

ANNEX TO ROADS: OVERVIEW



Table of Contents

Table of Contents	i
List of Tables	ii
List of Figures	ii
Glossary	iii
Executive Summary	iv
Road Network	iv
Capital Projects	iv
Road Maintenance	v
Maintenance Budget	vii
Rehabilitation and Maintenance Programme	viii
Financing	x
Conclusion	x
1. Terms of Reference	1
2. Outline	1
3. The Road Network	2
4. Topography and Climate	2
5. Road Standards	3
6. Road and Bridge Capital Works	4
7. Capital Works - Donor Funded Projects	4
8. Capital Works – Non Donor Funded Projects	5
9. Investment Programme	7
10. Road Maintenance	9
11. Maintenance Activities	10
12. Routine Maintenance	11
13. Winter Maintenance	12
14. Periodic Maintenance	12
15. Emergency Repairs	13
16. Maintenance Management	14
17. Indicative Maintenance Management Strategy	15
18. Maintenance Budget	16
19. Maintenance Programme	19
20. Financing	21
21. Conclusion	24
References	25

List of Tables

Table 1 Road Classification and Condition	2
Table 2 Summary of Donor Programme	5
Table 3 Donor Programme by Road Classification	5
Table 4 Funded Works (See Appendix 2)	6
Table 5 Rehabilitaion Needs	7
Table 6 Estimated Road Length Rehabilitated Each Year	8
Table 7 Annual Investment Budget for Road Rehabilitation 2002-2013 (USD Millions)	8
Table 8 Maintenance Costs	18
Table 9 Average Maintenance Costs	19
Table 10 Percentage of Road Length in Good or Fair Condition 2002-2013	20
Table 11 Annual Maintenance Budgets 2002-2013 (USD Millions)	20
Table 12 Financing of Donor Projects	21
Table 13 Summary of Required Road Budget	23
Table 14 Overall Road Budget Financing (USD millions)	24

List of Figures

Figure 1 Annual Investment in Road Rehabilitation	9
Figure 2 Annual Maintenance Costs 2002-2013	21
Figure 3 Total Annual Cost of Afghanistan Road Network	22

Glossary

AACA	Afghanistan Assistance Coordination Authority
AADT	Average Annual Daily Traffic
AC	Asphaltic Concrete
ACLU	Afghanistan Construction and Logistics Unit
ADB	Asian Development Bank
ARCS	Afghanistan Road Condition Survey
CNA	Comprehensive Needs Assessment (by ADB)
EU	European Union
GoA	Government of Afghanistan (TIGA)
IAA	Interim Afghanistan Administration
IRI	International Roughness Index
km	kilometre
MoPW	Ministry of Public Works
NDF	National Development Framework (of Afghanistan)
NGO	Non-government Organistaion
pa	per annum
ROCKS	Road Costs Knowledge System (by World Bank)
SIDA	Swedish Internaional Development Agency
TIGA	Transitional Islamic Government of Afganistan (GoA)
TSR	Transport Sector Reviw
UNEP	United Nations Environment Programme
UNOPS	United Nations Office of Project Services
USAID	United States Agency for International Development
USD	United State Dollars
yr	year

Executive Summary

The consultation paper on Operational Budgets and Financing identifies the proposed capital works programme and sets out an indicative programme of road maintenance activities and financing needs for Afghanistan for the next five years. Unless otherwise noted the costs, budgets and exchange rates used in this document are current as at 31 May 2003.

In developing the proposed budget for investment in and maintenance of the road network the following steps were undertaken:

1. Review programme of road investment projects for the next 5 years and determine budget required
2. Estimate budget required to meet the needs for sustainable maintenance of the fully rehabilitated (ie. future) road network
3. Estimate the length of road that will be in fair or good condition and thus must be maintained in the intermediate years (ie. The progressively rehabilitated network)
4. Estimate maintenance budget required in the intermediate years.

Road Network

The Afghanistan road network is comprised of the following approximate lengths of road:

Table 1 Road Classification and Condition (2003, estimated)

Road Classification	Total Length (kms)	Percent in "Good" or "Fair" Condition (kms)
National Primary Roads	3,398	34%
National Secondary Roads	2,773	34%
Provincial Primary Roads	5,364	20%
Provincial Secondary Roads	9,561	20%
Rural Feeder Roads	17,000	20%
Urban Roads	2,000	20%
Total	40,096	

Although detailed information is not readily available it is apparent that the majority of the country's road network is generally in poor condition.

