue predictions and then describes, for each toll corridor in which an alternative route is available, the determination of the value of the perceived benefits upon which the toll tariffs are based. When considering the revenue-maximising tariffs determined for the Lesotho corridors (based on potential traffic diversion), the conclusion is reached that these revenue-maximising tariffs are too high and that the toll tariffs required for the various funding scenarios should, therefore, be determined in an integrated application of traffic attraction analysis and financial modelling. The outcomes of these analyses are presented in Chapter 10 with the results of the financial modelling.

CHAPTER 9 – TOLL- AND ROAD-RELATED CAPITAL, OPERATING AND MAINTENANCE COSTS: This chapter explains the sources of the unit costs used for the determination of the toll- and road-related capital, operating and maintenance costs for a 30 year project life cycle and supplies the costs used in the financial evaluation for each of the six toll corridors.

CHAPTER 10 – FINANCIAL EVALUATION: This chapter provides a description of financial concepts and methodologies used in the financial analysis of the four financial evaluation scenarios indicated in Table 1-1 below:

Table 1-1: Scenarios Considered in Financial Evaluation

Scenario No.	External investments	Costs to cover from nett toll revenue (after plaza operating cost)	Max loan	Financial discipline
1. Resealing and Initial Plaza Construction Scenario	Road rehabilitation costs Initial road upgrading costs	• Initial plaza construction • Future plaza expansions • Routine road maintenance • Road resealing	No limit	DSCR > 1,0 year after plaza construction
2. Resealing Scenario	Initial plaza construction costs Road rehabilitation costs Initial road upgrading costs	• Future plaza expansions • Routine road maintenance • Road resealing	Zero	No debt
3. Rehabilitation and Resealing Scenario	Initial plaza construction costs Road rehabilitation costs Initial road upgrading costs	• Future plaza expansions • Routine road maintenance • Road resealing • Road rehabilitation	Zero	No debt
4. Self-funding Toll Project Scenario	No external investment	• Initial plaza construction • Road resealing • Road rehabilitation • Road upgrading • Future plaza expansions • Routine road maintenance	No limit	DSCR > 1 in year 5 of operation or DSCR >1 in year 1 of operation

Chapter 10 also provides the results of the evaluation of each scenario in the following two categories for each of the six potential toll corridors:

- Perceived benefits, toll tariffs and traffic and income predictions
- Financial results and interpretations of the financial results.

CHAPTER 11 – ECONOMIC ANALYSIS: The economic analysis methodology is described as well as how the results of the analysis should be interpreted. The following four alternatives were analysed for the A2 Mazenod – Mafeteng corridors which were chosen as example corridors because of the recent upgrading of these corridors:

- The 'do-nothing' alternative where the road is not tolled but is also not maintained. The verges are not cleared, road markings are not painted and pot holes are left unattended.
- The road could be tolled purely for routine maintenance. The maintenance includes ensuring that the verges are cut on a regular basis, painted markings on the road are kept in good condition and pot holes are filled.

- The road could be tolled for maintenance, resealing and rehabilitation. The rehabilitation would consist of periodic reseals and future upgrades.
- A further case was also evaluated where the road could be tolled for maintenance, rehabilitation and future upgrades as well as paying off the Initial Capital Works (ICW).

The limitations and assumptions of the analyses as well as the results of the economic analyses are provided in this chapter. It also provides certain conclusions and recommendations in respect of the economic analysis.

CHAPTER 12 – CONCLUSIONS/RECOMMENDATIONS: This chapter provides the most important overall conclusions regarding the feasibility of tolling the six potential toll corridors.

2. STUDY BACKGROUND, OBJECTIVES AND METHODOLOGY

The "Scope of Services", as contained in the Terms of Reference of the study, was regarded as a guideline in respect of the objectives of the study. The respective objectives are listed below with a summary of the methodology applied in respect of each objective as well as a reference to a section in the report that addresses the objective.

2.1 Service 1: Review of the Legal and Institutional Framework

This chapter provides an inventory and analysis of relevant portions of legislation (including regulations) and other documents that could impact on the Toll Roads Feasibility Project.

2.2 Service 2: Economic Feasibility

"Carry out traffic studies/forecast of selected corridors to assess the feasibility of tolling them."

2.2.1 Identification of potential toll corridors

The Lesotho major road system, indicated in Figure 2-1, was investigated in order to identify potential toll corridors, using the following criteria:

- routes with the highest traffic volumes
- routes with reasonable tollable distances
- routes with significant maintenance and/or upgrading needs.

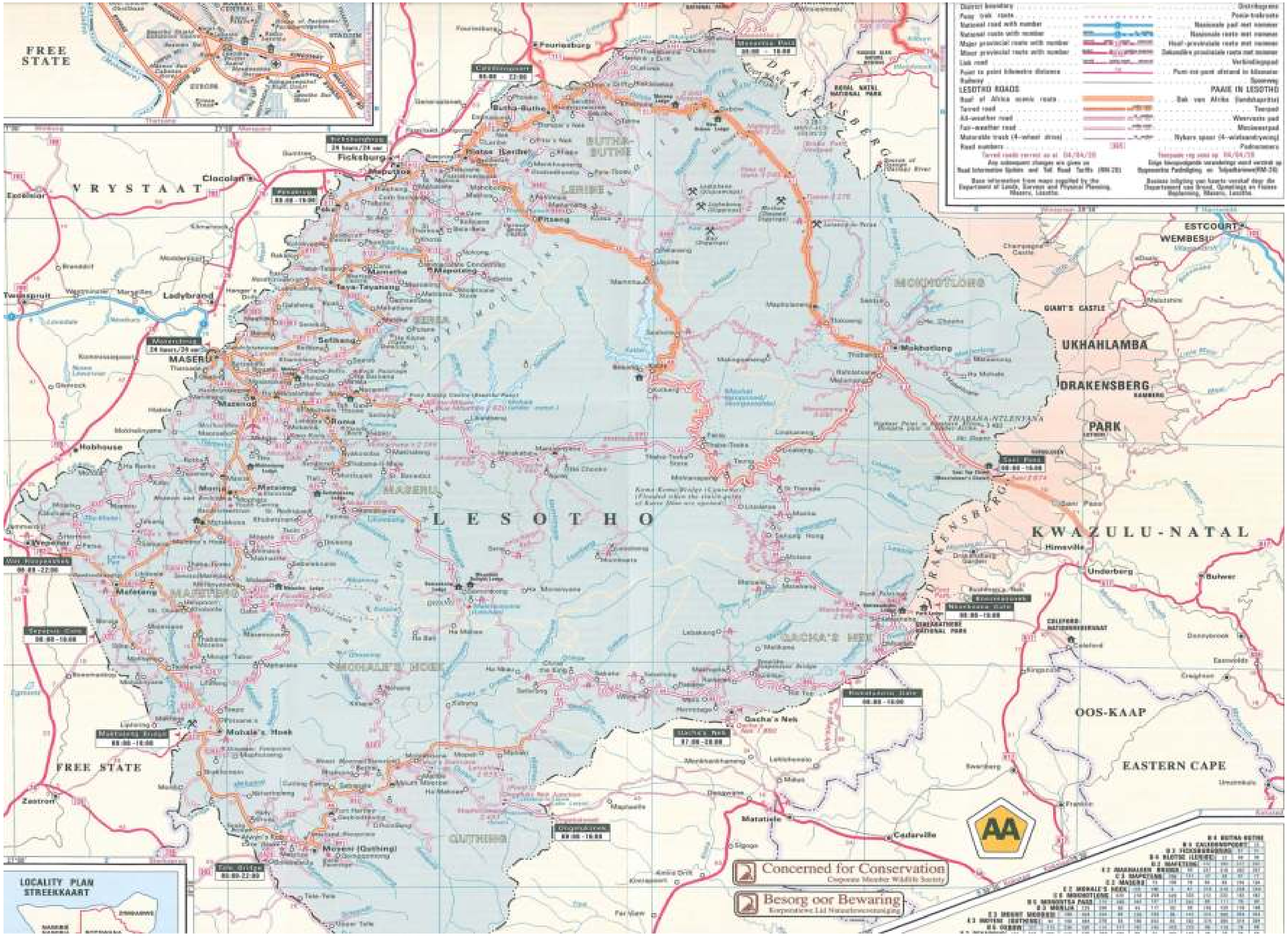


Figure 2-1: Study Area showing Primary Road Network

The investigation included undertaking journeys along the most promising routes in terms of traffic volumes as well as a review of maps and available traffic data. An initial analysis of potential gross revenue and financial feasibility was performed in order to identify the most promising routes. The six most promising routes were then identified for detailed toll road feasibility studies.

2.2.2 Procurement of traffic, origin-destination and travel time information in the selected corridors

The project team collected traffic count information from the Lesotho Roads Branch for the major routes in Lesotho. Since these traffic counts along the six selected corridors had mostly taken place in or close to urban areas, the available traffic counts were considered to be significantly higher than the traffic counts would be on the interurban road sections of the selected corridors where it would be more logical and equitable to possibly locate toll plazas. Such "equitable" locations of toll plazas on interurban road sections would be on the basis that most users passing through these potential toll plaza locations would use either the whole or a significant part of the road section being tolled at that toll plaza location. For the purpose of this study, one-week traffic counts were, therefore, performed at twelve locations representing the "rural" or inter-urban traffic of each corridor. Please refer to Section 5, Table 5-1 of this report for the locations and dates of the additional traffic counts.

The project team could not find any available origin-destination information for the selected toll corridors and, therefore, performed roadside interviews at a suitable location along each of the selected toll corridors for one day during the period from 26 to 28 November 2008. The locations and sample sizes of the roadside interviews are provided in Section 6, Table 6-1 of this report. The roadside interviews were performed to obtain information on trip origins and destinations, trip purpose, trip frequency and vehicle occupancy. This information is vital to be able to analyse what percentage of the vehicles passing through a potential toll plaza location would be using what percentage of a defined toll section. The public acceptability of a toll section will be greatly enhanced if most users of the section are using a significant or the whole distance of the section for which they are paying toll. Origin-destination information is also essential to be able to analyse potential traffic diversion from a toll corridor.

During the time that the roadside interviews were carried out, travel time surveys were also performed along the selected potential toll routes and along alternative routes that could be followed to avoid toll payment on the selected potential toll routes.

2.2.3 Investigation into alternative toll strategies

Since the economic feasibility of a tolled road section is affected by the capital, operating and maintenance cost associated with a specific toll strategy and by the degree of traffic diversion caused by the toll strategy, the alternative tolling strategies by means of which the selected corridors could potentially be tolled, were investigated carefully. It was considered that, because of the relatively short lengths of each of the toll road corridors, the tolling strategy of each corridor should ideally consist of only one toll plaza per corridor. As indicated in a previous paragraph, the most logical and equitable location for such a toll plaza would be a location at which most of the passing traffic would be using the entire toll section or a significant part thereof. The potential toll strategies were, therefore, analysed by studying the origins and destinations of road users in each corridor (as obtained from the origin-destination studies undertaken specifically for this project) in order to ensure that potential toll plaza locations comply with this requirement.

The selected toll strategies also played a major role in the determination of gross revenue which is an important part of the financial analysis of a toll road. The proposed toll strategies are described in Section 7 of this report.

2.2.4 Determination of perceived road user benefits and the "after toll" traffic volume of a tolled road section

This activity was included in view of the fact that, in many cases, some alternative road is available to a tolled road section, even if it is a lower quality secondary or tertiary route. The degree of traffic diversion from a tolled road section was determined by using a toll road attraction formula in which the ratio between the toll fee and the perceived road user benefit is the most important variable. The perceived road user benefit is the cost saving a user perceives if a tolled road is used rather than an available alternative route.

Where alternative routes to the potentially tolled road sections would be available, the perceived road user cost savings for major traffic movements were, therefore, determined so that the toll tariffs could be set at levels where they do not cause significant traffic diversion.

This was accomplished by developing a spreadsheet-based traffic attraction model in which the following activities/calculations were performed for a potential toll plaza location in each potential toll corridor:

- the average annual daily traffic (AADT) for each traffic movement and for each of the possible toll vehicle classes was estimated from traffic observations.
- by applying the so-called “generic traffic attraction” model, the percentage of traffic that would remain attracted to the toll road rather than an alternative route was determined for each traffic movement and for each potential toll vehicle class.
- by summing the predicted “after toll” traffic volumes for each traffic movement for all vehicle classes, the total “after toll” traffic at the potential toll plaza location in each toll corridor was determined.

2.2.5 Determination of the indices of economic worth

The indices of economic worth, i.e. the benefit-cost ratio (D/C ratio), the nett present value (NPV) and the economic internal rate of return (IRR) were determined for four alternatives, as identified in Chapter 1 in the summary of Chapter 11.

2.3 Service 3: Financial Feasibility

Explore different tolling strategies and scenarios and the potential cost of implementing a range of tolling schemes in selected corridors.

After familiarisation with the selected potential toll corridors, the development of possible toll strategy scenarios was undertaken for each route, taking into account various considerations. These considerations are discussed in Section 7.2.

The financial feasibility analysis included an assessment of road- and toll-related costs. The determination of these costs for each toll strategy and road section is discussed in Section 9. The following cost elements were considered:

- Road-related capital costs
- Initial and life-cycle capital costs of fixed toll plaza assets
- Initial and "replacement" capital costs of semi-fixed toll plaza assets
- Road- and toll-related operational and maintenance (O&M) costs

Developing alternative financing models

The analysis of the financial feasibility of the selected toll corridors was the point of departure for the development of alternative financing models. The alternative models aim to indicate whether the projects could be totally self-funding or partially self-funding from nett toll revenue.

The financial scenarios investigated are indicated in the description of Chapter 1 of the work performed in Chapter 10.

The methodology involved that, for each alternative financing model, the toll tariffs for each toll corridor were determined that would be required to achieve a feasible financing model. In the process of determining these toll tariffs, the calculated perceived benefits of each corridor were used in a traffic attraction model to determine the "after toll" traffic volumes and the gross revenue for the particular corridor and financing model.

2.4 Service 4: Stakeholder Participation

During the roadside interviews, road users were requested to express a view in favour of against the levying of tolls, provided that the road being tolled is upgraded. The stakeholder participation process will, however, primarily take place after the submission of this draft final report.

2.5 Service 5: Results

This report contains the results of the study in respect of traffic and origin-destination information, the evaluation of the equitability of toll strategies and the economic and financial feasibility studies.

3. REVIEW OF THE LEGAL AND INSTITUTIONAL FRAMEWORK

3.1 Introduction

This chapter provides an inventory and analysis of relevant portions of legislation (including regulations) and other documents that could impact on the Toll Roads Feasibility Project. Arising from the inventory and analysis, the chapter also provides a legal and institutional framework for the project.

The chapter constitutes a general overview and documents provided by or designated by the relevant Government Departments have been included. The chapter was originally drafted in December 2008, but has been updated and new legislation provided to the consultants has been included. Officials and stakeholders were requested to notify the consultants of other legislation or documents of which they may not be aware. The chapter must not be regarded as legal advice on any issue at this stage and specific legal advice must be obtained before any action is taken pursuant to its recommendations. As the project develops, some specific issues may require more individual attention.

3.2 Inventory and Analysis of Legislation

3.2.1 The Constitution

The Constitution is the supreme law of Lesotho and any law that is in conflict with the Constitution is void (section 2). It provides that certain rights must be protected, e.g. the right of freedom of movement, the right to a safe and sound environment, the right to economic activities, etc.

In terms of section 79 of the Constitution, Parliament may not proceed on any bill providing for taxation and other financial aspects except with the consent of the Cabinet signified by a Minister. This special procedure must be followed if new legislation is considered to impose tolls. For the sake of completeness it should also be noted that the National Planning Board created by section 105 of the Constitution should probably be involved in any major decisions in connection with toll roads, but it was confirmed recently that this Board is not active at present.

The question was raised whether tolling a road that has previously existed toll free would amount to an infringement of the constitutional rights of the road users. This is not viewed as a problem, because tolls are based on the “user pays” policy, i.e. persons who use roads should be responsible to pay for their maintenance and upgrading, rather than the taxpayer in general. In the consultants’ view no constitutional rights would be infringed by merely introducing a tolling system on an existing road. The social impact of the introduction of tolls, e.g. the effect on the disposable income of road users, is a different issue that should form part of a separate study.

3.2.2 Toll Roads Legislation

The Toll-Gates Act No. 2 of 1976 provides that the Minister may cause toll gates to be erected at such places as he or she deems fit. No vehicle may pass through a toll gate unless the tax has been paid or unless the Minister has granted exemption. Any person who does so commits an offence and is liable to receive a fine of R50 or imprisonment for three months. This fine should be revised due to inflation, which will require amending the Act. It would be advisable to amend the Act to provide that the fine will be fixed in regulations, to avoid having to amend the Act each time the fine is revised.

The tax levied on each vehicle must be fixed in regulations. The Minister is also empowered to make regulations on the cost and issue of season tickets, the exemption of certain owners of vehicles from paying the tax and the manner of collecting fees in respect of the tax. According to instructions, the Minister responsible for administering the Toll-Gates Act is the Minister of Finance.

A “toll gate” is defined as a bar placed across a road to prevent passage by a vehicle until the tax has been paid. This would exclude open road tolling (ORT) and electronic toll collection (ETC), if these were considered as future options. The Act is very specific in defining a toll gate as “a bar placed across a road to prevent passage by a vehicle until the tax has been paid”. Experience has shown, especially recently with the Gauteng Freeway Improvement Project in South Africa, that the public is vehemently opposed to new tolls and is likely to bring applications to court to challenge the process if there are any loopholes in the legislation. Therefore if ORT or ETC are being considered, new legislation should be passed to provide for them. This could possibly be done by means of regulations under section 27 of the Roads Act, 1969. Alternatively, the Toll-Gates Act could be amended to provide for this.

The latest available regulations promulgated under the Toll Gates Act are in Legal Notice 88 of 2008, in which the toll gate charges were increased, replacing Legal Notice 165 of 2001.

3.2.3 Roads Legislation

The Roads Act No. 24 of 1969 provides for various aspects relating to roads. The word "road" is defined as including a toll-bar or toll-gate in the course of a road. This Act has been amended by the Roads Directorate Act No. 16 of 2010. In terms of the 1969 Act, all roads were under the control of a road authority appointed by the Minister, but they now fall under the authority of the Roads Directorate established under section 3 of the 2010 Act. The Minister is responsible to declare roads or to deviate or close them. The Roads Directorate must determine and make recommendations to the Minister on the need to declare road reserves and building restrictions (section 4(1)(o)) as well as the need to declare corridors for the road network as selected development areas (section 4(1)(p)). It may recommend to the Minister the tolling of any road under its jurisdiction (section 4(1)(s).

The Roads Directorate (formerly a road authority) may construct and maintain roads itself or by means of contractors. No one may construct or maintain a road unless a road reserve has been declared by the Minister. The provisions of the Roads Act requiring the Principal or Ward Chief who has jurisdiction to set aside the land for the road and requiring a consultation process with chiefs have been repealed.

In terms of section 17(2) of the Roads Act, 1969 read with section 16(a) of the Roads Directorate Act, 2010, the Roads Directorate may establish toll bars and toll gates and demand and receive thereat tolls fixed under subsection (3), and no vehicle or animal may pass such a bar or gate unless the toll has been paid. What is stated in sub-section 3.2.2 above regarding ORT and ETC also applies to the Roads Act.

In terms of section 19 of the Roads Act, 1969, the Roads Directorate may restrict the types of vehicles allowed to use a road in the interests of safety and to protect the road.

In terms of section 27 of that Act, the Minister may make regulations on toll bars and toll gates, among other matters. Section 15 of the Roads Directorate Act, 2010 also empowers the Minister to make regulations for the carrying into effect of the provisions of that Act.

During 2005 a proposal was tabled to amend the Roads Act, 1969. The provisions of the Amendment Bill have been certified by the State Law Advisors but have not yet been passed into law. They do not appear to affect the current toll feasibility project.

In terms of the roads legislation, both the Minister and the Roads Directorate have the powers to establish toll bars and toll gates and to collect tolls. The provisions are empowering and should be read with each other if possible. If the recommendations of the Project suggest that toll roads should be established on roads under the jurisdiction of the Roads Directorate, a policy decision will have to be taken as to what the roles of the Minister and the Roads Directorate respectively should be in respect of the establishment of toll bars and collection of the tolls. In view of the potentially significant political implications associated with the tolling of upgraded existing roads and in view of the responsibility of the Road Fund for funding matters, it is recommended that either the Roads Directorate and the Road Fund jointly or just the Road Fund should make recommendations to the Minister regarding the collection of tolls. It is suggested that the Toll-Gates Act and Roads Act should be amended in due course to make provision for such a mechanism.

3.2.4 Road Fund Legislation

The Road Fund was established by Legal Notice 179 of 1995. It is governed by the Finance (Road Fund) Regulations 2005 published under Legal Notice No. 72 of 2005. In terms of section 3, the purpose of the Fund is to finance the following:

- Routine and periodic maintenance of all roads in Lesotho;
- On a cost-share basis, urban and rural community roads;
- Road rehabilitation, road upgrading, new road works and road safety projects; and
- Any other matter connected with roads.

Road works programmes must be identified and prioritised by the Minister responsible for the construction and maintenance of roads.

The following must be paid into the Fund (Section 4):

- Road toll-gate fees and all cross-border fees and levies
- Vehicle license fees
- Fees for motor vehicle permits
- Road maintenance levies on fuel
- Fines on overloaded vehicles, and
- Any other road user charges, including fines on road traffic offences.

The Fund is managed by a Board of Directors which reports to the Minister. One of the functions of the Board is "to approve procedures and process for collecting road user charges with due regard to efficiency and cost effectiveness". It must also review and approve Annual Roads Programmes, allocate the resources of the Fund and review and approve allocation of funds for maintenance of roads. The implementing agencies responsible for maintaining the roads network funded by the Fund (now the Roads Directorate) must prepare Annual Roads Programmes, in consultation with the Secretariat of the Fund, at least six months before the national budget is approved.

It has been confirmed that dedicated accounts can be created within the Road Fund for specific toll roads. (Such dedicated accounts could be important elements of some of the toll funding options). However, an issue that requires discussion and, possibly, further research is how such an account may be earmarked and protected from being used for other purposes. The danger is that if a surplus is built up in the Fund from tolls collected which are earmarked for the future maintenance or upgrading of the road(s), the surplus may be "swept" back to the general Revenue Fund.

3.2.5 Financial Legislation

The Finance Order No. 6 of 1988 deals with the control and management of public funds. Although it repeals the Finance Act, 1978, the Financial Regulations, 1973 remain in force until replaced. In terms of section 8 all public moneys must be paid into the Consolidated Fund. Money received by any accounting officer must be deposited at the earliest opportunity with a bank or banks as directed by the Accountant-General, and such a bank account may not be overdrawn without written authorization by the Principal Secretary.

In terms of section 23 of the Finance Order, 1988 the King may authorize the Minister to borrow money to meet short term Government requirements. The Minister is deemed to be authorized to borrow not more than M50 000 000 at any one time, unless the King authorizes otherwise. These borrowing powers are in addition to borrowing powers conferred by any other law. In terms of section 25, the Principal Secretary may lend money to a statutory body, such as the Road Fund, with the consent of the Minister of Finance, subject to the Loans (Statutory Bodies) Act, 1975.

The Financial Regulations, 1973, apply to the control and use of public moneys. They apply to all officers responsible for public moneys. Chapter 21 of these Regulations dealt with securing (procuring) of services and government contracts, and has been repealed by the Public Procurement Regulations (see below).

3.2.6 Procurement legislation

The Public Procurement Regulations, 2007 (Legal Notice 1 of 2007) made in terms of section 37 of the Finance Order, 1988 apply to the procurement of goods and services by public bodies. It establishes a Procurement Unit to carry out public procurement for ministries, district councils, state owned legal entities and any other body covered by Public Law, as well as any project implementing authority authorised to carry out public procurement and funded by foreign loans, grants and assistance. The Procurement Unit must maintain, update and disseminate Government Standard Conditions of Contract and apply them, and must place advertisements for procurement and awards of contracts in the Contracts Bulletin of the Government.

The Regulations also establish a Procurement Policy and Advice Division (PPAD) as a department in the Ministry of Finance and Development Planning. It must, among other functions, establish the criteria and process for the assessment of eligible suppliers. The Regulations provide for procurement procedures, as well as exceptional procedures e.g. where there is concern as to the degree of competition that can be secured. It also provides procedures for the selection of consultants and for open procurement procedures (tendering). A 15% margin of preference must be given to firms that are majority owned by Lesotho nationals.

The Regulations also set thresholds as follows:

- Goods and services between M0 and M30 000: direct contracting must be applied;
- Goods and services between M30 000 and M100 000: 3 quotations must be obtained from 3 different services providers; and
- Goods and services above M100 000: open tender method must be applied.

These Procurement Regulations must be applied in implementing the tolling system, wherever they are applicable.

3.2.7 Public-private partnerships (PPPs)

The financial legislation does not specifically regulate public-private-partnerships (PPPs), but these will have to be implemented applying the relevant provisions on procurement, etc. These provisions are broadly the following:

- Procurement of the private sector partner(s) must be selected using the procedures etc. mandated by the Public Procurement Regulations, 2007. The thresholds mentioned above will apply, e.g. if the amounts involved are more than M100 000, the open tender method must be applied unless the exceptional procurement procedures can be applied.
- If the PPP involves borrowing money, e.g. to build the toll infrastructure, the Minister of Finance may authorise the borrowing up to M50 000 000. If that amount is exceeded, the King must authorise the loan, unless there is another law that authorises the borrowing.

3.2.8 Road Traffic Legislation

The Road Traffic Act 8 of 1981 deals with the registration and licensing of motor vehicles, issuing of driving licenses, use of vehicles on public roads and the regulation of traffic.

Chapter VI of the Act makes a distinction between public motor vehicles and others. Public motor vehicles are passenger and freight vehicles operated for hire or reward, with the exclusion of certain vehicles, such as government vehicles and vehicles used to convey school children.

Chapter VII of the Act deals with traffic signs and speed limits. The Minister may prescribe traffic signs, signals and markings in regulations. These can be used to control traffic at toll plazas or similar installations, e.g. to cause traffic to stop. Non-compliance with a road sign constitutes an offence. It should be noted that Lesotho has undertaken in the SADC Transport Protocol to standardize its road traffic signs with those of other SADC countries.

Section 110 of the Act allocates powers to police officers, e.g. to stop vehicles and demand certain documents. These powers can be used to enforce toll road provisions, but only within the limits set by section 110.

In terms of section 114, the Minister may make regulations on certain issues, including "generally as to the use of any public road by traffic". These powers could be used to make regulations in relation to toll roads. The Road Traffic Regulations, 1981 have been promulgated as Legal Notice 84 of 1981. Part XII of the Regulations deals with traffic signs. Section 55 of the Road Traffic Act makes it an offence where a road user fails to comply with a traffic sign. If a traffic sign is erected to provide for a toll gate, a person who fails to pay the toll could be prosecuted under that section for failure to comply with the sign.

Section 74(4) of the Act exempts emergency vehicles such as ambulances, fire and police vehicles from Chapter VIII on Rules of the Road while they give warning of their movement by special warning devices.

3.2.9 Road Transport Legislation

The Road Transport Act 6 of 1981 provides for the regulation of road transport by public motor vehicles, which are basically those operated for hire or reward. Regulation is by means of permits, including permits for cross-border operations. The Act applies to both passenger and freight transport. It also applies to private vehicles with a carrying capacity of more than 1000 kg.

The Road Transport Regulations were promulgated under this Act in terms of Legal Notice 166 of 2004.

The permits issued under the Road Transport Act could be used as a method of controlling certain types of traffic for toll purposes, or to distinguish certain public vehicles (for example, those transporting passengers) from other vehicles if it is decided to have preferential tolls for such public vehicles.

3.2.10 Local Government Legislation

The Local Government Act 6 of 1997 as amended by the Local Government (Amendment) Act 5 of 2004 deals with the establishment and control of local authorities. Local authorities can be community councils, rural councils, urban councils or municipal councils. All councils have the powers to make by-laws on various subjects, including land and property, thoroughfares and the regulation of traffic in streets and thoroughfares, including the weight and speed of vehicles and the prevention or restriction of the use of vehicles on any bridge, road or street. Where toll proposals are being considered, the issue may be affected by by-laws that are in force in the municipal area in question.

In terms of the First Schedule, local authorities are responsible for the following, which could impact on toll issues:

- Control of natural resources such as sand and stones, and environmental protection
- Physical planning
- Land/site allocation
- Minor roads and bridle paths
- Promotion of economic development
- Streets and public places
- Control of building permits
- Roads and traffic
- Fencing
- Local administration of central regulations and licenses
- Omnibus terminals.

Of these matters, community councils are responsible only for control of natural resources such as sand and stones, environmental protection, land/site allocation and minor roads and bridle paths.

3.2.11 Environmental legislation

The Environment Act 10 of 2008 applies to environmental aspects. The Act is also binding on the State. The project must adhere to the principles of environmental management set out in chapter 3 of the Act. These include, among others:

- To require prior environmental impact assessment of proposed projects or activities that are likely to have adverse effects on the environment or natural resources.
- To ensure that the cost of environmental abuse or impairment is borne by the polluter.

In terms of section 19, an environmental impact assessment (EIA) or project brief must be undertaken on the following projects and activities, among others:

- Any activity out of character with its surroundings.
- Any structure not of a scale in keeping with its surroundings.
- Major changes in land use.
- Major roads.
- All roads in scenic, wooded or mountainous areas.
- Bridges.
- Clearance of forest areas.
- Projects or activities that could affect protected natural environments or wilderness areas, conservation areas, etc.

Where these projects or activities are undertaken, the developer must apply for an environmental impact licence.

A strategic environmental assessment is required for any bill, regulation, public policy, programme or plan that could have significant impact on the environment.

This means that, depending on the type of development or construction, the implementation of toll gates or making or upgrading of roads for the project may require a prior EIA.

3.2.12 Development planning legislation

For the purposes of this phase of the study, development planning legislation was not studied to avoid possible wastage of time and costs. However, it must be borne in mind that this legislation (if any) may be applicable if any new roads, toll plazas or other structures are planned or erected. Once decisions have been taken as to how to implement the findings of the study, the development planning aspects can be investigated.

3.2.13 The SADC Transport Protocol

The *SADC Protocol on Transport, Communications and Meteorology*, concluded in 1996 and to which Lesotho is a signatory, provides as follows in Article 5.1:

"Member states shall facilitate the unimpeded flow of goods and passengers between and across their respective territories by promoting the development of a strong and competitive commercial road transport industry which provides effective transport services to consumers."

Member states therefore agreed to develop a harmonised road transport policy providing for equal treatment, non-discrimination, reciprocity and fair competition.

Article 4.5 of the SADC Transport Protocol provides that member states must identify adequate, sustainable and appropriate sources of road funding. They must ensure that road users, including foreign road users, contribute to the full costs of maintaining roads and progressively contribute to the full costs of providing roads. In terms of Article 4.6 member states agreed to implement a harmonised cross-border road user charging system which is regularly reviewed, improved and supplemented through improved research and data collection.

The SADC Transport Protocol also provides that there should be equality of treatment of the nationals and service providers of member states with regard to the provision, access and use of infrastructure and immigration and clearance procedures (clause 2(d)). There is, therefore, a need to "level the playing fields" regarding road user charges between domestic Lesotho operators and foreign operators.

The Protocol also provides for the principle of non-discrimination, in that:

> "... international vehicles with similar characteristics and loads, undertaking trips between the same origins and destinations, should be treated equally in respect of the payment of road user charges, irrespective of the country in which such vehicles are registered."

Various meetings have been held between the SADC member States and a study has been undertaken to harmonise road user charges: see for example the document by the Southern Africa

Transport and Communications Commission (SATCC) titled *Proposed System of Harmonised Road Transit Charges for the SADC Region (April 1997)*. The Preferential Trade Area (PTA - later COMESA) and the Southern African Customs Union (SACU) have also taken steps to develop systems of harmonised road user charges for transit traffic in their regions. These studies differed in regard to some of the principles followed, as well as approach and methodology, and were not considered appropriate for harmonised application. This led to the 1997 study.

According to the SATCC report there are various motivations for road user charges, including the following:

- Fiscal - to raise general government revenue.
- Equity or income distribution - to recover costs from members of the community who benefit directly from the road infrastructure with reduced charges or increased subsidies for road transport in poorer areas.
- Economic - to promote efficient use of the road network to support national and international trade and economic growth, by having the charge mirror the cost to society of making use of the road.

Due to the provisions of the Protocol and the fact that operators in the SADC region should be treated on an equal basis, these provisions should be borne in mind, where relevant, in designing and implementing the potential toll corridor.

3.3 Institutional Structures

3.3.1 The Road Fund

The function of the Road Fund is to finance routine and periodic maintenance of roads, road rehabilitation, upgrading, new road works and related matters. The Fund is managed by a Board of Directors which reports to the Minister. The Board consists of the following:

- The Chairman and Deputy Chairman
- The Executive Secretary
- Three ex officio members who are officers representing:
    - the Ministry responsible for finance and development planning
    - the Ministry responsible for construction and maintenance of roads, and
    - the Ministry responsible for energy, and

- Four non-governmental members selected from passenger transport, freight transport, the engineering fraternity and the Law Society of Lesotho.

3.3.2 The Roads Branch

This is a Branch of the Ministry of Public Works and Transport and was responsible for the classified road network. Although Act 16 of 2010 does not mention this Branch, its functions have presumably been taken over by the Roads Directorate.

3.3.3 The Roads Directorate

The Roads Directorate Act, 2010 provides for the establishment of the Roads Directorate as a body corporate with perpetual succession, with the right to sue or be sued in its corporate name. It may acquire, hold and dispose of movable and immovable property. The functions of the Directorate are, among others:

- To implement government policy on road-related issues;
- To plan, develop and maintain all roads under its jurisdiction, and carry out quality assurance for all roads;
- To prepare proposals and designs for construction and upgrading of roads under its jurisdiction;
- To procure and manage contracts for development and maintenance of projects;
- To carry out traffic counts and monitor road conditions;
- To prepare strategic road network development plans;
- To set out and enforce road standards throughout the country and carry out technical and performance audits for all roads;
- To acquire and protect land earmarked for road network development;
- To determine and make recommendations to the Minister on the need to declare road reserves and building restrictions along any road and "corridors for road network as selected development areas";
- To ensure mitigation of negative environmental impacts from road construction and rehabilitate affected areas, in accordance with environmental guidelines;
- To recommend to the Minister the tolling of any road under its jurisdiction;
- To protect all roads and road furniture and ensure cost recovery from offenders who damage road furniture;

- To implement the provisions of the Roads Act, 1969. These include the provisions on establishing toll-bars and toll-gates in section 17.

In terms of section 17(2) of the Roads Act, 1969 the Roads Directorate may establish toll bars and toll gates and demand and receive tolls at such toll bars and toll gates. Various other functions of the Roads Directorate are to be found in the Roads Act, 1969, which were formerly functions of a road authority.

Act 16 of 2010 provides for the establishment of a Board of Directors to govern the Roads Directorate. The Board consists of:

- the Principal Secretary of the Ministry responsible for public works and transport as the chairperson;
- the Director-General of the Roads Directorate who shall be secretary;
- the Principal Secretary for the Ministry of Local Government;
- the Principal Secretary for the Ministry of Finance and Development Planning;
- the Executive Secretary of the Road Fund; and
- four representatives of the private sector nominated by that sector.

The functions of the Board are:

- To oversee the implementation of government policy on roads related issues;
- To monitor the activities of the Roads Directorate;
- To formulate, for the Minister's approval, strategies for the road network;
- To set priorities for road maintenance and approve road maintenance programmes;
- To ensure implementation of approved road standards;
- To advise the Minister on policy issues in the road sector, maintenance and development planning;
- To submit proposals for road investments on all roads of national importance; and
- To appoint senior management of the Roads Directorate.

The Minister must appoint a Director-General (DG) for the Directorate, on the advice of the Board. The functions of the DG include being responsible for the day-to-day running of the Directorate and entering into procurement contracts in accordance with internal procedures and the management and procurement of assets. The DG must liaise with the Board and other funding agencies in respect of any financial matter affecting the Directorate. The DG must also contribute to the development and formulation of policy and strategic plans for the road sector. The DG is also responsible for:

- liaising with the Board (of the RD) and other funding agencies in respect of any financial matter affecting the Directorate (section 11(1)(m)); and
- entering into procurement contracts in accordance with internal procedures (section 11(1)(g)).

The funds of the Directorate include monies appropriated by Parliament from the consolidated fund, funds allocated from the Road Fund, fees for services provided under the Act, monies loaned, donated or granted to the Directorate by any International Organisation and any other money that may be payable to or vested in the Directorate in respect of a matter incidental to its purposes.

The Act empowers the Minister to make regulations on various matters, including:

- Fees and levies that may be charged under the Act;
- Declaration of road reserves and building restriction roads;
- Methods of carrying out technical and performance audits for all roads;
- Protection of road furniture;
- The manner in which plans or designs for road construction and maintenance may be done.

The Act provides that "Roads Directorate" is substituted for "roads authority" wherever it occurs in the Roads Act, 1969.

3.3.4 The Department of Rural Roads

This is also a branch of the Ministry of Public Works and Transport and is responsible for the unclassified rural road network. The Ministry was in the process (in 2008) of combining this Department with the Roads Branch to form a single entity. It has now presumably been amalgamated with the Roads Directorate.

3.3.5 The Maseru City Council

The Maseru City Council was established as a Municipal Council under the Local Government Act, 1997. It is responsible for the urban roads within its municipal area as well as the related matters mentioned in 3.2.8 above.

3.3.6 Other Local Authorities

Other local authorities consist of community councils, rural councils or urban councils, which fall under the Ministry of Local Government. They are responsible for streets, public places, minor roads and bridle paths in their area, as well as the related matters referred to in 3.2.8 above.

3.3.7 Road Authorities

In terms of the Roads Act, 1969, the Minister responsible for roads could appoint a public officer, either by name or by office, by notice in the Government Gazette, to be a road authority. This provision was repealed by the Roads Directorate Act, 2010. Presumably the road authorities have now been subsumed into the Roads Directorate.

3.3.8 The Lesotho Police

The Police have fairly wide powers under the Road Traffic Act to stop vehicles and demand certain documents. However, these powers may not be wide enough to enforce toll collection if a system is devised of issuing road user charge (RUC) receipts or remote tolling. New legislation may be required to enforce these aspects. It is not possible to comment on this until the details of new, proposed tolling systems are available.

3.4 Conclusions and Recommendations

The following tentative conclusions and recommendations can be made at this stage. These are subject to discussion:

3.4.1 Conclusions

a. Power to declare toll roads

The power to declare toll roads and implement toll gates is, in legal terms, currently shared by the Minister responsible for the Toll-Gates Act (Minister of Finance according to instructions), who may cause toll-gates to be erected (section 3 of the Toll-Gates Act, 1976) and by the Roads Directorate which may also exercise this function (section 17(2) of the Roads Act, 1969 as amended by the Roads Directorate Act, 2010). It may be advisable to amend the legislation so that only one functionary may do so in the longer term, to avoid possible duplication or lack of co-ordination. In order to ensure political accountability, it seems that this power should vest with the Minister of Finance and it is recommended that he/she would do so either at the joint recommendation of the Roads Directorate and the Road Fund or at the recommendation of the Road Fund only, bearing in mind that the Fund is responsible for funding matters.

b. Fine for non-payment of tolls

The fine of M50 for non-payment of toll should be revised. If the Act is amended, it would be advisable to provide that the maximum fine will be stipulated in regulations from time to time, to avoid having to amend the Act each time the fine is revised.

c. Enforcement of toll payment

Road signs to manage toll plazas/gates can be erected in terms of the Road Traffic Act, and can be used to enforce the payment of tolls, e.g. persons not complying with the signs can be prosecuted under the Road Traffic Act.

d. Institutional issues: Funding Aspects

The Road Fund is responsible to finance routine and periodic maintenance of roads, road rehabilitation, upgrading, new road works and related matters. Road toll-gate fees and all cross-border fees and levies must be paid into the Fund. The Road Fund Board is also responsible to approve procedures and process for collecting road user charges with due regard to efficiency and cost effectiveness. It must also review and approve Annual Roads Programmes, allocate the resources of the Fund and review and approve allocation of funds for maintenance of roads. In view of its total control of funding aspects and in view of the fact that toll financing revolves around funding aspects, the Road Fund will have to play a pivotal role in the planning, directing and control of the funding aspects of the possible implementation of toll corridors in Lesotho.

In view of the toll financing approaches investigated in Chapter 10 of this report, a question that has to be addressed is whether the tolls collected in terms of the proposed toll road project could be set aside or ring-fenced for the exclusive upgrading, rehabilitation or periodic maintenance of the road in question ("toll road with savings") compared to a "toll road with loans" approach where the tolls would be applied to servicing and paying off the relevant loans. In the "toll road with savings" approach, the tolls would be "saved up" for a future rehabilitation or resealing of the road, say in 10 years' time. Alternatively, there could be a hybrid approach where some of the tolls are used to service and pay off loans and the remainder are saved up for rehabilitation or resealing.

In terms of section 4(1)(a) of the Finance (Road Fund) Regulations, road toll-gate fees must be paid into the Road Fund. In terms of section 14(b) of the Roads Directorate Act, 2010, the funds of the Roads Directorate consist, among others, of funds allocated from the Roads Fund.

It therefore seems that the current legislation allows for the following option to "save" and invest net toll income for future application such as the rehabilitation or resealing of the particular road:

- The Road Fund Board should create special accounts within the Fund for this purpose that are managed in terms of a tri-partite agreement between the Road Fund, the Roads Directorate and the Minister of Finance. The agreement should provide for the saving of the net toll revenue in each account for future application in each toll corridor for rehabilitation or resealing when required. The nett toll revenue as well as interest earned would then be transferred to the Roads Directorate as and when the funds are required for the specific toll project.
- In order to provide some flexibility, provision could possibly be made for the funds to be lent for an interim period to another toll corridor (to, for example, construct a new toll plaza) provided that such other toll corridor would be able to repay such a loan when required by the toll corridor to which the savings belong.