Capital Projects

Since the Comprehensive Needs Assessment (CNA) carried out by the ADB and World Bank in 2002 a programme of donor funded road rehabilitation works has taken shape and can be summarised as follows:

Road Infrastructure
Operational Budgets and Financing

Table 2 Summary of Donor Programme

Year	Kms	USD
2003-04	693	183,969,603
2004-05	1473	453,665,119
2005-06	1263	342,299,032
2006-07	495	156,010,688
2007-08	442	142,010,688
2008 +	383	113,021,376
Total	4749	1,390,976,506

The donor programme will rehabilitate some 4,750km of mostly national roads, at an average cost of USD293,000/km. The USD1.4bn of donor funded works includes some USD703m of grant funds and USD528m of loan projects, with the funding of the balance being currently unclear.

Provided the donor projects are actually implemented as currently indicated, and provided that all the roads are properly maintained thereafter, the full national network (national primary and national secondary roads) will be brought up to fair condition or better under the donor programme.

An estimate was made of the cost to rehabilitate the Provincial, Urban and Rural Feeder road components of the road network. Using average costs per kilometre and estimates of the amount of road in poor condition, the following table was derived.

Table 3 Rehabilitation Needs

Classification	Total Length	Percent in Poor Condition	Average cost (USD/km)	Budget
National Roads	6,171	66%	293,000 (Appendix 1)	1,400,000,000
Provincial Roads	14,925	80%	100,000	1,194,000,000
Rural Feeder Roads	17,000	80%	10,000	136,000,000
Urban Roads	2,000	80%	30,000	48,000,000
Total	40,096			2,778,000,000

The data in the above table indicates a total budget requirement of some USD2.8billion to rehabilitate the entire Afghanistan road network. Of this some USD1.4billion is understood to have been committed by donors and a small amount (USD157m) is considered as being funded from government sources over the next four years. The current shortfall for capital projects (road rehabilitation) is therefore approximately USD1.3billion

Road Maintenance

A road is a physical asset and like all physical assets will deteriorate over time and with use. Maintenance work will be necessary to restore the road due to:

- Road deterioration due to age, weathering and natural events, and

Road Infrastructure Operational Budgets and Financing

- Road deterioration (i.e. damage) due to traffic activity, which is mainly heavy vehicle wheel loads.

It has been well established that failure to adequately maintain roads incurs far greater long term costs for eventual rehabilitation than can be saved by omitting the maintenance. Furthermore, each dollar saved in maintenance tends to increase vehicle operating costs by two to three times the amount saved. Rather than saving money, cutting back on road maintenance increases the cost of road transport and raises the net cost to the economy as a whole. This importance of road maintenance may be summed up in the truism:

You pay for good roads whether you have them or not!

This is an important issue for Afghanistan given that a large part of the primary road network is about to be rehabilitated. To retain the value of the road investments now being made (which consist of both donor grant funds and loans which must eventually be repaid) funds must be allocated and management arrangements instituted for long term maintenance of the road network.

An indicative programme has been put forward of routine maintenance (minor activities required one or more times per year on any road section eg. Pothole repairs) and periodic maintenance (more substantial but less frequent activities eg. Pavement overlays) for the Afghanistan road network. Road maintenance in this country must also take account of the need for snow removal in the winter time and make provisions for emergency works (eg. Clearance of landslides) that can not be predicted in advance.

A general description of a maintenance strategy for non urban roads is as follows:

- for Bituminous Surfaced Roads
 - Pothole repair if > 1 pothole (>300mm dia) / km
 - Edge break repair if > 50m²/km (both sides of road)
 - Single Seal if > 10% damage or 10% ravelling or texture depth < 0.3mm
 - AC overlay if AADT > 1000 and IRI > 6 apply 50 mm, or mill 50 mm and replace with 100 mm where damage > 40% and AADT > 1000
- for Gravel Roads
 - Grade road every 6 months if AADT<100
 - Grade road every 4 months if AADT 100-200
 - Grade road every 2 months if AADT>200
 - Regravel with 250 mm of compacted material if surface thickness is < 75 mm.
- for all Earth Roads
 - Grade road every 4 to 6 months

As a general guide the above actions will maintain the rural road network in a fair to good trafficable condition. Other miscellaneous routine maintenance activities (drainage repairs, bridge repairs, vegetation clearance, sign repairs etc) are also required on an ongoing basis.