This approach would appear to be in line with the legislation and would accord with the intention for the Road Fund to manage road funding, while the Roads Directorate manages the actual planning, construction, maintenance and rehabilitation of roads. The creation of dedicated funds that would be able to roll-over from one year to another would not be a problem with the Road Fund, as it is a dedicated statutory Fund.

e. Institutional issues: Different types of roads

Various types of roads fall under various institutions, as indicated above. It appears that the roads being considered in terms of the project all fall under the control of the new Roads Directorate, which was formed by combining the Roads Branch with the Department of Rural Roads in 2009 and established by the Roads Directorate Act, 2010. It therefore appears that this will not be an issue, but that the Roads Directorate will have to liaise with other relevant institutions, such as local authorities, if the toll gates are planned to fall within their areas.

f. Method of toll collection

The Toll-Gates Act is framed so as to limit the powers of the Minister to the collection of toll at a toll gate, which is a physical barrier (bar) across a road. No one may pass the barrier unless the toll has been paid. The same applies to section 17 of the Roads Act, 1969. In view of the strong likelihood of the implementation of electronic toll collection, in future, amending legislation will be needed. This legislation could possibly be done by means of regulations under section 27 of the Roads Act, 1969.

g. Acquisition of land

If it is found that land should be acquired next to a road, say for a toll plaza, the procedures prescribed in the legislation must be followed. The Environment Act, 2008 as well as local government and development planning legislation must also be applied, where required by that legislation. For example, an EIA may be required in terms of the Environment Act.

h. Alternative routes

Nothing could be found in the legislation and documents requiring that alternative routes must be available. Whether or not alternative routes are provided will, therefore, have to be decided and implemented as a policy issue. This will be influenced by social issues and the issues described in the Toll Strategy (Chapter 7).

i. Public-Private-Partnerships

The financial legislation does not deal specifically with PPPs. Any proposed PPP arrangement will have to comply with normal procurement and financial legislation and procedures. New legislation may be required to regulate PPPs.

3.4.2 Recommendations

The following recommendations are made:

- It is recommended that legislation be amended so that only one functionary will have the power to declare toll roads. In order to ensure political accountability, it is recommended that this power should rest with the Minister of Finance who would do so either at the joint recommendation of the Road Fund and the Roads Directorate or at the recommendation of the Road Fund only, bearing in mind that the Fund is responsible for funding matters.
- The Road Fund Board should create special accounts within the Road Fund for the purpose of ring-fencing the toll funds related to a specific toll corridor and these funds should be managed in terms of a tri-partite agreement between the Road Fund, the Roads Directorate and the Minister of Finance. The agreement should provide for the saving of the net toll revenue in each toll corridor account for the future rehabilitation or resealing of the relevant toll corridor. The toll revenue would then be transferred to the Roads Directorate as and when the funds are required for the specific toll project.
- It is recommended that provision be made that funds in these special toll corridor accounts that are being saved for future periodic road maintenance or rehabilitation or for toll-related infrastructure or system procurement, replacement or expansion purposes, should not be allowed to be removed from such a fund, but should be invested conservatively on behalf of the toll corridor. In order to create flexibility amongst toll corridors, it is recommended that toll corridors be allowed to borrow funds from each other, provided that these funds can be repaid when required by the toll corridor to which the funds belong, all subject to the approval of the Minister of Finance.
- The fine of M50 for non-payment of toll should be revised. If the Act is amended, it would be advisable to provide that the maximum fine will be stipulated in regulations from time to time, to avoid having to amend the Act each time the fine is revised.
- Since the study recommends that electronic toll collection (ETC) should be used, amending legislation or just regulations will be needed for this purpose.

4. INITIAL IDENTIFICATION OF POTENTIAL TOLL CORRIDORS IN LESOTHO

4.1 Approach to Initial Identification of Potential Toll Corridors

One of the key activities of this study was the identification of potential toll corridors. As was indicated in the study proposal, the intention was to investigate the Lesotho primary road network, also by means of travelling along the major routes, in order to identify potential toll corridors, using the following initial criteria:

- routes with the highest traffic volumes
- routes with significant tollable distances
- routes with significant maintenance and/or upgrading needs.

The initial identification of potential toll corridors was, therefore, embarked upon by considering 2 of the above-mentioned criteria, namely routes with the highest traffic volumes and routes with significant maintenance and/or upgrading needs.

4.2 Considerations regarding urban toll roads

The reference of the terms of reference of this project to corridors was interpreted to refer to interurban corridors. Apart from this compelling interpretation, the potential for tolling of the urban parts of the corridors was considered very limited for the following reasons:

- If tolling of specific urban roads by means of toll plazas or overhead toll gantries are considered, in practice, tolling in urban areas virtually always take place on a motorway with limited access, i.e. with interchanges 3-5 kms apart and, when very high traffic volumes are involved, it takes place by means of toll gantries. The rationale for tolling limited access facilities is that, if the main arterials, i.e. the main streets with at-grade, usually signalised, intersections should be tolled, the tolling would affect road users with such a vast variety of urban trip origins and destinations and trip distances along the tolled arterial that it would be virtually impossible to toll equitably. Since urban arterials are usually located in a road system with a multitude or at least a few very easy routes around a toll plaza that might be located on such an arterial street, such "street" tolling is unlikely to be financially viable, except in special circumstances where the urban arterial does not have frequent at-grade intersections.

- In the Lesotho situation where urban traffic is served mostly by arterial streets rather than freeways/motorways, tolling of specific urban streets/roads by means of toll plazas/gantries was not considered to be a practical proposition (with a few possible exceptions).
- If "congestion tolling" by means of modem technology of an urban central district is considered as urban tolling (such as in London or Stockholm), this was not interpreted as forming part of an investigation into the tolling of certain **corridors** in Lesotho. These kinds of solutions are usually applied in large cities where congestion has assumed very significant proportions, since it is the reduction of congestion that makes these solutions economically sensible.

4.3 Lesotho Primary Road Network

The study started off by assessing all the primary roads in the Kingdom of Lesotho in terms of traffic volumes and maintenances and/or upgrading needs. The primary road network of Lesotho is shown in **Figure 4-1**.

The following primary roads were considered in terms of traffic volumes:

- Route A1, starting in Maseru and running parallel to the northwestern boundary of Lesotho linking Maseru with Teya-Teyaneng, Peka, Maputsoe, Hlotse, Butha-Buthe and ending at Mokhotlong in the eastern part of Lesotho.
- Route A2, starting in Maseru and running more or less parallel to the western boundary of Lesotho linking Maseru with Mazenod, the Moshoeshoe Airport, Morija, Mafeteng, Mohale's Hoek and ending at Moyeni (Quthing).
- Route A3, linking Route A5 northwest of Roma with Route A8 at Thaba-Tseka.
- Route A4, starting at Moyeni on the southern side of Lesotho and linking Moyeni with the Qacha's Nek border post to South Africa.
- Route A5, linking Route A2, south of Mazenod with Roma, the National University of Lesotho and ending in the interior of Lesotho at Semonkong.
- Route A8, starting at Hlotse and running in a south-easterly direction, linking Hlotse with Pitseng and the Katse Dam and ending where it links to Route A31 south of Mokhotlong.
- Route A31, linking Mokhotlong with the Sani Pass Border Post to South Africa.

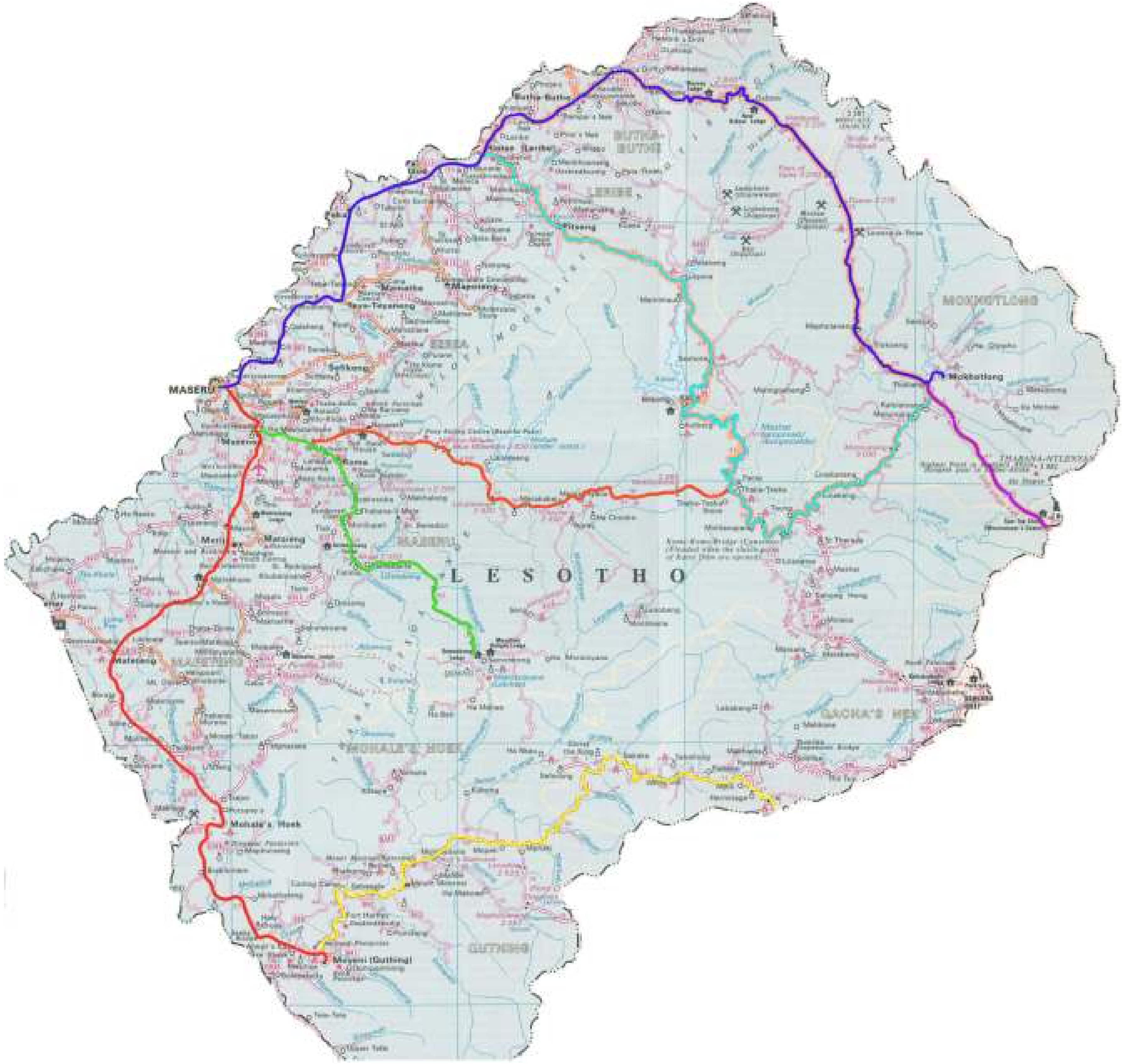


Figure 4-1: Primary Road Network of Lesotho

4.4 Consideration of routes with highest traffic volumes

The project team collected traffic count information from the Roads Branch for various routes in Lesotho. The average daily traffic (ADT) volumes derived from these 7 day traffic counts which were undertaken in June, 2007 are shown in Table 4-1.

Table 4-1: Lesotho Primary Road System: Available Average Daily Traffic Volumes (2007)

ROUTE	SECTION OF ROUTE	ADT
A1	Maseru to Teya-Teyaneng along the A1	2806
A1	Teya-Teyaneng to Leribe along the A1	2248-3545
A1	Leribe to Buthe-Buthe along the A1	1475-2595
A1	Buthe-Buthe to Mokhotlong along the A1	169-961
A2	Mazenod to Morija along the A2	3617
A2	Morija to Mafeteng along the A2	1938-2055
A2	Mafeteng to Mohale's Hoek along the A2	1233-1433
A2	Mohale's Hoek to Quthing along the A2	739-1276
A3	Mantsonyane to Makhotlong along the A3	33-149
A4	Quthing to Mphaki along the A4	182-1262
A4	White Hill to Tsoelike along the A4	208-229
A5	Mazenod to Route A3 Intersection along the A5	2554-2993
A5	Roma to Fatima along the A5	272
A6	Maseru A6	9659
A7	Maseru to A2 along the A7	881
A25 (A8)	Leribe to Pitseng along the A25 (A8)	1262-3829
A25 (A8)	Pitseng to Lejone along the A25 (A8)	214
A10	Maseru A10	6634-8874
A11	Border Peka	460
A12	Border Maputsoe	7029
A13	Border Butha-Butha	1650-2257
A21	Border Van Rooyen's	1444
A22	Border Borata	155
A23	Border Mohale's Hoek	167
A24	Border Quthing	290
B11	Teya-Teyaneng to B203 along the B11	1069
B12	Teya-Teyaneng to B13 along the B12	1478
B13	Maputsoe to B12 along the B13	539-2082
B22	Mazenod to A2 along the B22	733
B23	Mazenod to Morija along the B23	325
B24	Mazenod to Mafeteng along the B24	238-394
B25	Tsepo to A2 along the B25	584
B26	Mafeteng to Tsolbane along the B26	296-1234
B101	Kolonyama	470
B121	Mamhathe	154
B131	Maputsoe to Bela-Bela	537
B211	Kalichane to Patsa along the B211	166

The available average daily traffic volumes were also presented on a map of the Lesotho primary road system (See Figure 4-2). The traffic counts on the A-routes are indicated in red and the traffic counts on the B-routes are indicated in blue in Figure 4-2. From the available average daily traffic volumes, the following were concluded:

- Traffic volumes on the western side of Lesotho are significantly higher than on the eastern side.
- The roads in and around urban centres along the A1 from Butha-Buthe in the north to Maseru in the south and the A2 from Maseru in the north to Moyeni (Quthing) in the south were carrying the higher traffic volumes, i.e. between about 1 000 and 9 000 vehicles per day

Many of these traffic counts were on urban road sections but the tolling of urban roads in Lesotho was not deemed to be a practical proposition, as explained in Section 4.2. It was considered that further information was required before firm conclusions could be reached regarding the candidate toll corridors based on traffic volumes. *The preliminary conclusion was, however, drawn from the above-mentioned traffic counts that the A-routes in the western part of Lesotho were the internal routes with the highest interurban traffic volumes and were, therefore, the likely toll corridors.*

In order to be able to select potential toll corridors based on traffic volumes, it would be necessary to determine whether any traffic counts for the previous 3 years were available from the Roads Branch for the interurban sections of the A-routes in the western part of Lesotho. Indications from Mr Matela at the Roads Branch were that the available traffic counts generally did not cover the interurban sections of the A-routes. In view of the likely unavailability of traffic counts at the locations midway between the towns (the likely locations of interurban toll plazas), traffic counts had to be performed on these interurban sections. Table 4-2 identifies various primary road sections which were considered to be potential candidates for further traffic counts which would then be used to identify the six potential toll road corridors.

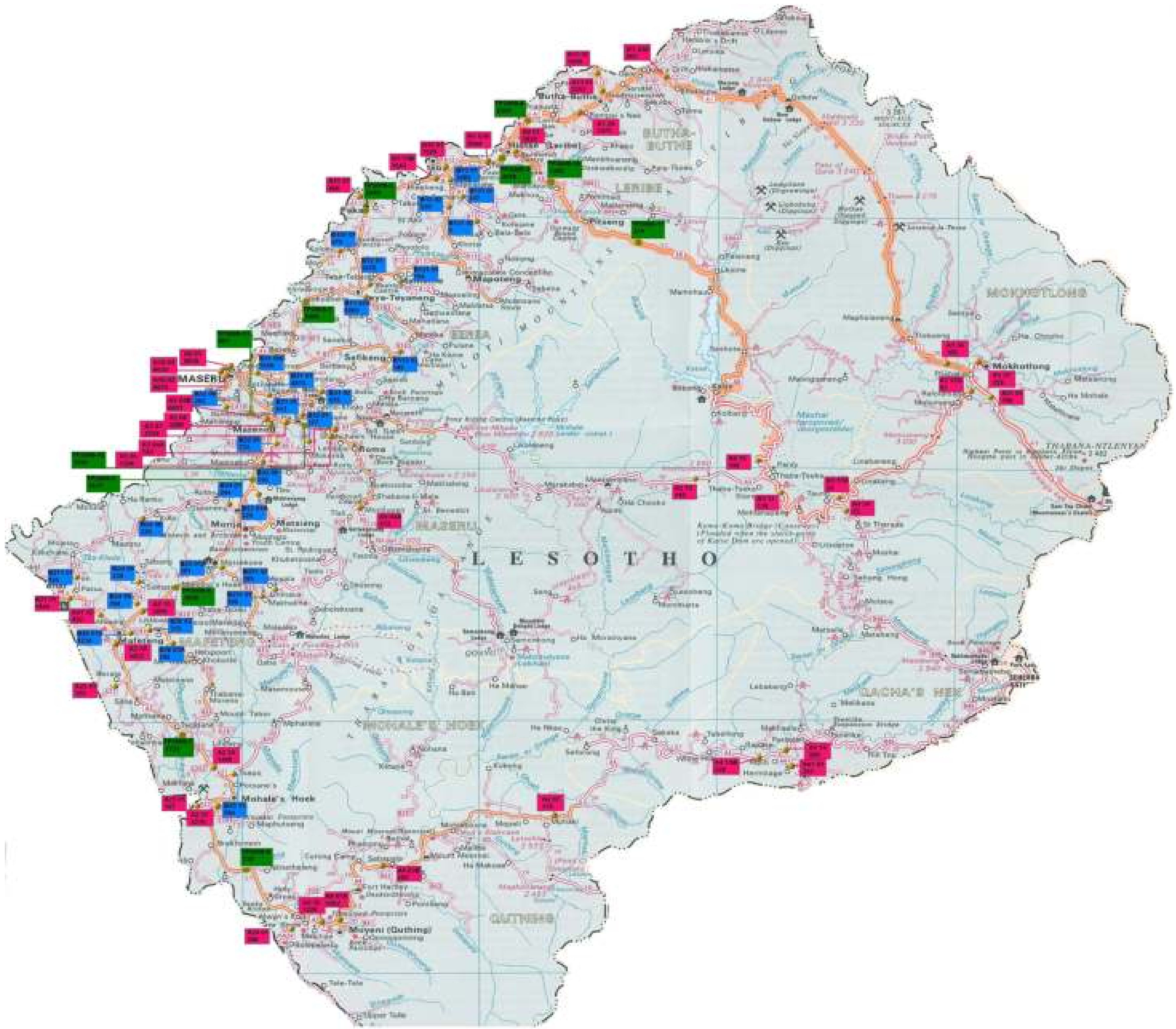


Figure 4-2: Average Daily Traffic Volume (available from Roads Branch 2007)

Table 4-2: Identification of Further Traffic Counts required in order to Identify Toll Corridors

						Potential Toll Route: Available Counts (for six months to Jun-07)				
Route	**From**	**To**	**Distance (Km)**	**Scouted?**	**Count (At Potential Plaza Location)**	**Link**	**Volume**	**Problem with Count**	**New Count Reqd?**	**Notes**
A1	Maseru	Teyateyaneng	42	Yes	Midway			No count available	Yes	
A1	Teyateyaneng	Maputsoe	40	Yes	Midway, south of Peka T	A1-13B	3,545	Count is possibly too close to a town (Maputsoe area)	Yes, on link A1-12B	
A1	Maputsoe	Leribe	16	Yes	Midway	A1-17A	3,044	Count is possibly too close to a town (Leribe)	Yes	
A1	Leribe	Butha-Buthe	30	Yes	Midway	A1-20	1,475	Count is possibly too close to a town (Butha-Buthe)	Yes	
A1	Butha-Buthe	Oxbow	68	Yes	Midway	A1-24A	961	Count is possibly too close to a town	Yes	
A1	Oxbow	Mokhotlong	114	No	Either end, due to remoteness	A1-36	169	Count is possibly too close to a town (Mokhotlong)	No, probably not viable for toll due to low volumes, but still to be considered further. Volumes may increase if Sani Pass / A31 is bituminised.	
A2	Maseru (A2/A3)	Morija	23	Yes	Midway			No count available	Yes	European Union funded upgrade imminent
A2	Morija	Mafeteng	38	Yes	Midway	A2-15	2,055	Count is further south than desired and possibly too close to a town	Yes	
A2	Mafeteng	Mohale's Hoek	47	Yes	Midway	A2-18	1,433	Count is possibly too close to a town	Yes	
						A2-24	1,400	Count is possibly too close to a town		
A2	Mohale's Hoek	Moyeni	55	Partial	Midway	A2-27	1,276	Count is possibly too close to a town	Yes	
						A2-35	1,220	Count is possibly too close to a town		
A3	Maseru (A2/A3)	St Michaels	8	Yes	Midway	A3-01	2,554	Count is possibly OK, but exact position is required		
A3	St Michaels	Blue Mountain Pass	39	Yes	cf Toll Gate House	A3-04A	742	Count is too far to the west of the road section	Yes	
A3	Blue Mountain Pass	Thaba-Tseka	103	No		A3-12	149	Count is too far to the east of the road section	No, probably not viable for toll due to low volumes, but still to be considered further.	
A3	Thaba-Tseka	Mokhotlong	102	No		A3-13	138		No, probably not viable for toll due to low volumes, but still to be considered further. Volumes may increase if Sani Pass / A31 is bituminised.	To be bituminised
						A3-15	33			
						A3-15G	93			
A3	Mokhotlong	Sani Top	49	No		A31-01	106		No, probably not viable for toll due to low volumes, but still to be considered further. Volumes may increase if Sani Pass / A31 is bituminised.	To be bituminised.
A4	Moyeni	Taung (A4/A3)	327	No		A4-01A	1,262	This is close to Moyeni, and counts drop off soon after?	No, probably not viable for toll due to low volumes, but still to be considered further.	
						A4-03B	182			
						A4-07	379			
						A4-13B	229			
						A4-14	208			
						A4-24	32			
A5	St Michaels	Roma	12	Yes	On A3?	A5-01	1,396		No	
A5	Roma	End A5	75	No		A5-04A	272		No, probably not viable for toll due to low volumes, but still to be considered further.	New road Semonkong to Ha Morainyane? (40km), to be bituminised, now only a track
A8 (Katse)	Leribe	Pitseng	26	Yes	Midway	A8-01	3,829	Count is possibly too close to a town (Leribe)	Yes	
A8 (Katse)	Pitseng	Katse	82	Partial	Either end, due to remoteness			No count available	Yes	
A8 (Katse)	Katse	Thaba-Tseka	44	No		A8-15	186		No, probably not viable for toll due to low volumes, but still to be considered further.	
A10	Maseru (A2/A3)	Pioneer Road	18	Yes	Midway	A10-01	11,601	Possibly too close to a town (Maseru)	Yes	
						A10-02	8,874	Possibly too close to a town (Maseru)		
						A10-03	6634	Possibly too close to a town (Maseru)		

Notes:

1. Potential plazas (count locations) are located between towns and not within urban areas.

In the study proposal, it was planned to perform detailed traffic counts and origin-destination surveys in the selected corridors at the same time. A*fter the initial gathering of traffic information, it was, however, considered that initially only traffic counts (and not origin-destination surveys) should be undertaken at the 12 selected locations in the A1 Oxbow – Maseru, A2 Maseru – Moyeni, A3 Maseru – Ntsi, A8 Hlotse (Leribe) – Katse and A10 Maseru – Pioneer Road corridors.* It was considered that the origin-destination surveys should only be undertaken after the initial traffic counts had become available to indicate the potential viability of individual corridors.

4.5 Initial assessment of the conditions of a part of the Lesotho primary road infrastructure

As was indicated in Section 4.1 of this report, the second factor that was considered in determining the potential toll corridors was the consideration of routes with significant maintenance and/or upgrading needs.

A scouting tour of the major Lesotho surfaced roads was undertaken from 22 to 23 April 2008. The aim of this exercise was to visually assess the road conditions and to assess possible needs for further analysis. The majority of surfaced roads were travelled during this time as is indicated in Table 4-3 below.

Table 4-3 summarizes the observations in April 2008 of the more important surfaced roads. The odometer of the vehicle was used in defining the approximate distance between destinations. In some cases, the full distance of the road between the destinations, for example between Mohale's Hoek and Quthing, was not travelled as is clear from the distance surveyed against the actual distance. The road sections that were surveyed did, however, give a good indication of road conditions at the time.

The following guidelines were used in assessing the status in respect of "fit for purpose" of the road sections as summarized in Table 4-3. In this subjective assessment of geometry and pavement condition, the volumes of traffic as well as the safety of pedestrians and the travelling public were kept in mind:

- Fit for purpose was defined on a scale of 0 to 5, 0 being totally inadequate or non-existent and 5 indicating a perfect condition.
- The width of the paved road was indicated in terms of three categories namely “wide” which implies a width of more than 10 meters, “narrow” which refers to a width of less than 8 meters and “average” which refers to a width between 8 and 10 meters wide.
- A value of 4.5 or more in the geometry column indicated wide travelling lanes, an adequate width of paved shoulder and a climbing lane where necessary, as shown in Figure 4-3 below. A value between 3 and 3.5 indicated a need for widening as well as paved shoulders due to the amount of traffic and pedestrians using the facility. Less than 3 implied an inadequacy of compliance to the perceived required geometric standards.
- A value of 4.5 or more in the pavement column indicated a pavement structure that seemed to be adequate for the traffic using it. An assessment of 3 and 3.5 indicated a warning situation where structural failures had occurred with unacceptable rutting for the traffic using the road, as shown in Figure 4-4 below. Immediate repairs were necessary over some sections and rehabilitation within the next 3 years would be required for this rating. Where the assessment was less than 3, the pavement was considered to have failed.

Table 4-3: A Visual Survey of the Condition of Some Major Surfaced Roads in Lesotho in 2008

Location	Approx. length (km)	Width	Geometry	Pavement
South of Maseru:				
Maseru to Mazenod via Thetsane	22	wide	5	4.5
Maseru to Botsabelo	5	wide	4	4.5
Botsabelo to Masianokeng	8	average	3.5	3
Masianokeng to Mazenod	4	average	3.5	3
Mazenod to Mantsebo	11	narrow	3	3
Mantsebo to Morija	15	narrow	4	4
Morija to Motsekuoa	12	narrow	4	3
Motsekuoa to Mafeteng	26	narrow	3.5	3
Mafeteng town	3	average	2.5	2.5
Mafeteng to Mohaleshoek	44	average	4	4
Mohaleshoek towards Quthing	13	average	5	5

Location	Approx. length (km)	Width	Geometry	Pavement
East of Maseru:				
Mazenod to St Michaels	10	wide	5	5
St Michaels to Blue Mountain pass	39	average	5	5
St Michaels to Roma	5	narrow	3	3.5
Roma to Nyakosoba	7	narrow	2.5	2
North of Maseru:				
Maseru to traffic circle at edge of town	9	wide	2.5	2
Circle to Teya-Teyaneng	33	narrow	3.5	3
Teya-Teyaneng to Mapoteng	27	narrow	4.5	3.5
Teya-Teyaneng to Maputsoe via Peka	40	narrow	3.5	4
Mapoteng to Maputsoe	22	narrow	4.5	2.5
Maputsoe to Leribe	15	narrow	4	4
Leribe towards Katse via Pitseng	40	narrow	4.5	4
Leribe to Butha-Buthe	30	narrow	3.5	4
Butha-Buthe to Oxbow	58	narrow	4.5	4
Oxbow towards Mokhotlong	11	narrow	4.5	2

Inspection of Table 4-3 leads to the observation that the condition of the roads, both in terms of geometry as well as pavement structure, improved as one moved away from the urban areas, especially Maseru.

Most of the sections between Maseru and Mafeteng with the width indicated as narrow in Table 4-3 form part of the recent and current (2010) reconstruction of route A2 between these two towns. Such a major reconstruction is usually perceived by the travelling public as a sound rationale for tolling, since the funds so collected are often used to service and redeem loans procured to fund the major reconstruction and to continue maintaining the road in a good condition. As was indicated in Section 4.3 above, route A2 between Mazenod and Mafeteng was included into the routes to be considered as potential toll corridors.

Figure 4-3: Example of a road rated 4.5 for its geometric adequacy

Figure 4-4: Example of a road with a 3.0 rating for its pavement adequacy.

5. INTERIM IDENTIFICATION OF SIX POTENTIAL TOLL CORRIDORS

5.1 Additional Traffic Counts performed as part of this study

Figure 5-1 indicates the locations of the 13 additional 7 day traffic counts undertaken specifically for this study between 27 July and 3 August 2008 or between 4 and 11 August 2008. (Figure 5-2 and Figure 5-3 show the same information for these stations on enlarged maps).

The 2008 ADTs (Average Daily Traffic volumes) at each of the 13 stations along the A1, A2, A5, A8 and A10 at which the additional traffic counts were undertaken are indicated in Table 5-1.

Table 5-1: Additional Traffic Counts carried out by the Study Team (2008)

Station ID	Location of Count	Survey date	2008 ADT	%HV
Station-1	Maseru – Teya-Teyaneng along the A1	27 Jul to 03 Aug 08	2806	10,4%
Station-2	Teya-Teyaneng - Leribe along the A1	27 Jul to 03 Aug 08	2248	15,3%
Station-3	Maputsoe - Leribe along the A1	27 Jul to 03 Aug 08	3050	11,0%
Station-4	Leribe – Butha-Buthe along the A1	26 Jul to 02 Aug 08	2595	6,6%
Station-5	Mazenod - Morija along the A2	04 Aug to 11 Aug 08	3617	0,8%
Station-6	Morija - Mafeteng along the A2	04 Aug to 11 Aug 08	1938	15,1%
Station-7	Mafeteng - Mohale's Hoek along the A2	04 Aug to 11 Aug 08	1233	12,2%
Station-8	Mohale's Hoek - Quthing along the A2	04 Aug to 11 Aug 08	739	30,0%
Station-10	Leribe - Pitseng along the A8	27 Jul to 03 Aug 08	1262	19,1%
Station-11	Pitseng - Lejone along the A8	11 Aug to 18 Aug 08	214	15,0%
Station-12	Mazenod - Roma along the A5	03 Aug to 10 Aug 08	2993	7,1%
Station-13	Maseru - A2 along the A10	04 Aug to 11 Aug 08	881	10,4%

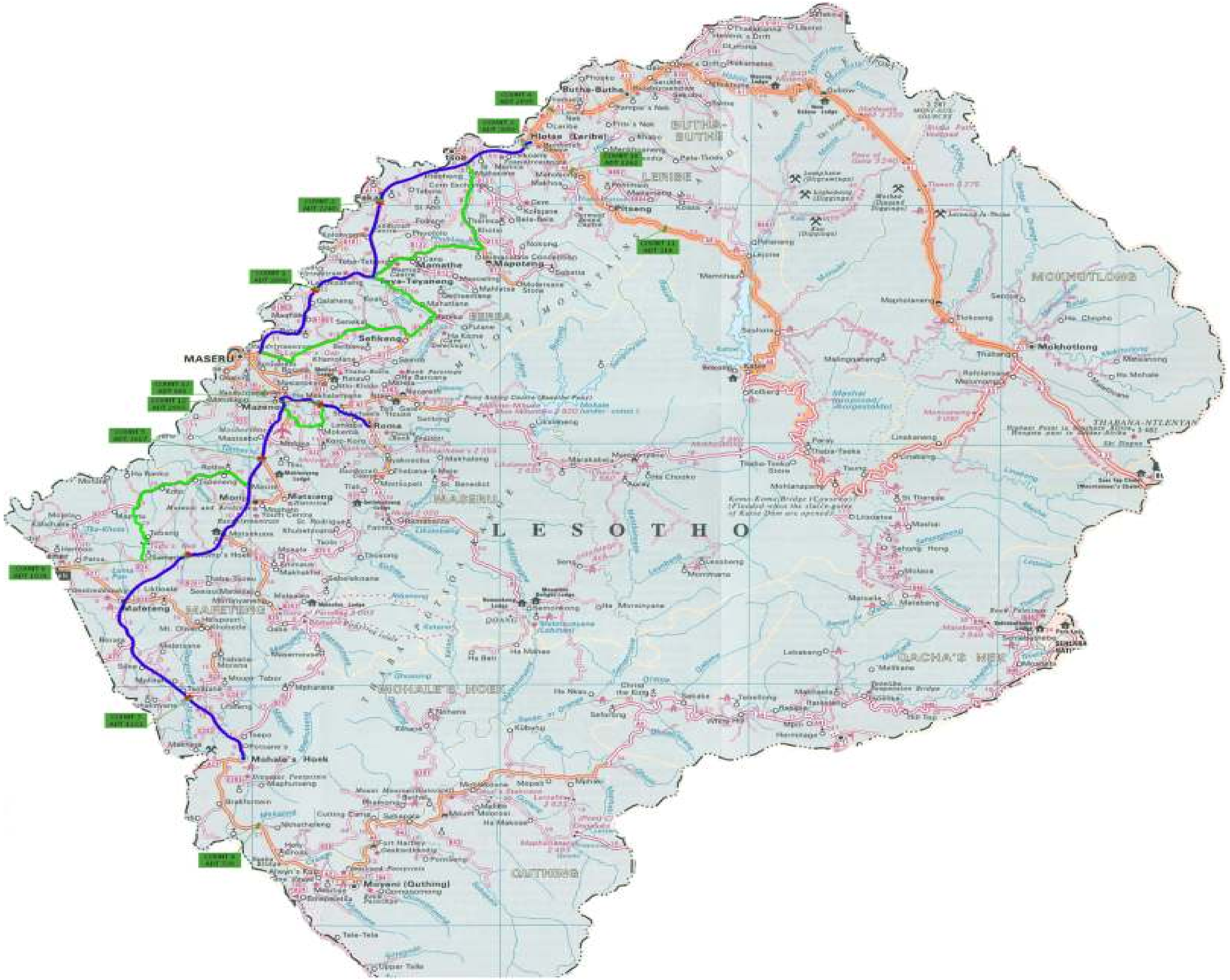


Figure 5-1: Potential Lesotho Toll Corridors: Locations of Additional 7 Day Traffic Counts (2008) - Countrywide

Figure 5-2: Potential Lesotho Toll Corridors (A1 and A8): Locations of Additional 7 Day Traffic Counts (2008)

Figure 5-3: Potential Lesotho Toll Corridors (A2 and A5): Locations of Additional 7 Day Traffic Counts

From the average daily traffic volumes at the "interurban" locations listed in Table 5-1 above and indicated in Figure 5-1, the following more specific conclusions were drawn:

- Traffic on Route A1 between Maseru and Butha-Buthe was between 2 250 and 3 050 vehicles per day, while the traffic volumes on the section east of Butha-Buthe was lower than 1000 vehicles per day (the last traffic count was amongst those available from the Roads Branch).
- Traffic on Route A2 between Maseru and Mohale's Hoek was between 1 200 and 3 600 vehicles per day, while the traffic volumes on the section south of Mohale's Hoek was just above 700 vehicles per day.
- Traffic on Route A5 between Mazenod and the intersection with Route A3 was just below 3 000 vehicles per day, while traffic on Route A5 between Roma and the intersection with Route A3 was around 1 400 vehicles per day (the last traffic count was amongst those available from the Roads Branch).

5.2 Selection of six potential toll corridors

Based on the above-mentioned traffic volumes and the need for improvement of the A2 between Mazenod and Mafeteng, the following road sections were provisionally identified as potential toll corridors based on the average daily traffic volumes:

- Route A1 between Teya-Teyaneng and Hlotse (Leribe),
- Route A1 between Maseru and Teya-Teyaneng,
- Route A2 between Mazenod and Morija,
- Route A2 between Morija and Mafeteng,
- Route A2 between Mafeteng and Mohale's Hoek, and
- Route A5 between Route A2 and Roma.

Although the study proposal referred to five potential toll corridors to be analysed, a sixth corridor was added. It has to be acknowledged that the A1 Hlotse – Butha-Buthe section has similar (or higher) volumes than the A2 Mafeteng – Mohale's Hoek section which appears on the above list as one of the six potential corridors. The A2 Mafeteng – Mohale's Hoek section was, however, selected because of its significantly longer "tollable" distance.

In order to perform a more thorough analysis of the correct definition of the above-mentioned road sections as toll corridors, roadside surveys involving, inter alia, questions regarding the origins and destinations of traffic passing at the interview locations, were carried out in each of these higher volume corridors. The results of these origin-destination surveys and their impact upon the definition of the toll corridors and the toll strategies in the various toll corridors are discussed in Section 7 of this report.

6. ROADSIDE SURVEYS

6.1 Location, Sample Sizes and Objectives of Surveys

The roadside surveys were performed along the higher volume road sections between major towns, as identified in Section 5.2 of this report. A total of six surveys were carried out in both directions for one day. The six survey locations are indicated in red in Figures 5-1, 5-2 and 5-3. The surveys aimed to select respondents randomly from the passing traffic at the survey locations. The services of the Lesotho traffic police and Department of Transport were used to manage traffic at the survey points. The date on which each survey took place and the sample size of each survey are shown in Table 6-1. A total of 2 521 interviews were carried out.

Table 6-1: Locations and Sample Sizes of Roadside Surveys

Route	Direction	Date	Sample
Route A1 between Teya-Teyaneng and Hlotse (Leribe)	Northbound	Friday 28 November 2008	207
Route A1 between Teya-Teyaneng and Hlotse (Leribe)	Southbound	Friday 28 November 2008	180
Route A1 between Maseru and Teya-Teyaneng	Northbound	Friday 28 November 2008	154
Route A1 between Maseru and Teya-Teyaneng	Southbound	Friday 28 November 2008	199
Route A5 between Mazenod and Roma	Eastbound	Wednesday 26 November 2008	246
Route A5 between Mazenod and Roma	Westbound	Wednesday 26 November 2008	305
Route A2 between Mazenod and Morija	Northbound	Wednesday 26 November 2008	237
Route A2 between Mazenod and Morija	Southbound	Wednesday 26 November 2008	273
Route A2 between Morija and Mafeteng	Northbound	Thursday 27 November 2008	210
Route A2 between Morija and Mafeteng	Southbound	Thursday 27 November 2008	211
Route A2 between Mafeteng and Mohale's Hoek	Northbound	Thursday 27 November 2008	146
Route A2 between Mafeteng and Mohale's Hoek	Southbound	Thursday 27 November 2008	153
Total			2521

The extent to which each vehicle class was included in the survey at each location is shown in Table 6-2.

Table 6-2: Lesotho Roadside Surveys: Extent of Vehicle Classes in each Origin-Destination Survey

Route	Direc-tion	Sample	Light vehicles	Mini-buses	Buses	Heavy vehicle	Un-known
Route A1 between Teya-Teyaneng and Hlotse (Leribe)	NB	207	128	57	3	16	3
	SB	180	104	42	2	22	10
Route A1 between Maseru and Teya-Teyaneng	NB	154	107	28	4	15	0
	SB	199	127	42	7	23	0
Route A5 between Mazenod and Roma	EB	246	152	57	10	14	13
	WB	305	193	71	8	21	12
Route A2 between Mazenod and Morija	NB	237	116	69	4	33	15
	SB	273	150	61	8	49	5
Route A2 between Morija and Mafeteng	NB	210	114	48	6	36	6
	SB	211	125	51	5	25	5
Route A2 between Mafeteng and Mohale's Hoek	NB	146	82	38	3	18	5
	SB	153	81	45	2	20	5

The objective of the roadside surveys was to collect the following information from each respondent:

- Town where respondent lived
- Employment status
- The origin and destination of the particular trip
- The frequency of the trip, i.e. how often the respondent undertook the trip.
- The purpose of the trip

The results of the surveys insofar as it concerns the origins and destinations of trips are described extensively in the next section of this report in conjunction with the evaluation of the toll strategy in each toll corridor. Results regarding the frequency and trip purposes in each toll corridor are provided in the rest of this section.

6.2 Frequency of trips

Table 6-3 below indicates the frequency of the trips undertaken by respondents along each of the routes identified as potential toll corridors. It should be noted that a trip constitutes travel in one direction between an origin and a destination.

Table 6-3: Frequency of Trips

Route	2 or more trips per day	1 to 2 trips per day	1 to 7 trips per week	1 to 4 trips per month	Less than 1 trip per month
Route A1 between Maseru and Teya-Teyaneng	12%	10%	52%	24%	3%
Route A1 between Teya-Teyaneng and Hlotse (Leribe)	17%	17%	48%	15%	2%
Route A2 between Morija and Mafeteng	17%	14%	46%	21%	2%
Route A2 between Mazenod and Morija	18%	17%	45%	17%	3%
Route A2 between Mafeteng and Mohale's Hoek	12%	21%	51%	14%	2%
Route A5 between Route A2 and Roma	29%	22%	39%	9%	1%

The following conclusions can be drawn from Table 6-3:

- If route A5 between route A2 and Roma is excluded, between 45% and 52%, (i.e. about half) of road users in the potential toll corridors used the routes for between 1 and 7 trips per week. In the case of route A5 between route A2 and Roma where a very high percentage of daily trips occurred, the percentage of 1-7 trips per week was significantly lower at 39%.
- If high frequency travellers, i.e. those using the corridors for one or more trips per day, are considered, it can be concluded that this category of travellers constituted 22% to 35% of all respondents for all corridors except route A5 between route A2 and Roma. In the case of route A5, the higher frequency travellers constituted 51% of the respondents, indicating a strong commuter movement between Maseru and Roma.
- If the A5 is, once again, excluded, 14% to 24% of road users make 1 to 4 trips per month.

6.3 Purpose of Trip

The roadside interviews included the following options for road users to select in terms of their trip purpose:

- Work
- Education
- Transportation of goods (aimed at goods vehicles)
- Transportation of passengers (aimed at taxis and buses)
- Recreational

- Shopping
- Other

The distribution of trip purpose for each survey location is shown in Table 6-4.

Table 6-4: Distribution of Trip Purposes at each O-D Survey Location

Route	Work	Edu-cation	Trans-port goods	Trans-port passen-gers	Recrea-tional	Shop-ping	Other
Route A1 between Maseru and Teya-Teyaneng	39,8%	2,3%	10,4%	21,0%	21,0%	0,3%	5,2%
Route A1 between Teya-Teyaneng and Hlotse (Leribe)	51,3%	0,0%	4,7%	18,8%	22,5%	0,0%	2,6%
Route A2 between Morija and Mafeteng	37,6%	1,4%	13,4%	23,7%	19,2%	1,4%	3,1%
Route A2 between Mazenod and Morija	30,4%	2,4%	20,5%	27,8%	14,7%	0,6%	3,6%
Route A2 between Mafeteng and Mohale's Hoek	54,1%	0,3%	10,3%	19,0%	14,5%	1,0%	0,7%
Route A5 between A2 and Roma	43,3%	1,8%	8,5%	22,9%	8,9%	4,7%	9,8%

The following conclusions can be drawn from Table 6-4:

- Work was by far the most important trip purpose, with between 30,4% and 54,1% of all trips that had work as their objective.
- The transportation of passengers was the trip purpose indicated by between 18,8% and 27,8% of all respondents. It can probably be assumed that a significant percentage of the passengers being transported also had work as the objective of their trips.
- Recreation was indicated as the trip purpose by between 8,9% and 22,5% of respondents.

6.4 Public Support for Tolling an Upgraded Road

The roadside interviews in 2008 included a question to road users regarding whether they would support the tolling of the road that they were driving on, provided that the toll money is applied towards upgrading the road. Table 6-5 provides a summary of the responses from the roadside interviews in the various corridors.

Table 6-5: Responses to question regarding support for tolling an upgraded road

	Yes	No
A1 Maputsoe - Teya-Teyaneng	64,0%	36,0%
A1 Teya-Teyaneng - Maseru	50,1%	49,9%
A5 Mazenod - Roma	52,0%	48,0%
A2 Mazenod - Morija	63,5%	36,5%
A2 Morija - Mafeteng	62,8%	37,2%
A2 Mafeteng - Mohale's Hoek	69,2%	30,8%
TOTAL	60,0%	40,0%

As can be concluded from Table 6-5, 60% of road users interviewed supported tolling the roads, with slightly higher percentages south of Maseru where the roads had already been upgraded.

It can be concluded from the above-mentioned information that the public is likely to be very divided on the issue of tolling upgraded roads. It is, therefore, very important that a road should be upgraded prior to its tolling to demonstrate to the public the benefits made possible by tolling.

7. TOLL STRATEGY

7.1 Introduction

This chapter describes the objectives of toll strategies as well as the approaches that are followed to achieve equitable open tolling strategies. The traffic streams as indicated by the origin-destination surveys are then analysed for each corridor to test the equitability of the possible toll strategy and, in some cases, the tolling section definitions are adjusted to achieve tolling equitability.

7.2 Considerations in developing toll strategies

After familiarisation with the selected potential toll corridors, the development of possible toll strategy scenarios was undertaken for each corridor, taking into account, inter alia, the following major objectives:

- In view of the intrinsic controversial nature of tolling an existing major road section, it is considered important to develop a reasonable rationale for the tolling of an existing major road section. Public acceptability of the tolling of an existing major road section is significantly improved if it can be shown that road users paying toll will benefit from significant capital or maintenance expenditure that has been or will be made possible by investments to be serviced and repaid by the toll income, for example, as a result of the addition of shoulders to existing road sections and/or the rehabilitation or resealing of the pavement of a road section. Tolling usually makes such expenditure possible in the sense that the future nett toll revenue of a toll project provides the "security" for loans to fund the initial capital expenditure. Nett toll revenue is used to pay the interest in respect of such loans and also to eventually repay initial infrastructure funding loans.
- In the case of Lesotho, where the loans are obtained from development partners (for example, The World Bank) and the interest payments are not as significant as in the case of an ordinary commercial loan, the above-mentioned logic for achieving public acceptability might not be so compelling and the emphasis would be upon providing funding from nett toll revenue for rehabilitation, resealing and annual routine maintenance purposes.
- The initial and continual achievement of a significantly higher quality of road will, however, regardless of the source of the funding, remain an important characteristic of a toll corridor In order to make the tolling of the corridor acceptable to the public.

- Public acceptability of a toll strategy is usually facilitated if the toll strategy is perceived to be equitable by road users. The perception of equitability can be achieved in the following ways:
- The location of a toll plaza on an interurban road section must be such that the vast majority of toll plaza traffic uses virtually the entire road section being tolled at that location. Also, those users not using the entire toll road section should be given a discount in respect of that section of the road not used by them.
- Perceived equitability may also be achieved by charging a toll tariff lower than the perceived road user cost saving resulting from the road improvement or perceived road user cost savings relative to an alternative route.
- Public acceptability of a toll strategy may, however, also in some cases be achieved by not being equitable, but by being sympathetic in respect of a particular local problem, for example by reducing the toll tariff if it would reduce diversion to a sensitive secondary road in that particular area.
- The minimisation of toll-related capital, operating, and maintenance costs is an important objective in order to minimise the cost of toll collection and, in so doing, possibly achieving the best financial and economic results in respect of a toll project. High toll-related costs are also often an indication of an economically inefficient toll project.
- Toll strategies should be devised that would actively promote and not negatively impact upon public transport services. This could be achieved by, for example, granting a discount to taxis and other public transport vehicles passing through a toll plaza.
- The maximisation of gross toll income is an important objective for the achievement of financial viability. In the context of the development of toll strategies, the implication is that a tolling configuration should be devised which leads to toll payments by most or all toll road users.

7.3 Closed vs. Open Toll Strategies

7.3.1 Closed toll strategies

Equitable tolling may be achieved by means of a so-called closed toll strategy. A closed toll strategy usually entails the tolling of all possible entrances and exits to a major road. By adopting this strategy, the road user is charged for exactly the distance travelled on the toll road and a closed toll strategy is, therefore, the most equitable toll strategy. Such a closed strategy, however, requires the erection of entrance and exit toll plazas at all the entrances to and exits from the tolled road which is usually only possible on a motorway standard road and is, therefore, very expensive to implement. Since the potential toll corridors in Lesotho do not, at this time, warrant to be converted to motorway standard routes, a closed toll system would not be feasible in Lesotho.

7.3.2 Open toll strategies

Open toll strategies are usually employed to reduce the high toll-related capital, operating and maintenance costs associated with closed toll strategies. As was the case with many South African and international toll projects, open toll strategies consisting of only one mainline toll plaza (sometimes combined with some ramp plazas) provide a means for the efficient and equitable tolling of an interurban road section.

7.3.3 Approaches to achieve equitable open tolling strategies

The most important challenge in the development of an open toll strategy is to achieve equitable tolling. The approaches employed in this study to develop equitable open toll strategies included the following:

- By using the results of origin-destination surveys, it was possible to identify the extent of road sections used by a large percentage of important traffic streams. The usefulness of the identification of the extent of such road sections is that it is usually then possible to toll these sections at one mainline toll plaza only. When upgraded existing roads are tolled, it is usually necessary to provide a so-called “local user discount” to be fair towards users using only a part of the road sections being tolled in this way at a single mainline toll plaza.
- If important origins and destinations of traffic occur along a provisionally defined toll corridor, the most equitable solution may be to toll the sub-sections separately.
- Equitable tolling at the lowest reasonable toll-related capital, operating and maintenance costs could be achieved by locating a mainline toll plaza on a section common to two major traffic streams, using different major routes for a part of the tolled section(s).

7.4 Evaluation of traffic streams in toll corridors by means of origin-destination surveys

The consideration of the origins and destinations of the traffic using each of the provisionally defined toll corridors is important for the following reasons:

- Since the planned toll strategy for each of the provisionally defined toll corridors is to toll traffic at one toll plaza location in the corridor where most of the interurban traffic would pass, it is important to analyse the origins and destinations of traffic to confirm that most of the traffic would use a significant section of the toll corridor. If this is not the case, road users would perceive the tolling as inequitable, since they would not be using the number of kilometres of toll road for which they would be paying and they would, therefore, consider alternative routes.

- Insight into the extent to which different traffic streams passing through a toll plaza will use a toll corridor is vital to be able to determine the toll tariffs at which the likely diversion of traffic from the toll corridor to an alternative route could be minimised to an acceptable level. This is necessary to be able to determine the likely gross revenue that the toll corridor will be able to produce and, therefore, in order to determine its financial viability. It is also necessary to determine the likely diversion of traffic in order to determine the likely impact of tolling upon the economic viability of the upgrading/improvement of the toll corridor. If too many road users are tolled "off" a toll corridor, the economic benefits of the upgrading/improvement of the corridor could be reduced to a level where the investment would no longer be worthwhile.
- Since land use along the selected routes is such that there will, inevitably, be some short distance trips, a consideration of origins and destinations is also important to determine which users should receive a local user discount in respect of toll payment because they are passing through a toll plaza in a toll corridor but they are using only a short section of it.

The locations of the roadside surveys in each of the toll corridors are indicated in red on Figures 5-1, 5-2 and 5-3. The traffic streams between the origins and destinations at each of the roadside survey locations are shown in Figures 7-1, 7-5, 7-7, 7-9 and 7-11 which are analysed in the following sub-sections. The figures indicated on each horizontal bar represent the 2008 daily traffic volume of a particular traffic stream passing the survey location (potential plaza location) in each of the six potential toll corridors. The traffic stream can be identified by referring to the place names at the end of each horizontal bar, but indicated at the top along the horizontal line with the place names in the particular toll corridor. The percentages in brackets represent the percentage that particular traffic stream constitutes of the total traffic volume past the survey point. Thicker lines represent higher volumes.

7.5 Proposed Tolling Strategies for Selected Six Toll Corridors

7.5.1 Toll Section 1 : Route A1 between Teya-Teyaneng and Maputsoe

a. Evaluation of traffic streams on the A1 Teya-Teyaneng – Hlotse (Leribe) Section

An assessment of the traffic streams on Route A1 between Teya-Teyaneng and Hlotse (Leribe) (see Figure 7-1) indicates that the main traffic streams are between:

- Maputsoe and Maseru (28.1%),
- Maputsoe and Teya-Teyaneng (8.5%),
- Hlotse and Maseru (27.2%), and
- Areas north of Hlotse and Maseru (15.8%).

If Figure 7-1 is considered in order to determine which percentage of traffic uses which section of the toll corridor, the following conclusions can be drawn:

- About 50% of the road users, i.e. 1 137 of the average daily traffic volume of 2 248 vehicles per day, used the entire potential toll corridor distance of 49,0 km between Teya-Teyaneng and Hlotse (Leribe) as part of their trips.
- Another approximately 38% of the road users, i.e. 848 of the 2 248 vehicles per day, used about 78% (38,0 km) of the toll corridor, i.e. a significant part of the toll corridor, between Teya-Teyaneng and Maputsoe. This is such a significant part of the total traffic volume that the conclusion is reached below that the toll corridor definition should be revised to be between Maputsoe and Teya-Teyaneng, i.e. a distance of 38,0 km. With this revised definition of the corridor, about 87% of the road users will use the full corridor.

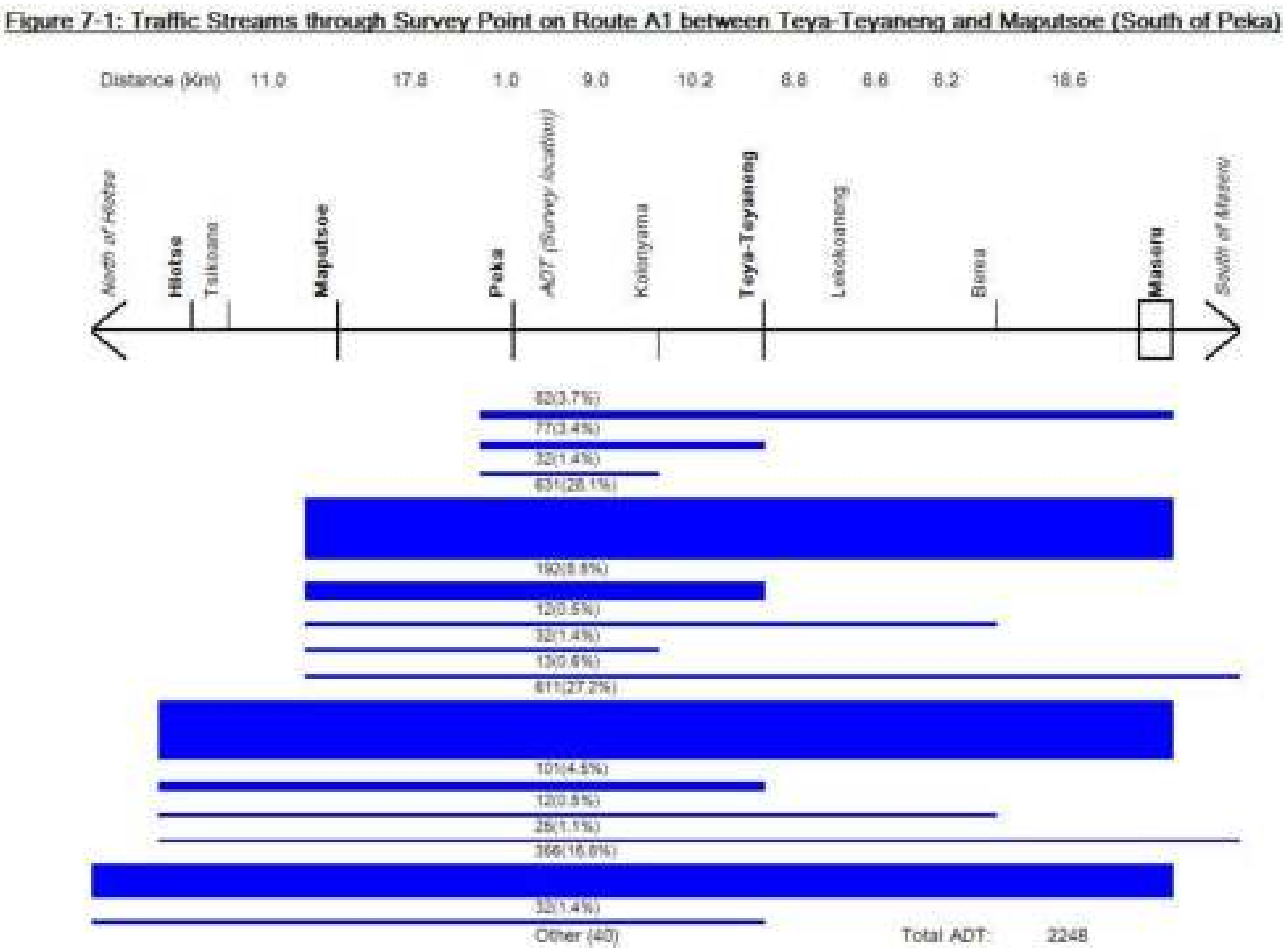


Figure 7-1: Traffic Streams through Survey Point on Route A1 between Teya-Teyaneng and Maputsoe (South of Peka)

- About 7% of the road users, i.e. 159 of the 2 248 vehicles per day travelling between Teya-Teyaneng and Peka, used about 50% (19,2 km) of the revised toll corridor between Teya-Teyaneng and Maputsoe.
- About 1,4% of the users, i.e. 32 of the 2 248 vehicles per day travelling between Maputsoe and Kolonyama, used about 75% (27,8 km) of the revised toll corridor.
- Another 1,4% of the users, i.e. 32 of the 2 240 vehicles per day travelling between Peka and Kolonyama used only about 25% (9 km) of the revised toll corridor.

The important overall conclusions regarding the definition of the toll corridor are, therefore, as follows:

- Since more than 87% of the road users in this toll corridor use the full distance between Teya-Teyaneng and Maputsoe of 38 km, this toll corridor should, ideally, be defined between Teya-Teyaneng and Maputsoe.
- Since the best alternative route to the A1 Teya-Teyaneng – Hlotse (Leribe) toll corridor, as indicated in green in Figures 5-1 and 5-2, would be the same for traffic with origins/destinations in Maputsoe or in Hlotse (Leribe) or beyond, the ability of the toll corridor to attract traffic at a particular toll tariff will be the same for all of the above-mentioned 87% of the corridor traffic. From the point of view of traffic attraction, it, therefore, does not really matter much with which northern end-point this corridor is defined.

In the interest of equitability, it is proposed that this A1 toll section be defined between Teya-Teyaneng and Maputsoe, since more than 87% of all users surveyed south of Peka would then be using the full toll section. It is also proposed that the following local user discounts should be granted, in the event that this road section is tolled at a location south of Peka:

- a local user discount of at least 75% to users living/working in Peka, since some of these users, when travelling to/from Kolonyama, would only be using 9 km of the 38 km toll section between Teya-Teyaneng and Maputsoe.
- a local user discount of at least 75% to users living/working in Kolonyama, since some of these users, when travelling to/from Peka, would only be using 9 kms of the 38,0 km toll section between Teya-Teyaneng and Maputsoe.

b. <u>Summary of Characteristics of Possible Toll Section 1: Route A1 between Teya-Teyaneng and Maputsoe (See Figure 7-2)</u>

This possible toll section is along Route A1 between Teya-Teyaneng and Maputsoe and is approximately 38 km long. The town of Peka is located approximately in the middle of this section. One potential toll plaza location is approximately 1km south of Peka. The roadside survey indicated that around 87% of traffic passing this location would travel the full tolling distance of 38 km with only around 13% of traffic making use of shorter distances of the toll corridor. The average daily traffic volume passing this potential toll plaza location was about 2 250 vehicles in 2008.

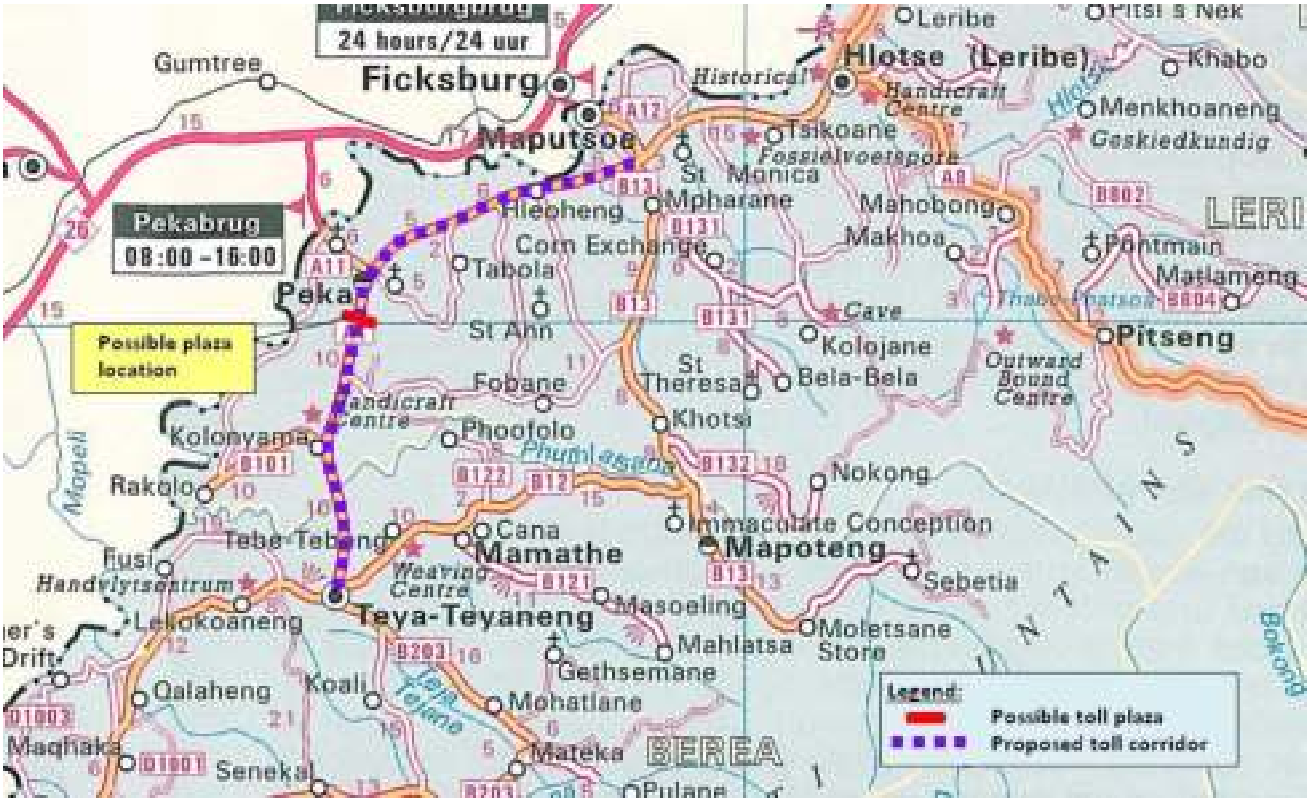


Figure 7-2: Proposed Toll Section 1: Route A1 between Maputsoe and Teya-Teyaneng

It should be noted that several other potential toll plaza locations have been identified on this section. A study to identify the optimal toll plaza location is usually undertaken after a decision to toll has been taken. Several toll plaza locations are usually considered in such a study which should also include public consultation and participation.

7.5.2 Toll Section 2: Route A1 between Teya-Teyaneng and Maseru

a. Evaluation of traffic streams on the A1 Maseru – Teya-Teyaneng Section

An assessment of the traffic streams on Route A1 between Maseru and Teya-Teyaneng (see Figure 7-3) indicates that the main traffic streams are between:

- Hlotse (Leribe) and Maseru (10%)
- Teya-Teyaneng and Maseru (28,4%)

- Maputsoe and Maseru (33,0%)
- Areas north of Hlotse and Maseru (16,4%).

Figure 7-3: Traffic Streams through Survey Point on Route A1 between Teya-Teyaneng and Maseru (South of Lekokoaneng)

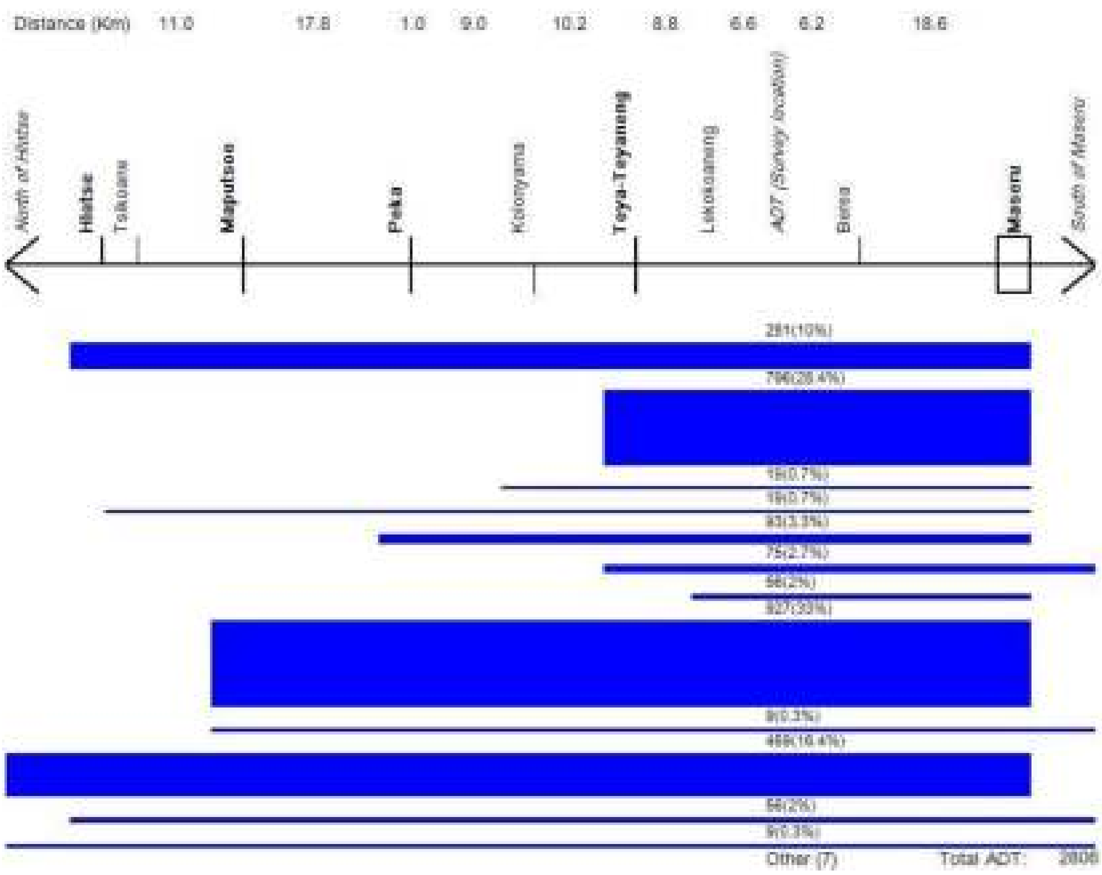


Figure 7-3: Traffic Streams through Survey Point on Route A1 between Teya-Teyaneng and Maseru (South of Lekokoaneng)

If Figure 7-3 is considered in order to determine which percentage of traffic uses which section of the toll corridor, the following conclusion can be drawn:

- With the exception of 56 vehicles per day travelling between Lekokoaneng and Maseru (or further south), i.e. 2% of the average daily traffic volume of 2 806 vehicles per day, all the traffic interviewed at the survey location south of Lekokoaneng use the entire toll corridor between Teya-Teyaneng and Maseru.

The important overall conclusions regarding the definition of the toll corridor are, therefore, as follows:

- The definition of the toll corridor appears to be close to perfect, since a toll tariff based on the full distance along the A1 Teya-Teyaneng and Maseru toll corridor would be equitable for 98% of the users.
- If tolling of this section takes place south of Lekokoaneng, a local user discount of about 20% would be appropriate for road users living/working in Lekokoaneng, since they would be using 31,4 km of the 40,2 km full toll section between Maseru and Teya-Teyaneng.

b. Summary of Characteristics of Possible Toll Section 2: Route A1 between Teya-Teyaneng and Maseru (See Figure 7-4)

This possible toll section is along Route A1 between Maseru and Teya-Teyaneng and is approximately 40,2 km long. There are no major towns along this section. One potential toll plaza location is about 25km north of Maseru at a location south of Lekokoaneng. The roadside survey indicated that about 98% of traffic passing this location would travel the full tolling distance of 40,2 km with only around 2% of traffic only making use of 31 4 km (8.8km less) between Maseru and Lekokoaneng. The average daily traffic volume passing the potential toll plaza location was about 2 800 vehicles in 2008.

Figure 7-4: Proposed Toll Section 2: Route A1 between Teya-Teyaneng and Maseru

It should be noted that several other potential toll plaza locations have been identified on this section. A study to identify the optimal toll plaza location is usually undertaken after a decision to toll has been taken. Several toll plaza locations are usually considered in such a study which should also include public consultation and participation.

7.5.3 Toll Section 3: Route A5 between the A2 and Roma

a. Evaluation of traffic streams on the A5 Section between the A2 and Roma

An assessment of the traffic streams on Route A5 between the A2 and Roma (see Figure 7-5) indicates that the main traffic streams are between:

- Areas north of Mazenod and the St Michaels turn-off (16.5%),
- Areas north of Mazenod and Roma (63,6 %), and
- Areas north of Mazenod and areas east of Roma (8.6%).

Figure 7-5: Traffic Streams through Survey Point on Route A5 between the A2 and Roma (East of Ha Makhalanyane)

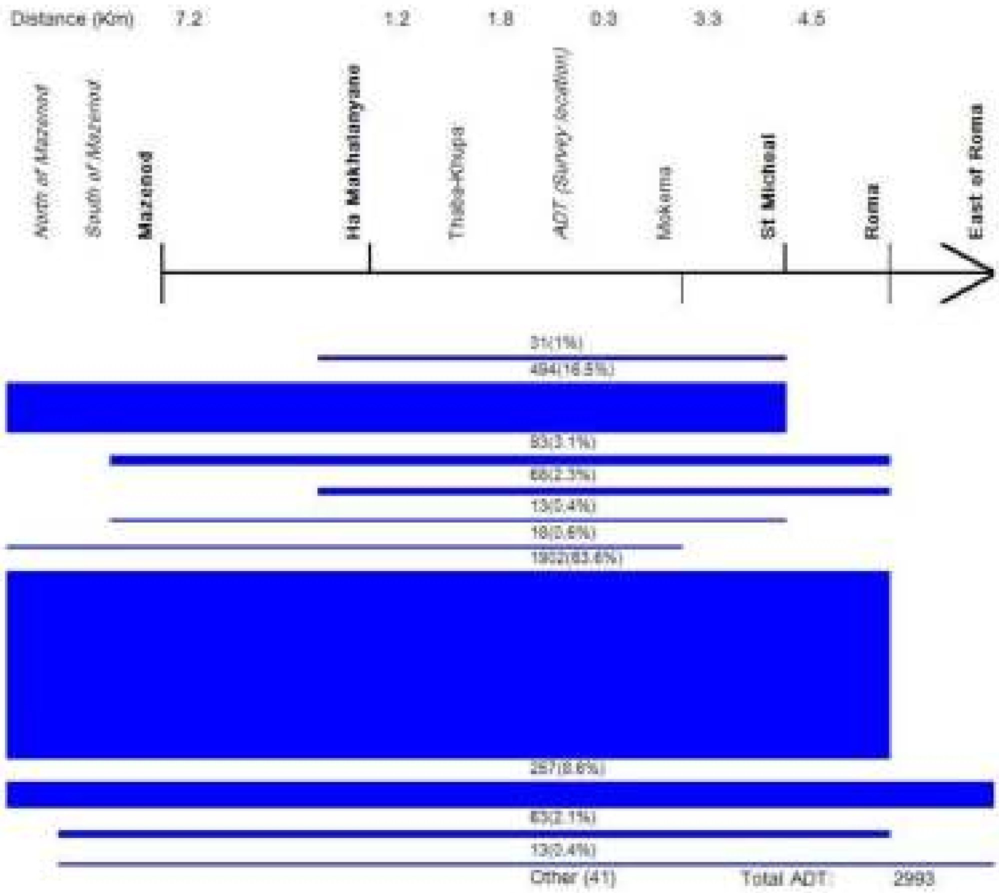


Figure 7-5: Traffic Streams through Survey Point on Route A5 between the A2 and Roma (East of Ha Makhalanyane)

If Figure 7-5 is considered to determine which percentage of traffic uses which section of the toll corridor, the following conclusions can be drawn:

- About 78% of all the traffic surveyed at the survey location on the A5 just east of Ha Makhalanyane, i.e. 2 328 of the 2 993 vehicles per day in 2008, used the entire A5 toll corridor between the A2 and Roma.
- The most important movement(s) not using the entire toll corridor are those between north or south of the A2/A5 intersection and the St Michaels turn-off which involves about 17% of all the traffic surveyed at the survey location, i.e. 507 of the 2 993 vehicles per day.

- Some 3,3% of the vehicles are involved in short-distance movements starting, ending or passing through Ha Makhalanyane.

The important overall conclusion regarding the definition of the toll corridor is that a significant percentage (17%) of Route A5 traffic turned off at St Michaels in order to use the A3. These users did not use the section of the A5 between the A3 and Roma, i.e. a section of 4,2 km.

It is considered that this inequitability could be overcome by adding the section of the A3 between the A3/A5 intersection (at St Michaels) and Ntsi to the definition of the toll corridor (see red broken line in Figure 7-6). This would then mean that with an A5 toll plaza between the A2/A5 intersection and the A3/A5 intersection, the following road sections would be tolled:

- the A5 between the A2 and the A3 (a common road section)
- the A3 between the A3/A5 intersection and Ntsi
- the A5 between the A3/A5 intersection and Roma.

The remaining 3,9% local movements should be accommodated by allowing for a local user discount of 65% which is based upon that part of the total 18,3 km Mazenod – Roma section not used by local traffic between Ha Mokhalanyane and the St Michaels intersection.

b. Summary of Characteristics of Possible Toll Section 3: Route A5 between the A2 and Roma and Routes A5 and A3 between the A2 and Ntsi (See Figure 7-6)

The possible toll section was originally defined along Route A5 between Route A2, south of Mazenod, and Roma (approximately 18.5km long) – See Figure 7-6. In view of the inequitability towards the road users who turn of or get onto the toll section at St Michaels, the definition of the toll section was expanded to also include Route A3 between the A2 and Ntsi (approximately 9,9 km long), i.e. the road section indicated in green dots in Figure 7-6. The total A5/A3 toll section is 21,9 km in length. One potential toll plaza location is approximately 8km east of the A2/A5 intersection between the Ha Makhalanyana and St Michael turn-offs. The roadside survey indicated that about 78% of traffic passing this potential toll plaza location would travel the full A5 tolling distance of 18.5km while around 17% would use 11.7km of Route A5 between the A2/A5 Intersection and the St Michaels turn-off as well as 9,9 km of Route A3 between the

A5 and Ntsi. The rest of the traffic would use Route A5 for shorter distances. The average daily traffic volume passing the potential toll plaza location was about 3 000 vehicles in 2008.

Figure 7-6: Expanded Proposed Toll Section 3: Route A5 between A2 and Roma and Routes A5 and A3 between the A2 and Ntsi

It should be noted that several other potential toll plaza locations have been identified on this section. A study to identify the optimal toll plaza location is usually undertaken after a decision to toll has been taken. Several toll plaza locations are usually considered in such a study which should also include public consultation and participation.

7.5.4 Toll Section 4: Route A2 between Mazenod and Morija

a. Evaluation of traffic streams on the A2 Section between Mazenod and Morija

An assessment of the traffic streams on Route A2 at a location on the Mazenod – Morija section and, more specifically, south of the King Moshoeshoe Airport between Mantsebo and Ha Moruthoane (see Figure 7-7) indicates that the main traffic streams are between:

- Areas north of Mazenod and Mafeteng (36.5%),
- Areas north of Mazenod and Morija (21.8%),
- Areas north of Mazenod and Mohale's Hoek (21,4%), and
- Areas north of Mazenod and areas south of Mohale's Hoek (6.9%).

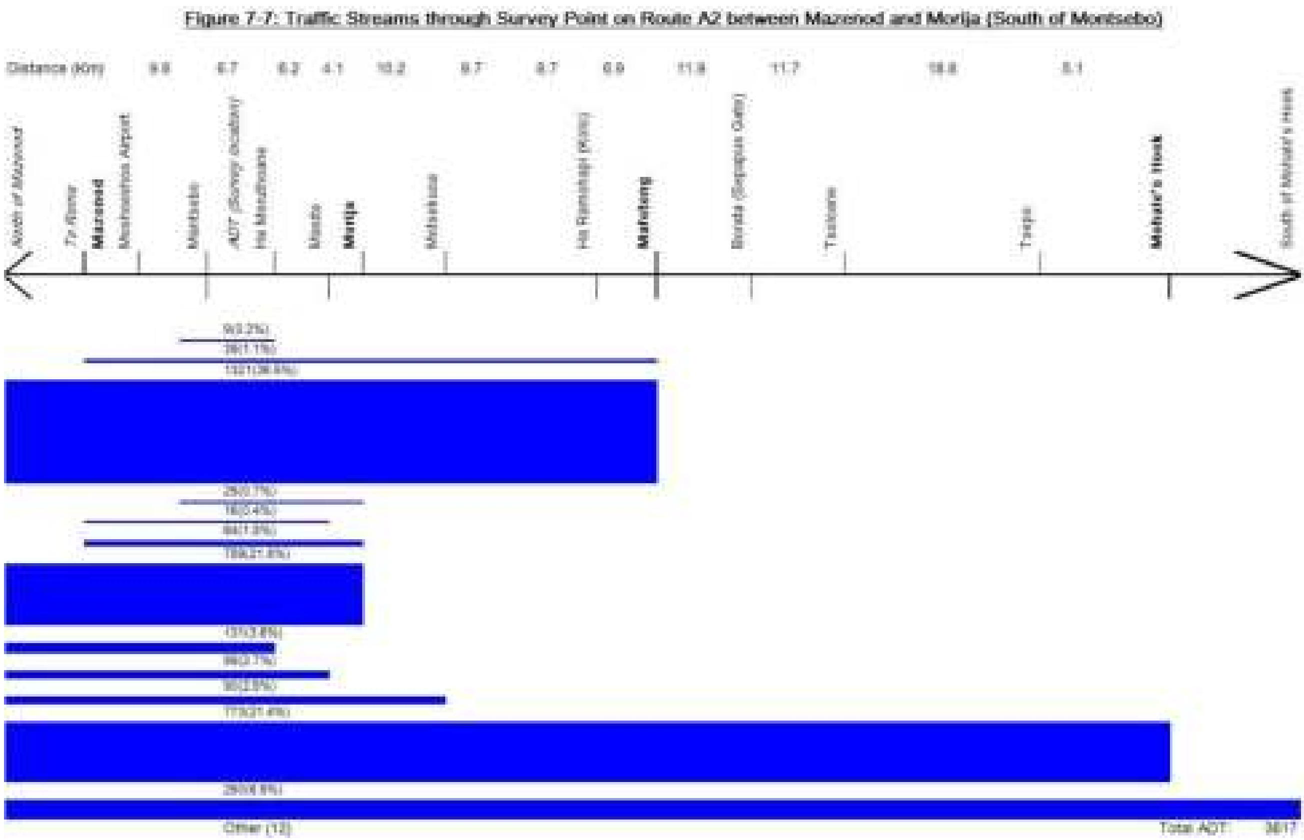


Figure 7-7: Traffic Streams through Survey Point on Route A2 between Mazenod and Morija (South of Mantsebo)

If Figure 7-7 is considered to determine which percentage of traffic uses which section of the potential toll corridor, the following conclusions can be drawn:

- About 92% of all the traffic surveyed at the survey location on the A2 between Mantsebo and Ha Moruthoane, i.e. 3 326 of the 3 617 vehicles per day in 2008, used the entire A2 toll corridor between Mazenod and Morija.

- The other 8% of the surveyed traffic have origins or destinations at Mantsebo, Ha Moruthoane and Masite and do, therefore, not use the entire A2 road section.

The important overall conclusion regarding the definition of the toll corridor and local user discounts are, therefore, as follows:

- The definition of the potential toll corridor appears to be very good, since a toll tariff based upon the full distance along the A2 between Mazenod and Morija would be equitable for 92% of the users.
- Road users living/working in Mantsebo, Ha Moruthoane and Masite should receive an appropriate local user discount, since they would only be using parts of the 29,4 km A2 toll section between Mazenod and Morija. Since it would not be possible to know the exact origin and destination of each local user trip, the conservative approach is to charge local users for the shortest trip that they are likely to undertake. In this case, this would appear to be the trip between Mantsebo and Ha Moruthoane which constitutes a trip of about 6,7 km on the A2. Since these local users would not be using 75% of the toll corridor when this trip is undertaken, a 75% local user discount is proposed.

b. Summary of Characteristics of Possible Toll Section 4: Route A2 between Mazenod and Morija (See Figure 7-8)

This possible toll section is along Route A2 between Mazenod and Morija and it is approximately 29,4 km long. The town of Mantsebo and the Moshoeshoe International Airport are located along this section of Route A2. One potential toll plaza location is approximately 14km south of the A2/A5 intersection, between the Mantsebo and the Matsieng turn-off. The roadside survey indicated that about 92% of traffic passing this location would travel the full A2 tolling distance of 26.8km, while around 3,6% would use 16,5 km (Mazenod – Ha Moruthoane turn-off) and 3,1% would use 22,7 km (Mazenod – Masite) of the A2 between Mazenod and Morija. About 0,2% of the traffic would only use the 6,7 km between Mazenod and the Ha Moruthoane turn-off. The average daily traffic volume passing the potential toll plaza location was about 3 600 vehicles in 2008.

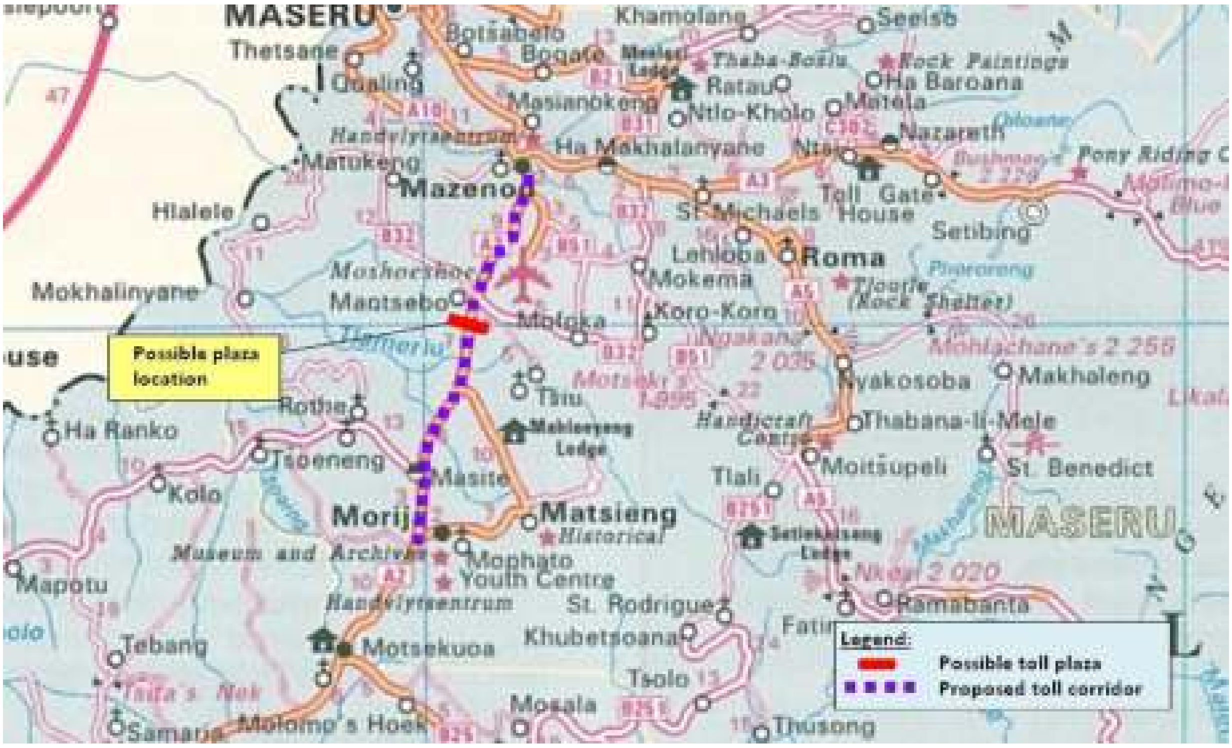


Figure 7-8: Proposed Toll Section 4: Route A2 between Mazenod and Morija

It should be noted that several other potential toll plaza locations have been identified on this section. A study to identify the optimal toll plaza location is usually undertaken after a decision to toll has been taken. Several toll plaza locations are usually considered in such a study which should also include public consultation and participation.