Road Infrastructure
Operational Budgets and Financing

Maintenance Budget

The funds required to sustainably maintain Afghanistan's rehabilitated road network have been estimated at approximately USD 117m pa, which is divided as shown in the following table.

Table 4 Road Maintenance Costs

Annual Cost of Maintaining the Afghanistan Road Network (After Rehabilitation of Roads Currently in Poor Condition)

Road Classification	Length (km)	AADT	Routine Maintenance (USD millions)	Periodic Maintenance (USD millions)	Total
National Roads					
Paved	3,300	1,000	10,977,865	12,323,140	23,301,004
Gravel	2,671	300	2,687,126	8,629,125	11,316,251
Earth	200	50	187,384	0	187,384
Sub Total	6,171		13,852,374	20,952,264	34,804,639
Provincial Roads					
Paved	200	300	551,427	339,743	891,170
Gravel	10,994	300	11,060,125	35,517,199	46,577,324
Earth	3,731	50	3,495,874	0	3,495,874
Sub Total	14,925		15,107,426	35,856,942	50,964,368
Rural Feeder Roads					
Paved	0	-	0	0	0
Gravel	2,550	50	2,537,370	6,045,029	8,582,399
Earth	14,450	50	13,538,460	0	13,538,460
Sub Total	17,000		16,075,829	6,045,029	22,120,858
Urban Roads					
Paved	300	1,000	997,988	509,614	1,507,602
Gravel	1,700	300	1,710,264	5,492,142	7,202,406
Earth	0	-	0	0	0
Sub Total	2,000		2,708,252	6,001,757	8,710,008
Totals	40,096		47,743,881	68,855,992	116,599,873

**Total Annual Maintenance Cost (Routine + Periodic + Winter +
Emergency)**

= USD 116,599,873 pa

The average cost of maintaining each road surface type is therefore as shown below:

Road Infrastructure Operational Budgets and Financing

Table 5 Average Maintenance Costs

Surface Type	Total kms	Average Cost USD	Difference USD
Paved	3,800	6,763/km-yr	2,650/km-yr
Gravel	17,915	4,113/km-yr	3,176/km-yr
Earth	18,381	937/km-yr	
Whole Network Average	40,096	2,908/km-yr	

Rehabilitation and Maintenance Programme

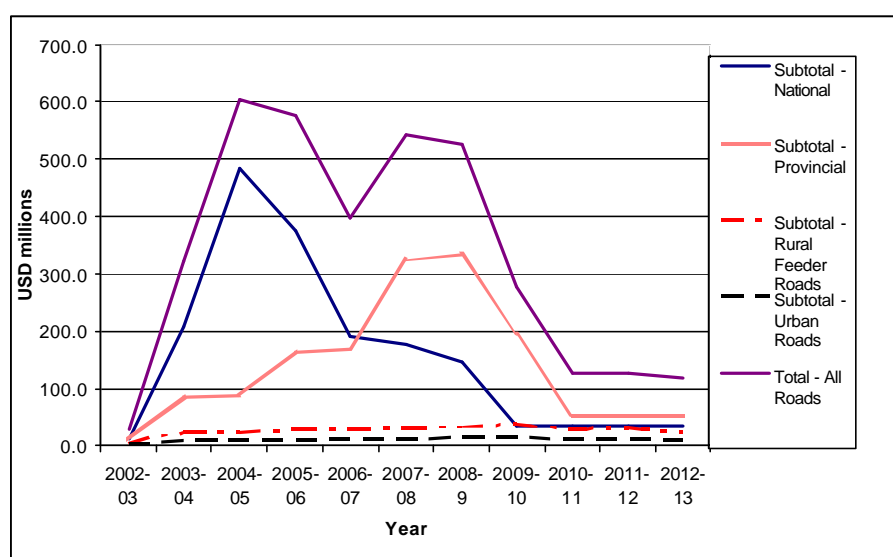
Estimates have been made of the annual funding required to rehabilitate and maintain the road network. Due to the long period of neglect and the resultant deteriorated condition of the road network, it will take several years to fully rehabilitate the roads of Afghanistan. Only after the roads that are in a poor condition have been rehabilitated to a “fair” or “good” condition can they be maintained in that state by a well planned and optimised maintenance programme.