7.5.5 Toll Section 5: Route A2 between Morija and Mafeteng

a. Evaluation of traffic streams on the A2 Section between Morija and Mafeteng

An assessment of traffic streams on Route A2 at a location south of Motsekuoa (See Figure 7-9) indicates that the main traffic streams are between:

- Areas north of Mazenod and Mafeteng (50,9%),
- Areas north of Mazenod and Mohale's Hoek (21,9%)
- Morija and Mafeteng (7%)
- Motsekuoa and Mafeteng (6,9%)

If Figure 7-9 is considered to determine which percentage of the traffic uses which section of the potential toll corridor, the following conclusions can be drawn:

- About 92% of all traffic surveyed on the A2 south of Motsekuoa, i.e.. 1 787 of the 1 938 vehicles per day in 2008, used the entire potential A2 toll corridor between Morija and Mafeteng.
- About 7% of the surveyed traffic have origins or destinations at Motsekuoa which means that this traffic would use 25,3 km of the 35,5 km corridor, i.e. about 71% of the toll corridor.

The important overall conclusions regarding the definition of the toll corridor and local user discounts are, therefore, as follows;

- The definition of the potential toll corridor appears to be very good, since a toll tariff based upon the full distance between Morija and Mafeteng would be equitable for 92% of the users.
- Road users living/working at Motsekuoa should receive a local user discount of 30% at this toll plaza, since they would use 70% of the A2 toll corridor between Morija and Mafeteng.

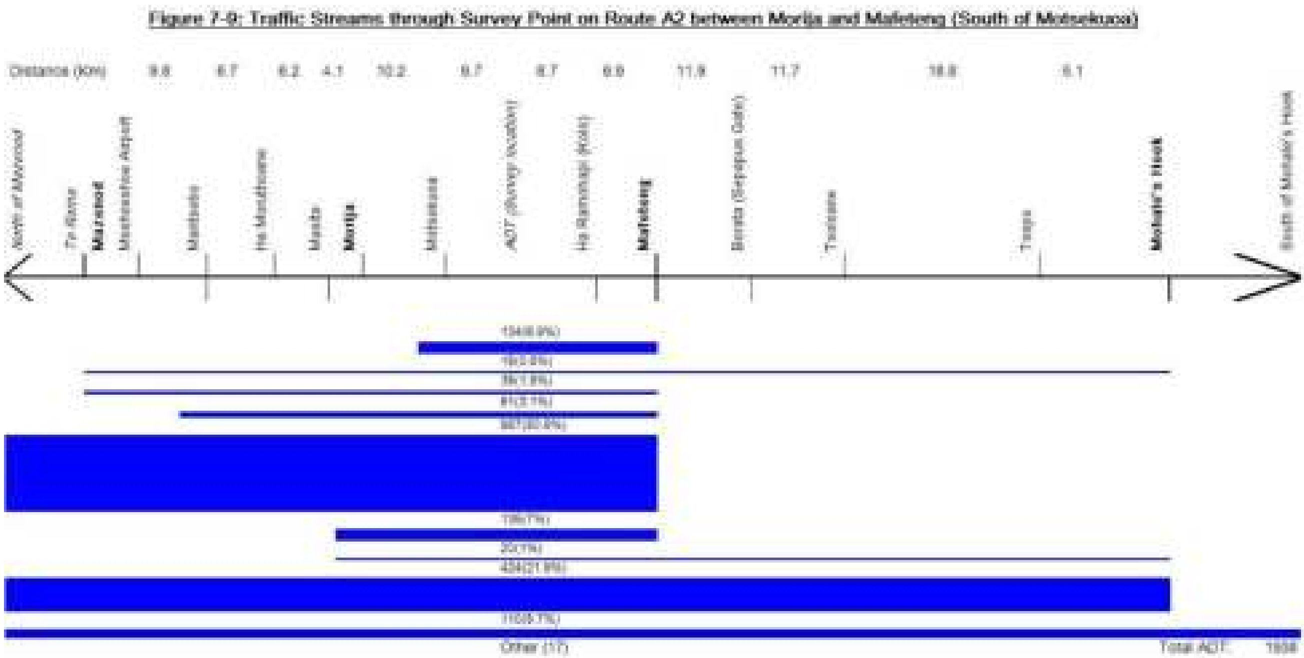


Figure 7-9: Traffic Streams through Survey Point on Road A2 between Morija and Mafeteng

b. <u>Summary of Characteristics of Possible Toll Section 5: Route A2 between Morija and Mafeteng (See Figure 7-10)</u>

This possible toll section is along Road A2 between Morija and Mafeteng and it is approximately 35,6 km long. There are no large towns located along this section of route A2. A possible toll plaza location is approximately 15 km south of the turn-off to Morija, between Motsekuao and the Ha Ramohapi turn-off. The roadside survey indicated that about 92% of traffic passing this possible toll plaza location would travel the full tolling distance of 35,6 km, while around 7% would use 25,3 km of the road to travel between Motsekuoa and Mafeteng. The average daily traffic volume passing the potential toll plaza location was about 1 900 vehicles in 2008.

Figure 7-10: Proposed Toll Section 5: Route A2 between Morija and Mafeteng

It should be noted that several other potential toll plaza locations have been identified on this section. A study to identify the optimal toll plaza location is usually undertaken after a decision to toll has been taken. Several toll plaza locations are usually considered in such a study which should also include public consultation and participation.

7.5.6 Toll Section 6: Route A2 between Mafeteng and Mohale's Hoek

a. Evaluation of Traffic Streams on the A2 between Mafeteng and Mohale's Hoek

An assessment of traffic streams on route A2 at a location on the Mafeteng – Mohale's Hoek section and, more specifically, south of Tsoloane indicates that the main traffic streams are between:

- Areas north of Mazenod and Mohale's Hoek (40,6%)
- Mafeteng and Mohale's Hoek (32,4%)
- Areas north of Mazenod and south of Mohale's Hoek (19,1%).

If Figure 7-11 is considered to determine which percentage of the traffic uses which section of the potential toll corridor, the conclusion that can be drawn is that 100% of the traffic surveyed at the survey location on the A2 south of Tsoloane used the entire A2 corridor between Mafeteng and Mohale's Hoek.

The conclusion regarding the definition of the toll corridor can, therefore, be made that this is a virtually perfect toll corridor, since very little local user traffic occur (none was picked up in the roadside interview survey). Insofar as these local users are not using the entire toll section, they should receive appropriate local user discounts. More specifically, if the final toll plaza location is between Tsoloane and Tshepo, then road users living or working in Tsoloane should receive a local user discount for the section of the road between Mafeteng and Tsoloane, i.e. 23,6 km of the 47,5 km (approximately 50%), that they would not be using when travelling between Tsoloane and Mohale's Hoek. It is, therefore, proposed that a 50% discount be granted to road users living or working in Tsoloane.

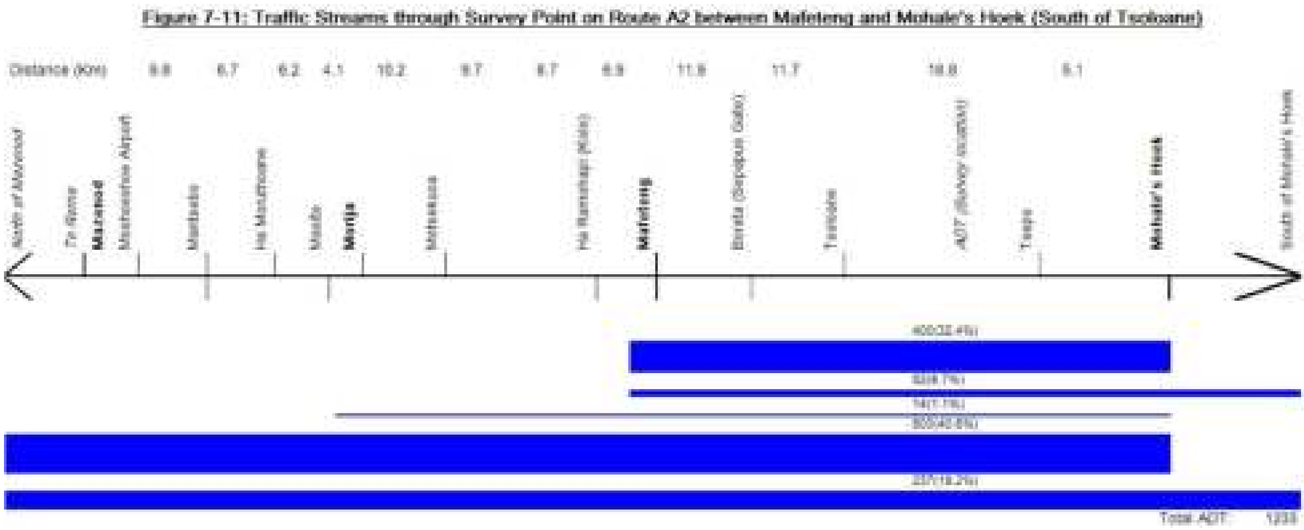


Figure 7-11: Traffic Streams through Survey Point on Road A2 between Mafeteng and Mohale's Hoek (South of Tsoloane)

b. <u>Summary of Characteristics of Possible Toll Section 6: Route A2 between Mafeteng and Mohale's Hoek (See Figure 7-12)</u>

This possible toll section consists of Road A2 between Mafeteng and Mohale's Hoek and it is approximately 45.8km long. There are no large towns located along this section of road. A possible toll plaza location is approximately 25km south of the A2/A21 intersection in Mafeteng, between the Tsoloane and Tsepo turn-offs. The roadside survey indicated that all traffic passing this point will travel the full tolling distance of 45.8km. The average daily traffic volume passing this point was about 1 200 vehicles in 2008.

Figure 7-12: Proposed Toll Section 6: Route A2 between Mafeteng and Mohale's Hoek

It should be noted that several other potential toll plaza locations have been identified on this section. A study to identify the optimal toll plaza location is usually undertaken after a decision to toll has been taken. Several toll plaza locations are usually considered in such a study which should also include public consultation and participation.

8. DETERMINATION OF PERCEIVED BENEFITS AND TOLL TARIFFS AND PREDICTION OF TOLL TRAFFIC AND GROSS REVENUE FOR THE SIX TOLL CORRIDORS

8.1 Introduction

The analysis and prediction of the reaction of road users to the levying of toll in each of the six toll corridors was undertaken in order to be able to predict the potential traffic through the possible toll plaza locations at different toll tariff levels. The intention of the analysis was to either use the traffic volumes predicted to pass through the possible toll plazas and the proposed toll tariffs to determine the potential gross toll income for each of the six toll corridors or if the perceived benefits indicate that road users would rather pay high toll tariffs than drive around toll plazas, to determine lower toll tariffs based on project financial needs rather than the maximum tariffs users would be willing to pay based on the benefits they perceive.

The current (2008) traffic volumes past the possible toll plazas were considered to be the *toll eligible* traffic volumes at each toll plaza location. As soon as road tolls are levied, these *"toll eligible"* traffic volumes usually decline due to some road users making use of alternative routes or not making some trips any more. The extent of traffic diversion at toll plazas is usually proportional to the toll tariff, but is also dependent on other factors such as:

- The availability and condition of and likely travel time along alternative routes and
- The trip purpose of a road user: For example, a road user with shopping as a trip purpose may choose to visit alternative shopping centres that do not require travelling through a toll plaza.

The traffic volume that is predicted to choose to remain on a toll road section after the toll is levied is referred to as *tolled traffic* and is used in potential gross revenue calculations. The methodology that was used to determine the tolled traffic is discussed below.

8.2 Methodology for derivation of tolled traffic

8.2.1 Overview of methodology

Due to the corridor nature of the road network along the selected six toll corridors and the trip patterns in these corridors, a spreadsheet-based transport model was used to determine tolled Average Daily Traffic (ADT) volumes through the possible toll plaza locations.

The methodology used to determine the predicted toll traffic volumes is shown graphically in Figure 8-1 and is discussed in subsequent sub-sections.

8.2.2 Assessment of road sections and determination of travel time and distance savings offered by toll road sections

The methodology starts with an assessment of the proposed toll road sections and alternative road sections in order to determine the benefits a toll road section offers in terms of travel time and travel distance. A significant input into this part of the model is travel time surveys which were carried out on the tolled and alternative road sections in the possible six toll corridors in Lesotho. The methodology is repeated for each toll vehicle class.

In order to understand the travel patterns of the toll eligible traffic on the proposed toll road sections in the six possible toll corridors, analyses of the different traffic streams thought the potential toll plaza locations were performed. These traffic streams are the ones identified in Figures 7-1, 7-3, 7-5, 7-7, 7-9 and 7-11.

8.2.3 Determination of perceived road user benefits

The perceived road user benefit, as defined below, is an important variable in the algorithm presented in Section 8.2.4 below by means of which the attraction of traffic to a toll road section was predicted. As indicated by the term, it refers to the benefit a road user would perceive if he/she uses an upgraded toll road section rather than any alternative road section that may be available.

More specifically, the perceived road user benefit in respect of light vehicles is defined as:

- Savings in fuel and time cost if a toll road section is used instead of an alternative route section.
- The value of the motorway bonus, i.e. the value of the increased safety, comfort and convenience associated with travelling on a higher quality road facility rather than a lower quality secondary road.

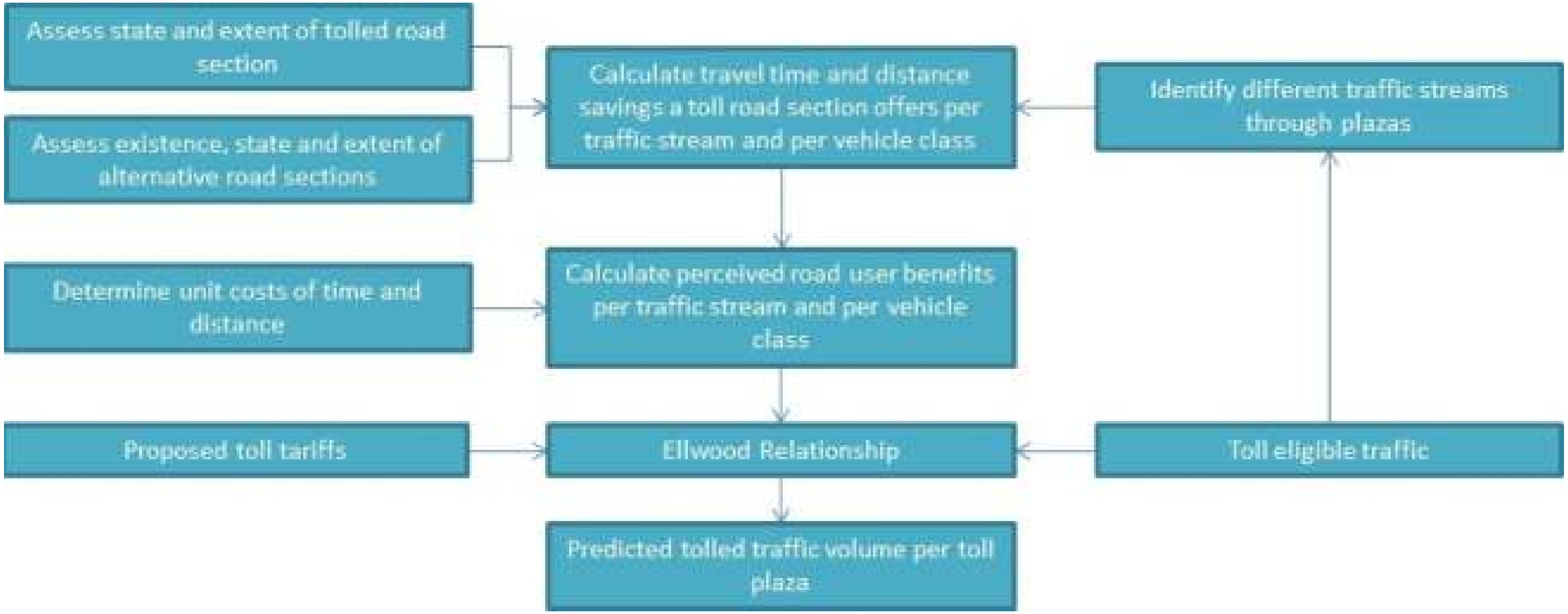


Figure 8-1: Methodology to Determine Predicted Toll Traffic Volumes

The perceived road user benefit in respect of heavy vehicles is defined as:

- Savings in variable operating costs.
- Savings in time costs which are considered to be equal to the saving in respect of the total fixed costs (standing cost) of the vehicle. This is based on the premise that, in order to break even, a heavy vehicle operator should at least be covering his/her fixed costs of operation and, therefore, the value of time of a heavy vehicle is at least equal to its fixed costs (standing costs).
- The value of the motorway bonus.

In the case of the six possible Lesotho corridors, the perceived road user benefits were determined for each toll vehicle class in each major traffic stream using each of the toll road sections.

8.2.4 Relationship between perceived benefit, toll tariff and traffic attraction rate

The benefits perceived by potential users of the toll road sections are required to determine realistic toll tariffs and the associated traffic attraction rates at each of the six possible toll plaza locations. The relationship between traffic attraction, perceived benefit and toll tariff is expressed by means of the Ellwood formula which is indicated and explained below:

$$a = \frac{1}{1 + (t/p)^n}$$

where
a = the proportion of the toll eligible traffic attracted to the toll road
t = toll tariff for the particular vehicle class
p = perceived benefit in respect of a particular vehicle class offered by the toll road relative to the best alternative route
n = an empirically determined integer in the range 6 - 12

The generic Ellwood attraction formula was refined for this project to take cognisance of the assumptions that a minimum attraction rate, estimated at 10% of the toll eligible traffic, and a maximum attraction rate, estimated at 95% of the toll eligible traffic volume, will always be achieved. These assumptions are based on actual observations of cases in which it did not make sense to use a toll road from a perceived benefit point of view, but a minimum toll road attraction rate was still being achieved. The formula was, therefore, adjusted to the following:

$$a = \frac{1}{1+(t/p)^n}(a_{\max} - a_{\min}) + a_{\min}$$

where a_{min} = estimated minimum attraction rate and a_{max} = estimated maximum attraction rate.

When n in the above-mentioned adjusted formula is equal to 6 (a value which has been found in South Africa to reflect actual road user behaviour better than the higher values suggested by Ellwood), the maximum toll revenue is obtained when the toll tariff = 78,6% of the perceived benefit. This optimum or revenue-maximising tariff is regarded as an initial indication of the possible toll tariff and is sometimes unrealistic from the perspective of the road user, especially if the alternative road sections are very lengthy and/or in a bad state. The proposed toll tariff is, therefore, determined in the financial modelling which takes other factors such as tariff affordability, tariff discounts and project costs into account.

8.3 Toll eligible traffic

The 2008 ADT volumes, as counted by the project team at locations nearest to the proposed tolling locations, were regarded as the *toll eligible* traffic volumes. The vehicle classification scheme, similar to the one currently used at Lesotho border posts, shown in Figure 8-2 was used. References to Class 1, 2, 3 and 4 vehicles throughout the study are to the classes indicated in Figure 8-2.

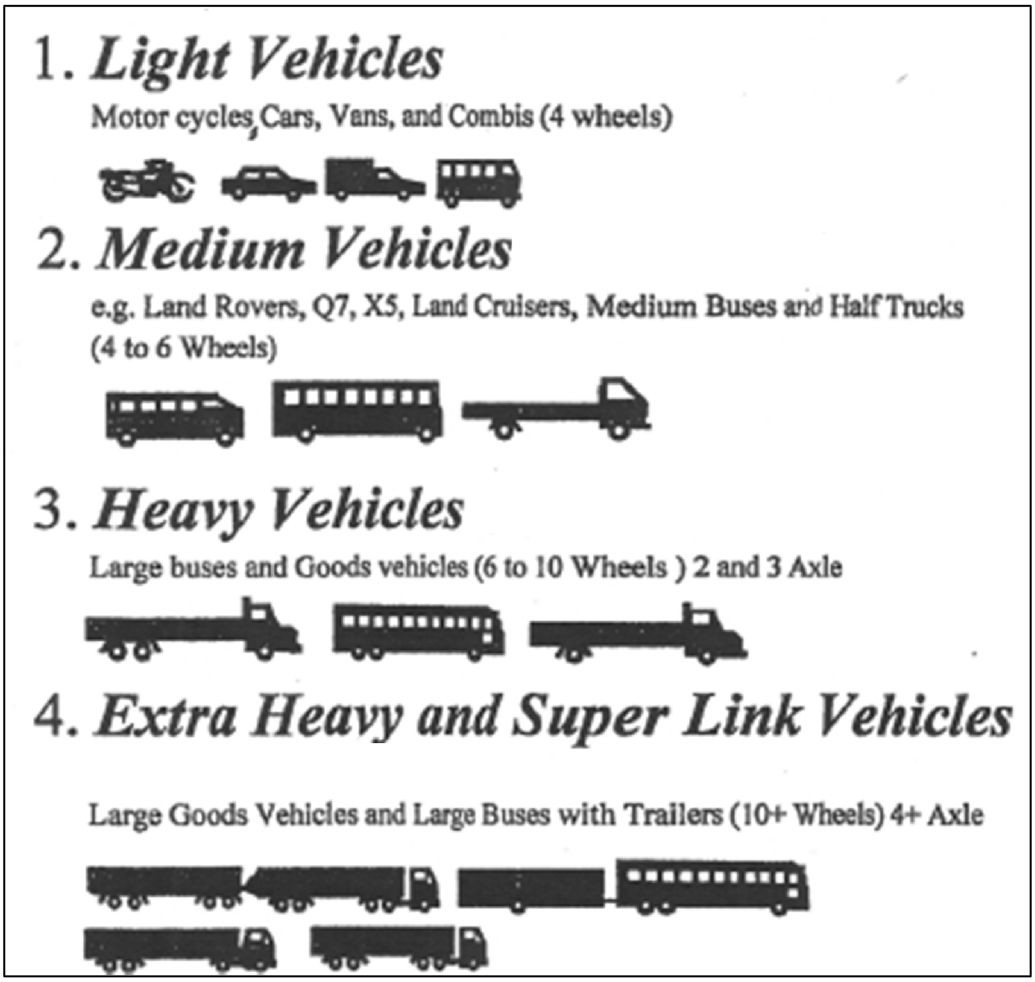


Figure 8-2 Lesotho Vehicle Classification Scheme

During the roadside surveys, a manual classification of all the passing vehicles in terms of the vehicle classification system in Figure 8-2 was undertaken. The ratios of vehicle classes determined in these surveys were applied to the average daily toll eligible traffic volumes to determine the average daily 2008 traffic volume of each vehicle class at each toll plaza location. These volumes were then used to determine the gross toll revenue of each potential toll corridor.

The average daily 2008 toll eligible traffic volumes for each vehicle class at the selected possible toll plaza location in each of the six toll corridors are shown in Table 8-1.

Table 8-1: Toll Eligible Traffic (2008)

Toll Section	Description Of Toll Corridor	Average daily toll eligible traffic volume (2008) Vehicles Class				
		I	II	III	IV	Total
1	Route A1 between Maputsoe and Teya-Teyaneng	1 348 60,0%	508 22,6%	141 6,3%	250 11,1%	2 247 100,0%
2	Route A1 between Teya-Teyaneng and Maseru	1 860 66,3%	534 19,0%	148 5,3%	263 9,4%	2 805 100,0%
3	Route A5 between Mazenod and Roma	1 874 62,6%	632 21,1%	176 5,9%	311 10,4%	2 993 100,0%
4	Route A2 between Mazenod and Morija	1 886 52,2%	978 27,0%	272 7,5%	481 13,3%	3 617 100,0%
5	Route A2 between Morija and Mafeteng	1 100 56,8%	474 24,4%	131 6,8%	233 12,0%	1 938 100,0%
6	Route A2 between Mafeteng and Mohale's Hoek	672 54,5%	317 25,7%	88 7,1%	156 12,7%	1 233 100,0%

The following conclusions may be drawn from Table 8-1:

- The percentage of light vehicles in the six toll corridors varies between 52,2% and 60% of the total traffic volumes which are relatively low percentages compared to the South African situation.
- The so-called medium vehicle class, consisting of sports utility vehicles and 4-wheeled trucks and buses, constitute a significant 19,0% - 27,0% of the total traffic volumes in the six possible Lesotho toll corridors.
- The Class 3 heavy vehicles (6 to 10 wheels) constituted between 5,3% and 7,5% of the total traffic volumes in the six possible Lesotho toll corridors.
- The Class 4 heavy vehicles (more than 10 wheels) constituted between 9,4% and 13,3% of the total traffic volumes in the six possible Lesotho toll corridors.

8.4 Travel time analysis

In order to determine realistic average speeds to use in the calculation of the perceived road user benefits, travel time surveys were conducted along the proposed toll and alternative route sections in the six possible toll corridors. These surveys were conducted using light vehicles (Class 1 vehicles) and were then compared to South African travel time surveys to estimate the average speeds of Class 2, 3 and 4 heavy vehicles.

The total distance covered on the tarmac alternative routes amounted to 117,9 km and travelling this distance took 2,02 hours. The observed average speed for a light vehicle (Class 1) on these tarmac alternative routes was, therefore, 58,46 km/h and this average speed was applied to all alternative routes. In the case of heavy vehicles, the average speeds for Lesotho vehicle classes 2, 3 and 4 were taken to be in the same ratios to the average speed of light vehicles as the rates determined in a South African study for the South African National Roads Agency, as shown in Table 8-2. The average speeds of vehicles on gravel alternative routes were predicted to be 80% of the speeds on the tarmac alternative routes.

The total distance covered on the potential toll routes in the six corridors amounted to 146,6 km and travelling this distance took 2,4 hours. The observed average speed for a light vehicle on the possible toll sections was, therefore, 61,08 km/h. In the case of heavy vehicles, the average speeds for Lesotho vehicle classes 2, 3 and 4 were taken to be in the same ratios to the average speed of light vehicles as those ratios determined in a South African study for the South African National Roads Agency, as shown in Table 8-2.

Table 8-2 Observed and Predicted Average Travel Speeds in Possible Lesotho Toll Corridors

Vehicle Class	Alternative Route (SA) (km/h)	Ratio to Class 1 Average Speed	Toll Road (km/h)	Alternative Road (km/h)
1	95,00	1,0	61,08	58,46
2	75,27	0,7923	48,40	46,32
3	70,56	0,7428	45,37	43,42
4	64,92	0,6833	41,74	39,95

8.5 Perceived road user benefits

8.5.1 Time and distance saving

In the case of an upgraded existing road section which is subsequently tolled, it could correctly be argued that the road user benefits are related to the travel time prior to and after the upgrading, whilst no distance saving would be involved. If such an upgraded road section is, however, actually tolled, the practical reality that a road user would be faced with would be a choice between paying toll or using an alternative route. The perceived road user benefits for this study were, therefore, based upon the choice between the upgraded toll road section and the then available alternative road section.

The time and distance savings components of the perceived benefit were determined for the selected toll strategy in each potential toll corridor. Since virtually all origin-destination (OD) pairs or traffic streams (except local traffic streams) passing through a potential toll plaza location will use the entire toll section, the time- and distance-related benefits of each entire toll corridor will be experienced by virtually all the traffic streams on the toll road section tolled at each plaza (except the local traffic streams). These benefits were determined by calculating the travel time and distance on the possible toll road section and along the most likely alternative road section, using the estimated average speeds referred to in Section 8.4. The difference between these values, always in favour of the possible toll road section, was regarded as the savings if the tolled road section was chosen rather than the alternative road section. The time benefit was expressed in minutes and the distance benefit in kilometres.

8.5.2 Proposed unit costs for the calculation of perceived road user benefits

The following unit costs were used to convert the time and distance savings into monetary values:

Value of time for Light Vehicles (Class 1):

Time savings are the single most important benefit of transport improvement projects all over the world. The value of a person's time is a subjective value that is attached to time savings when decisions are made. Extensive literature exists on the value of time and how it should be interpreted for specific applications, but it is generally accepted that a person's value of time is correlated with his or her level of income.

Since the average income of the drivers of light vehicles had, initially (prior to the stakeholders' workshop), not been determined in the Lesotho roadside interviews, a value of time determined in the Free State Province of South Africa between Welkom and Bloemfontein (where an income survey was performed for another project) was used as a point of departure. These surveys were performed on the N1, R30 and R700 roads in October 2010 and yielded a value of time for light vehicles of R97,10 (in October 2010 Rand) or R91,75 (in June 2009 Rand), if the CPI is used to de-escalate this value of time. (Note that the June 2009 Rand value was used since the original perceived benefit analysis was performed in that value of money).

Although the Lesotho light vehicle fleet appears to be very comparable to the South African fleet, it was considered that, in order to be conservative, a Lesotho value of time of 80% of the N1/R30/R700 routes in the Free State should be used. This yielded a value of time of M73,40 in June 2009 Maloti.

Since concern was expressed at the stakeholders' meeting in Maseru in March, 2011 regarding the use of South African information, a special roadside interview was undertaken on Wednesday, 16 March, 2011 on the A2 just south of the airport. During this interview, the following information was obtained:

- Information regarding the income category into which the driver fell: Some 550 responses to this question were obtained and the income information obtained is summarised in Table 8-3 below. It has been calculated from the information in Table 8-3 that the average annual income per capita of the road user group is M 54 818.
- The trip purposes: The trip purposes of the light vehicle drivers interviewed were as follows:
- Business 44%
- Transporting Passengers 32%
- Visiting family 11,09%
- Commuting to/from Work or School 6,55%
- Transporting Goods 5,27%
- Holiday 1,09%
- It may be concluded from the above-mentioned trip purposes that about 32% of the interviewed vehicles were taxis and that the income figures supplied by the taxi drivers are, therefore, their own income figures. An assumption therefore had to be made regarding the value of the time of the passengers and this is discussed below.
- Vehicle Occupancy: The vehicle occupancy is an important further observation, since the other occupants of a vehicle also have a value of time that has to be taken into consideration. Table 8-3 indicates that the average vehicle occupancy of vehicles transporting passengers was 9,59 persons, while the average vehicle occupancies for other trip purposes varied between 1,67 for holiday trips and 2,69 for commuting trips to work or school.

Table 8-3 A2 Masianokeng – Mafeteng: Value of Time Calculations

LESOTHO VALUE OF TIME CALCULATIONS											
Average Annual Income		54,818			Trip Purpose Distribution						
Income Category	Count	Annual Income	Group Total Income	1080 Work Hours Assumed	1 Commuting to/from Work/School	2 Transporting Goods	3 Transporting Passengers	4 Business	5 Holiday	6 Visiting Family	TOTAL
1	328	15,000	4,920,000								
2	92	40,000	3,680,000	Number of Trips	36	29	176	242	6	61	550
3	58	75,000	4,350,000		6.55%	5.27%	32.00%	44.00%	1.09%	11.09%	
4	26	125,000	3,250,000	Average Vehicle Occupancy:	2.60	1.79	9.59	2.63	1.67	2.03	
5	12	175,000	2,100,000								
6	7	225,000	1,575,000	Factor for 1st Occupant	0.40	1.00	1.00	1.00	0.30	0.30	
7	8	275,000	2,200,000	Factor for other Occupants	0.40	0.50	0.50	1.00	0.30	0.30	
8	4	325,000	1,300,000								
9	5	375,000	1,875,000	Factor for 1st Occupant	0.4	1	1	1	0.3	0.3	
10	2	425,000	850,000	Factor for other Occupants	0.68	0.40	4.30	1.63	0.20	0.31	
11	3	475,000	1,425,000	Total Factor	1.00	1.40	5.30	2.63	0.50	0.61	
12	5	525,000	2,625,000	29.04	31.29	40.55	153.75	76.31	14.52	17.71	
TOTAL:	550		30,150,000	Trip purpose weight	2.05	2.14	49.20	33.58	0.16	1.96	89.00

In order to determine an average value of time for a light vehicle, a specific weight was applied to the average household income for the driver and any additional occupants respectively. Table 8-4 below indicates the weights for each trip purpose category. It should be noted that percentages of income used for the driver or occupants (30% - 50%) reflect the fact that international research has shown lower values of time for other trip purposes than work (typically 30% - 45%). In the case of passengers being transported, it was assumed that some passengers in taxi's would actually be on a work trip (as opposed to a commuting trip) and, therefore, a 50% factor was used.

Table 8-4 A2 Masianokeng – Mafeteng: Percentage of Income Applicable to Different Trip Purposes

Trip Purpose	Percentage of driver income used	Percentage of income for other occupants used
Commuting to/from Work/School	40% [1)]	40%
Transporting Goods	100%	50%
Transporting Passengers	100%	50%
Business	100%	100%
Holiday	30% [1)]	30%
Visiting family/friends	30% [1)]	30%

1) It should be noted that the 40% value is a conservative estimate. In a major "value of travel time" study in Britain (1981-86), it was found that the value of trips for other purposes than work amounted to 43% of the average hourly income of full-time employed adults.

Using the above-mentioned approach, the weighted average value of time was found to be M 89,08 per hour in March 2011 Maloti. If this is de-escalated to June 2009 Maloti (date of perceived benefit analysis) by discounting the March 2011 value of time to June 2009 Maloti, a March 2011 average light vehicle value of time of M 83,62 is obtained. This compares well with the M 73,40 motivated above which was used in the financial analysis.

Value of distance-related transport costs for Light Vehicles (Class 1):

The fuel price varies significantly with the price of oil. At the time of performing the calculations (June 2009), the Lesotho price for a litre of 93 Unleaded petrol was M7.51. Assuming a conservative average rural travel fuel consumption of 10 litres per 100 km, fuel cost amounted to M0,751 per km. A value of 75 cents per kilometre was used in the feasibility study.

Value of time for Heavy Vehicles (Classes 2, 3, 4):

As indicated in Section 8.2.3, the value of time for heavy vehicles is at least equal to the fixed (standing) cost per hour of a heavy vehicle. In order to determine this cost, the fixed costs for different types of heavy vehicles were obtained from the Vehicle Cost Schedule (April 2008, Edition 37) of the South African Road Freight Association and an average was determined for each heavy vehicle class – See Table 8-5. In order to convert annual/daily fixed costs to hourly costs, a 12 hour operating day, as indicated by the Road Freight Association, was accepted. These costs were then escalated to June 2009 Rand by using the Consumer Price Index for metropolitan and other urban areas.

A summary of the unit costs, i.e. the average values of time for the heavy vehicle classes, is also shown in the last column of Table 8-6.

Table 8-5 Summary of Fixed and Variable Costs of Heavy Vehicles: April 2008 Heavy Vehicle Cost Schedule (RFA Edition 37)

TABLE 8-5 SUMMARY OF FIXED AND VARIABLE COST OF HEAVY VEHICLES: APRIL 2008 HEAVY VEHICLE COST SCHEDULE (RFA EDITION 37)

VARIABLE Cost in c/km

Class	RFA Type	Drop Side	Van	Flat Bed	Tipper	Tanker	Fridge	Lowbed	PMA	Average	Relative Weight	Class Average
	01	164.20	165.00							164.60	0.25	
2	02	218.75	220.02							219.38	0.25	265.05
	03	310.10	311.05							311.02	0.25	
	04	378.10	380.26							379.18	0.25	
	05	471.16	473.73	469.87	501.98	486.56	409.13		404.50	452.42	0.33	
3	06	646.33	650.21	644.39	688.07	660.61	673.49			662.09	0.33	554.07
	07	547.45	549.43	546.45						547.78	0.33	
	08	616.73	618.83	615.68	798.80	629.39			638.77	653.10	0.08	
	09	707.37	709.06	706.13	903.77	722.27	724.75	820.71		757.55	0.08	
	10	657.48	659.75	656.35	731.45	671.10	673.37			674.92	0.08	
	11	748.83	751.49	747.49	956.06	764.83	767.50	873.20		801.46	0.08	
	12	647.73	650.70	646.25						648.23	0.08	
	13	734.66	737.58	733.21		690.92				726.09	0.08	
4	14	787.18	790.06	785.74						787.66	0.08	739.01
	15	660.21	661.60	662.02					604.05	650.50	0.08	
	16	706.65	709.18	705.38						707.07	0.08	
	17	781.46	784.21	780.07	997.30	844.62				825.53	0.08	
	18	781.45	784.21	780.07	870.05	844.69	800.80			810.20	0.08	
	19	811.69	814.46	810.31			831.04			816.87	0.08	

FIXED (STANDING) Cost in c/hour (12 Hours according to Vehicle Cost Schedule)

Class	RFA Type	Drop Side	Van	Flat Bed	Tipper	Tanker	Fridge	Lowbed	PMA	Average	Relative Weight	Class Average
	01	49.64	52.89							50.55	0.25	
2	02	89.67	91.44							90.55	0.25	90.74
	03	96.07	98.90							97.48	0.25	
	04	114.51	118.25							116.38	0.25	
	05	121.01	123.78	116.59	109.79	142.69	163.12		275.48	150.33	0.33	
3	06	167.01	171.56	162.35	158.76	236.21	213.62			184.92	0.33	165.03
	07	159.36	165.57	154.69						159.85	0.33	
	08	190.72	199.65	187.40	195.00	220.25			432.15	236.04	0.08	
	09	221.18	230.11	217.86	216.57	250.20	283.95	295.16		248.58	0.08	
	10	211.22	223.01	207.00	217.21	272.40	273.16			234.00	0.08	
	11	232.53	242.81	227.53	239.86	261.66	295.97	317.40		259.68	0.08	
	12	186.20	195.68	180.64						188.53	0.08	
	13	224.65	240.46	218.18		311.75				248.76	0.08	
4	14	237.07	250.37	230.01						239.15	0.08	251.06
	15	216.13	237.17	210.31					486.82	287.61	0.08	
	16	216.00	232.45	211.17						219.87	0.08	
	17	256.35	272.80	251.59	257.60	345.18				275.50	0.08	
	18	255.96	273.41	251.14	257.64	339.76	352.22			288.35	0.08	
	19	259.59	276.08	254.66			355.42			286.39	0.08	

Variable operating cost for Heavy Vehicles (Classes 2, 3 and 4):

The heavy vehicle variable operating costs were determined by averaging variable operating costs of different vehicle types in a toll vehicle class, according to the April 2008 Vehicle Cost Schedule of the Road Freight Association of South Africa, as indicated in Table 8-5. These costs were then escalated to June 2009 Rands by using the Consumer Price Index for metropolitan and other urban areas. The variable cost per vehicle type and the average variable cost per vehicle class are shown in Table 8-3. A summary of the unit cost values per vehicle class is also shown in Table 8-6.

Motorway bonus

As indicated in Section 8.2.3 of this report, the motorway bonus is the value of the increased safety, comfort and convenience associated with travelling on a higher quality road facility rather than a lower quality secondary road. Although this feature is most definitely present on, for example, the recently upgraded A2 route between Mazenod, south of Maseru, and Mafeteng, it was not taken into account in the calculation of perceived benefits in this report.

Summary of value of time and distance-related unit transport costs per vehicle class

A summary of the proposed value of time and distance-related unit transport costs used in the traffic forecasting model is shown in Table 8-6.

Table 8-6: Proposed Value of Time and Distance-Related Unit Transport Costs per Vehicle Class (April 2008 Rand)

Unit description	Unit Cost per vehicle class			
	1	2	3	4
Value of time	R73,40 per hour*	R98,74 per hour	R165,03 per hour	R251,06 per hour
Value of distance	R0,75 per km*	R2,66 per km	R5,64 per km	R7,40 per km

* in June 2009 Rand

Using the values of time and the distance-related unit transport costs in Table 8-6 and the features of every toll corridor, the next six sub-sections describe the calculation of the perceived road user benefits offered by the toll road sections in each of the six possible toll corridors. Since the above-mentioned unit costs for heavy vehicles are in April 2008 Rand, they were escalated to June 2009 Rand values in the course of the analyses.

8.5.3 Perceived road user benefits for Toll Section 1: Route A1 between Teya-Teyaneng and Maputsoe

The potential toll plaza location used in the analysis of this section is approximately 1km south of Peka – See Figure 8-3. The only reasonable alternative route around this plaza is the B13/B12 route via Khotsi and Mamathe, as shown in Figure 8-3. As indicated in Section 7.5.1a., about 87% of the users would use the entire toll section between Teya-Teyaneng and Maputsoe and all of these users would have the B13/B12 alternative route at their disposal. The other 13% of the users undertaking trips with origins/destinations such as Peka and Kolonyama will have no paved alternative route at their disposal and will receive a 75% local user discount, as explained in Section 7.5.1a.

The travel time savings, the distance saving and the calculated monetary values of these savings and the total perceived benefits that will be experienced by 87% of road users on the A1 between Teya-Teyaneng and Maseru are shown in Table 8-7 for vehicle classes 1, 2, 3 and 4 respectively.

Figure 8-3: Alternative Route between Maputsoe and Teya-Teyaneng

The length of the proposed toll section is 38,1 km as opposed to the length of the alternative route which is 47.6km (See Figure 8-3), yielding a distance saving of about 9,5 km. The determination of the monetary value of the time saving offered by the proposed toll road section relative to the alternative road section involved calculating the saving in time, as described in Section 8.5.1 of this report, and multiplying that by the value of time per hour for each vehicle class, which was determined as described in Section 8.5.2 of this report. Table 8-7 below shows the calculated values of the travel time savings for classes 1, 2, 3 and 4. The value of the distance saving is determined by multiplying the saving in distance by the unit value of distance for each vehicle class.

The perceived benefits offered to each vehicle class by the proposed toll section is determined by simply adding the value of the time and distance savings for each vehicle class. Table 8-7 shows the calculated perceived benefits for using the possible toll road section on the A1 route between Teya-Teyaneng and Maputsoe instead of the alternative route section.

Table 8-7: Calculated Perceived Benefits offered by Potential A1 Toll Road Section between Teya-Teyaneng and Maputsoe (June 2009 Maloti)

Vehicle Class	Time Saving (Hours)	Distance Benefit (Km)	Value of Travel Time Saving (M)	Value of Distance Saving (M)	Perceived Benefit (M)
1	0,19	9,50	13,98	7,13	21,11
2	0,24	9,50	25,77	27,44	53,20
3	0,26	9,50	45,94	58,17	104,11
4	0,28	9,50	75,96	76,30	152,25

8.5.4 <u>Perceived road user benefits for Toll Section 2: Route A1 between Maseru and Teya-Teyaneng</u>

The potential toll plaza location used in the analysis of this section is approximately 25km north of Maseru and is south of Lekokoaneng – See Figure 8-4. The reasonable alternative route around this plaza is a combination of routes B31 and B203 between Maseru and Teya-Teyaneng, as shown in Figure 8-4.

Figure 8-4: Alternative route between Teya-Teyaneng and Maseru

As is indicated in section 7.5.2a of this report, about 98% of the road users use the full distance of the toll road section between Maseru and Teya-Teyaneng and they will, therefore, all have the B31/B203 alternative route at their disposal. It is recommended in Section 7.5.2a that the 2% local users with origins or destinations in Lekokoaneng with no reasonable alternative route at their disposal should receive a 20% discount.

The length of the proposed toll section is 40,3 km as opposed to the length of the alternative route which is 48.3km, yielding a distance saving of about 8 km. The travel time savings, the distance saving, the calculated monetary values of these savings and the total perceived benefits that will be experienced by 98% of road users on the A1 between Maseru and Teya-Teyaneng are shown in Table 8-8 for classes 1, 2, 3 and 4 respectively.

Table 8-8: Calculated Perceived Benefits offered by potential A1 Toll Road Section between Maseru and Teya-Teyaneng (June 2009 Maloti)

Vehicle Class	Time Saving (Hours)	Distance Benefit (Km)	Value of Travel Time Saving (M)	Value of Distance Saving (M)	Perceived Benefit (M)
1	0,17	8,02	12,24	6,02	18,26
2	0,21	8,02	22,56	23,16	45,72
3	0,22	8,02	40,22	49,11	89,32
4	0,24	8,02	66,50	64,41	130,91

8.5.5 Perceived road user benefits for Toll Section 3: Route A5 between Mazenod and Roma

On this section, the potential toll plaza location used in the analysis is approximately 8km east of the A2/A5 intersection, between the Ha Makhalanyana and St Michaels intersections. A possible alternative route via routes B51 and B32 past Mokema around the possible toll plaza location is shown in Figure 8-5.

As was indicated in Section 7.5.3a, about 95% of all road users passing the above-mentioned toll plaza location will be using the full 19,3 km A5 Mazenod – Roma section or the full A5/A3 section between Mazenod and Ntsi. All of these road users could, therefore, use the B51/B32 alternative route if the toll plaza is in the location indicated in Figure 8-5. It is recommended in Section 7.5.3a that the 5% local users with origins or destinations in Ha Makhalanyane or in the vicinity if St Michaels should receive a 65% local user discount.

Figure 8-5: Alternative route around the Mazenod-Roma Toll Plaza

The length of the part of the proposed toll section for which an alternative route exists is 9.0km as opposed to the length of the alternative route which is 21.0km (distances were measured between the A2/A5 and the A5/B32 intersections). In this specific case, the average speed on the alternative route is assumed to be 80% of the paved alternative route average speed, since this alternative route has a gravel surface. The travel time savings, the distance saving, the calculated monetary values of these savings and the total perceived benefits that will be experienced by users of the tolled road section are shown in Table 8-9 for vehicle classes 1, 2, 3 and 4 respectively.

Table 8-9: Calculated Perceived Benefits offered by potential A5 Toll Road Section between Mazenod and Roma and by potential A5/A3 Toll Road Section between Mazenod and Ntsi (June 2009 Maloti)

Vehicle Class	Time Saving (Hours)	Distance Benefit (Km)	Value of Travel Time Saving (M)	Value of Distance Saving (M)	Perceived Benefit (M)
1	0,21	11,99	15,54	9,00	24,54
2	0,27	11,99	28,64	34,63	63,27
3	0,29	11,99	51,06	73,42	124,48
4	0,31	11,99	84,43	96,29	180,73

8.5.6 Perceived road user benefits for Toll Section 4: Route A2 between Mazenod and Morija

The potential toll plaza location to be considered for this section is approximately 14km south of the A2/A5 intersection, between the Mantsebo and the Ha Moruthoane intersections. Since this possible toll section does not have a realistic alternative route, all traffic streams on this section would have to make use of the potential toll road section. It is therefore not possible to determine the perceived benefit of the potential toll section relative to any realistic alternative.

As motivated in Section 7.5.4.a, it is, nevertheless, proposed that road users living/working in Mantsebo, Ha Moruthoane and Masite (about 8% of all users of this section) be granted a local user discount of 25%.

8.5.7 Perceived road user benefits for Toll Section 5: Route A2 between Morija and Mafeteng

A potential toll plaza location used in this analysis is approximately 14km south of the intersection to Morija, between the Motsekuoa and Ha Ramohapi intersections. The alternative route around this plaza is quite long and runs along Route B24 from Mosite via Tsoeneng, Kolo, Mapotu and Kalichane to route A21 (near Patsa) and then via route A21 to Mafeteng – See Figure 8-6.

Figure 8-6: Map of Alternative route between Motsekuoa and Tsepo on Route A2

The length of the proposed tolled section is 35,6 km as opposed to the length of the alternative route which is 49,5 km (distances were measured between the A2/B24 intersection at Masite and the A2/A21 intersection in Mafeteng). The speed on the gravel road was assumed to be 20% lower than that recorded on the tarred alternative routes.

The travel time savings, the distance saving, the calculated monetary values of these savings and the total perceived benefits that will be experienced by users of the tolled road section between Morija and Mafeteng are shown in Table 8-10 for vehicle classes 1, 2, 3 and 4 respectively.

Table 8-10: Calculated Perceived Benefits offered by potential A2 Toll Road Section between Morija and Mafeteng (June 2009 Maloti)

Vehicle Class	Time Saving (Hours)	Distance Benefit (Km)	Value of Travel Time Saving (M)	Value of Distance Saving (M)	Perceived Benefit (M)
1	0,26	13,88	19,34	10,42	29,77
2	0,33	13,88	35,66	40,09	75,74
3	0,35	13,88	63,57	84,99	148,56
4	0,39	13,88	105,11	111,47	216,58

8.5.8 Perceived road user benefits for Toll Section 6: Route A2 between Mafeteng and Mohale's Hoek

The potential toll plaza location to be used in this analysis is approximately 35km south of the A2/A21 intersection in Mafeteng, between the Tsoloane and Tsepo intersections.

Since this possible toll section does not have a realistic alternative route, all traffic streams on this section would have to make use of the potential toll road section. It is therefore not possible to determine the perceived benefit of the potential toll section relative to any realistic alternative.

As motivated in Section 7.5.6a, it is, nevertheless, proposed that road users living/working in Tsoloane be granted a local user discount of 50%.

8.5.9 Conclusion on perceived road user benefits per toll section

It is clear from the preceding sub-sections that the perceived benefit of a toll section is dependent upon the characteristics of both the tolled and alternative road sections. The perceived benefits for Class 1 vehicles for the Lesotho toll sections for which perceived benefits could be calculated range from M18,26 to M29,77 (in June 2009 Maloti).

The perceived benefits are used as the most important variable to determine the level of traffic attraction at specific toll tariffs by means of the Ellwood algorithm (See Section 8.2.4).

8.6 Estimation of tolled traffic and gross revenue

In order to demonstrate the application of the perceived benefits, the revenue-maximising toll tariffs for those toll sections (with alternative routes) were determined by means of the Ellwood algorithm as a percentage of the value of the perceived benefit for the relevant vehicle class. These revenue-maximising toll tariffs are indicated in Table 8-11.

Table 8-11: Revenue-maximising Toll Tariffs based on Perceived Benefits (June 2009 Maloti) for Toll Sections with Alternative Routes

Possible Toll Sections	Toll Distance (in km)	Vehicle Class	Perceived Benefit (M)	Optimum Toll Tariff (M)	Unit Toll Tariff (M/km)
Section 1: Maputsoe - Teya-Teyaneng	38,1	1	21,11	16,36	0,43
		2	53,20	41,23	1,08
		3	104,11	80,67	2,12
		4	152,25	117,97	3,10
Section 2: Teya-Teyaneng – Maseru	40,3	1	18,26	14,15	0,35
		2	45,72	35,43	0,88
		3	89,32	69,21	1,72
		4	130,91	101,43	2,52
Section 3: Mazenod – Roma	18,5	1	24,54	19,02	1,03
		2	63,27	49,03	2,65
		3	124,48	96,46	5,21
		4	180,73	140,04	7,57
Section 5: Morija – Mafeteng	35,6	1	29,77	23,07	0,65
		2	75,74	58,69	1,65
		3	148,56	115,11	3,23
		4	216,58	167,82	4,71

If it is considered that the average South African light vehicle toll tariff in 2009/10 was about 34c per km, it may be concluded from Table 8-11 that the revenue-maximising unit toll tariff that may be charged in the possible Lesotho toll corridors with alternative routes are too high (in most cases).

The toll tariffs required for various funding scenarios and the resulting traffic volumes were, therefore, determined in an integrated application of the Ellwood algorithm and the financial modelling of the Lesotho toll corridors and are presented in Chapter 10 of this report.

9. TOLL- AND ROAD-RELATED CAPITAL, OPERATING AND MAINTENANCE COSTS

9.1 Road-related Capital and Maintenance Costs

9.1.1 Initial Road-related Capital Costs

As will be observed in Chapter 10, only two corridors were investigated where the initial capital costs of the road upgrading was repaid from the future nett toll revenue. This particular scenario involves the repayment, to the Lesotho Government, of the initial capital cost of 19,7 million Euro for the upgrading of the A2 Mazenod – Morija and Morija – Mafeteng road sections. At an exchange rate of M9,13 = 1 Euro (November 2010), the initial capital costs of the above-mentioned two sections were as indicated in Table 9-1. For the sake of interest, the initial capital costs of road upgrading for the other sections, in the event that the same cost per kilometre would be incurred, are also shown in Table 9-1.

Table 9-1: Possible Lesotho Toll Corridors: Estimated and Actual Upgrading Cost

Possible Toll Section	Distance (km)	Road Upgrading Costs (June 2009 Maloti)	
		Actual	Estimated
(1) Maputsoe – Teya-Teyaneng	38,1		R105,4 million
(2) Teya-Teyaneng - Maseru	40,3		R111,5 million
(3) Mazenod – Roma/Ntsi	28,4		R78,6 million
(4) Mazenod – Morija*	29,4	R81,4 million	
(5) Morija – Mafeteng*	35,6	R98,5 million	
(6) Mafeteng - Mohale's Hoek	45,8		R126,7 million
TOTAL	**217,6**	**R179,9 million**	**R427,2 million**

* These are the two already upgraded toll sections

9.1.2 Future Road-related Capital and Maintenance Costs

The proposed unit costs of road rehabilitation, resealing and routine road maintenance were compared in interviews with officials from the Lesotho Ministry of Public Transport and Roads with values used in Lesotho. The unit costs can be summarised as follows:

- Routine Road Maintenance	M 60 000/km (annually)
- Road Reseal	M 450 000/km (10 and 26 years respectively after road upgrading)
- Road Rehabilitation	M 3 million/km (18 years after road upgrading)

The estimated routine road maintenance cost, road resealing cost and road rehabilitation cost for each of the proposed toll sections are shown in Table 9-2.

Table 9-2: Possible Lesotho Toll Corridor: Estimated Road-related Future Capital and Maintenance Costs (Millions, June 2009 Maloti)

Possible Toll Section	Distance	Annual Routine Maintenance cost	Road Resealing Costs	Road Rehabilitation Costs
Maputsoe – Teya-Teyaneng	38,1	M 2,29	M 21,43	M 142,84
Teya-Teyaneng – Maseru	40,3	M 2,42	M 22,65	M 151,01
Mazenod - Roma	28,4*	M 1,71	M 15,99	M 106,58
Mazenod - Morija	29,4	M 1,76	M 16,54	M 110,25
Morija - Mafeteng	35,6	M 2,13	M 20,00	M 133,31
Mafeteng - Mohale's Hoek	45,8	M 2,75	M 25,74	M 171,60

* includes 18,5 km of the A5 between Mazenod and Roma and 9,9 km of the A3 between St Michaels and Ntsi

9.2 Toll-related Capital Costs

9.2.1 Determination of the initial and life-cycle sizing of toll plazas

The numbers of toll lanes required at each of the toll plazas in the selected toll strategy options were estimated by using the following approach:

- A toll collector service rate of 250 vehicles per hour, which is frequently being achieved in peak periods at rural toll plazas of South Africa, was selected.
- In order to provide acceptable service standards, it was assumed that the average queue length per toll lane in all toll lanes should not be more than 6 vehicles, including the vehicle being serviced, for 95% of the time. This standard is currently applicable in South Africa.
- It is generally accepted that the 30th highest hourly traffic volume in a year should be used as a design hour volume. Since traffic counts for a full year were not available, the design hour traffic volume was considered to be the highest hourly volume of the sample data collected in August 2008. The hourly traffic volumes were then escalated to December 2010 (the projected

first year of toll operation being 2011/12) by applying a traffic growth rate of 3% per annum.

- The design horizon for the toll plazas was selected to be 8 years of operation after the selected plaza opening year of 2011/2012, i.e. 2019/20. An 8 year design horizon was found to be the economically optimal design period in a study in respect of the Trans-European Motorway. It represents the balance between frequent plaza expansions and the achievement of economies of scale in respect of construction costs by providing slightly larger expansions than those that are immediately required.
- The predicted traffic growth rates used for the determination of future traffic volumes were 5% per annum for Class 1 vehicles and 5% per annum for Class 2, 3 and 4 vehicles up to 2021/2022. For the period 2021/2022 to 2031/2032 the traffic growth rate was predicted to be 2/3 of those in previous years and from 2031/2032 onward the traffic growth rate was predicted to be 2% per annum.
- Multi-channel queueing theory was employed in the determination of the required plaza sizes.

Table 9-3 below indicates the initial number of total toll lanes and reversible toll lanes required at each of the possible toll plazas. The number of lanes required is also indicated for every 8 years thereafter.

The total lanes referred to in Table 9-3 represent the total number of physical toll plaza lanes and include the physical lane(s) that is(are) reversible. In the financial analysis, the required lanes were provided 8 years in advance of the design year, as explained above.

Reversible toll lanes are lanes that are equipped with a toll booth and toll equipment in both directions of travel to facilitate operation in either direction of travel. In order to be reversible, these lanes have to be located in the middle area of the toll plaza.

Table 9-3: Possible Lesotho Toll Corridors: Estimated Toll Plaza Sizes

Toll Road Section	Lane Requirement (2019 Design Year)		Lane Requirement (2027 Design Year)		Lane Requirement (2035 Design Year)		Lane Requirement (2043 Design Year)	
	Total	Reversible	Total	Reversible	Total	Reversible	Total	Reversible
Maputsoe - Teya-Teyaneng	4	0	4	0	5	1	6	0
Maseru – Teya-Teyaneng	4	0	5	1	6	2	7	1
Mazenod – Roma	5	1	6	0	6	2	7	1
Mazenod – Morija	5	1	6	2	7	3	8	2
Morija – Mafeteng	4	0	5	1	5	1	6	0
Mafeteng – Mohale's Hoek	3	0	3	1	4	0	4	0

9.2.2 Initial and life-cycle capital costs of fixed and semi-fixed toll plaza assets

For the purpose of estimating toll-related capital costs, these costs were divided into the capital costs of fixed assets and of semi-fixed assets. Fixed assets are assets with a significant life such as buildings, structures, earthworks, pavement layers etc., whereas semi-fixed assets refer to assets with a shorter life-span such as toll systems, air-conditioning, UPS units, etc.

The capital costs of fixed assets were estimated by using the tendered toll plaza construction and engineering costs of the Verkeerdevlei, Baobab and Diamond Hill toll plazas in South Africa to determine the unit capital costs of some fixed toll plaza assets (for example, the control building) per mainline toll plaza as well as the unit capital costs of other fixed toll plaza assets (such as the canopy, earthworks and pavement layers) per physical toll lane.

The initial capital costs of semi-fixed assets (i.e. the toll system, air-conditioning, UPS units, etc.) were estimated by using the tendered costs of semi-fixed assets in the Comprehensive Toll Road Operations and Maintenance (CTROM) contracts for the N1 North, N1 South, N2 North Coast, N2 South Coast, N2 Tsitsikamma, N3 Mariannhill, N4 Magalies and N17 Toll Roads in South Africa. These tendered costs were used to determine the unit capital costs of semi-fixed assets in term of a formula in which some cost elements vary per plaza and others per physical toll lane.

The application of the unit costs for fixed and semi-fixed assets to the numbers of toll lanes determined yielded the estimated capital costs in millions of June 2009 Maloti, as indicated in

Table 9-4 below. It should be noted that the capital costs indicated in Table 9-4 will have to be incurred 8 years in advance of the design year. In the case of the 2019 design year, the cost would have to be incurred prior to the toll road opening.

Table 9-4: Possible Lesotho Toll Corridors: Toll Related Capital Cost per Toll Section (Millions of June 2009 Maloti)

Toll Section	Lane Requirement (2019 Design Year)		Lane Requirement (2027 Design Year)		Lane Requirement (2035 Design Year)		Lane Requirement (2043 Design Year)	
Cost Type	**Fix**	**Semi-fix**	**Fix**	**Semi-fix**	**Fix**	**Semi-fix**	**Fix**	**Semi-fix**
Maputsoe - Teya-Teyaneng	M 44	M 6.5	-	M 5.2	M 8	M 6.2	M 8	M 6.0
Maseru – Teya-Teyaneng	M 44	M 6.5	M 8	M 6.2	M 8	M 7.0	M 8	M 6.9
Mazenod – Roma	M 52	M 7.5	M 8	M 6.0	-	M 7.0	M 8	M 6.9
Mazenod – Morija	M 52	M 7.5	M 8	M 7.0	M 8	M 7.8	M 8	M 7.7
Morija – Mafeteng	M 44	M 6.5	M 8	M 6.2	-	M 6.0	M 8	M 6.0
Mafeteng – Mohale's Hoek	M 36	M 6.0	-	M 5.3	M 8	M 5.2	-	M 5.2
TOTAL COST	M 272	M 40.5	M 32	M 35,9	M 32	M 39.2	M 40	M 38.7

9.2.3 Annual toll-related operating and maintenance costs

The annual toll-related operating costs were estimated by using the tendered toll-related operating and maintenance costs of the Magalies Toll Plaza west of Pretoria, South Africa. The South African National Road Agency Ltd. (SANRAL) is currently making use of CTROM contract(s) to operate virtually all SANRAL-funded toll plazas in South Africa. A significant amount of fraud risk is transferred to the operating companies in these contracts. The Magalies Toll Road is being operated with a lower transfer of risk at a lower operating cost and it was considered that it would compare better to what is required on the possible toll sections in Lesotho.

The application of these unit costs to the numbers of toll lanes determined for the toll plazas on the various toll sections yielded the estimated annual toll-related operating and maintenance costs.

The unit cost for toll plaza operations at the Magalies Toll Plaza in South Africa was determined as M 3.3 million per annum (in June 2009 Maloti) for operating a 5 lane plaza for a year. The cost of operation of an additional lane or the operational cost saving of one fewer lane was estimated at R 300 000 per annum (in June 2009 Maloti). Table 9-5 below summarizes the plaza operating cost per year for the assumed design years.

Table 9-5: Possible Lesotho Toll Corridors: Estimated Plaza Operating Costs (Millions of June 2009 Maloti)

Possible Toll Section	Lane Requirement (2019 Design Year)	Lane Requirement (2027 Design Year)	Lane Requirement (2035 Design Year)	Lane Requirement (2043 Design Year)
Maputsoe - Teya-Teyaneng	M 3,0	M 3,0	M 3,3	M 3,6
Maseru – Teya-Teyaneng	M 3,0	M 3,3	M 3,6	M 3,9
Mazenod – Roma	M 3,3	M 3,6	M 3,6	M 3,9
Mazenod – Morija	M 3,3	M 3,6	M 3,9	M 4,2
Morija – Mafeteng	M 3,0	M 3,3	M 3,3	M 3,6
Mafeteng – Mohale's Hoek	M 2,7	M 2,7	M 3,0	M 3,0

10. FINANCIAL EVALUATION

10.1 Financial Feasibility Concepts: The LSR Model

10.1.1 Objectives

The primary objective of the application of the LSR (Loan Supportable by Revenue) model is to perform financial evaluations of potential and existing toll authority toll roads, i.e. toll roads for which the funding is procured directly by the toll authority in the capital and money markets or from Government.

More specifically, the financial model, inter alia, determines the so-called LSR (Loan Supportable by Revenue) of a toll project. The LSR is defined as the present value of the capital and/or money market loans or other loans that a toll project will be able to service and repay from its nett revenue during a selected evaluation period.

Other objectives of the model are:

- To provide the annual debt service cover ratios for each year of the project life, i.e. the ratio between the annual nett toll income and the required interest payments on loans. The ability of a toll project to service its loans from either its first year of operation or within its first 5 years (at the very least) is a very important test of financial viability.
- To provide the predicted capital and money market and/or other debt levels at the end of each financial year in order to put the toll authority in a position where it can predict its likely annual debt and, where necessary, can obtain authorisation for additional debt from the relevant authority.

10.1.2 Model Input Variables

The variables which are entered into the model are the following:

- Base year for traffic and for monetary values.
- Year of start of project operation (i.e. start of revenue stream).
- Duration of initial construction period.
- Project evaluation period.
- Gross toll revenue for first year of operation.

- Predicted traffic growth rates during evaluation period.
- Road-related expenditure for every year of the evaluation period, including:
- initial construction and engineering costs.
- future upgrading, rehabilitation and periodic maintenance costs.
- annual routine road maintenance costs.
- Toll-related expenditure for every year of the evaluation period, including:
- initial toll plaza construction and engineering/architecture costs.
- future toll plaza expansion costs.
- initial and future toll plaza semi-fixed asset costs (i.e. mostly toll collection and control equipment).
- toll operations and maintenance costs.
- A variable operating cost growth factor (related to traffic growth factors).
- Inflation rate(s) during the evaluation period.
- Different real interest rate scenarios during the evaluation period.
- Earned interest rate per annum on surplus funds.

10.1.3 Model Outputs and Processes

The model generates the following outputs:

- The LSRs of the project at different real interest rates: The LSR is essentially the sum of the present values of the nett toll income for each year of the evaluation period, discounted in the model at different nominal interest rates which correspond to a range of real interest rate scenarios.
- The annual debt service ratios of each interest rate scenario is generated by determining the nett revenue (before interest) of each year and comparing this to the interest due, while taking into account potential loan repayments from surplus nett revenue.
- The predicted annual capital and money market debt level of the project at different interest rate scenarios is determined.
- The model may also be employed "in reverse", i.e. instead of supplying the gross toll revenue, based on predicted traffic reaction to toll, as an input, the gross toll revenue level required to achieve desired financial outcome may be derived by using the model, for example:
- the gross toll revenue required to achieve an LSR = initial capital cost of the project.

- the gross toll revenue required to achieve a debt service cover ratio = 1 in the first year of operation.
- the gross toll revenue required to ensure that no project debt develops (applied in the case of the six potential Lesotho toll corridors).

10.1.4 Applications

The great value of the LSR lies in its ability to provide decision-makers with a simple but powerful indication of project viability. This is achieved by a comparison of:

The Loan Supportable by the future Project Revenue (LSR)
and the
Initial Capital Cost of the Project (ICC).

The other major application of the LSR model is that the LSRs of all existing toll authority projects for a selected evaluation period may be compared with the currently outstanding capital and money market loans of these projects (at the same point in time, for example at the end of the previous financial year). This comparison is performed to determine whether the LSR (i.e. the revenue-generating potential) of the toll road portfolio of a toll authority exceeds the outstanding debt by a comfortable margin.

10.1.5 Specific Inputs for Six Potential Lesotho Toll Corridors

The following specific input values were used in the financial model in the analysis of the Lesotho project:

Inflation rate	6% per annum
Real Interest Rate	
- debt predictions	4% per annum
- sensitivity analyses	2%, 3% and 5% per annum

The implied assumption of a combination of the above-mentioned inflation rate and a 4% per annum real interest rate is that a nominal interest rate of 10,24% will be paid by the Lesotho Road Fund.

The nominal interest rate used for interest earned by the toll authority is one percent below the inflation rate at 5% per annum.

10.2 Financial Evaluation Scenarios

In the communication with the Lesotho Road Fund, it was pointed out to the study team that it was not a prerequisite that the possible Lesotho toll corridors should be totally self-funding and that options such as the funding of the routine road maintenance and/or resealing and/or rehabilitation should be investigated.

The following scenarios were investigated from a financial feasibility point of view:

Scenario 1: The "Resealing and Initial Plaza Construction" Scenario

In this scenario, it was assumed that significant costs such as the initial road upgrading costs and subsequent road rehabilitation costs would be funded from external sources such as the Government of Lesotho and/or its development partners and that these "investments" would not have to be paid back by the projects from nett toll revenue. The implication of this approach is that the projects would have to fund the following costs from nett toll revenue (after plaza operating costs):

- Initial plaza construction costs
- Future plaza expansion costs
- Routine road maintenance costs
- Road resealing costs.

As far as the funding of the above-mentioned costs are concerned, it was assumed that it would be possible for the Lesotho Road Fund to borrow for this purpose, and that there was no specific monetary limit for loans that has to be adhered to. The required loans would then be serviced and repaid from nett toll revenue. The financial discipline imposed in this analysis is that the debt service cover ratio should be more than 1,0 as from the first year after plaza construction, i.e. that the project should be capable of paying the interest upon its loans from the first year of operation.

Scenario 2: The "Resealing" Scenario

In this scenario, it was assumed that, apart from significant costs like the initial road upgrading costs and subsequent road rehabilitation costs, the initial toll plaza construction costs would also be funded from external sources such as the Government of Lesotho and/or its development partners in order to achieve the objective that no debt should be allowed in this scenario. This implies that a fund should be built up from nett toll revenue (after plaza operating costs) for the funding of the resealing costs when required after 9 years of operation. The objective of these changes is to create a self-funding system for the funding of the following costs from nett toll revenue (after plaza operating costs) without incurring any debt:

- Future plaza expansion costs
- Routine road maintenance costs
- Road resealing costs.

The financial discipline imposed in this analysis is that no debt will be allowed and that nett toll revenue should be "saved" in order to build up a fund to pay for road resealing when it is required.

Scenario 3: The "Rehabilitation and Resealing" Scenario

In this scenario, it was assumed that the only significant cost to be funded from external sources, i.e. the Lesotho Government and its development partners, would be initial plaza construction costs and initial road upgrading costs. It was, furthermore, considered that no debt should be allowed in this scenario, i.e. a fund should be built up from nett toll revenue (after plaza operating costs) for the funding of the resealing and rehabilitation costs when required. The objective of these measures is to create a self-funding system for the funding of the following costs from nett toll revenue (after plaza operating costs) without incurring any debt:

- Future plaza expansion costs
- Routine road maintenance costs
- Road resealing costs
- Road rehabilitation costs.

The financial discipline imposed in this analysis is that no debt will be allowed and that nett toll revenue should be "saved" in order to build up a fund to pay for road resealing and road rehabilitation when it is required.

Scenario 4: Self-funding Toll Project

The possible A2 toll road sections between Mazenod and Morija and between Morija and Mafeteng were selected as the first potential candidates for this approach in view of the significant upgrading of these sections at a cost of €19,7 million. It could be argued that these road sections are, after their upgrading, truly of "toll road standard". In this scenario, it is assumed that the possible toll sections should eventually be self-funding in that, apart from covering all other costs, it should also repay the loan incurred for its original construction, i.e. the above-mentioned €19,7 million loan. The implication of this approach is that the project would have to fund the following costs from nett toll revenue (after plaza operating costs):

- Initial road upgrading costs
- Initial plaza construction costs
- Future plaza expansion costs
- Road resealing costs
- Road rehabilitation costs
- Routine road maintenance costs.

As far as the funding of the above-mentioned costs are concerned, it was assumed that it would be possible for the Lesotho Road Fund to borrow for this purpose, and that there was no specific monetary limit for loans that has to be adhered to. The required loans would then be serviced and repaid from nett toll revenue. The financial discipline imposed in this analysis is that the debt service cover ratio should be more than 1,0 as from the first year after plaza construction, i.e. that the project should be capable of paying the interest upon its loans from the first year of operation.

Table 10-1 provides a summary of the features of the four scenarios.

Table 10-1: Scenarios Considered in Financial Evaluation

Scenario No.	External investments	Costs to cover from nett toll revenue (after plaza operating cost)	Max loan	Financial discipline
1. Resealing and Initial Plaza Construction Scenario	Road rehabilitation costs Initial road upgrading costs	• Initial plaza construction • Future plaza expansions • Routine road maintenance • Road resealing	No limit	DSCR > 1,0 year after plaza construction
2. Resealing Scenario	Initial plaza construction costs Road rehabilitation costs Initial road upgrading costs	• Future plaza expansions • Routine road maintenance • Road resealing	Zero	No debt Nett toll revenue "saved" to cover indicated costs
3. Rehabilitation and Resealing Scenario	Initial plaza construction costs Road rehabilitation costs Initial road upgrading costs	• Future plaza expansions • Routine road maintenance • Road resealing • Road rehabilitation	Zero	No debt Nett toll revenue "saved" to cover indicated costs
4. Self-funding Toll Project Scenario - Applied in respect of A2 Mazenod - Mafeteng sections	No external investment or External investment repaid	• Initial road upgrading • Initial plaza construction • Road resealing • Road rehabilitation • Future plaza expansions • Routine road maintenance	No limit	DSCR > 1 in year 5 of operation or DSCR >1 in year 1 of operation

10.3 Financial Results of Scenario 1: The Resealing and Initial Plaza Construction Scenario

10.3.1 Perceived Benefits, Toll Tariffs and Traffic and Income Predictions

Table 10-2 indicates, for Scenario 1, the following results:

- The perceived benefit calculations are indicated for those toll sections with alternative routes.
- The proposed toll tariffs to achieve a debt service cover ratio of at least 1,0 in the first year of operation are indicated for all toll vehicle classes and for all six toll sections.

TOLPLAN

TABLE 10-2 SCENARIO 1 - RESEALING AND INITIAL PLAZA CONSTRUCTION SCENARIO: PERCEIVED BENEFITS, PROPOSED TOLL TARIFFS, BEFORE AND AFTER TOLL TRAFFIC AND ANNUAL INCOME PREDICTIONS

Proposed Toll Plaza	Traffic Stream	Class	Toll Distance (Km)	Alternative Distance (Km) Tarmac	Alternative Distance (Km) Gravel	Alternative Distance (Km) Total	Average Speed Toll Route	Average Speed Alt Tarmac	Average Speed Alt Gravel	Perceived value of Distance Benefit Km/Benefit	Perceived value of Distance Benefit Maloti/Km	Perceived value of Distance Benefit Total	Perceived value of Time Benefit Benefit (H)	Perceived value of Time Benefit Maloti/Hour	Perceived value of Time Benefit Value of Time	Perceived Benefit Total	Perceived Benefit Ave 50 MWh	Perceived Benefit % used	Perceived Benefit Total	Proposed Toll tariff and attraction Tariff	Proposed Toll tariff and attraction Additional Toll	Proposed Toll tariff and attraction Total Toll	Proposed Toll tariff and attraction Attraction	Potential Traffic	Tolled Traffic	Class Annual Income (Maloti)	Plaza Annual Income (Maloti)
(1) Teyateyaneng Maputsoe	Teyateyaneng - Maputsoe (Teyateyaneng Maputsoe, Tarmac)	Class 1	38.09	47.59		47.59	61.08	58.40	46.77	9.50	0.75	7.13	0.19	73.40	13.98	21.11	1.71	0.00%	21.11	7.67		7.67	94.79%	1214	1151	3,223,058	
		Class 2	38.09	47.59		47.59	48.40	46.32	37.06	9.50	2.89	27.44	0.24	107.19	25.77	53.20	1.67	0.00%	53.20	15.35		15.35	94.93%	458	435	2,437,836	
		Class 3	38.09	47.59		47.59	45.37	48.42	34.74	9.50	6.12	58.17	0.26	179.15	45.94	104.11	1.65	0.00%	104.11	23.02		23.02	94.99%	127	121	1,016,111	
		Class 4	38.09	47.59		47.59	41.74	39.93	31.96	9.50	8.03	76.30	0.28	272.54	75.96	152.25	1.30	0.00%	152.25	30.69		30.69	94.99%	225	214	2,398,697	9,075,701
	Teyateyaneng Maputsoe (Local User Discount Group)	Class 1	38.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.92	-	1.92	95.00%	134	127	80,927	
		Class 2	38.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.84	-	3.84	95.00%	50	48	67,157	
		Class 3	38.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.76	-	5.76	95.00%	14	13	27,978	
		Class 4	38.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.67	-	7.67	95.00%	25	24	66,097	250,100
(2) Maseru Teyateyaneng	Maseru - Teyateyaneng (Maseru Teyateyaneng, Tarmac)	Class 1	40.27	48.29		48.29	61.08	58.40	46.77	8.02	0.75	6.02	0.17	73.40	12.24	18.26	1.71	0.00%	18.26	6.20		6.20	94.80%	1804	1711	3,871,954	
		Class 2	40.27	48.29		48.29	48.40	46.32	37.06	8.02	2.89	23.16	0.21	107.19	22.56	45.72	1.67	0.00%	45.72	12.40		12.40	94.96%	518	492	2,227,972	
		Class 3	40.27	48.29		48.29	45.37	48.42	34.74	8.02	6.12	49.11	0.22	179.15	40.22	89.32	1.65	0.00%	89.32	18.60		18.60	94.99%	144	137	928,513	
		Class 4	40.27	48.29		48.29	41.74	39.93	31.96	8.02	8.03	64.41	0.24	272.54	66.50	130.91	1.30	0.00%	130.91	24.80		24.80	95.00%	255	242	2,191,876	9,220,313
	Maseru Teyateyaneng (Local User Discount Group)	Class 1	40.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.96	-	4.96	95.00%	56	53	96,504	
		Class 2	40.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.92	-	9.92	95.00%	16	15	55,400	
		Class 3	40.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.88	-	14.88	95.00%	4	4	21,306	
		Class 4	40.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.84	-	19.84	95.00%	8	8	57,775	230,589
(3) Mazenod Roma	Mazenod - Roma (Mazenod Roma)	Class 1	9.02	21.01	0	21.01	61.08	58.40	46.77	11.99	0.75	9.00	0.21	73.40	15.54	24.54	1.71	0.00%	24.54	5.88		5.88	94.98%	1812	1721	3,694,153	
		Class 2	9.02	21.01	0	21.01	48.40	46.32	37.06	11.99	2.89	34.63	0.27	107.19	28.64	63.27	1.67	0.00%	63.27	11.76		11.76	95.00%	611	581	2,493,483	
		Class 3	9.02	21.01	0	21.01	45.37	48.42	34.74	11.99	6.12	73.42	0.29	179.15	51.06	124.48	1.65	0.00%	124.48	17.64		17.64	95.00%	170	161	1,038,886	
		Class 4	9.02	21.01	0	21.01	41.74	39.93	31.96	11.99	8.03	96.29	0.31	272.54	84.43	180.73	1.30	0.00%	180.73	23.52		23.52	95.00%	301	286	2,452,353	9,678,876
	Mazenod Roma (Local User Discount Group)	Class 1	9.02	-	-	-	61.08	-	-	-	-	-	-	-	-	-	-	-	-	2.06	-	2.06	95.00%	62	59	44,336	
		Class 2	9.02	-	-	-	48.40	-	-	-	-	-	-	-	-	-	-	-	-	4.12	-	4.12	95.00%	21	20	29,656	
		Class 3	9.02	-	-	-	45.37	-	-	-	-	-	-	-	-	-	-	-	-	6.17	-	6.17	95.00%	6	6	12,439	
		Class 4	9.02	-	-	-	41.74	-	-	-	-	-	-	-	-	-	-	-	-	8.23	-	8.23	95.00%	10	10	29,167	115,075
(4) Mazenod Morija	Mazenod - Morija (No Reasonable Alternative)	Class 1	29.40				61.08													4.46		4.46	95.00%	1748	1656	2,693,914	
		Class 2	29.40				48.40													8.91		8.91	95.00%	904	858	2,793,022	
		Class 3	29.40				45.37													13.37		13.37	95.00%	251	238	1,163,650	
		Class 4	29.40				41.74													17.83		17.83	95.00%	444	422	2,746,857	9,397,443
	Mazenod Morija (Local User Discount Group)	Class 1	29.40	-	-	-	61.08	-	-	-	-	-	-	-	-	-	-	-	-	1.11	-	1.11	95.00%	131	124	55,418	
		Class 2	29.40	-	-	-	48.40	-	-	-	-	-	-	-	-	-	-	-	-	2.23	-	2.23	95.00%	24	21	37,457	
		Class 3	29.40	-	-	-	45.37	-	-	-	-	-	-	-	-	-	-	-	-	3.34	-	3.34	95.00%	21	20	23,928	
		Class 4	29.40	-	-	-	41.74	-	-	-	-	-	-	-	-	-	-	-	-	4.46	-	4.46	95.00%	37	35	56,517	173,320
(5) Morija Mafeteng	Morija - Mafeteng (Masite - B24)	Class 1	35.60	49.48		49.48	61.08	58.40	46.77	13.88	0.75	10.42	0.26	73.40	19.34	29.77	1.71	0.00%	29.77	8.02		8.02	94.97%	1024	973	2,845,720	
		Class 2	35.60	49.48		49.48	48.40	46.32	37.06	13.88	2.89	40.09	0.33	107.19	35.65	75.74	1.67	0.00%	75.74	16.03		16.03	94.95%	441	419	2,450,011	
		Class 3	35.60	49.48		49.48	45.37	48.42	34.74	13.88	6.12	84.99	0.35	179.15	63.57	148.56	1.65	0.00%	148.56	24.05		24.05	95.00%	122	116	1,020,812	
		Class 4	35.60	49.48		49.48	41.74	39.93	31.96	13.88	8.03	111.47	0.39	272.54	105.11	216.58	1.30	0.00%	216.58	32.07		32.07	95.00%	217	206	2,409,696	8,726,239
	Morija Mafeteng (Local User Discount Group)	Class 1	35.60	-	-	-	61.08	-	-	-	-	-	-	-	-	-	-	-	-	5.61	-	5.61	95.00%	26	22	148,018	
		Class 2	35.60	-	-	-	48.40	-	-	-	-	-	-	-	-	-	-	-	-	11.22	-	11.22	95.00%	33	31	177,401	
		Class 3	35.60	-	-	-	45.37	-	-	-	-	-	-	-	-	-	-	-	-	16.83	-	16.83	95.00%	9	9	53,075	
		Class 4	35.60	-	-	-	41.74	-	-	-	-	-	-	-	-	-	-	-	-	22.45	-	22.45	95.00%	16	15	125,215	451,722
(6) Mafeteng Mohale's Hoek	Mafeteng Mohale's Hoek (No Reasonable Alternative)	Class 1	45.70				61.08													11.55		11.55	95.00%	672	639	2,692,371	
		Class 2	45.70				48.40													23.10		23.10	95.00%	317	301	2,539,033	
		Class 3	45.70				45.37													34.65		34.65	95.00%	88	84	1,057,832	
		Class 4	45.70				41.74													46.21		46.21	95.00%	156	148	2,497,063	8,786,300

Table 10-2: **Resealing and Initial Plaza Construction Scenario: Perceived Benefits, Proposed Toll Tariffs, Before and After Toll Traffic and Annual Income Predictions**

- The traffic attraction rates to the tolled sections are indicated for all vehicle classes and toll sections. As can be observed in Table 10-2, the traffic attraction rates are virtually always at 95% or just below it, i.e. at the maximum attraction rate allowed by the amended Ellwood algorithm. The potential traffic (toll eligible traffic) and the tolled traffic are also shown in Table 10-2.
- The gross toll revenue for each vehicle class and for each toll section.

10.3.2 Financial Results

Table 10-3 provides a summary of the financial results of Scenario 1 for the six toll sections, while Figure 10-1 provides a graphical presentation of the predicted debt levels of Scenario 1 for the six toll sections. The conclusions that may be drawn from Table 10-3 and Figure 10-1 are presented in the following sub-sections:

a. Ability to fund resealing and initial plaza construction cost

The loans supportable by revenue (LSRs) in Table 10-3 indicate the present values of future nett revenue that will be available to fund the initial plaza construction costs, after already having made provision in the LSR analysis for the subtraction of future plaza expansion costs, routine road maintenance costs and road resealing costs.

Table 10-4 provides a comparison of the available LSRs and required Initial Plaza Construction Costs (IPCC) of the six potential toll sections.

Table 10-3: Scenario 1: Comparison of LSRs and Initial Plaza Construction Costs (IPCC)

Possible Toll Section	LSR	IPCC	LSR/IPCC
1. Maputsoe - Teya-Teyaneng	M106,4 m	M43,7 m	2,43
2. Teya-Teyaneng - Maseru	M95,4 m	M43,7 m	2,18
3. Mazenod – Roma	M122,6 m	M51,7 m	2,37
4. Mazenod – Morija	M114,9 m	M51,7 m	2,22
5. Morija – Mafeteng	M102,5 m	M43,7 m	2,35
6. Mafeteng – Mohale's Hoek	M90,9 m	M35,7 m	2,55

It can be concluded from Table 10-4 that the LSRs of the various toll sections (i.e. the present values of future nett revenue) are more than adequate to fund the initial plaza construction costs of the various toll sections. Please note, once again, that the LSR represents the present value of future nett revenue after provision has already been made for, inter alia, road resealing costs.

TABLE 10-3: FINANCIAL SCENARIO 1 - RESEALING AND INITIAL PLAZA CONSTRUCTION SCENARIO							
Toll Section	LSR (in June 2009 Maloti)	Year DSCR > 1	Maximum Debt	Year of maximum Debt	Year of Debt Repayment	Toll Collection Cost as % of Gross Toll Revenue	Light Vehicle Toll Tariff (c/Km)
1. Teyateyaneng - Maputsoe	M 106.40 Million	2011/2012	M 59.92 Million	2019/2020	2024/2025	38.34%	0.20
2. Maseru - Teyateyaneng	M 95.40 Million	2011/2012	M 79.40 Million	2019/2020	2025/2026	41.33%	0.15
3. Mazenod - Roma	M 122.58 Million	2011/2012	M 72.38 Million	2019/2020	2024/2025	40.90%	0.32
4. Mazenod - Morija	M 114.90 Million	2011/2012	M 75.15 Million	2019/2020	2024/2025	43.54%	0.15
5. Morija - Mafeteng	M 102.51 Million	2011/2012	M 75.30 Million	2019/2020	2025/2026	39.59%	0.23
6. Mafeteng - Mohale's Hoek	M 90.89 Million	2011/2012	M 63.40 Million	2019/2020	2024/2025	34.34%	0.25

Table 10-4: Financial Scenario 1 – Resealing and Initial Plaza Construction Scenario

Figure 10-1: Scenario 1– Resealing and Initial Plaza Construction Scenario

b. Debt levels and debt repayment

As far as the debt levels and repayment of debt are concerned, it can be concluded (from Table 10-3 and Figure 10-1) that the maximum debt levels will be reached in 2019/20, i.e. during the year when all the resealing is allowed for in the financial model and that the maximum debt level per toll section would amount to about M60 million to M80 million with a total maximum debt for all 6 potential toll sections together of about M425 million in 2019/20. This debt is, however, predicted to then be repaid by 2025/26.

c. Toll tariffs

The proposed unrounded full toll tariffs (i.e. before any local user discount) for Scenario 1, as indicated in Table 10-2, are summarised in Table 10-5 below. In practice, these tariffs would be rounded to, for example, the nearest full Maloti. The tariffs for the three heavy vehicle classes are 2, 3 and 4 times the light vehicle tariff for classes 2, 3 and 4 respectively.