The cost estimates are based on the following assumptions:

- The donor programme will be implemented generally as set out in Appendix 1 of the consultation paper. This will improve the full National road network (6,171km) up to at least fair or good condition by 2007.
- Although currently under-funded, it is assumed that money will be found to rehabilitate the Provincial road network so that all of it (14,925km) will be in fair condition or better by 2011.
- Similarly the feeder and urban roads will be progressively rehabilitated until by 2013 they are all in fair condition or better.

The budget for a programme to rehabilitate and maintain the road network is shown in the figure below and the subsequent table.

Figure 1 Total Annual Cost of Afghanistan Road Network (Rehab. + Maint.)



Road Infrastructure
Operational Budgets and Financing

Table 6 Summary of Road Budget

Road Classification & Type of Road Works		2003- 04	2004- 05	2005- 06	2006- 07	2007- 08	2008- 09	2009- 10	2010- 11	2011- 12	2012- 13
National	Maintenance	23.8	30.9	33.1	34.8	34.8	34.8	34.8	34.8	34.8	34.8
National	Rehabilitation	184.0	453.7	342.3	156.0	142.0	113.0	0.0	0.0	0.0	0.0
Subtotal – National Roads		207.8	484.5	375.4	190.8	176.8	147.8	34.8	34.8	34.8	34.8
Provincial	Maintenance	10.2	12.7	15.3	20.4	25.5	35.7	45.9	51.0	51.0	51.0
Provincial	Rehabilitation	74.6	74.6	149.3	149.3	298.5	298.5	149.3	0.0	0.0	0.0
Subtotal - Provincial		84.8	87.4	164.5	169.6	324.0	334.2	195.1	51.0	51.0	51.0
Rural Feeder Roads	Maintenance	4.4	6.6	8.8	11.1	13.3	15.5	17.7	19.9	21.0	22.1
Rural Feeder Roads	Rehabilitation	17.0	17.0	17.0	17.0	17.0	17.0	17.0	8.5	8.5	0.0
Subtotal - Rural Feeder Roads		21.4	23.6	25.8	28.1	30.3	32.5	34.7	28.4	29.5	22.1
Urban Roads	Maintenance	1.7	2.6	3.5	4.4	5.2	6.1	7.0	7.8	8.3	8.7
Urban Roads	Rehabilitation	6.0	6.0	6.0	6.0	6.0	6.0	6.0	3.0	3.0	0.0
Subtotal - Urban Roads		7.7	8.6	9.5	10.4	11.2	12.1	13.0	10.8	11.3	8.7
Total - All Roads		321.8	604.2	575.2	398.9	542.3	526.6	277.6	125.0	126.6	116.6

Road Infrastructure Operational Budgets and Financing

Financing

By combining available data on anticipated donor and government funding with the total road budget required, the likely budget shortfall over the next five years can be estimated as shown in the following table.

Table 7 Overall Road Budget Financing (USD millions)

	Donor	Government	Shortfall	Total - All Roads
2003-04	184.0	24.0	113.8	321.8
2004-05	453.7	66.0	84.5	604.2
2005-06	342.3	63.1	169.8	575.2
2006-07	156.0	69.4	173.4	398.9
2007-08	142.0	76.4	323.9	542.3

The donor contributions (grants and loan funds) are only intended as a temporary measure to help the country back on its feet. Further sustainable sources of funds will be required to complete rehabilitation of the roads, for road maintenance, and to a lesser extent for new construction over the longer term. Despite the current donor contributions there will be a large shortfall to be financed by the government directly or from other sources. The issue of road funding sources and mechanisms in Afghanistan has been addressed in detail in the separate TSR consultation paper “2.3 Funding” which forms another part of this Road Infrastructure Report. Recommendations regarding institutional arrangements for administration of the different levels of the road network are also contained therein.

Conclusion

This paper has reviewed and presented preliminary work programmes and developed budget estimates to first rehabilitate and then maintain the Afghanistan road network. The Budget estimates have been separated into four main network components (ie. National, Provincial, Rural Feeder Roads and Urban Roads) . The budget has also been separated into estimates for rehabilitating existing roads (which includes bridges) to restore them to fair condition or better and the costs of optimum maintenance works that will sustain each network component at the required condition into the future.