Table 10-5: Scenario 1 – Resealing and Initial Plaza Construction Scenario : Proposed Toll Tariffs (in 2009 Maloti)

Possible Toll Section	Proposed Toll Tariffs			
	Class 1	Class 2	Class 3	Class 4
Maputsoe - Teya-Teyaneng	M7,67	M15,35	M23,02	M30,69
Teya-Teyaneng - Maseru	M6,20	M12,40	M18,60	M24,80
Mazenod – Roma	M5,88	M11,76	M17,64	M23,52
Mazenod – Morija	M4,46	M8,91	M13,37	M17,83
Morija – Mafeteng	M8,02	M16,03	M24,05	M32,07
Mafeteng – Mohale's Hoek	M11,55	M23,10	M34,65	M46,21

The above-mentioned proposed light vehicle toll tariffs for Scenario 1 for the six possible toll sections vary between 15c and 25c per km with the A5 Mazenod – Roma Section being an outlier at 32c per km (See Table 10-3). These light vehicle toll tariffs are still significantly below the average light vehicle tariffs of about 35c per km on South African toll roads in 2009 which is considered as a kind of a benchmark that should not be exceeded.

d. The cost of toll collection

Table 10-3 also indicates the toll collection cost as a percentage of gross toll revenue for Scenario 1 for each possible toll section. More specifically, this represents the present value of all toll-related capital, operating and maintenance costs (i.e. including initial plaza construction costs, future plaza expansion costs, semi-fixed toll plaza asset costs and toll plaza operating and maintenance costs) as a percentage of the present value of gross toll revenue, with all present values being determined by the predicted inflation rate being applied as a discount rate to the nominal future revenue and expenditure figures.

As can be concluded from Table 10-3, the present values of toll collection costs as percentages of the present values of gross revenues vary between about 34% and 44% for Scenario 1 which are quite high percentages.

e. Conclusion

Since the cash flow of each of the toll sections after 2024/25 or 2025/26, the years of debt repayment, is predicted to become very positive, it would appear to be an under-utilisation of the potential revenue of the toll sections at the tariff levels in sub-section c. above to only fund the cost items included in Scenario 1.

It is, therefore, considered that more expenditure such as rehabilitation expenditure should be funded by the toll revenue in order to fully explore the potential of tolling and this alternative is further explored in Scenario 3. This funding will require higher toll tariffs than those determined for Scenario 1, but as is indicated in sub-section c above, the Scenario 1 tariffs are still significantly below the average South African light vehicle tariffs.

10.4 Financial Results of Scenario 2: The Resealing Scenario

10.4.1 Perceived Benefits, Toll Tariffs and Traffic and Income Predictions

Table 10-6 indicates, for Scenario 2, the following results:

- The perceived benefit calculations are indicated for those toll sections with alternative routes.
- The proposed toll tariffs to achieve a situation in which no debt whatsoever is incurred which becomes possible if the Lesotho Government and/or its development partners also fund the initial plaza capital costs.

- The traffic attraction rates to the tolled sections are indicated for all vehicle classes and toll sections. As can be observed in Table 10-6, the traffic attraction rates are virtually always at 95% or just below it, i.e. at the maximum attraction rate allowed by the amended Ellwood algorithm. The potential traffic (toll eligible traffic) and the tolled traffic are also shown in Table 10-6.
- The gross toll revenue for each vehicle class and for each toll section.

10.4.2 Financial Results

Table 10-7 provides a summary of the financial results of Scenario 2 for the six toll sections, while Figure 10-2 provides a graphical presentation of the predicted debt levels of Scenario 2 for the six toll sections. The conclusions that may be drawn from Table 10-7 and Figure 10-2 are presented in the following sub-sections:

a. Ability to fund resealing costs

The loans supportable by revenue (LSRs) in Table 10-7 indicate the present values of future nett revenue that will be available, after already having made provision in the LSR analysis for the subtraction of future plaza expansion costs, routine road maintenance costs and road resealing costs.

b. Positive cash flow

Since the semi-fixed toll plaza assets to be supplied require expenditure of M6,5 million – M7,5 million (in 2009 Maloti) per toll plaza over and above the plaza operating costs during the first year of operation, toll tariffs have to be set at levels a bit higher than those required to fund only toll operations and routine road maintenance in order not to incur any debt. With the underlying assumption that these tariffs would increase at the inflation rate, the predicted cash flows grow by so much that the resealing expenditure in 2019/20 can easily be funded from the built-up positive cash flow (See Figure 10-2).

TABLE 10-6 SCENARIO 2 - RESEALING SCENARIO: PERCEIVED BENEFITS, PROPOSED TOLL TARIFFS, BEFORE AND AFTER TOLL TRAFFIC AND ANNUAL INCOME PREDICTIONS

Proposed Toll Plaza	Traffic Stream	Class	Toll Distance (Km)	Alternative Distance (Km)			Average Speed			Perceived value of Distance Benefit			Perceived value of Time Benefit			Perceived Benefit				Proposed Toll Tariff and attraction							
				Tarmac	Gravel	Total	Toll Route	Alt Tarmac	Alt Gravel	Km/Benefit	Maloti/Km	Total	Benefit (H)	Maloti/Hour	Value of Time	Total	Ave SA MWR	% used	Total	Tariff	Additional Toll	Total Toll	Attraction	Potential Traffic	Tolled Traffic	Class Annual Income (Maloti)	Place Annual Income (Maloti)
(1) Teyateyaneng Maputsoe	Teyateyaneng - Maputsoe (Teyateyaneng Maputsoe, Tarmac)	Class 1	38.09	47.59		47.59	61.08	58.40	46.77	9.50	0.75	7.13	0.19	73.40	13.98	21.11	1.71	0.00%	21.11	10.00		10.00	94.00%	1214	1141	4,164,815	
		Class 2	38.09	47.59		47.59	48.40	46.32	37.06	9.50	2.89	27.44	0.24	107.19	25.77	53.20	1.67	0.00%	53.20	20.00		20.00	94.75%	458	434	3,170,140	
		Class 3	38.09	47.59		47.59	45.37	43.42	34.74	9.50	6.12	58.17	0.26	179.15	45.94	104.11	1.65	0.00%	104.11	30.00		30.00	94.95%	127	121	1,323,582	
		Class 4	38.09	47.59		47.59	41.74	39.95	31.96	9.50	8.03	76.30	0.28	272.54	75.96	152.25	1.30	0.00%	152.25	40.00		40.00	94.97%	225	214	3,125,107	11,783,650
	Teyateyaneng Maputsoe (Local User Discount Group)	Class 1	38.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.50	-	2.50	95.00%	134	127	115,935	
		Class 2	38.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.00	-	5.00	95.00%	50	48	87,510	
		Class 3	38.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.50	-	7.50	95.00%	14	13	36,450	
		Class 4	38.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.00	-	10.00	95.00%	25	24	86,064	325,959
(2) Maseru Teyateyaneng	Maseru - Teyateyaneng (Maseru Teyateyaneng, Tarmac)	Class 1	40.27	48.29		48.29	61.08	58.40	46.77	8.02	0.75	6.02	0.17	73.40	12.24	18.26	1.71	0.00%	18.26	8.05		8.05	94.34%	1804	1702	5,000,535	
		Class 2	40.27	48.29		48.29	48.40	46.32	37.06	8.02	2.89	23.16	0.21	107.19	22.56	45.72	1.67	0.00%	45.72	16.10		16.10	94.83%	518	492	2,889,051	
		Class 3	40.27	48.29		48.29	45.37	43.42	34.74	8.02	6.12	49.11	0.22	179.15	40.22	89.32	1.65	0.00%	89.32	24.15		24.15	94.90%	144	137	1,205,387	
		Class 4	40.27	48.29		48.29	41.74	39.95	31.96	8.02	8.03	64.41	0.24	272.54	66.50	130.91	1.30	0.00%	130.91	32.20		32.20	94.95%	255	242	2,845,835	11,940,808
	Maseru Teyateyaneng (Local User Discount Group)	Class 1	40.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.44	-	6.44	95.00%	56	54	125,835	
		Class 2	40.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.88	-	12.88	95.00%	16	15	72,130	
		Class 3	40.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.32	-	19.32	95.00%	4	4	30,135	
		Class 4	40.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25.76	-	25.76	95.00%	8	8	71,135	299,436
(3) Mazenod Roma	Mazenod - Roma (Mazenod Roma)	Class 1	9.02	21.01	0	21.01	61.08	58.40	46.77	11.99	0.75	9.00	0.21	73.40	15.54	24.54	1.71	0.00%	24.54	7.74		7.74	94.91%	1812	1720	4,861,215	
		Class 2	9.02	21.01	0	21.01	48.40	46.32	37.06	11.99	2.89	34.63	0.27	107.19	28.64	63.27	1.67	0.00%	63.27	15.49		15.49	94.95%	611	581	3,283,165	
		Class 3	9.02	21.01	0	21.01	45.37	43.42	34.74	11.99	6.12	73.42	0.29	179.15	51.06	124.48	1.65	0.00%	124.48	23.23		23.23	95.00%	170	161	1,368,081	
		Class 4	9.02	21.01	0	21.01	41.74	39.95	31.96	11.99	8.03	96.29	0.31	272.54	84.43	180.73	1.30	0.00%	180.73	30.98		30.98	95.00%	301	286	3,229,478	12,741,939
	Mazenod Roma (Local User Discount Group)	Class 1	9.02	-	-	-	61.08	-	-	-	-	-	-	-	-	-	-	-	-	2.71	-	2.71	95.00%	62	59	58,258	
		Class 2	9.02	-	-	-	48.40	-	-	-	-	-	-	-	-	-	-	-	-	5.42	-	5.42	95.00%	21	20	39,518	
		Class 3	9.02	-	-	-	45.37	-	-	-	-	-	-	-	-	-	-	-	-	8.13	-	8.13	95.00%	6	6	16,001	
		Class 4	9.02	-	-	-	41.74	-	-	-	-	-	-	-	-	-	-	-	-	10.84	-	10.84	95.00%	10	10	38,568	[illegible]
(4) Mazenod Morija	Mazenod - Morija (No Reasonable Alternative)	Class 1	29.40				61.08													5.86		5.86	95.00%	1743	1656	3,543,780	
		Class 2	29.40				48.40													11.73		11.73	95.00%	904	858	3,674,155	
		Class 3	29.40				45.37													17.59		17.59	95.00%	251	238	1,530,754	
		Class 4	29.40				41.74													23.45		23.45	95.00%	444	422	3,613,425	12,362,114
	Mazenod Morija (Local User Discount Group)	Class 1	29.40	-	-	-	61.08	-	-	-	-	-	-	-	-	-	-	-	-	1.47	-	1.47	95.00%	141	136	[illegible]	
		Class 2	29.40	-	-	-	48.40	-	-	-	-	-	-	-	-	-	-	-	-	2.93	-	2.93	95.00%	34	31	[illegible]	
		Class 3	29.40	-	-	-	45.37	-	-	-	-	-	-	-	-	-	-	-	-	4.40	-	4.40	95.00%	21	20	[illegible]	
		Class 4	29.40	-	-	-	41.74	-	-	-	-	-	-	-	-	-	-	-	-	5.86	-	5.86	95.00%	37	35	[illegible]	254,567
(5) Morija Mafeteng	Morija - Mafeteng (Mazide - B20)	Class 1	35.60	49.48		49.48	61.08	58.40	46.77	13.88	0.75	10.42	0.26	73.40	19.34	29.77	1.71	0.00%	29.77	10.45		10.45	94.81%	1024	971	3,703,322	
		Class 2	35.60	49.48		49.48	48.40	46.32	37.06	13.88	2.89	40.09	0.33	107.19	35.66	75.74	1.67	0.00%	75.74	20.90		20.90	94.92%	441	419	3,181,963	
		Class 3	35.60	49.48		49.48	45.37	43.42	34.74	13.88	6.12	84.99	0.35	179.15	63.57	148.56	1.65	0.00%	148.56	31.34		31.34	94.99%	122	116	1,330,304	
		Class 4	35.60	49.48		49.48	41.74	39.95	31.96	13.88	8.03	111.47	0.39	272.54	105.11	216.58	1.30	0.00%	216.58	41.79		41.79	95.00%	217	206	3,140,361	11,366,130
	Morija Mafeteng (Local User Discount Group)	Class 1	35.60	-	-	-	61.08	-	-	-	-	-	-	-	-	-	-	-	-	7.31	-	7.31	95.00%	75	72	172,305	
		Class 2	35.60	-	-	-	48.40	-	-	-	-	-	-	-	-	-	-	-	-	14.63	-	14.63	95.00%	33	31	186,032	
		Class 3	35.60	-	-	-	45.37	-	-	-	-	-	-	-	-	-	-	-	-	21.94	-	21.94	95.00%	9	9	91,176	
		Class 4	35.60	-	-	-	41.74	-	-	-	-	-	-	-	-	-	-	-	-	29.25	-	29.25	95.00%	16	15	151,291	[illegible]
(6) Mafeteng Mohale's Hoek	Mafeteng Mohale's Hoek (No Reasonable Alternative)	Class 1	45.76				61.08													15.41		15.41	95.00%	672	639	3,591,763	
		Class 2	45.76				48.40													30.82		30.82	95.00%	317	301	3,387,211	
		Class 3	45.76				45.37													46.23		46.23	95.00%	88	84	1,411,205	
		Class 4	45.76				41.74													61.64		61.64	95.00%	156	148	3,331,224	11,721,403

Table 10-6: Scenario 2 – Resealing Scenario: Perceived Benefits, Proposed Toll Tariffs, Before and After Toll Traffic and Annual Income Predictions

TABLE 10-7: FINANCIAL SCENARIO 2 - RESEALING SCENARIO							
Toll Section	LSR (in June 2009 Maloti)	Year DSCR > 1	Maximum Debt	Year of maximum Debt	Year of Debt Repayment	Toll Collection Cost as % of Gross Toll Revenue	Light Vehicle Toll Tariff (c/Km)
1. Teyateyaneng - Maputsoe	M 182.86 Million	N/A	N/A	N/A	N/A	24.17%	0.26
2. Maseru - Teyateyaneng	M 172.01 Million	N/A	N/A	N/A	N/A	26.60%	0.20
3. Mazenod - Roma	M 207.72 Million	N/A	N/A	N/A	N/A	25.11%	0.42
4. Mazenod - Morija	M 200.10 Million	N/A	N/A	N/A	N/A	27.19%	0.20
5. Morija - Mafeteng	M 178.79 Million	N/A	N/A	N/A	N/A	24.97%	0.29
6. Mafeteng - Mohale's Hoek	M 171.50 Million	N/A	N/A	N/A	N/A	21.22%	0.34

N/A - Not Applicable.

Table 10-7: Financial Scenario 2 – Resealing Scenario

Figure 10-2: Scenario 2 – Resealing Scenario

As far as the positive cash flow levels are concerned, it can therefore be concluded (from Figure 10-2) that no debt will be incurred and that the surpluses (savings) will reach about R500 million for each toll section within 18-20 year after the start of operation, if toll tariffs are increased annually at the inflation rate, even after having funded the required resealing of the toll sections in 2019/20.

c. Toll tariffs

The proposed unrounded full toll tariffs (i.e. before any local user discount) for Scenario 2, as indicated in Table 10-6, are summarised in Table 10-8 below. In practice, these tariffs would be rounded to, for example, the nearest full Maloti. The tariffs for the three heavy vehicle classes are 2, 3 and 4 times the light vehicle tariff for classes 2, 3 and 4 respectively.

Table 10-8: Scenario 2 – Resealing Scenario : Proposed Toll Tariffs (in 2009 Rand)

Possible Toll Section	Proposed Toll Tariffs			
	Class 1	Class 2	Class 3	Class 4
Maputsoe - Teya-Teyaneng	M10,00	M20,00	M30,00	M40,00
Teya-Teyaneng - Maseru	M8,05	M16,10	M24,15	M32,20
Mazenod – Roma	M7,74	M15,49	M23,23	M30,98
Mazenod – Morija	M5,86	M11,73	M17,59	M23,45
Morija – Mafeteng	M10,45	M20,90	M31,34	M41,79
Mafeteng – Mohale's Hoek	M15,41	M30,82	M46,23	M61,64

The above-mentioned proposed light vehicle toll tariffs for Scenario 2 for the six possible toll sections vary between 20c and 34c per km with the A5 Mazenod – Roma Section being an outlier at 42c per km (See Table 10-7). Except for Mazenod – Roma, these light vehicle toll tariffs are still below the average light vehicle tariffs of about 35c per km on South African toll roads (in 2009).

d. The cost of toll collection

Table 10-7 also indicates the toll collection cost as a percentage of gross toll revenue for Scenario 2 for each possible toll section. More specifically, this represents the present value of all toll-related capital, operating and maintenance costs (i.e. including initial plaza construction costs, future plaza expansion costs, semi-fixed toll plaza asset costs and toll plaza operating and maintenance costs) as a percentage of the present value of gross toll revenue, with all present values being determined by the predicted inflation rate being applied as a discount rate to the nominal future revenue and expenditure figures.

As can be concluded from Table 10-7, the present values of toll collection costs as percentages of the present values of gross revenues vary between about 21% and 27% for Scenario 2 which are in line with the higher percentages of some South African toll roads.

e. Conclusion

Since the cash flow of each of the toll sections after 2019/20, the years of funding resealing, is predicted to become very positive, it would appear to be an under-utilisation of the potential revenue of the toll sections at the tariff levels in sub-section c. above to only fund the cost items included in Scenario 2.

It is, therefore, considered that more expenditure such as rehabilitation expenditure should be funded by the toll revenue in order to fully explore the potential of tolling and this alternative is further explored in Scenario 3. This funding will require similar or slightly higher toll tariffs than those determined for Scenario 2, but as is indicated in sub-section c above, the Scenario 2 tariffs are still mostly somewhat below the average South African light vehicle tariffs.

10.5 Financial Results of Scenario 3: The Rehabilitation and Resealing Scenario

10.5.1 Perceived Benefits, Toll Tariffs and Traffic and Income Predictions

Table 10-9 indicates, for Scenario 3, the following results:

- The perceived benefit calculations are indicated for those toll sections with alternative routes.
- The proposed toll tariffs to achieve a situation in which no debt whatsoever is incurred which becomes possible if the Lesotho Government and/or its development partners fund the initial plaza capital costs.
- The traffic attraction rates to the tolled sections are indicated for all vehicle classes and toll sections. As can be observed in Table 10-9, the traffic attraction rates are virtually always at 95% or just below it, i.e. at the maximum attraction rate allowed by the amended Ellwood algorithm. The potential traffic (toll eligible traffic) and the tolled traffic are also shown in Table 10-9.

TABLE 10-9 SCENARIO 3 - REHABILITATION AND RESEALING SCENARIO: PERCEIVED BENEFITS, PROPOSED TOLL TARIFFS, BEFORE AND AFTER TOLL TRAFFIC AND ANNUAL INCOME PREDICTIONS

Proposed Toll Plaza	Traffic Stream	Class	Toll Distance (Km)	Alternative Distance (Km)			Average Speed			Perceived value of Distance Benefit			Perceived value of Time Benefit			Perceived Benefit				Proposed Toll Tariff and attraction							
				Tarmac	Gravel	Total	Toll Route	Alt Tarmac	Alt Gravel	Km/Benefit	Maloti/Km	Total	Benefit (H)	Maloti/Hour	Value of Time	Total	Ave SA MWR	% used	Total	Tariff	Additional Toll	Total Toll	Attraction	Potential Traffic	Tolled Traffic	Class Annual Income (Maloti)	Plaza Annual Income (Maloti)
(1)Teyateyaneng Maputsoe	Teyateyaneng - Maputsoe (Teyateyaneng Maputsoe, Tarmac)	Class 1	38.09	47.59		47.59	61.08	58.40	46.77	9.50	0.75	7.13	0.19	73.40	13.98	21.11	1.71	0.00%	21.11	10.46		10.46	93.69%	1214	1137	4,341,134	
		Class 2	38.09	47.59		47.59	48.40	46.32	37.06	9.50	2.89	27.44	0.24	107.19	25.77	53.20	1.67	0.00%	53.20	20.91		20.91	94.67%	458	434	3,312,380	
		Class 3	38.09	47.59		47.59	45.37	43.42	34.74	9.50	6.12	58.17	0.26	179.15	45.94	104.11	1.65	0.00%	104.11	31.37		31.37	94.93%	127	121	1,383,871	
		Class 4	38.09	47.59		47.59	41.74	39.95	31.96	9.50	8.03	76.30	0.28	272.54	75.95	152.25	1.30	0.00%	152.25	41.83		41.83	94.90%	225	214	3,267,685	12,305,070
	Teyateyaneng Maputsoe (Local User Discount Group)	Class 1	38.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.61	-	2.61	95.00%	134	127	121,105	
		Class 2	38.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.23	-	5.23	95.00%	50	48	91,511	
		Class 3	38.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.84	-	7.84	95.00%	14	13	38,125	
		Class 4	38.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.46	-	10.46	95.00%	25	24	89,299	340,041
(2) Maseru Teyateyaneng	Maseru - Teyateyaneng (Maseru Teyateyaneng, Tarmac)	Class 1	40.27	48.29		48.29	61.08	58.40	46.77	8.02	0.75	6.02	0.17	73.40	12.24	18.26	1.71	0.00%	18.26	9.05		9.05	93.69%	1804	1690	5,580,888	
		Class 2	40.27	48.29		48.29	48.40	46.32	37.06	8.02	2.89	23.16	0.21	107.19	22.56	45.72	1.67	0.00%	45.72	18.10		18.10	94.60%	518	491	3,240,998	
		Class 3	40.27	48.29		48.29	45.37	43.42	34.74	8.02	6.12	49.11	0.22	179.15	40.22	89.32	1.65	0.00%	89.32	27.14		27.14	94.93%	144	137	1,354,196	
		Class 4	40.27	48.29		48.29	41.74	39.95	31.96	8.02	8.03	64.41	0.24	272.54	66.50	130.91	1.30	0.00%	130.91	36.19		36.19	94.90%	255	242	3,197,683	13,373,765
	Maseru Teyateyaneng (Local User Discount Group)	Class 1	40.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.24	-	7.24	95.00%	56	54	141,424	
		Class 2	40.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.48	-	14.48	95.00%	16	15	81,290	
		Class 3	40.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21.72	-	21.72	95.00%	4	4	33,868	
		Class 4	40.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28.95	-	28.95	95.00%	8	8	79,506	336,579
(3) Mazenod Roma	Mazenod - Roma (Mazenod Roma)	Class 1	9.02	21.01	0	21.01	61.08	58.40	46.77	11.99	0.75	9.00	0.21	73.40	15.54	24.54	1.71	0.00%	24.54	7.74		7.74	94.91%	1812	1720	4,861,215	
		Class 2	9.02	21.01	0	21.01	48.40	46.32	37.06	11.99	2.89	34.63	0.27	107.19	28.64	63.27	1.67	0.00%	63.27	15.49		15.49	94.93%	611	581	3,283,165	
		Class 3	9.02	21.01	0	21.01	45.37	43.42	34.74	11.99	6.12	73.42	0.29	179.15	51.06	124.48	1.65	0.00%	124.48	23.23		23.23	95.00%	170	161	1,308,081	
		Class 4	9.02	21.01	0	21.01	41.74	39.95	31.96	11.99	8.03	96.29	0.31	272.54	84.43	180.73	1.30	0.00%	180.73	30.98		30.98	95.00%	301	286	3,229,478	12,741,939
	Mazenod Roma (Local User Discount Group)	Class 1	9.02	-	-	-	61.08	-	-	-	-	-	-	-	-	-	-	-	-	2.71	-	2.71	95.00%	62	59	58,258	
		Class 2	9.02	-	-	-	48.40	-	-	-	-	-	-	-	-	-	-	-	-	5.42	-	5.42	95.00%	21	20	39,118	
		Class 3	9.02	-	-	-	45.37	-	-	-	-	-	-	-	-	-	-	-	-	8.13	-	8.13	95.00%	6	6	16,001	
		Class 4	9.02	-	-	-	41.74	-	-	-	-	-	-	-	-	-	-	-	-	10.84	-	10.84	95.00%	10	10	38,868	152,624
(4) Mazenod Morija	Mazenod - Morija (No Reasonable Alternative)	Class 1	29.40				61.08													5.86		5.86	95.00%	1743	1656	3,540,811	
		Class 2	29.40				48.40													11.72		11.72	95.00%	904	858	3,671,077	
		Class 3	29.40				45.37													17.57		17.57	95.00%	251	238	1,529,472	
		Class 4	29.40				41.74													23.43		23.43	95.00%	444	422	3,610,398	12,351,759
	Mazenod Morija (Local User Discount Group)	Class 1	29.40	-	-	-	61.08	-	-	-	-	-	-	-	-	-	-	-	-	1.46	-	1.46	95.00%	141	136	72,600	
		Class 2	29.40	-	-	-	48.40	-	-	-	-	-	-	-	-	-	-	-	-	2.93	-	2.93	95.00%	24	23	25,520	
		Class 3	29.40	-	-	-	45.37	-	-	-	-	-	-	-	-	-	-	-	-	4.39	-	4.39	95.00%	21	20	31,464	
		Class 4	29.40	-	-	-	41.74	-	-	-	-	-	-	-	-	-	-	-	-	5.86	-	5.86	95.00%	37	35	74,771	204,054
(5) Morija Mafeteng	Morija - Mafeteng (Masite - B24)	Class 1	35.60	49.48		49.48	61.08	58.40	46.77	13.88	0.75	10.42	0.26	73.40	19.34	29.77	1.71	0.00%	29.77	10.63		10.63	94.81%	1024	971	3,767,741	
		Class 2	35.60	49.48		49.48	48.40	46.32	37.06	13.88	2.89	40.09	0.33	107.19	35.65	75.74	1.67	0.00%	75.74	21.26		21.26	94.90%	441	419	3,247,793	
		Class 3	35.60	49.48		49.48	45.37	43.42	34.74	13.88	6.12	84.99	0.35	179.15	63.57	148.56	1.65	0.00%	148.56	31.89		31.89	94.99%	122	116	1,353,622	
		Class 4	35.60	49.48		49.48	41.74	39.95	31.96	13.88	8.03	111.47	0.39	272.54	105.11	216.58	1.30	0.00%	216.58	42.52		42.52	94.99%	217	206	3,195,418	11,564,574
	Morija Mafeteng (Local User Discount Group)	Class 1	35.60	-	-	-	61.08	-	-	-	-	-	-	-	-	-	-	-	-	7.44	-	7.44	95.00%	25	22	156,291	
		Class 2	35.60	-	-	-	48.40	-	-	-	-	-	-	-	-	-	-	-	-	14.88	-	14.88	95.00%	31	31	168,979	
		Class 3	35.60	-	-	-	45.37	-	-	-	-	-	-	-	-	-	-	-	-	22.32	-	22.32	95.00%	5	5	41,005	
		Class 4	35.60	-	-	-	41.74	-	-	-	-	-	-	-	-	-	-	-	-	29.77	-	29.77	95.00%	16	15	166,157	531,785
(6) Mafeteng Mohale's Hoek	Mafeteng Mohale's Hoek (No Reasonable Alternative)	Class 1	45.76				61.08													18.58		18.58	95.00%	672	639	4,331,304	
		Class 2	45.76				48.40													37.17		37.17	95.00%	317	301	4,084,629	
		Class 3	45.76				45.37													55.75		55.75	95.00%	88	84	1,701,769	
		Class 4	45.76				41.74													74.33		74.33	95.00%	156	148	4,017,114	14,134,816

Table 10-9: Rehabilitation and Resealing Scenario: Perceived Benefits, Proposed Toll Tariffs, Before and After Toll Traffic and Annual Income Predictions

- The gross toll revenue for each vehicle class and for each toll section.

10.5.2 Financial Results

Table 10-10 provides a summary of the financial results of Scenario 3 for the six toll sections, while Figure 10-3 provides a graphical presentation of the predicted debt levels of Scenario 3 for the six toll sections. The conclusions that may be drawn from Table 10-10 and Figure 10-3 are presented in the following sub-sections:

a. Ability to fund resealing and rehabilitation costs

The loans supportable by revenue (LSRs) in Table 10-10 indicate the present values of future nett revenue that will be available to fund the initial plaza construction costs, after already having made provision in the LSR analysis for the subtraction of future plaza expansion costs, routine road maintenance costs, road resealing costs *and road rehabilitation costs*.

b. Application of Positive Cash Flow

As can be observed in Figure 10-3, the build-up of positive cash flow for all six toll sections is such with this scenario that it can actually fund both its predicted resealing costs and its predicted rehabilitation costs over a 17 year period. After this period, a new build-up of cash would occur.

c. Toll tariffs

The proposed unrounded full toll tariffs (i.e. before any local user discount) for Scenario 3, as indicated in Table 10-9, are summarised in Table 10-11 below. In practice, these tariffs would be rounded to, for example, the nearest full Maloti. The tariffs for the three heavy vehicle classes are 2, 3 and 4 times the light vehicle tariff for classes 2, 3 and 4 respectively.

TABLE 10-10: FINANCIAL SCENARIO 3 - REHABILITATION AND RESEALING SCENARIO							
Toll Section	LSR (in June 2009 Maloti)	Year DSCR > 1	Maximum Debt	Year of maximum Debt	Year of Debt Repayment	Toll Collection Cost as % of Gross Toll Revenue	Light Vehicle Toll Tariff (c/Km)
1. Teyateyaneng - Maputsoe	M 127.08 Million	N/A	N/A	N/A	N/A	23.14%	0.27
2. Maseru - Teyateyaneng	M 137.84 Million	N/A	N/A	N/A	N/A	23.75%	0.22
3. Mazenod - Roma	M 155.11 Million	N/A	N/A	N/A	N/A	25.11%	0.42
4. Mazenod - Morija	M 145.68 Million	N/A	N/A	N/A	N/A	27.19%	0.20
5. Morija - Mafeteng	M 118.72 Million	N/A	N/A	N/A	N/A	24.54%	0.30
6. Mafeteng - Mohale's Hoek	M 153.08 Million	N/A	N/A	N/A	N/A	17.59%	0.41

N/A - Not Applicable

Table 10-10: Financial Scenario 3 – Rehabilitation and Resealing Scenario

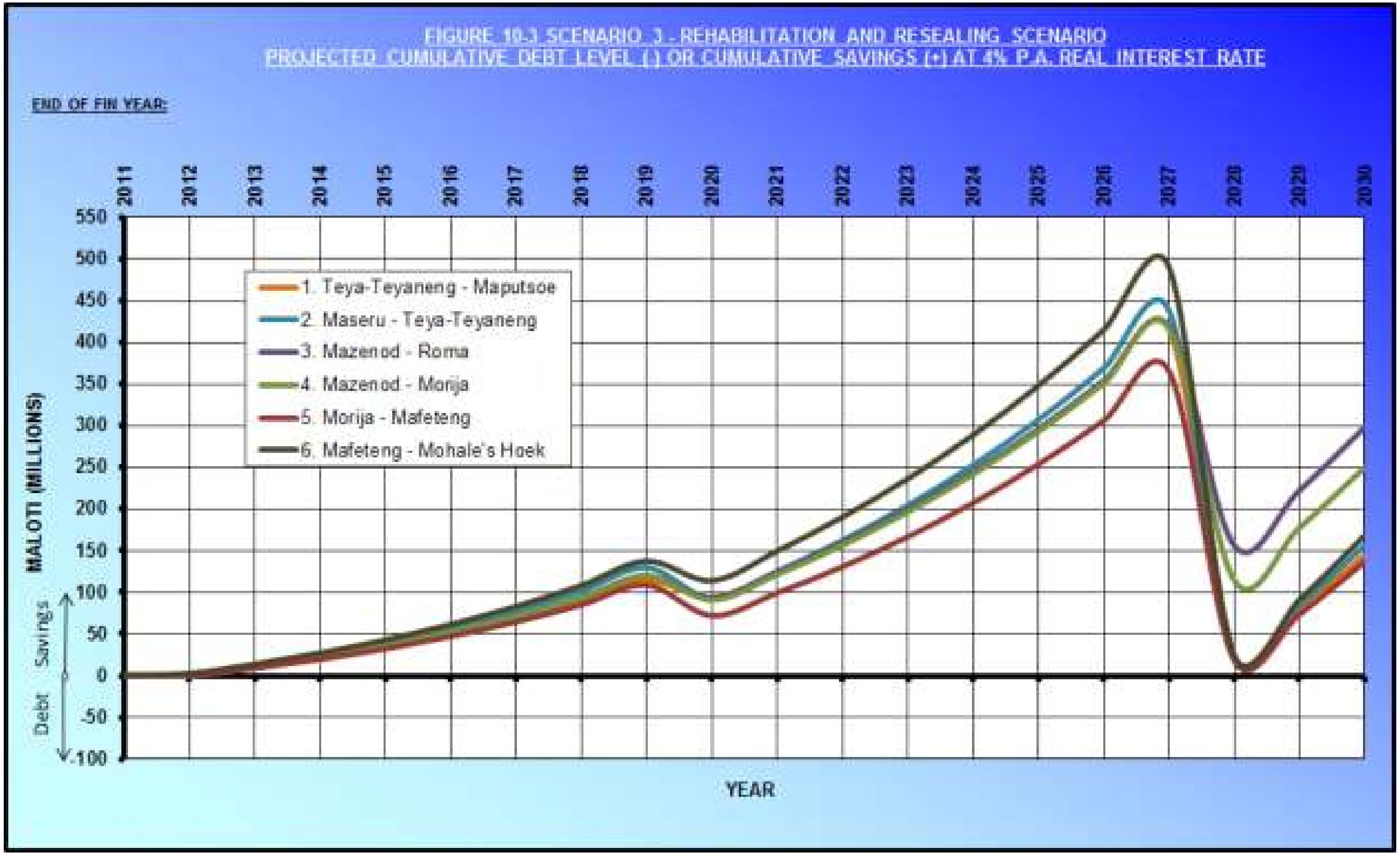


Figure 10-3: Scenario 3 – Rehabilitation and Resealing Scenario

Table 10-11: Scenario 3 – Rehabilitation and Resealing Scenario : Proposed Toll Tariffs (in 2009 Maloti)

Possible Toll Section	Proposed Toll Tariffs			
	Class 1	Class 2	Class 3	Class 4
1. Maputsoe - Teya-Teyaneng	M10,46	M20,91	M31,37	M41,83
2. Teya-Teyaneng - Maseru	M9,05	M18,10	M27,14	M36,19
3. Mazenod – Roma	M7,74	M15,49	M23,23	M30,98
4. Mazenod – Morija	M5,86	M11,72	M17,57	M23,43
5. Morija – Mafeteng	M10,63	M21,26	M31,89	M42,52
6. Mafeteng – Mohale's Hoek	M18,58	M37,17	M55,75	M74,33

The above-mentioned proposed light vehicle toll tariffs for Scenario 3 for the six possible toll sections vary between 20c and 30c per km with the A5 Mazenod – Roma Section and the A2 Mafeteng – Mohale's Hoek Sections being outliers at 42c and 41c per km respectively (See Table 10-10). Except for these two sections, these light vehicle toll tariffs are still somewhat below the average light vehicle tariffs of about 35c per km on South African toll roads (in 2009).

d. <u>The cost of toll collection</u>

Table 10-10 also indicates the toll collection cost as a percentage of gross toll revenue for Scenario 3 for each possible toll section. More specifically, this represents the present value of all toll-related capital, operating and maintenance costs (i.e. including initial plaza construction costs, future plaza expansion costs, semi-fixed toll plaza asset costs and toll plaza operating and maintenance costs) as a percentage of the present value of gross toll revenue, with all present values being determined by the predicted inflation rate being applied as a discount rate to the nominal future revenue and expenditure figures.

As can be concluded from Table 10-10, the present values of toll collection costs as percentages of the present values of gross revenues vary between about 18% and 27% for Scenario 3 which are in line with the more expensive South African toll roads.

e. Conclusion

This scenario is a classic example of how toll financing could be applied without incurring debt to provide for ("save for") future road resealing and rehabilitation expenditure. The most significant challenge will probably be to ensure that the nett toll revenue being saved could be safeguarded against other applications prior to its application for resealing and rehabilitation respectively.

10.6 Financial Results of Scenario 4: The Self-funding Toll Project Scenario

10.6.1 Perceived Benefits, Toll Tariffs and Traffic and Income Predictions

This scenario was only investigated for the two recently upgraded sections on the A2, i.e. Mazenod – Morija and Morija – Mafeteng in respect of which €19,7 million was spent on the upgrading of these road sections.

Table 10-12 indicates, for Scenario 4, the following results:

- The perceived benefit calculations are indicated for the toll section with an alternative route.
- The proposed toll tariffs to achieve a debt service cover ratio of at least 1,0 in the first year of operation are indicated for all toll vehicle classes for the two toll sections.
- The traffic attraction rates to the tolled sections are indicated for all vehicle classes and for the two toll sections. As can be observed in Table 10-12, the traffic attraction rates are always above 90%. The potential traffic (toll eligible traffic) and the tolled traffic are also shown in Table 10-12.
- The gross toll revenue for each vehicle class and for each toll section.