Due to the lack of data about road condition, vehicle fleets and tender prices in Afghanistan, many assumptions and approximations have been adopted in preparing this report. For this reason the costs in this paper can only be considered as “ball park” estimates and should be reviewed and refined as the road sector develops. Two of the top priorities should be to review and update the current functional classification system for roads and to carry out a thorough condition survey of all roads and bridges, starting with the national roads but extending to all levels of the road hierarchy. These will provide the base data for road network managers to accurately assess the extent of road rehabilitation and maintenance required.

A further, and most critical, priority is to put in place adequately resourced arrangements to sustainably maintain the road infrastructure and thus preserve the benefits of the current investments in road rehabilitation. Without proper maintenance the roads will inevitably deteriorate resulting in huge costs to road users and the need for further major rehabilitation efforts within less than 10 years.

Operational Budgets and Financing

1. Terms of Reference

The Terms of Reference for the Transport Sector review require the consultant to prepare a 5 year budget for road maintenance and the operations of the institutions in the road sector as well as a financing plan, identifying separately local and expected foreign financing. This document identifies the proposed capital works programme and sets out an indicative programme of road maintenance activities and financing needs for the next five years. Unless otherwise noted the costs, budgets and exchange rates used in this document are current as at 31 May 2003.

2. Outline

Afghanistan is now in a phase of intensive post conflict reconstruction of major infrastructure. There is a large programme of donor funded road rehabilitation and reconstruction projects either in progress or under consideration. A few projects are currently underway and several others are about to start. The definition of the individual construction projects that make up the donor programme is somewhat fluid. Changes occur as the donors variously extend, withdraw, accelerate, defer or reallocate previously pledged financial support for specific road sections.

Donor funded projects are addressing the most critical road deficiencies which are, for the most part, on the national road network. Despite uncertainties in the status of some individual projects the overall shape of the donor programme is now fairly clear. It is focussed on restoring the complete Kabul – Herat - Kabul ring road, several routes to international borders and selected other route sections.

As most of the existing network is in very poor condition, assessment of maintenance needs has focussed on the funding required to sustainably maintain those roads that are in a maintainable (“good” or “fair”) condition. This means that apart from emergency works maintenance resources will generally not be applied to roads that are currently in poor condition until after they have been rehabilitated to a reasonable and maintainable standard.

In developing the proposed budget for investment in and maintenance of the road network the following steps were undertaken:

1. Review programme of road investment projects for the next 5 years and determine budget required
2. Estimate budget required to meet the needs for sustainable maintenance of the fully rehabilitated (ie. future) road network
3. Estimate the length of road that will be in fair or good condition and thus must be maintained in the intermediate years (ie. progressively rehabilitated network)
4. Estimate maintenance budget required in the intermediate years.

3. The Road Network

The Afghanistan road network is comprised of the following approximate lengths of road:

Table 1 Road Classification and Condition

Road Classification	Total Length (kms)	Percent in “Good” or “Fair” Condition (kms)
National Primary Roads	3,398	34%
National Secondary Roads	2,773	34%
Provincial Primary Roads	5,364	20%
Provincial Secondary Roads	9,561	20%
Rural Feeder Roads	17,000	20%
Urban Roads	2,000	20%
Total	40,096	

The length and condition data in the table is adapted from the “Comprehensive Needs Assessment (CNA – ADB 2002) and from data provided by MoPW. It has been augmented by estimates by the consultant. A road inventory database for Afghanistan (ARCS 1994) was developed but the consultant has not been able to obtain a copy. The inventory database is cited as the original source of the data reported by the ADB.

It should be noted that the CNA states that 54% of the National network (ie National Primary plus National Secondary) is in poor condition, which implies that 46% is in good or fair condition. In the consultant’s opinion, and based on some 1,500km of road travel in Afghanistan, this would overstate the current condition of the national network. Instead of 46%, a figure of 34% has been assumed as the proportion of the National road network that is in fair or good condition.

As also noted elsewhere in the TSR documents, the road network of Afghanistan is in desperate condition. For purposes of road maintenance budgeting it is proposed that, at a minimum, every effort should be made to ensure that roads that are currently in good or fair condition should at least receive sufficient maintenance so that they do not deteriorate further. Roads that are already in poor condition generally require major rehabilitation, rather than maintenance treatment.