10.6.2 Financial Results

Table 10-13 provides a summary of the financial results of Scenario 4 for the two toll sections, while Figure 10-4 provides a graphical presentation of the predicted debt levels of Scenario 4 for the two toll sections. The conclusions that may be drawn from Table 10-13 and Figure 10-4 are presented in the following sub-sections:

TABLE 10-12 SCENARIO 4 - SELF-FUNDING TOLL PROJECT SCENARIO: PERCEIVED BENEFITS, PROPOSED TOLL TARIFFS, BEFORE AND AFTER TOLL TRAFFIC AND ANNUAL INCOME PREDICTIONS

Proposed Toll Plaza	Traffic Stream	Class	Toll Distance (Km)	Alternative Distance (Km)			Average Speed			Perceived value of Distance Benefit			Perceived value of Time Benefit			Perceived Benefit				Proposed Toll Tariff and attraction							
				Tarmac	Gravel	Total	Toll Route	Alt Tarmac	Alt Gravel	Km/Benefit	Maloti/Km	Total	Benefit (H)	Maloti/Hour	Value of Time	Total	Ave SA MWR	% used	Total	Tariff	Additional Toll	Total Toll	Attraction	Potential Traffic	Tolled Traffic	Class Annual Income (Maloti)	Plaza Annual Income (Maloti)
[4] Mazenod - Morija	Mazenod - Morija (No Reasonable Alternative)	Class 1	29.40				61.08													8.36	0.00	8.36	95.00%	1743	1656	5,052,460	
		Class 2	29.40				48.40													16.72	0.00	16.72	95.00%	904	858	5,238,339	
		Class 3	29.40				45.37													25.08	0.00	25.08	95.00%	251	238	2,182,436	
		Class 4	29.40				41.74													33.44	0.00	33.44	95.00%	444	422	5,151,755	17,624,991
	Mazenod - Morija (Local User Discount Group)	Class 1	29.40	-	-	-	61.08	-	-	-	-	-	-	-	-	-	-	-	-	2.09	-	2.09	95.00%	141	136	100,507	
		Class 2	29.40	-	-	-	48.40	-	-	-	-	-	-	-	-	-	-	-	-	4.18	-	4.18	95.00%	74	71	107,761	
		Class 3	29.40	-	-	-	45.37	-	-	-	-	-	-	-	-	-	-	-	-	6.27	-	6.27	95.00%	21	20	44,896	
		Class 4	29.40	-	-	-	41.74	-	-	-	-	-	-	-	-	-	-	-	-	8.36	-	8.36	95.00%	37	35	105,579	[illegible]
[5] Morija Matelong	Morija - Mafeteng (Masite - B24)	Class 1	35.60	49.48		49.48	61.08	58.46	46.77	13.88	0.75	10.42	0.26	73.40	19.34	29.77	1.71	0.00%	29.77	17.15	0.00	17.15	91.83%	1024	940	5,886,552	
		Class 2	35.60	49.48		49.48	48.40	46.32	37.06	13.88	2.89	40.09	0.33	107.19	35.66	75.74	1.67	0.00%	75.74	34.30	0.00	34.30	94.23%	441	415	5,199,294	
		Class 3	35.60	49.48		49.48	45.37	43.42	34.74	13.88	6.12	84.99	0.35	179.15	63.57	148.56	1.65	0.00%	148.56	51.45	0.00	51.45	94.84%	122	116	2,180,294	
		Class 4	35.60	49.48		49.48	41.74	39.95	31.96	13.88	8.03	111.47	0.39	272.54	105.11	216.58	1.30	0.00%	216.58	68.60	0.00	68.60	94.91%	217	206	5,150,183	18,416,323
	Morija - Mafeteng (Local User Discount Group)	Class 1	35.60	-	-	-	61.08	-	-	-	-	-	-	-	-	-	-	-	-	12.00	-	12.00	95.00%	76	72	316,555	
		Class 2	35.60	-	-	-	48.40	-	-	-	-	-	-	-	-	-	-	-	-	24.01	-	24.01	95.00%	33	31	[illegible]	
		Class 3	35.60	-	-	-	45.37	-	-	-	-	-	-	-	-	-	-	-	-	36.01	-	36.01	95.00%	9	9	113,551	
		Class 4	35.60	-	-	-	41.74	-	-	-	-	-	-	-	-	-	-	-	-	48.02	-	48.02	95.00%	16	15	298,011	[illegible]

Table 10-12: Scenario 4 – Self-Funding Toll Project Scenario: Perceived Benefits, Proposed Toll Tariffs, Before and After Toll Traffic and Annual Income Predictions

TABLE 10-13: FINANCIAL SCENARIO 4 - SELF-FUNDING TOLL PROJECT SCENARIO							
Toll Section	LSR (in Millions of June 2009 Maloti)	Year DSCR > 1	Maximum Debt	Year of maximum Debt	Year of Debt Repayment	Toll Collection Cost as % of Gross Toll Revenue	Light Vehicle Toll Tariff (c/Km)
4. Mazenod - Morija	M 307.60 Million	2011/2012	M 148.02 Million	2010/2011	2022/2023	23.07%	0.28
5. Morija - Mafeteng	M 323.04 Million	2011/2012	M 156.51 Million	2010/2011	2022/2023	18.75%	0.48

Table 10-13: Financial Scenario 4 – Self-Funding Toll Project Scenario

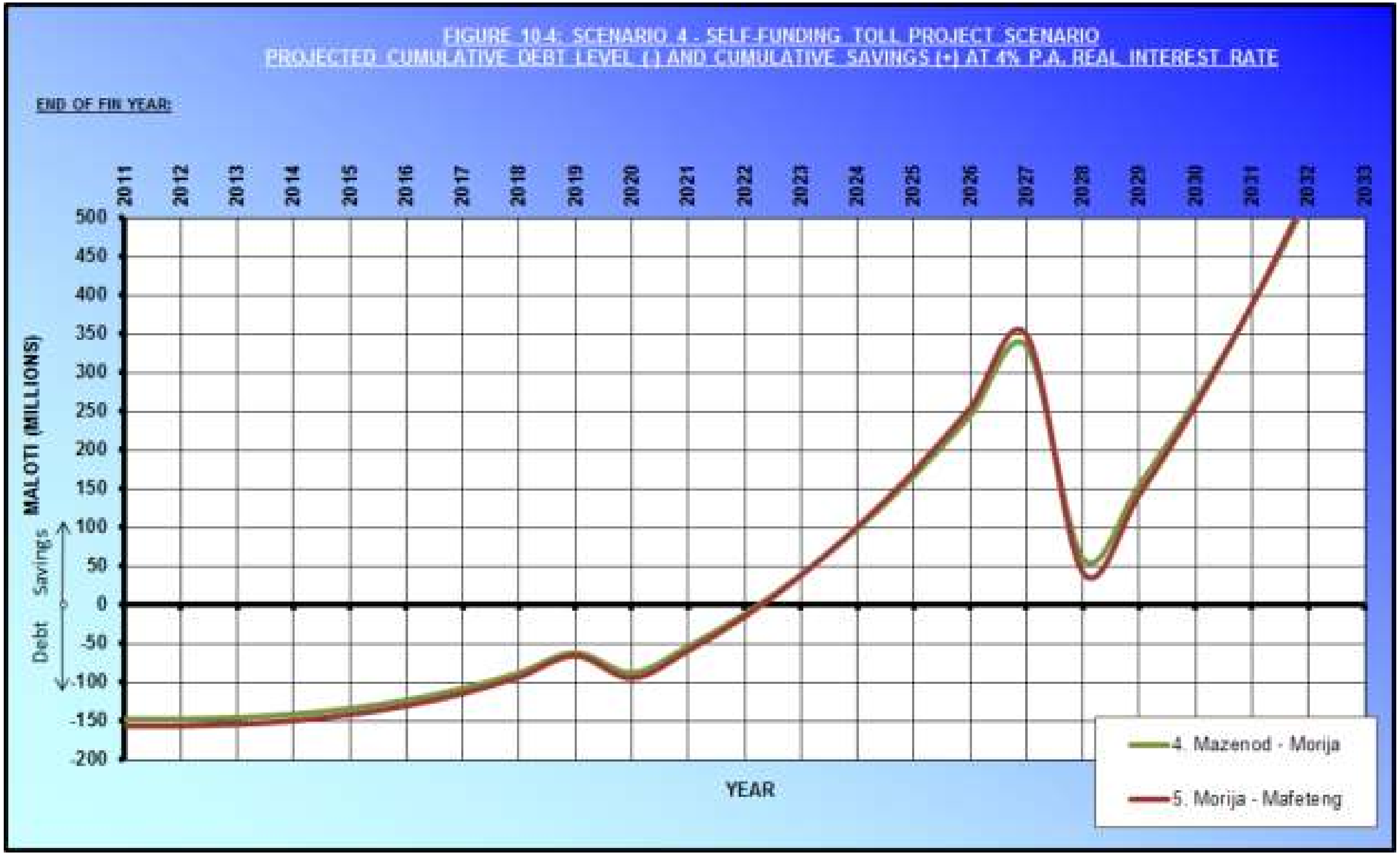


Figure 10-4: Scenario 4 – Self-Funding Toll Project Scenario

a. Ability to fund all project costs

The loans supportable by revenue (LSRs) in Table 10-13 indicate the present values of future nett revenue that will be available to fund all project costs, after already having made provision in the LSR analysis for the subtraction of future plaza expansion costs, routine road maintenance costs, road resealing costs and road rehabilitation costs.

Table 10-14 provides a comparison of the available LSRs and required Initial Capital Costs (ICC) of the two potential toll sections.

Table 10-14: Scenario 4: Comparison of LSRs and Initial Capital Costs (ICC)

Possible Toll Section	LSR	IPCC	LSR/ICC
Mazenod – Morija	M307,6 m	M140,9 m	2,18
Morija – Mafeteng	M323,0 m	M149,0 m	2,17

It can be concluded from Table 10-14 that the LSRs of the two toll sections (i.e. the present values of future nett revenue) are more than adequate to fund all the project costs of the two toll sections. Please note, once again, that the LSR represents the present value of future nett revenue after provision has already been made for, inter alia, road rehabilitation and resealing costs.

b. Debt levels and debt repayment

As far as the debt levels and repayment of debt is concerned, it can be concluded (from Table 10-13 and Figure 10-4) that the maximum debt levels will be reached in 2010/11, i.e. at the end of the year before toll collection starts and that the maximum debt level would amount to about M148 million for the A2 Mazenod – Morija section and to M157 million for the A2 Morija – Mafeteng section. This debt is, however, predicted to then be repaid by 2022/23.

c. Toll tariffs

The proposed unrounded full toll tariffs (i.e. before any local user discount) for Scenario 4, as indicated in Table 10-12, are summarised in Table 10-15 below. In practice, these tariffs would be rounded to, for example, the nearest full Maloti. The tariffs for the three heavy vehicle classes are 2, 3 and 4 times the light vehicle tariff for classes 2, 3 and 4 respectively.

Table 10-15: Scenario 4 – Self-funding Toll Project Scenario : Proposed Toll Tariffs (in 2009 Rand)

Possible Toll Section	Proposed Toll Tariffs			
	Class 1	Class 2	Class 3	Class 4
1. Mazenod – Morija	M8,36	M16,72	M25,08	M33,44
2. Morija – Mafeteng	M17,15	M34,30	M51,45	M68,60

The above-mentioned proposed light vehicle toll tariffs for Scenario 4 for the two possible toll sections amount to 28c per km for the A2 Mazenod – Morija section and to 48c per km for the A2 Morija – Mafeteng section. In order to bring these tariffs in line with the light vehicle tariffs of about 35c per km on South African toll roads in 2009, it may be advisable to decrease the A2 Morija - Mafeteng tariffs and to increase the A2 Mazenod – Morija tariffs to an equal tariff per km.

d. The cost of toll collection

Table 10-13 also indicates the toll collection cost as a percentage of gross toll revenue for Scenario 4 for each of the two toll sections. More specifically, this represents the present value of all toll-related capital, operating and maintenance costs (i.e. including initial plaza construction costs, future plaza expansion costs, semi-fixed toll plaza asset costs and toll plaza operating and maintenance costs) as a percentage of the present value of gross toll revenue, with all present values being determined by the predicted inflation rate being applied as a discount rate to the nominal future revenue and expenditure figures.

As can be concluded from Table 10-13, the present values of toll collection costs as percentages of the present values of gross revenues are about 19% and 23% respectively for Scenario 4. These percentages are in line with those of the more expensive South African toll roads.

e. Conclusion

It is clear from the above analysis that it would be possible for the A2 Mazenod – Morija and the A2 Morija – Mafeteng road sections to be self-funding, including servicing and repaying the "loans" to the projects by the Lesotho Government for the upgrading of the projects.

11. ECONOMIC ANALYSIS

11.1 Introduction

Since the A2 between Mazenod and Mafeteng has recently been upgraded to toll road quality, Tolplan considered these two toll corridors to have the best chance of achieving acceptable indices of economic worth, if tolled. This economic evaluation of the tolling of this section of the A2 is restricted to the cost benefit analysis (CBA) required by the appointment.

The chapter has seven further sub-sections.

- Section 11.2 describes the project and project alternatives.
- Section 11.3 explains the type of analysis that was used and how to interpret the results of the analysis.
- Section 11.4 lists the limitations and main assumptions that were used in the analysis.
- Section 11.5 gives the results of the analysis.
- Section 11.6 reports on the results of a sensitivity analysis on a number of key assumptions.
- Section 11.7 concludes the chapter.
- A number of recommendations are made in Section 11.8.

11.2 Description of Project and Alternatives

The A2 from Masianokeng to Mafeteng is 62.3km long. The road consists of a single lane in each direction. The road has shoulders and there are passing lanes in strategic places. The speed limit on the road varies between 50kph and 80ph. There are long stretches of road where the speed limit is 50kph. Conditions on the road vary between very urban with large numbers of people walking alongside the road to rural where there are no people to be seen. Most of the terrain is undulating. The location of the road is shown in Figure 11-1.

Figure 11-1: Map of A2

Four alternatives were evaluated:

- The 'do-nothing' alternative where the road is not tolled but is also not maintained. The verges are not cleared, road markings are not painted and pot holes are left unattended.
- The road could be tolled purely for routine road maintenance. The maintenance includes ensuring that the verges are cut on a regular basis, painted markings on the road are kept in good condition and pot holes are filled.
- The road could be tolled to cover rehabilitation, resealing and maintenance costs.
- A further case was also evaluated where the road could be tolled for maintenance, resealing and rehabilitation as well as paying off the cost of the Initial Capital Works (ICW).

There are a number of different locations where toll plazas could be positioned. This positioning determines potential diversion of traffic off the toll road onto secondary roads as well as trip suppression.

11.3 Understanding the Economic Analysis

Cost Benefit Analysis (CBA) treats the national economy as an entity in and of itself. It assumes, with some important caveats, that what is demonstrably good for the economy as a whole is a reasonable approximation of what would be good for the majority of the people living and working in that area.

Cost benefit analysis is a means of taking all the direct costs and all the direct benefits of a proposed project and comparing these. It is the conventional method that is used in project appraisal. The outcome of this analysis is the reporting of a net present value (NPV), a benefit cost ratio (BCR) and an internal rate of return (IRR). In the appraisal of a project, one performs both a financial analysis and an economic cost benefit analysis. The difference between the financial and economic results is that the financial analysis uses monetary costs and benefits of the alternatives while the economic analysis includes the costs to society.

The economic analysis is performed by adjusting for shadow prices and wages and removing the potential distortions caused by taxes and subsidies. A high BCR is usually a good indicator that it would be possible to raise finance to implement a project. In the case of a private sector investment the good BCR would be part of the business case to funders. If it is a public infrastructure project, a high BCR should give confidence that it is worth funding the project.

If the evaluated benefits of a project are indeed greater than the overall project costs, then the BCR ratio would be greater than 1. A BCR greater than 1 indicates that the completed project would constitute an economic asset; a BCR less than 1 implies that the project would be an economic liability. The higher the BCR, the less risk there is that the proposed investment could turn out to be less than beneficial economically. Low BCRs, even if greater than 1, provide a warning that a project could be risky and may turn out to become an economic liability instead of an asset.

In a cost benefit analysis one always compares the new project to the base case or "do nothing" case. The costs of a road project relate to the initial construction costs, the rehabilitation and maintenance costs and the operating costs. The benefits relate to the reduction (or increases in some cases) in road user costs from using the upgraded road when compared to the non-upgraded road. The analysis period incorporates all the costs over a 20 year period and values are discounted to present day values by using a social discount rate of 8% per annum. This corresponds to the rate prescribed by the South African National Treasury (Conningarth) and the Provincial Department of Transport of the Western Cape Government. This rate has also been applied to the Lesotho context.

Technically, two different costs are defined in respect of the use of a vehicle. The first is the so-called vehicle operating cost. These costs are specific to the cost of using a vehicle. The second cost is road user cost. Road user costs include vehicle operating costs but also include costs of potential accidents and time costs. These costs also take into account potential traffic diversion and the cost of this to other motorists and to the authorities in the form of increased road maintenance costs. Some analysts use HDM4 software directly to evaluate road user costs and benefits. We do however find the available HDM4 software very restrictive, somewhat 'black box' in nature and the results difficult to convey to the general public in any convincing way. As a consequence, we have developed our own spreadsheet-based software which, while it follows the HDM4 algorithms, is more flexible, transparent and the results are easier to convey to the-lay person.

The study has employed an economic cost benefit analysis that has taken a number of costs and benefits into account. These are:

- the capital cost of building and/or upgrading the road (if applicable for a particular alternative);
- the capital cost of constructing the toll plazas and installing the necessary equipment;
- the costs of maintaining the road to specific standards;
- the savings in vehicle operating costs that result from a better quality road and easier driving conditions;
- the travel time savings arising from a reduction in road congestion, where relevant;
- The reduced loss of life and injuries that are associated with improved road provision;
- Potential traffic diversions as well as the increased costs to authorities from having to maintain those alternative routes.

The economic analysis focused purely on direct costs and benefits and did not take any indirect costs and benefits into account. Indirect costs and benefits would include those costs and benefits obtained through multiplier effects. For example, the upgrading of a road would have spin off effects for the construction industry and the building materials supply industries. These, in turn, would have backward linkages with other commodity suppliers and retail industries. In addition, a number of other potential economic impacts have not been taken into account in the CBA analysis. These include any positive or negative impacts on businesses and potential impacts on captive communities.

11.4 Limitations and Assumptions

The analysis was subject to a number of limitations largely because of a lack of information. As a result a variety of assumptions had to be made. Some of the assumptions are based on experience in Southern Africa and it is considered that these assumptions can be used in the Lesotho context. However, there are two assumptions that are project and context specific. These are travelling speeds and trip suppression. Travelling speeds are a function of road quality and congestion and will be lower if the road quality is allowed to decline. Trip suppression is a function of the toll charged in relation to the perceived benefits that a road user would experience.

The assumptions that were made relate to:

- Annual traffic growth;
- The cost of time;
- Vehicle operating costs;
- Accident rates;
- Travelling speeds;
- Waiting time at plazas;
- Diversions;
- Trip Suppression;
- The condition of the riding surface;
- The design life and specifications of the road.

11.4.1 Annual Traffic Growth

Annual traffic growth has been assumed to be 3% per annum. This is the average long term traffic growth trend for analysis in South Africa which has been assumed to be true of the Lesotho context.

11.4.2 Cost of Time

The cost of time is based on road side interviews performed along the A2 road in Lesotho and was determined as M120.14 per hour for business trips (in 2010 prices) per vehicle. This value is subjected to a sensitivity test in section 11.6.5.

According to K.W. Gwouldiam (1997), as cited in Belli et al (1998), working time only applies to people driving on work-related business and does not include commuting to and from work. The same report suggests that non-working time be taken as one third that of working time. Consequently the cost of a business vehicle is taken as the M120.14 per hour while that for a non-business vehicle is taken as M40.05 per hour.

11.4.3 Vehicle Operating Costs

Vehicle operating costs (VOCs) are sourced from information for South African vehicles but adjusted to allow for the cost of petrol and diesel in Lesotho. These vehicle operating costs vary for different types of roads and different types of terrain and allow for fuel and oil consumption, tyre costs, maintenance costs and depreciation of the cost of the vehicle. Table 11-1 illustrates the values that have been used for this analysis which correspond to light and heavy vehicles operating on paved two lane roads with shoulders in undulating terrain.

Table 11-1: Vehicle Operating Costs per kilometre for different vehicles

Lights	Heavy Vehicles		
Class 1	Class 2	Class 3	Class 4
2.90	8.83	12.63	23.23

Ideally the vehicle operating costs should be Lesotho based costs. Such costs are available for Lesotho and the costs given in the table were compared to the Lesotho sources costs and found to be comparable. The Lesotho based costs were not used because they are average costs for all roads and not for the specific topographical conditions and road characteristics of this particular road. Vehicle operating costs can be sensitive to road conditions.

11.4.4 Accident Rates

No accident rates could be sourced for Lesotho and, as a result, South African statistics were used. While Lesotho accident incidents might be different to South Africa, accidents make up a very small part of the overall VOC calculation and minor differences are largely immaterial. It is assumed that 692 accidents would occur for every 100 million vehicle kilometres travelled on the A2. This rate corresponds to that for paved two lane roads with shoulders in undulating terrain with at-grade intersections.

11.4.5 Travelling Speeds

It is quite plausible that speeds would be slower if the road is not maintained. An estimate had to be made about the reduction in speeds if the road were to deteriorate, if it is not maintained or if it had not been upgraded. It is quite plausible that speeds would be slower if the road is not maintained but the actual potential speed reduction could not be determined without sophisticated traffic modelling. As a result, an allowance was made that travelling speeds would be 20kph lower by 2030 if the road was not maintained. In the model the speeds were decreased incrementally year after year. In reality it can be expected that speeds will be maintained at their current rates until the appearance of potholes which would bring about a dramatic drop in speeds. The current average travelling speed on the A2 has been assumed to be 61.1kph for light vehicles and 45.2kph for heavy vehicles. This is based on a number of trips that were done on the road by members of Tolplan and SES.

11.4.6 Waiting Time at Toll Plazas

The waiting time at toll plazas has been assumed to be half a minute. This includes the time taken for decelerating, stopping and returning back to normal travelling speeds.

11.4.7 Diversions

Experience with toll roads throughout South Africa has shown that the traffic volumes are never as high after tolling as they were before tolling and that a degree of diversion will take place. However it appears that traffic diversion is unlikely for this project. The alternative routes were explored and the distances on these alternatives are so significant that they are required as unviable diversions. The fuel cost alone for driving the increased distance of the diversion would be higher than the toll tariffs. This conclusion is further reinforced when time savings and lower maintenance costs are added.

Nevertheless, the potential for diversion was considered and this was done as part of the sensitivity analysis in Section 11.6.4.

11.4.8 Trip Suppression

It has also been found that tolling may result in trip suppression with suppression increasing as the toll increases. Trip suppression needs to be taken into account because this represents a loss in benefits to those people who no longer make the journey.

- Before tolling, people would have undertaken the journey because of some inherent benefit.
- Imposition of a toll tariff means they no longer undertake the journey and hence lose this benefit.
- This benefit has been assumed to be at least as much as the cost of the journey before the toll tariff (and associated upgrade). It would probably be more but has been taken as equal to the cost in the analysis.

It was assumed that trip suppression for the:

- maintenance tolling alternative would be 5%;
- maintenance and rehabilitation alternative would be 5%;
- ICW, road maintenance and rehabilitation alternative would be 10%.

Each of these trip suppression assumptions is subjected to a sensitivity analysis.

11.4.9 Condition of Riding Surfaces

The condition of the road surface affects the vehicle operating costs. The Present Serviceability Index (PSI) is used to represent the quality of the riding surface. PSI's can vary between 1.5 at the end of the design life of a lightly trafficked road to 4.5 for the constructed riding quality of a major interurban freeway (REACT 1998, p65). In this analysis the following PSIs have been assumed:

- Current A2 (just after upgrade) – 3.5;
- Alternative routes (on average) – 2.5;
- Before Upgrade – 2.0;
- Terminal PSI – 1.5.

11.4.10 Design E80

It has been assumed that the road has been designed for 12 million E80s (REACT 1998, pg 60) over a twenty year time period.

11.5 Results

This section gives the results of the economic cost benefit analysis. The assessment takes into account all financial costs and benefits. These are then used to determine the overall economic costs and benefits to society. The decision about whether or not the project goes ahead should be made on the basis of the economic costs and benefits. In this case, the decision is made on the basis of the highest benefits in comparison to the do nothing alternative.

11.5.1 Maintenance Tolling Alternative

The overall economic costs and benefits of maintaining the road and tolling compared to not maintaining and not tolling are given in Table 11-2.

Table 11-2: Economic cost benefit analysis for maintenance tolling

Economic Costs and Benefits	PV (M m)
Plaza Construction Costs	118,0
Maintenance Costs	31,9
Professional Fees	4,0
Plaza Operating Costs	43,5
Total Costs	197,5
Road User Cost Savings	531,3
Diverted Traffic	0,0
Trip Suppression	-318,0
Total Benefits	213,4
Net Benefits	15,9
BCR	1,08
IRR	9%

The costs associated with this alternative are:

- Plaza construction costs with a PV of M118.0m.
- Routine maintenance costs with a PV of M31.9m.
- Professional fees of M4.0m.
- Plaza operating costs of M43.5m.
- Total costs therefore have a PV of M197,5m.

The benefits are:

- Savings in road user costs with a PV of M531,3m.
- Trip suppression of 5%, which has a negative benefit of M318,0m.
- Total benefits are therefore M213,4m.

The net benefits for maintenance tolling are M15.9m and the BCR ratio is 1.08. This suggests that the benefits slightly outweigh the costs and that this alternative is therefore only marginally economically efficient and would be sensitive to any diversion between the assumptions that the calculations are based on and reality.

11.5.2 Maintenance, Rehabilitation and Future Upgrade Tolling Alternative

The overall economic costs and benefits of maintaining and rehabilitating the road, future upgrades and tolling relative to not tolling, maintaining or upgrading are given in Table 11-3.

Table 11-3: Economic cost benefit analysis for maintenance and rehabilitation tolling

Economic Costs and Benefits	**PV (M m)**
Future Road & Plaza Upgrade Costs	190,1
Maintenance Costs	31,9
Professional Fees	4,0
Plaza Operating Costs	43,5
Total Costs	269,6
Road User Cost Savings	818,4
Diverted Traffic	0,0
Trip Suppression	-318,0
Total Benefits	500,4
Net Benefits	230,8
BCR	1,86
IRR	17%

The costs associated with this alternative are:

- Future road and plaza upgrade costs with a PV of M190.1m.
- Maintenance costs with a PV of M31.9m.
- Professional fees of M4.0m.
- Plaza operating costs of M43.5m.
- Total costs therefore have a PV of M269.6m.

The benefits are:

- Savings in road user costs with a PV of M818,4m.
- Trip suppression of 5%, which has a negative benefit of M318,0m.
- Total benefits are therefore M500,4m.

The net benefits are M230,8m and the BCR is 1.86. The results suggest that this alternative is also economically efficient even though it is less efficient than the next alternative.

11.5.3 Tolling to Cover Maintenance, Future Rehabilitation Costs and Initial Capital Works

This alternative compares the situation before and after construction of the recent upgrade of the A2 between Masianokeng and Mafeteng. It therefore also includes the cost of the Initial Capital Works. In this alternative it has also been assumed that speeds on the non-upgraded road would be 20kph slower than they currently are. The difference is that in this alternative the speeds are slower from 2010 rather than slowing gradually for 2010 to 2030. The overall economic costs and benefits are given in Table 11-4.

Table 11-4: Economic cost benefit analysis for ICW, maintenance and rehabilitation tolling

Economic Costs and Benefits	**PV (M m)**
ICW & Future Upgrade Costs	355,4
Maintenance Costs	31,9
Professional Fees	4,0
Plaza Operating Costs	43,5
Total Costs	434,9
Road User Cost Savings	2 529,1
Diverted Traffic	0,0
Trip Suppression	-767,6
Total Benefits	1 761,5
Net Benefits	1 326,6
BCR	4,05
IRR	47%

The costs associated with this alternative are:

- Initial capital works, future road and plaza upgrade costs with a PV of M355.4m.
- Maintenance costs with a PV of M31.9m.
- Professional fees of M4.0m.
- Plaza operating costs of M43.5m.
- Total costs therefore have a PV of M434.9m.

The benefits are:

- Savings in road user cost with a PV of M2 529,1m.
- Trip suppression of 10%, which has a negative benefit of M767,6m.
- Total benefits are therefore M1 761,5m.

The net benefits (i.e. benefits less costs) are M1 326,6m and the BCR is 4,05. This means that it would be economically efficient if the decision is made that both the upgrade and maintenance of the A2 road will be paid for by tolling.

11.6 Sensitivity analyses

Sensitivity analyses were performed on four key components of the analysis. These are:

- Reduction in travelling speeds
- Maintenance and rehabilitation costs;
- Trip suppression;
- The Cost of Time.

11.6.1 Reduction in Travelling Speeds

One of the key assumptions in the analysis is the degree to which travelling speeds are reduced if the road is not maintained. It will be recalled that travelling speeds are currently estimated to be 61.1kph for light vehicles and 45.2kph for heavy vehicles. The assumption was made that speeds for light vehicles would be 20kph slower (14.8kph for heavy vehicles) by 2030 if the road is not maintained. This section tests the extent to which higher or lower travelling speeds change the findings. The results are shown in Table 11-5.

Table 11-5: Sensitivity analysis on reduction in travelling speed

Scenario Description	Reduction in Travelling Speed - kph			
	0	10	**20**	30
Maintenance Tolling	0.47	0.74	**1.08**	1.53
Maintenance & Rehabilitation Tolling	1.41	1.61	**1.86**	2.18
ICW, Maintenance & Rehabilitation Tolling	3.27	3.59	4.05	4.81

For maintenance tolling it can be seen that a smaller difference in travelling speeds between the "maintenance tolling" case and the "do nothing" case immediately makes the BCR less than one and renders this alternative economically undesirable. Clearly higher travelling speeds increase the BCR but not by enough for this alternative to be anything but economically marginal.

For maintenance, rehabilitation and upgrade tolling it was found that while the results did vary with smaller differences in travelling speeds between this alternative and the "do nothing" case, this alternative did not switch from being economically efficient to inefficient. What this means is that even if travelling speeds remained as they are today, the difference in riding surface would provide sufficient benefits for this alternative to still be economically efficient.

The same result holds for the alternative of tolling to cover the ICW costs in addition to future rehabilitation and maintenance.

The conclusion that is drawn from this sensitivity analysis is that benefit-cost ratios of the maintenance tolling alternative move below the threshold for economic viability when the difference in travelling speeds become lower than 20 km/h, whereas the other two alternatives do not move below the threshold for economic viability, even when there is no difference in travelling speeds between those alternatives and the "do nothing" option.

11.6.2 Maintenance and Rehabilitation Costs

The effect of varying the maintenance and rehabilitation costs on the benefit cost ratios is presented in Table 11-6. The results are presented for each of the three alternatives analysed but it will be appreciated that for maintenance tolling there are no rehabilitation costs. The values used in section 11.5 are given in bold in Table 11-6.

Table 11-6: Impact on BCR of changes in Maintenance and Rehabilitation Costs

Scenario Description	**Maintenance & Rehabilitation Costs**			
	0.75x	**1.0x**	1.25x	1.5x
Maintenance Tolling	1.13	**1.08**	1.04	1.00
Maintenance & Rehabilitation Tolling	1.91	**1.86**	1.80	1.75
ICW, Maintenance & Rehabilitation Tolling	4.01	**4.05**	3.98	3.91

If maintenance and rehabilitation costs decrease by 25% (to 0.75x) then the BCR would increase from:

- 1.08 to 1.13 for the maintenance tolling alternative;
- 1.86 to 1.91 for the maintenance and rehabilitation alternative; and
- 4.05 to 4.13 for the alternative where tolling covers the cost of the initial construction works, maintenance and future rehabilitation.

If the maintenance and rehabilitation costs had to increase by 25% then the BCR would decrease from

- 1.08 to 1.04 for the maintenance tolling alternative;
- 1.86 to 1.80 for the maintenance and rehabilitation alternative; and
- 4.05 to 3.98 for the alternative where tolling covers the cost of the initial construction works, maintenance and future rehabilitation.

The results of this sensitivity analysis indicate that, even though the economic viability of the maintenance tolling alternative is relatively sensitive to increases in the cost of maintenance, it remains marginally economically viable up to a 50% cost increase. The other two alternatives remain economically efficient for as much as a 50% increase in maintenance costs.

11.6.3 Trip Suppression

Tolling a road without a reasonable alternative route may result in trip suppression. Various assumptions were made about a likely degree of trip suppression with suppression increasing as the toll tariff increases. The following assumptions were made:

- A 5% trip suppression for the maintenance tolling.
- A 5% trip suppression for maintenance & rehabilitation tolling.
- A 10% trip suppression for ICW, maintenance & rehabilitation tolling.

The impact on the BCR of varying these assumptions is shown in Table 11-7.

Table 11-7: Impact on BCR for changes in Trip Suppression

Scenario Description	**Trip Suppression Percentages**				
	0%	2.5%	5%	10%	15%
Maintenance Tolling	0,58	0,83	**1,08**	1,50	1,82
Maintenance & Rehabilitation Tolling	1,57	1,72	**1,86**	2,06	2,18
ICW, Maintenance & Rehabilitation Tolling	4.09	4,10	4,09	**4,05**	3,96

Varying trip suppression for the three alternatives gives the following results:

- For the maintenance tolling alternative, the effect of no trip suppression is to reduce the BCR to 0,58. On the other hand, increasing trip suppression to 10% increases the BCR to 1,50.

- Reducing trip suppression from 5% to 0% for the maintenance and rehabilitation alternative decreases the BCR from 1,86 to 1,57. Reducing trip suppression to 2.5% returns a BCR of 1,72. Increasing trip suppression to 10% increases the BCR to 2,06.
- Reducing trip suppression from 10% to 0% for the ICW, maintenance & rehabilitation alternative increases the BCR from 4,05 to 4,09. Increasing trip suppression to 15% reduces the BCR to 3,96.

The rather counter-intuitive results for maintenance tolling and for maintenance and rehabilitation tolling can be explained as follows:

The best way of explaining this is to understand that those people who no longer undertake a journey (i.e. the “suppressed” journeys) have lost a benefit. This benefit has been valued at least as much as the cost of having undertaken the journey before the upgrades and cost of tolling, otherwise they would not have undertaken the journey in the first place. So, with the upgraded and tolled road these people no longer have the cost of the journey, but they also have lost out on their benefit, resulting in a zero sum game for them. However, for the remaining road users there are fewer vehicles using the road, resulting in less wear and tear and therefore increasing their benefit when compared to the situation without road upgrades. Therefore, as the trip suppression increases, the wear and tear on the road reduces and the BCR improves. This is the trend for the maintenance tolling and the maintenance and rehabilitation tolling scenarios

For the case of the ICW, maintenance and rehabilitation tolling scenario other benefits come into play such as a much bigger difference in travelling speeds. This tends to mask the benefit of the lower wear and tear on the road, hence the same pattern is not observed for the higher trip suppressions in this case.

The overall conclusion from this sensitivity analysis is that only the maintenance tolling alternative is sensitive to changes in trip suppression in the sense that it may change from being economically efficient to inefficient. For the other two alternatives, changes in trip suppression do not change the economic efficiency of the project.

11.6.4 Diversion onto Alternative Routes

There is always some concern when roads are being considered for tolling that this might result in some diversion of traffic from the tolled roads onto the rest of the road network. In this case, it is considered unlikely that traffic would divert onto alternative routes purely because of the length of these alternative routes. The additional fuel cost alone would be more than the proposed toll tariffs. However, for the sake of completeness, an analysis was performed on the potential impact of some of the traffic diverting onto the alternative routes. The results reported in Table 11-8 are for traffic diversions of up to 5%. (It should be noted that these traffic diversions are over and above a trip suppression of 5% of traffic)

Table 11-8: Impact on BCR for Traffic Diversions

Scenario Description	% Traffic Diverting		
	0.0%	2.5%	5.0%
Maintenance Tolling	**1.08**	0.65	0.23
Maintenance & Rehabilitation Tolling	**1.86**	1.47	1.08
ICW, Maintenance & Rehabilitation Tolling	**4.05**	3.74	3.42

Potential traffic diversion impacts on the benefit cost ratio in the following ways:

- The BCR for the maintenance tolling option would reduce from 1.08 to 0.65 if 2.5% of the traffic were to divert. The BCR would further reduce to 0.23 if 5.0% of the traffic were to divert.
- The BCR for the maintenance & rehabilitation tolling option would reduce from 1.86 to 1.47 if 2.5% of the traffic were to divert and to 1.08 if 5.0% of the traffic were to divert.
- The BCR for the ICW, maintenance & rehabilitation tolling option would reduce from 4.05 to 3.74 if 2.5% of the traffic were to divert and to 3.42 if 5.0% of the traffic were to divert.

The analysis shows that, although the results are sensitive to traffic diversion, the only option that became economically inefficient was the maintenance tolling option. This is an option that has always been marginal. The maintenance & rehabilitation tolling and ICW, maintenance & rehabilitation tolling remain economically efficient with up to a 5% traffic diversion.

11.6.5 Cost of Time

The analysis used a business cost of time equal to M120.14 per hour[1]. The effect on the BCR of varying this cost of time from M50 to M200 is shown in Table 11-9.

Table 11-9: Impact on BCR of changes in the Cost of Time

Scenario Description	Cost of Time - M/hr				
	50.00	100.00	**120.14**	150.00	200.00
Maintenance Tolling	0.76	0.99	**1.08**	1.22	1.44
Maintenance & Rehabilitation Tolling	1.62	1.79	**1.86**	1.96	2.12
ICW, Maintenance & Rehabilitation Tolling	3.61	3.92	**4.05**	4.24	4.55

Reducing the cost of time from M120.14 per hour to M50.00 results in the BCR for the:

- maintenance tolling decreasing from 1.08 to 0.76;
- maintenance & rehabilitation tolling decreasing from 1.86 to 1.62;
- ICW, maintenance & rehabilitation tolling decreasing from 4.05 to 3.61.

Decreasing the cost of time from M120.14 to M100 makes the BCR for the maintenance tolling alternative decrease from 1.08 to 0.99. It results in the BCR for the maintenance & rehabilitation tolling alternative decreasing from 1.86 to 1.79.

Increasing the cost of time to M150 increases the BCR for the maintenance tolling alternative from 1.08 to 1.22. It results in the BCR for the maintenance & rehabilitation tolling alternative increasing from 1.86 to 1.96. For ICW, maintenance & rehabilitation tolling the BCR increases to 4.24 for a cost of time of M150 per hour and to 4.55 for a cost of time of M200 per hour.

The overall conclusion is that although the results are sensitive to the cost of time, it is only the maintenance tolling scenario that would switch from being economically marginal to inefficient (at values of time of M100 or lower per hour).

11.7 Conclusions

The following conclusions for the tolling of the A2 between Masianokeng and Mafeteng are drawn from the analysis:

[1] This is the full value of time per vehicle, taking average occupancies of the vehicles into account. For leisure time vehicles this value is reduced to one-third in accordance with World Bank Guidelines.

The maintenance tolling alternative is economically marginal and extremely sensitive to changes in key assumptions. This alternative should not be adopted.

The maintenance, resealing and rehabilitation alternative is economically efficient and is not particularly sensitive to reasonable changes in key assumptions.

The ICW, maintenance, resealing and rehabilitation alternative is economically extremely efficient since it yields very good economic results and is not sensitive to reasonable changes in key assumptions. If it can correctly be argued that the funds used for the upgrading of the A2 were effectively a loan to the A2 project from the Lesotho Government to be serviced and repaid from the nett toll revenue (after operating costs) of the A2, then the ICW, maintenance, resealing and rehabilitation alternative could be regarded as economically the most efficient alternative.

11.8 Recommendations

As a result of the conclusions drawn above and additional socio-economic considerations, two recommendations are made:

- Before a final decision about tolling is taken, there needs to be an investigation into the affordability of tolling in these main road corridors of Lesotho.
- Depending upon an acceptable outcome of the investigation into the affordability of tolling in the main road corridors of Lesotho, it is recommended that, from an economic efficiency point of view, the following tolling options be implemented:
- as the most economically efficient option, the ICW, maintenance, resealing and rehabilitation tolling option, should be the first choice purely from an economic efficiency point of view.
- if the toll tariffs associated with the previous option are not regarded as affordable, then it would still be economically efficient to implement the tolling option involving maintenance, resealing and rehabilitation.

11.9 References

Conningarth (2007) *Manual for Cost Benefit Analysis in South Africa*

REACT (1998) *Economic Analysis of Short-Term Rehabilitation Actions,* Published by the South African Bitumen Association (SABITA)

12. TECHNICAL FEASIBILITY

12.1 Introduction

Different toll technologies are available throughout the world; each one was well-researched before implementation to suit the unique and particular circumstances of a particular project/country.

The most well-known toll systems are:

- Conventional toll plazas
- Multi-lane free flow systems (also known as Open Road Tolling systems)
- GPS or satellite based toll systems

In order to perform a technical feasibility study for the unique circumstances of Lesotho, the already existing toll technologies will be reviewed. The advantages and disadvantages of each system will be indicated and discussed. The equipment required for each system will also be evaluated so that an informed decision can be made in terms of the implementation of a tolling system for Lesotho.

12.2 Review of the existing Toll Technologies

In this section, a short overview of the three systems is given in order to gain a better understanding of the existing technologies. Such an overview lends itself to comparison and assessment and enables the decision-maker to make an informed decision.

12.2.1 Conventional Toll Plazas

A conventional toll plaza consists of toll lanes (physically separated from one another by toll islands) and toll booths, usually under a canopy. The collection of tolls in each lane can either be done manually only or by adding Electronic Toll Collection (ETC) into the manual lane and, therefore, creating a mixed manual/ETC lane. If the expected ETC traffic is high enough, it becomes efficient to dedicate a toll lane to

An example of a conventional toll plaza.

Electronic Toll Collection.

Every vehicle passage should be accurately detected, classified and counted in the toll lane. A transaction record is generated for each vehicle and transmitted to the Management Information System at the back office, which is usually housed in the toll plaza control building.

An automatic vehicle classification system (AVC) is used to classify the vehicle, independent of the toll collector. Camera systems are used for verification and audit purposes.

Conventional toll plazas are normally used where the traffic flow is not extremely high (below 90 000 vehicles per day). ETC lanes have to be used in conventional toll plazas to achieve throughputs above 40 000 vehicles per day.

12.2.2 Multi-Lane Free Flow (MLFF) Tolling

A multi-lane free flow system, also known as an Open Road Tolling system, consists of gantry-based toll equipment in a free flow electronic tolling environment without the use of toll lanes. Tags in vehicles communicate with readers on the toll gantries and/or, if no vehicle tag is present, photographs of number plates are used to identify vehicles for the levying and collection of toll fees.

An example of a gantry in a multi-lane free flow system.

Every vehicle passage should be accurately detected, classified and counted. A transaction record is generated for each vehicle and transmitted to a central Back Office.

An automatic vehicle classification system is used to classify the vehicle. Automatic Number Plate Recognition (ANPR) is used to identify the vehicle licence number.

The vehicle through-put in a multi-lane free flow system is equal to the road capacity and is, therefore, much higher that at a conventional toll plaza. The control of violators and non-registered road users is, however, much more complicated, since there is no barrier to stop a vehicle.

12.2.3 GPS or Satellite-Based Toll Systems

The Satellite Tolling System is based on **GPS/Galileo positioning** and **cellular communication systems**. An On-Board Unit (OBU) autonomously determines the position of the vehicle, identifies road sections subject to toll according to predefined rules, calculates the charge if required inside the OBU and transmits the result to the toll centre.

Because of the high cost of a GPS system for every vehicle, GPS or satellite-based toll systems are only used in tolling solutions where heavy vehicles are tolled. It is typically used in cases of large numbers of junctions and slip roads.

The on-board unit stores relevant vehicle data and automatically locates the position of the vehicle on motorways, using signals from a global positioning satellite. The on-board unit calculates the toll by determining whether the road segment is subjected to toll and, if so, the toll rate. The data is periodically transmitted to a central computing centre that stores billing information and transmits invoices.

12.3 Advantages and Disadvantages of Different Toll Technologies

The advantages and disadvantages of each toll technology are discussed below:

12.3.1 Conventional System

Advantages:

- One of the main advantages of conventional toll plazas is that violations can be controlled easily since there is a barrier which prevents a vehicle to exit the lane if the transaction is not paid for.
- The capital outlay for a conventional plaza is relatively low.

- A basic toll system can be very simple and easy to operate, e.g. cash only and without any road user registration and accounting structure.

Disadvantages:

- There is a time delay during toll payment, since vehicles have to stop, pay their tolls and proceed as soon as the barrier opens.
- At the locations of toll plazas, roads have to be widened significantly to accommodate lanes and toll booths.
- A conventional toll plaza should be located where the majority of vehicles have to pass. This could be a problem in the case of an urban motorway with many on- and off-ramps. In other words, the application of conventional tolling to an urban motorway is likely to lead to inequitable tolling.

12.3.2 MLFF or ORT System

Advantages:

- The vehicle through-put in a multi-lane free flow toll system is equal to the road capacity, since vehicles do not have to stop at the toll gantries. The toll system is, therefore, not a capacity constraint as is often the case with conventional toll plazas and can, therefore, be used on urban motorways where land adjacent to the road is not available for a toll plaza.
- Toll gantries do not impact on the width of the road.
- It is a popular application on urban motorways with multiple on- and off-ramps, since short sections of road may be tolled equitably by just adding additional gantries and charging appropriate toll tariffs.

Disadvantages:

- The control of violators and non-registered road users is more complicated, since there is no barrier to stop a vehicle. A reliable vehicle owner database is required in order to identify non-registered road users.
- Enforcement of toll payment by violators is complex and expensive.
- In countries in which number plates are not standardized, automatic number plate recognition may cause problems. The ANPR will, for example, not be able to identify hand-made number plates.
- It is a complex toll system and is, therefore, significantly more expensive than a conventional plaza toll system.

- There is no cash collection and road users, therefore, need to be pre-registered and supplied with toll tags in order for toll to be recovered. Apart from the toll system, an extended accounting system is required.
- Facilities where road users can register, lodge complaints and collect toll tags should also be made available.

12.3.3 Satellite System

Advantages

- Levying toll with this system requires less roadside equipment and fewer gantries, since such gantries/equipment is only required for enforcement purposes.
- The vehicle through-put of a satellite system is equal to that of the road, since the vehicles do not have to stop at a plaza.

Disadvantages

- Satellite tolling systems are relatively new and complex. Because of the high cost of the GPS equipment, it is currently used where only heavy vehicles are tolled.
- It is a rather expensive solution.
- Accuracy is dependent on satellite coverage being available on the whole road network. Unscheduled interruptions result in data loss.
- The control of violators and non-registered road users is more complicated, since there is no barrier to stop a vehicle. A reliable vehicle owner database is required in order to identify non-registered road users.
- Enforcement of toll payment by violators is complex and expensive.
- There is no cash collection. Road users need to be pre-registered in order to be invoiced. Apart from the toll system, an extended accounting system is required.
- Facilities where road users can register, lodge complaints and collect on-board units should be available.
- Since road users have to be registered on the system, extreme privacy protection should be provided.

12.4 Equipment Requirements

12.4.1 General Requirements

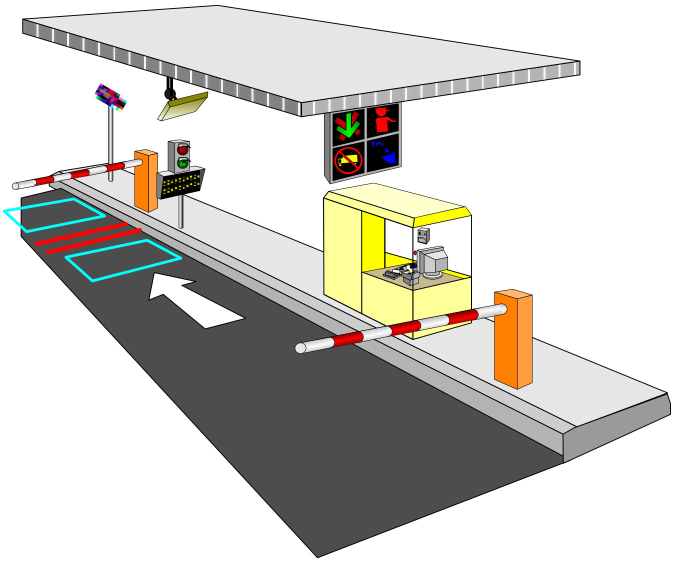
A few general guidelines with regard to equipment should be considered:

- Outside equipment should successfully accommodate high and low temperatures, the glare of the sun, excessive rain and spray on the roads.
- All outside equipment exposed to the elements (including but not limited to cameras, tag readers, automatic vehicle classification devices, etc.) should be housed in weatherproof enclosures that are fit for the purpose and fabricated from corrosion resistant metal. It should be robust and suitable for long and trouble-free service in areas subject to lightning storms, occasional wind storms, periods of high condensation, high sun temperatures, vehicle-induced vibration and vehicle emissions. Suitable corrosion proofing should be employed.
- The server equipment should be accommodated in a dedicated server room which should conform to the standards and requirements for server rooms or technical shelters, such as a sufficiently large, well-lit and properly ventilated area.
- The provision of an adequate earth system is imperative, as the effectiveness of surge suppression depends directly on its adequacy.
- The equipment should be protected against radio interference in order to prevent any hampering of equipment functionality due to such interference.
- To the extent possible, currently supported “off-the-shelf” components and software (including the operating system and the database management system) should be used.
- Processors, internal memory and disk drive(s), along with planned upgrades, should support the estimated volume of transaction data anticipated over a period of time, for example for the next ten (10) years, without degradation in performance.
- The toll system should have adequate redundancy and storage capacity to manage any transaction data transmission, processing or system availability risks appropriately and successfully.

In addition to the general equipment guidelines, the unique equipment requirements of each technology option need to be reviewed.

12.4.2 Equipment in a Conventional Toll Plaza Lane

Below is a diagram of a typical lane at a Conventional Plaza:



The following toll system equipment components are usually installed in a toll plaza lane:

a. Toll Collector Computer (TCC)

The Toll Collector Computer (TCC) is usually mounted inside a manhole below the lane or in the tunnel system of the plaza below the specific lane.

b. Toll Collection Terminal (TCT)

The Toll Collector Terminal or Keyboard is required for data capturing. The TCT is exposed to a lot of dust and should therefore have a rugged and spill-proof housing. All cabling into the TCT should not be visible or accessible to the collector.

c. Receipt Printer

The printer is required for the printing of lane receipts and tax invoices.

d. Card Reader Device

Card readers are required if magnetic cards are used as a method of payment. Card readers can either be inside the booth or outside the booth in a semi-automatic lane. However, external readers (out of booth) need to be of a rugged design, capable of handling all ambient weather conditions.

e. Panic Button and Surveillance Cameras

Panic alarms and surveillance cameras are usually installed in the toll booths for security purposes.

f. Overhead Lane Sign (OHLS)

The Overhead Lane Sign (OHLS) indicates whether a toll plaza lane is open (available) for toll collection or closed. The OHLS is mounted on the approaching edge of the toll plaza canopy above the centreline of each lane and facing the direction of the approaching traffic.

Additional OHLS and signage are required for ETC and automatic coin machine/card lanes.

g. Traffic Lights

Traffic lights are required in each toll lane to indicate to the road user that he/she should stop for toll payment and may proceed after toll payment. Traffic lights are mounted on a pole downstream of the toll booth.

h. Exit Barrier (Boom)

Exit barriers prevent vehicles from proceeding until toll payment has been made. The software should enable the boom to open, once a transaction record is created and validated and should close immediately after a vehicle has left.

A vehicle presence detection mechanism is usually installed as an additional safety feature in order to prevent premature closure of the barrier.

i. Entry Barrier (Boom)

Some projects have entry barriers to prevent the entry of a vehicle into a closed lane. The software should enable a boom to open, once a toll collector has logged into the lane software.

j. User Fare Display (UFD)

Messages are displayed on the User Fare Display (UFD) to provide the road user with information and /or data, such as the vehicle class, transaction tariff, discounts and payment method.

k. Automatic Vehicle Classification System (AVC)

An Automatic Vehicle Classification system (AVC) is used to audit the classification of the toll collector. The AVC is usually a stand-alone unit which accurately detects, counts, tracks and classifies all vehicles (including motor cycles) passing through the lane.

Should there be any discrepancy between the AVC classification and the classification of the toll collector, an alarm should notify the supervisor.

The AVC is also responsible for the detection of abnormal conditions.

For conventional plazas, an axle and wheel based AVC system is more practical.

l. Camera/Video Grabbing System (VGS)

The purpose of a camera or VGS system is to serve as a primary, independent and stand-alone control and audit tool. In addition, the images and/or continuous video streams are used to record and verify all events and abnormal conditions such as class discrepancies (i.e. differences between the AVC and toll collector vehicle classifications), violations and system failures.

The VGS includes a digital video recorder which collects the continuous video.

m. Shifted Load Detection

The purpose of a load shift detection structure is to monitor if a load on a truck has shifted to a side of the vehicle and there is, therefore, a danger that the load may collide with the toll booth, should the vehicle move further forward. It is installed at the sides of each lane. A sensor is attached to the structure in such a way that only those rotations exceeding a specific degree activates an alarm to inform the system and road user that the load has shifted.

n. Abnormal Vehicles

Each toll plaza should have at least one extra-wide lane in each direction of travel for abnormally wide heavy vehicles. The AVC system should accurately detect and classify a vehicle passing through the extra wide section of such a lane.

o. Passage Control for Emergency Vehicles

Emergency vehicles may use any lane in case of emergency. The toll system should make provision for any lane to be opened for emergencies. Any vehicle passing through should generate a Violation with appropriate images.

p. ETC Reader

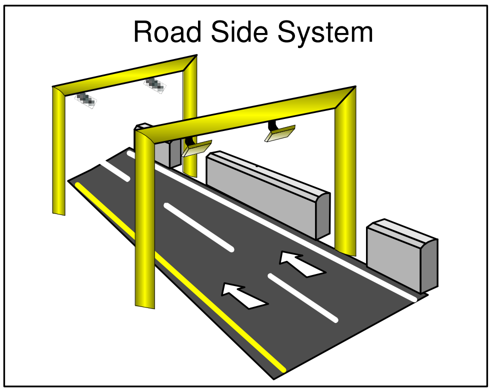
For Mixed and Dedicated ETC Lanes, an ETC Tag Reader has to be installed which communicates with the tags in vehicles.

q. ANPR

ANPR is at least required in dedicated ETC Lanes where booms are not installed in order to identify the vehicle licence number. The accuracy, quality and performance of the ANPR system is of the utmost importance. The quality of the ANPR equipment, including the cameras, controllers, lighting and Optical Character Recognition (OCR) engine(s), is just as important.

12.4.3 Equipment at a Road Side System (RSS) in an Open Road Tolling Scheme

The RSS has to detect and track each vehicle (including motorcycles) passing through a Tolling Point accurately. A transaction record should be generated for each vehicle detected, including vehicles on the left and right shoulder of the road.



In addition, it needs to classify each vehicle accurately according to the classification scheme of the project. Furthermore, it should capture supporting images of the specific vehicle, including front and rear Vehicle License Number images, to determine the VLN automatically by means of Optical Character Recognition (OCR).

The RSS interfaces with the Back Office System and should use a guaranteed messaging communication protocol to ensure that each transaction is delivered only once. In the event of a communication failure, there should be no loss of data.

The RSS should provide for the maximum traffic capacity on the highway. The RSS consists of a gantry structure across the road with a Technical Shelter in close proximity to the toll gantries at the side of the road.

a. Technical Shelters

The Technical Shelters are installed at the side of the road in close proximity to the toll gantries and need to store the utility power connections, back-up generator, air-conditioner and an uninterruptible power supply (UPS), as required for the equipment on the gantries.

b. Gantry Structures

The gantry structures can span across varying lane configurations (2 to 6 trafficked lanes, plus shoulders or emergency lanes).

The RSS equipment is primarily mounted on these overhead gantries. In addition, gantries should have the necessary sub-surface cable and cable ducts between the Technical Shelter and the gantry and the requisite civil works (such as access roads).

c. RSS Controller

The RSS controller is a generic "logical" entity that encompasses the processing functionality of the RSS. It receives the raw data from equipment mounted on the gantry structure and processes and combines such data to create a transaction record for each vehicle passing the Tolling Point.

d. Automatic Vehicle Classifier (AVC)

A gantry mounted Automatic Vehicle Classifier (AVC) is used to detect, count, separate, track and classify all vehicles continuously at each Tolling Point, including vehicles on the left and right shoulders. The RSS should be able to link the correct vehicle class with the appropriate vehicle (as a function of accurate vehicle framing) under all traffic conditions specified within the parameters of the classification scheme.

The AVC should be able to detect and trigger all appropriate image capturing systems accurately and should be able to identify all vehicles travelling in close proximity or at high speed, regardless of environmental conditions.

The AVC should be capable to detect abnormal conditions such as:

- Vehicles travelling in the wrong direction;
- Vehicles travelling on the shoulders (left or right shoulder of the road);
- Vehicles exceeding the clearance height; and
- Stationary vehicles in the measurement area.

A volumetric AVC system is more practical for a RSS as the system determines the vehicle class according to the length, width and height of the vehicle.

In case of a difference between the vehicle class registered on the system by the user and the measured AVC class, the RSS must capture all required information for the vehicle in question.

e. VLN and Scene Image Requirements

In a free flow environment, the RSS has to capture the scene image of a vehicle (which clearly identifies the vehicle) and provide images of the front and back vehicle registration plates in order to identify the vehicle licence number of the vehicle through an ANPR process.

- Images of Vehicle Licence Numbers may be captured as monochrome images but should be of an acceptable image quality in order to identify the Vehicle Licence Numbers through a manual process. Images should comply to the standards and legislation of the specific country, should they be needed for enforcement.

- The images should be of good quality even when taken under extreme conditions, such as daybreak, sunset or in wet conditions.

f. Transaction Framing

All data captured and generated during a transaction should be combined to identify (frame) a vehicle accurately. This data should all be linked to a unique and sequential transaction number. The system must make provision for data from all the sources.

g. RSS Accuracy and Monitoring

The accuracy of the following subsystems of the RSS should be monitored and audited on a regular basis

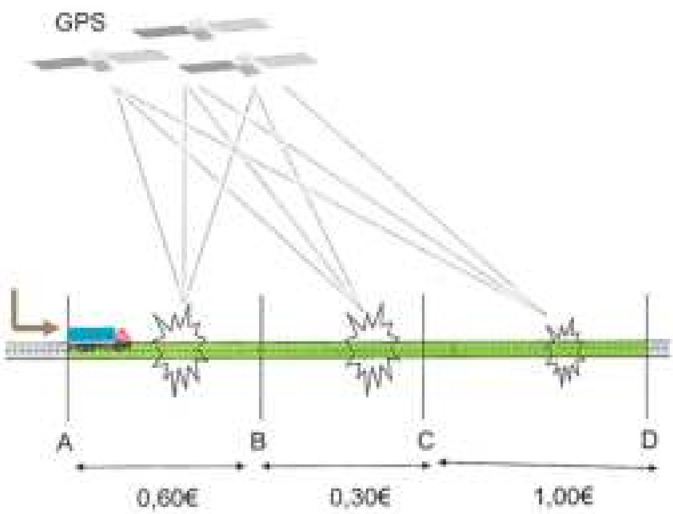
- Tag read accuracy (for speeds between 0 and 160km/h)
- AVC total vehicle count (for speeds between 0 and 160km/h)
- AVC vehicle classification for all classes (for speeds between 0 and 160km/h)
- ANPR trigger rate for front cameras and rear cameras (for speeds between 0 and 160km/h)
- ANPR capture rate for front cameras and rear cameras (for speeds between 0 and 160km/h)
- ANPR correct read rate for front cameras and rear cameras (for speeds between 0 and 160km/h)
- Framing accuracy

Periodic audits are necessary and may include the review of an audit video.

In addition, an Independent Traffic Audit System (ITAS) may be used to validate the total traffic through a Tolling Point. This system should not interface with the RSS.

12.4.4 Equipment for a GPS/Satellite-based System

Although interaction between roadside systems is not required, an on-board unit has to be installed in every vehicle. Most projects will require enforcement gantries.



a. On-Board Unit

An on-board unit (OBU) uses an **autonomous positioning system** such as the Global Positioning System (GPS) to locate itself.

The OBU usually contains the appropriate charge structure and charging information. The OBU establishes communication via a cellular network to the Back Office regarding toll charges and operational updates.

b. Enforcement

Enforcement is done in various ways:

- Mobile Enforcement;
- Automatic Enforcement with enforcement gantries; and/or
- Interfacing with other tolling solutions responsible for enforcement.

12.5 System Requirements

12.5.1 General System Requirements

Software development should include a well-defined software methodology and a formal development strategy with measurable deliverables (i.e. Functional Specifications, a Quality Assurance Plan and Risk Assessment Plan).The software system should be subjected to formal reviews, tests and audits.

The selected operating systems should be procured from a reputable dealer and the toll system should be supported by a reliable Database Management System (DBMS).

a. Data Management Requirement Guidelines

The system should provide an effective combination of application and general controls over the system operations to ensure that data remains complete, accurate and valid during its input, update and storage. These controls must include the following:

- Error handling procedures
- Accuracy, completeness and authorisation checks
- Data input and processing error handling
- Data processing validation and editing
- Output balancing and reconciliation
- Output review and error handling
- Security provision for output reports
- Protection of sensitive information during transmission and transport and over the internet
- Storage management
- Electronic transaction integrity

b. Language Requirements

The language requirements of the user interface of the toll system have to be specified.

c. Information Requirement Guidelines

To satisfy the business objectives, the information received, produced and used by all the role players needs to conform to certain criteria. The system provided should adhere to the following standards:

- Effectiveness
- Efficiency
- Confidentiality
- Integrity
- Availability
- Compliance
- Reliability

d. System Documentation

All documentation supplied should be project-specific rather than generic and should only contain relevant standard documentation. The documentation suite should also be self-contained.

e. Software Recovery Procedure

In order to prevent the loss of information due to system failures and software defects, a system recovery procedure is required.

f. Change Control Procedures

Change control procedures have to be specified so that changes and system updates are done in a controlled and coordinated way. Change control procedures should be based on the ISO 12207 (Systems and Software engineering – Software life cycle processes) or similar guidelines.

g. TAX/VAT Requirements

The system has to comply with the tax and VAT requirements of the country, if applicable. Tax invoices should be made available to road users on request and must comply with the VAT requirements of the country.

h. Methods of Payments

The following methods of payment can be accepted in toll lanes:

- Bank cards (excluding Debit Cards)
- Toll Operator cards
- Cash
- ETC Tag

The system should allow for legally-exempted vehicles such as police vehicles or vehicles for which credit is granted such as ambulances.

12.5.2 Back Office System Requirements

a. Back Office Requirements for Conventional Toll Plazas

The purpose of the Back Office System (also referred to as Management Information System (MIS)) at a Conventional Toll Plaza is to:

i. Receive data from all the lanes, validate data to ensure correctness and completeness, and provide system tools to the plaza supervisory personnel to assist with the efficient management of the data and the plaza.

ii. Allow manual input of additional data required for accurate transaction processing, including adding an "actual" class for transactions with class discrepancies and adding transaction information not captured in the lane, e.g. transactions processed during Manual Mode operations.

iii. Verify and consolidate complete data received from each toll lane linked to each toll plaza (all mainline and ramp toll plazas along a route separately) and linked to the Back Office to process all data including additional payments received, or made at the Back Office level, allow for the employee cash-up and provide employee and period reconciliations (calendar day, operational day and/or other shift periods).

iv. Perform local ETC account maintenance, including:

- Real time updating of account balances with payments received, transactions processed, discounts realized and account corrections processed.
- The provision of pro forma and actual VAT statements.

- The provision of a secure internet site for the road user to perform account related enquiries and actions.
- Facilitation of the automated interaction with account holders.
- The processing of debit or credit notes on termination or for corrections.
- The functionality to transfer money between accounts.
- The receipt, banking and control of sundry account related fees.
- The management of pre paid float.
- Low balance warnings.
- Automatic top-ups from banking institutions.

v. Allocate discounts, transfer data files to external systems, provide consolidated reconciliations, allow controlled system configuration and provide comprehensive reports on all activities. The system also has to manage the integrated verification interface to the approved financial institution providing bank card verification and transaction processing, employing a Point-of-Sale (POS) unit.

12.5.3 Back Office Requirements for Open Road Toll Plazas

The main purpose of a Back Office System for Open Road Tolling is to validate and process all transaction records received from the various Tolling Points and either perform local account maintenance or transfer the transaction records to a central *Transaction Clearing House (TCH) or an Information Exchange Agent (IEA).*

The ORT Back Office System provides the following functionality:

- Verify the completeness and authenticity of data received from the Road Side System;
- Perform ANPR functions on transaction records, if ANPR is performed at Back Office System level;
- Perform Manual Number Plate Recognition (MNPR) functions when required;
- Automatically identify transaction records of registered identifiers according to the Validation List(s) by using the Identifier(s) e.g. a tag, a vehicle licence number or other;
- Handle class and vehicle licence number discrepancies, in accordance with the business rules of the project;
- Apply route specific discounts to transaction records;
- Determine the transaction t*ariff;*

- Interface with the TCH or IEA system to send the processed transaction records to the TCH or IEA System and retrieve validation list(s) from the TCH or IEA;
- Reconcile transaction records sent to the TCH/IEA system and the associated transaction value;
- Monitor the Back Office System and RSS;
- Report and manage events that occur at the Back Office System or RSS;
- Report on various aspects of the system; and
- Interface with the RSS to transfer data.

If a central TCH or IEA is not used, the Back Office will be responsible for account maintenance, similar to a Conventional Plaza. The system will also allow for the employee cash-up and provide employee and period reconciliations (calendar day, operational day and or other shift periods).

12.5.4 Back Office Requirements for Satellite Systems

The main purpose of a Back Office System for Satellite Systems is to validate and process all transaction data received from the on-board units (OBUs), perform account maintenance and invoice the road users.

- The Satellite Back Office System provides the following functionality:
- Verify the completeness and authenticity of data received from the OBUs;
- Apply route specific discounts to transaction records (if applicable);
- Determine the transaction t*ariff (if not performed by the OBU software)*;
- Interface with external systems as required;
- Reconcile data;
- Account Maintenance;
- Cash-up;
- Report and manage events that occur at the Back Office System or in respect of the Satellite System;
- Report on various aspects of the system; and
- Interface with the OBUs to transfer data.

12.6 Consideration of the Choice of Toll System

The characteristics of the three options can be summarized as follows:

	Conventional Plaza	MLFF*	Satellite
Violation processing (enforcement)	Barrier prevents vehicle to proceed	No barrier, alternative violation processing required	No barrier, alternative violation processing required
Capital Layout	Relatively Low	Moderate	Expensive
Road User Accounts	Optional	Required	Required
Vehicle Licence Plates	Not applicable	Standardized Vehicle Licence Plates	Not applicable
Complexity	Relatively easy	Complex	Very Complex
Traffic Throughput	High enough for all but busy freeways	High	High
Road Construction	Roads to be widened at Toll Plaza	Not required	Not required
Construction/Buildings required	Lanes and Plaza building	Gantries Operations Centre Kiosks for Road Users	Operations Centre Kiosks for Road Users
Satellite Coverage	Not required	Not required	Required
Communication Network	Required – between the lanes and control room	Required – over the whole network	Satellite
Vehicle Types	All	All	Mainly Heavy Vehicles

* MLFF = Multi Lane Free Flow (also known as ORT - Open Road Tolling)

12.7 Recommendation on the most suitable Toll Technology Solution for Lesotho

Having taken the advantages and disadvantages, as well as the equipment and software requirements of the different toll technologies, as discussed, into consideration, the following conclusion in respect of the possible Lesotho toll scheme was made:

Lesotho should implement Conventional Toll Plazas with mixed manual/ETC lanes for the tolling of the major internal roads. Conventional Toll Plazas are the least complex, relatively easy to operate and applicable to all vehicles types. The vehicle throughput of such toll plazas is more than adequate for the Lesotho traffic. In order to provide the benefits of non-stop Electronic Toll Collection, mixed manual/ETC lanes should be used. All road users do not have to register on the system, since cash payments can be done in the toll lanes. The lane barrier will prevent a vehicle from proceeding through a toll lane; therefore, the percentage of violators at the toll plazas should be very low.

Although both the MLFF (ORT) and Satellite-based systems do not require any vehicles to stop, the systems are more complex. All road users have to register on the system and there is no barrier to stop road users. The enforcement of toll payment by unauthorized road users is one of the highest risks of such a project. Enforcement items such as enforcement vehicles, policing and enforcement gantries are required and are quite costly.

Satellite-based systems are complex, costly and up to this point in time mainly used for heavy vehicles. Accuracy is dependent on continuous satellite coverage.

12.8 Required Functionality for a Toll System with Mixed ETC and Manual Lanes, as recommended for Lesotho

Conventional Toll Plazas with mixed manual/ETC lanes are recommended for Lesotho. Depending on the expected ETC market share at a specific toll plaza, an analysis will have to be done as to whether ETC is required in specific lanes only or in every lane.

The toll system should be able to perform the following functions in a manual lane, for vehicles without tags:

- Direct a vehicle via an OHLS into an open lane
- Receive a classification of the vehicle into one of the vehicle classes from the toll collector;
- Use the details obtained from the Validation Lists (Hot Lists) received from the Back Office System to determine the validity of the transaction and take the required action;
- Receive a method of payment from the toll collector
- Indicate the classification and acceptance of the method of payment to the road user
- Provide a lane tax invoice/proof of passage to the road user (if requested)
- Detect and classify the vehicle via the AVC into one of the specified vehicle classes; and
- Combine the data collected for the vehicle and road user into a transaction record and send it to the Back Office System.

The toll system should have the following minimum functionality for a vehicle with an ETC Tag:

- Direct a vehicle via an OHLS into an open lane with an ETC Reader;
- Conduct a 5.8 GHz DSRC transaction with any conforming interoperable tag present in the vehicle (also known as a tag transaction);
- Detect and classify the vehicle via the AVC into one of the specified vehicle classes;
- Use the details obtained from the Validation Lists received from the Back Office System to determine the validity of the transaction and take the required action;
- Combine the collected data for both the vehicle and the road user into a transaction record and send it to the Back Office System; and.
- Provide the capability to process the number of vehicles and deliver the service levels as required.

As far as lane modes are concerned, the system should allow for different lane modes of operation, such as:

- Normal mode of operation;
- Fault mode operation, where the lane is functional but experience some peripheral problems such as device communication failures; or
- Stand alone/local mode; where there is a communication failure between the TCC and the AVC and/or Back Office.

The toll lane controller software should be configurable to accommodate basic changes in business rules such as annual tariff changes, without requiring software changes.

The toll lane controller should communicate with its peripheral devices utilizing standard networking diagnostics and other automated methods to detect operational status. All failures should be logged and alerts and alarms generated for critical conditions or events that require immediate operator intervention.

It is recommended that, in the event of failure of either the RSS controller or part of it, the tag reader and Automatic Vehicle Classifier should be capable of operating in stand-alone mode and store data that are used to recreate transactions that would otherwise be lost.

If tags are used, as recommended for the Lesotho project, road users have to register on the system. The toll system should then allow for the following account functions in the toll lane:

- Verification of identifiers against validation lists.
- Verification of account balances and associated restrictions, where applicable.
- Provision of a top-up account facility, where activated. This option is only applicable to registered users with local toll authority cards instead of ETC tags.

In case of abnormal and extraordinary conditions in the lane, the supervisor at the Back Office should be notified by means of a message on a computer screen or an alarm and an error log should be generated.

If an error log is generated of all irregular incidents that may occur at the lane level, it is a helpful tool for the support and maintenance department to assist during maintenance, repair and upgrade activities. The Operator of the Lesotho project should implement operational procedures on the required actions when severe and less severe incidents occurred.

13. OPERATIONAL FEASIBILITY

13.1 Typical Scope of Toll Operations

The scope of operations at a toll plaza typically includes the following major functional areas:

- Traffic Management: Since road users pay for the time saving and comfort, convenience and safety offered by a toll road, they do not appreciate it if their time saving is eroded by a long wait at a toll plaza. The traffic management at a toll plaza, therefore, has to be of a high standard and typically involves compliance with a queueing specification, for example that the waiting time at a toll plaza may not exceed an average of 30 seconds 95% of the time, except when the capacity of the toll plaza is exceeded by the arriving traffic (A South African toll plaza waiting time specification).
- Financial Management: The ultimate objective of a toll plaza is to collect a very high percentage (99% plus) of all toll revenue due to the toll authority or concessionaire and to ensure that these monies are paid into the relevant account of the authority or concessionaire. In order to achieve this, a sophisticated toll collection control system is required in terms of which the supervisor of a shift uses the toll system, as described in Chapter 12, to check the revenue collected by a toll collector during that shift. The toll system usually also includes photographic/video information by means of which internal or external auditors can check the supervisor and his toll collection team on a sample basis or when specific incidents have occurred. Such a toll collection control system requires reconciliation of toll revenue after every shift and, while it has to allow for any potential deficiencies of a toll system, it also has to require toll collectors to take responsibility for shortfalls in their collection of toll monies during a shift.
- While the study team does not have any information regarding the current success of toll collection at the Lesotho border posts in terms of the percentage of revenue actually ending up in the coffers of the Lesotho Road Fund, the team is aware of the fact that it used to be a significant problem earlier in the previous decade.

  It should be noted that, whether toll operations are performed in-house or outsourced, the required financial control is not really possible without the availability of a toll system that registers every passing vehicle and that includes an automatic vehicle classification device in each toll lane. This device provides a vehicle classification result for every vehicle passing through a toll lane and the toll lane collection control system compares the toll system vehicle classification with the toll collector vehicle classification for each passing vehicle.

Apart from the control of toll collection with the aid of a toll system, the financial management function in respect of the collection of toll revenue involves management of cash storage and transport, financial reporting and liaison with banks, also in respect of credit/debit card transactions, if these are allowed.

- Maintenance Management: The most important maintenance tasks at a toll plaza are those related to the maintenance of the toll plaza lighting and the support of the toll system, but maintenance of all toll plaza assets (buildings, canopies, etc.) and semi-fixed assets (generator, UPS) is very important for safe and successful operations at a toll plaza. A toll plaza without electricity at night becomes a deadly road hazard and this situation should, therefore, be avoided by means of adequate maintenance of the standby generator.

13.2 Feasibility of outsourcing the operations of the toll scheme

13.2.1 Rationale for outsourcing toll operations

The in-house execution of toll operations by a toll authority occurs reasonably frequently, for example in the large State toll authorities in the United States of America. An important rationale for performing toll operations in-house is that it is usually cheaper than outsourcing. The reason why outsourced toll operations is more expensive is that the private sector has to price for the risks that are being transferred to it by the relevant toll authority in terms of the outsourcing contract, for example, the obligation to pay across at least 99% of the gross toll revenue, as determined by independent traffic counters, in the South African Comprehensive Toll Road Operations and Maintenance (CTROM) Contracts.

Whether the apparent low cost of in-house toll operations is, however, really efficient depends very much upon what percentage of toll revenue ends up in the coffers of the toll authority. In order to determine what percentage of the toll revenue is really collected, an independent estimate of the gross revenue, based on independently observed traffic volumes in the different vehicle classes, should be obtained, since the internal functioning of a toll collection scheme cannot really be audited satisfactorily in order to obtain certainty regarding the percentage of toll revenue being collected. This results from the possibility of collusion between management and toll collection staff and, therefore, the independent observation of traffic volumes is strongly recommended.

If an in-house operation succeeds in collecting 99% or more of gross toll revenue (independently verified), it is very likely that it represents the most efficient means of collecting toll revenue. If an in-house operation with a lower cost than an outsourced operation, however, only succeeds in collecting a smaller percentage of the toll revenue, it is highly likely that revenue leakage is occurring and that it will be more efficient to outsource the toll operations with a contractual requirement that, for example, 99% of toll revenue, independently verified, should be collected by the private sector operating company.

13.2.2 Contract types for outsourcing of toll operations

The contracts and specifications used for the outsourcing of toll operations, including revenue collection and control, may vary from very *prescriptive contracts* with little risk transfer to the operating company to *performance-based contracts* in which significant risks are transferred to the operating company.

Prescriptive toll operations contracts are essentially contracts where performance is prescribed through detailed control specifications. Compliance to these prescriptions is ensured by means of hands-on project and contract management by the toll authority or concessionaire or its specialist toll road management consultants.

An important feature of the prescriptive kind of toll operations contract is that detailed revenue and fraud control management and audits by the toll authority or concessionaire are essential to determine the revenue due by the operating company. Practical experience in South Africa has, however, shown that it is difficult to achieve reimbursement to the toll authority by the toll operating company in the case of fraud, transaction losses or negligence detected by means of detailed revenue and fraud audits, since these audits only cover a small sample of all transactions, unless these risks are specifically transferred to the operating company in the contract.

Whilst revenue control is, therefore, facilitated to some extent by regular toll system and operations audits, it is essential to use a totally separate traffic observation or counting device at each toll plaza as an overall check of the toll plaza traffic volume.

The major advantage of the *prescriptive toll operations contracts* is that, because no major transfer of risk occurs, the provision of the service is relatively cheap.

In the case of *performance-based toll operations contracts*, the payment of toll revenue to the toll authority or concessionaire by the toll operating company is specified in such a way that it includes the transfer of all transaction and revenue-related risks.

A proven and effective mechanism to manage payment in a performance-based toll operations contract is to apply a decision tree using various sources of traffic measurements, namely:

- a parallel data stream (from the automatic vehicle classification devices in the toll lanes) to which the operating company does not have access
- the toll management information system
- two totally separate or independent traffic observation or counting devices at each toll plaza

The reliance for control of toll revenue collection upon four different sources of traffic information and a decision tree eliminates the need for detailed control of the procedures and methodologies followed by the toll operating company, as is the case with the prescriptive toll operations contract. The risk of fraud is, therefore, elegantly transferred to the toll operating company where it is most effectively managed. The operating company should, however, be required to procure a specified toll system that will facilitate its control of revenue in order to have all of the above data streams available and to ensure sound revenue management.

Whilst the cost of project and contract management of the performance-based toll operations contract is, therefore, lower than that of the prescriptive contract, the very nature of a higher risk operations contract implies a higher operational cost. This loading can be as much as 20-40%, depending on the risk profile!

The main features of the two types of toll operations and maintenance contracts are summarised below:

MAIN FEATURES OF TOLL OPERATIONS CONTRACT TYPES	
Prescriptive Toll Operations Contract	***Performance-based Toll Operations Contract***
• Revenue control risk only very partially transferred	• Revenue control risk may be transferred totally
• Significant project/contract management required by authority/concessionaire or its consultants	• Reduced project/contract management required by authority/concessionaire or its consultants
• Lower toll operations cost	• Higher toll operations cost

13.2.3 Conclusion

A toll authority therefore has to weigh up the almost total peace of mind regarding revenue collection in the case of the performance-based toll operations contract described above and the higher price associated with this approach against the limited revenue collection and control risk transfer of the prescriptive type of toll operations and maintenance contract which can, however, be mitigated by means of detailed toll auditing and which does carry the benefit of a lower price.

13.3 Combination of outsourcing of toll operations with the outsourcing of the supply of toll infrastructure and the toll system

Since the publication of the final draft of this report, it has become known that the Lesotho Government is not, at this time, inclined to fund the construction costs of the required toll facilities on the A2 Mazenod/Masianokeng - Mafeteng road sections where the upgrade of the road sections has already taken place and the road sections could, therefore, in theory be tolled in order to recover the initial upgrading costs and/or to provide funding for the future road rehabilitation, resurfacing and routine maintenance costs.

A possible solution in this situation is to outsource all the following functions to a single private sector consortium:

- funding of the initial capital costs for the construction of toll plazas and the procurement of a toll system
- construction of toll plazas
- procurement and installation of a toll system

- toll operations, including the collection and transfer of toll revenue to the Lesotho Road Fund/Roads Directorate
- repair and maintenance of the toll infrastructure and the toll system
- transfer of all the toll infrastructure and the toll system to the Lesotho Road Fund in good condition after 8-10 years.

Since the Lesotho Road Fund/Roads Directorate would want the toll infrastructure/toll system to be of a required standard at the time of transfer or in the event that a contractor/operator should become insolvent and withdraw from the project, it is recommended that the Lesotho Road Fund/Roads Directorate should appoint consultants to specify and design the required toll infrastructure and the toll system as well as prepare the required tender documentation and adjudicate the tender submissions.

The likely success of this proposed FUND-BUILD-OPERATE-TRANSFER (F-BOT) approach will be very dependent upon the following factors:

- the degree of assurance that the Lesotho Government could provide to the potential F-BOT consortium that all legal and public participation processes to facilitate tolling have been completed and that tolling of the project is, therefore, irreversible
- an acceptable guarantee of re-imbursement for costs incurred to construct a toll plaza/procure a toll system in the event of the toll project being terminated by the Lesotho Government
- the right should ideally be given to the consortium to subtract the monthly interest and repayment in respect of the toll infrastructure and toll system loans funded by them from the monthly gross revenue payable to the Lesotho Road Fund
- payment to the consortium for toll collection services should, however, not be subtracted by the consortium and should be subject to performance penalties before payment by the Lesotho Road Fund/Roads Directorate for these services takes place.

13.4 Recommendation

In view of the likely non-availability of funds from the Lesotho Government at this time for the funding of toll plazas/toll systems on the A2 Masianokeng - Mafeteng road sections, it is recommended that the implementation of this toll project be undertaken by means of a FUND-

BUILD-OPERATE-TRANSFER (F-BOT) contract in terms of which the contractor/operator undertakes the following functions:

- funding of the initial capital costs for the construction of toll plazas and the procurement of a toll system
- construction of toll plazas
- procurement and installation of a toll system
- toll operations, including the collection and transfer of toll revenue to the Lesotho Road Fund/Roads Directorate
- repair and maintenance of the toll infrastructure and the toll system
- transfer of all the toll infrastructure and the toll system to the Lesotho Road Fund in good condition after 8-10 years.

The above-mentioned approach could also be applied to the other potential toll corridors, provided that the funding of the road upgrading is available from other sources such as the Lesotho Government or development partner funding or a combination thereof.

14. CONCLUSIONS AND RECOMMENDATIONS

14.1 Legal/Institutional Recommendations

The following recommendations are made:

14.1.1 It is recommended that legislation be amended so that only one functionary will have the power to declare toll roads. In order to ensure political accountability, it is recommended that this power should rest with the Minister of Finance who would do so either at the joint recommendation of the Road Fund and the Roads Directorate or at the recommendation of the Road Fund only, bearing in mind that the Fund is responsible for funding matters.

14.1.2 The Road Fund Board should create special accounts within the Road Fund for the purpose of ring-fencing the toll funds related to a specific toll corridor and these funds should be managed in terms of a tri-partite agreement between the Road Fund, the Roads Directorate and the Minister of Finance. The agreement should provide for the saving of the net toll revenue in each toll corridor account for the future rehabilitation or resealing of the relevant toll corridor. The toll revenue would then be transferred to the Roads Directorate as and when the funds are required for the specific toll project.

14.1.3 It is recommended that provision be made that funds in these special toll corridor accounts that are being saved for future periodic road maintenance or rehabilitation or for toll-related infrastructure or system procurement, replacement or expansion purposes, should not be allowed to be removed from such a fund, but should be invested conservatively on behalf of the toll corridor. In order to create flexibility amongst toll corridors, it is recommended that toll corridors be allowed to borrow funds from each other, provided that these funds can be repaid when required by the toll corridor to which the funds belong, all subject to the approval of the Minister of Finance.

14.1.4 The fine of M50 for non-payment of toll should be revised. If the Act is amended, it would be advisable to provide that the maximum fine will be stipulated in regulations from time to time, to avoid having to amend the Act each time the fine is revised.

14.1.5 Since the study recommends that electronic toll collection (ETC) should be used, amending legislation or just regulations will be needed for this purpose.

14.2 Recommendations related to Toll Strategy, the Definition of Toll Corridors and Local User Discounts

14.2.1 Before commencement of tolling, a toll corridor should be upgraded, ideally to the standard achieved in the two A2 Masianokeng - Mafeteng toll corridors in order to achieve public acceptance of the introduction of tolling.

14.2.2 It is recommended that, if it is decided to implement the toll corridors, the following definition of toll corridors be accepted:

- Route A1 between Maputsoe and Teya-Teyaneng.
- Route A1 between Teya-Teyaneng and Maseru.
- Route A5 between A2 and Roma and Routes A5 and A3 between the A2 and Ntsi (tolled at the same mainline toll plaza).
- Route A2 between Mazenod/Masianokeng and Morija.
- Route A2 between Morija and Mafeteng.
- Route A2 between Mafeteng and Mohale's Hoek.

14.2.3 It is also recommended that local user discounts should be provided to communities (traffic streams) not using the full distance of the defined toll sections, as detailed in the following sub-sections of the Executive Summary: 4.3, 4.4, 4.5, 4.6, 4.7 and 4.8. In the event that different toll plaza locations are selected, the required local user discounts should be redefined.

14.3 Toll Infrastructure and Equipment

It is recommended that:

- Once a decision is taken to proceed with tolling, a toll plaza location study should be undertaken for each selected toll corridor. Such a study should compare alternative locations from a geometric, operational, tolling equitability and financial point of view.
- In view of the importance of minimising travel delays, Electronic Toll Collection (ETC) should be introduced into the payment methods available in toll plaza lanes. Once the ETC market share has built up adequately, a non-stop ETC lane in a direction of travel could be introduced in order to delay/prevent the need for future toll plaza expansion.

14.4 Financial/Economic Recommendations

The most important conclusion that may be drawn is that, from both a financial and an economic point of view, the funding by means of tolls of maintenance and resealing only is significantly less efficient than the funding by means of tolls of maintenance, resealing, rehabilitation and upgrading. This conclusion is based upon the relatively high cost of toll collection as a percentage of toll revenue (financial analysis) and the relatively lower benefit-cost ratio of the alternative involving maintenance only compared to the alternative involving maintenance, resealing, rehabilitation and upgrading (economic analysis).

It is, therefore, recommended that, in order to efficiently explore the financial and economic potential of toll financing whilst still charging toll tariffs that are lower than or in line with those charged in South Africa, toll financing should ideally fund routine road maintenance, resealing, rehabilitation and road upgrading costs, since such options yield the best financial and economic results.

As a second best option from the point of view of optimally exploring the financial and economic potential of toll financing, toll financing should at least fund routine road maintenance, resealing and rehabilitation in the identified toll corridors which have been shown to be economically and financially viable.

14.5 Need for Affordability and Macro-Economic Studies

As was identified at the Stakeholders' Workshop in March 2011, studies should be undertaken into the affordability of the proposed toll tariffs and also into the macro-economic impact of the planned tolling in order for the Lesotho Government to be able to better motivate the possible tolling decisions from a social and a macro-economic point of view.

14.6 Potential funding solution

In view of the likely non-availability of funds from the Lesotho Government at this time for the funding of toll plazas/toll systems on the A2 Masianokeng - Mafeteng road sections, it is recommended that the implementation of this toll project be undertaken by means of a FUND-BUILD-OPERATE-TRANSFER (F-BOT) contract in terms of which the contractor/operator undertakes the following functions:

- funding of the initial capital costs for the construction of toll plazas and the procurement of a toll system
- construction of toll plazas
- procurement and installation of a toll system
- toll operations, including the collection and transfer of toll revenue to the Lesotho Road Fund/Roads Directorate
- repair and maintenance of the toll infrastructure and the toll system
- transfer of all the toll infrastructure and the toll system to the Lesotho Road Fund in good condition after 8-10 years.

The above-mentioned approach could also be applied to the other potential toll corridors, provided that the funding of the road upgrading is available from other sources such as the Lesotho Government or development partner funding or a combination thereof.

14.7 Possible Need for Public-Private Partnership Study Extension

If there is an interest in the Road Fund or Lesotho Government to execute the development of the toll corridors by means of public-private partnerships (PPP) such as the one described in sub-section 14.6, a limited expansion of the study should be undertaken to define the work to be performed and the required contractual mechanisms as well as to indicate the financial (tariff) and other implications for each toll corridor of a PPP approach. The changes in toll tariffs compared to the current study would result from the required return on investment of private sector companies for the funding risk that they would be required to take.