Many road bridges in Afghanistan have been destroyed or seriously damaged as result of conflict and natural events (eg. Floods and landslides) and chronic lack of maintenance over many years. The bridges which are still trafficable are often suffering various degrees of non structural damage and require major maintenance and rehabilitation treatments to restore them to reasonable levels of service and service-life. There is currently no comprehensive inventory or condition database of the road bridges in Afghanistan so their numbers have not been estimated. However, it is understood that the major donor funded road rehabilitation projects will generally include restoration or replacement of most river crossings on their subject road sections.

4. Topography and Climate

Afghanistan’s total land area is approximately 650,000km². Most of the land (about 63%) can be classified as mountainous using formal criteria based on slope and elevation (UNEP 2003). Around 27% of the land area lies above 2,500m altitude.

The rugged Hindu Kush range covers some 456,000 km² of the central core of the country and rises to about 5,100m. Peaks up to 7,000m occur in the Wakhan Corridor in the extreme northeast of the country.

In the southwest (around Helmand), and to a lesser extent to the north (between the foothills of the Hindu Kush and the Amu Darya River) are extensive areas of flat land. These include significant areas of sand desert, particularly in the southwest.

The climate is continental in nature with cold winters and hot summers. Most of the country is arid or semi arid. Annual precipitation varies from around 1,200mm in some parts of the northeast to less than 100mm in the southwest. Precipitation over most of the country lies in the lower half of this range. Kabul receives less than 400mm pa. Winter temperatures can be very low, with many weeks below -15°C being not uncommon in the winter months.

These climatic and topographic factors have a significant influence on the construction and maintenance of roads in Afghanistan. The large proportion of mountainous terrain means that roads in those areas are often built very narrow and with tortuous alignments to minimise costs in the steep country. River crossings tend to require bridges because the water courses are either deeply incised or have wide and highly mobile gravel/boulder river beds which are difficult to negotiate by vehicle even when not in flood. The need for emergency repairs, such as for land slides and flood damage, is more frequent in mountainous terrain. The high altitude of much of the country means that winter maintenance requires substantial effort to keep roads clear of snow and ice and open to traffic as much as practicable.

5. Road Standards

Assessment of financing and budget requirements for operating and maintaining the road network in Afghanistan needs to consider the design and maintenance standards applied to the various road categories. In general, construction standards for the new roads and major rehabilitation projects are currently being adopted on an ad hoc basis, but with reference to international practice, by the designers of the various donor funded projects. In time the MPW will need to update and publish its own road design standards (eg. Geometric design, road drainage and construction quality standards) for various categories of new and reconstructed roads and bridges in the country.

Performance standards for maintenance of existing and reconstructed roads in Afghanistan is also an important issue. At present there is very little, and often no, regular maintenance undertaken on most rural roads in the country. What little maintenance that does occur often consists of small scale village level activities to address urgent local problems such as washouts, landslides and blocked drains. UNOPS and NGOs are undertaking selected labour intensive road works in rural areas. These are all small scale and often emergency works. They are addressing an urgent need and are certainly beneficial both to road users and to the labourers employed. However the NGO programmes do not, and are not intended to, constitute a national programme of managed road maintenance. That is the role of the road controlling authority, which in most cases, at least for the primary and secondary road network, is the Ministry of Public Works. Typical maintenance activities and indicative performance standards are set out later in this section.

6. Road and Bridge Capital Works

The Afghanistan National Development Framework (IAA 2002) states that “The goal of the programme for transport is to have an efficient, affordable transport system enabling people, commodities and ideas to move and connect”. This goal guides the development of programmes to restore and maintain the road network of Afghanistan.

In developed countries investment in road and bridge works usually comprises a mix of construction of new road links, capacity expansion on existing roads (eg. Widening from 2 lanes to 4 lanes) and replacement of old infrastructure that can no longer be economically maintained or is reaching the end of its service life. While Afghanistan remains in a situation of post-conflict recovery road investments in the near term must focus firstly on rehabilitation of its war damaged and neglected road infrastructure. As described elsewhere the country has (or at least, had) quite an extensive road network. Although the road density of 0.03km of road per square kilometre and 0.88km per thousand people (ADB 2002) is very low in comparison with most developing countries the network touches all the major population centres and reaches into the remote areas. Rehabilitation of existing roads, particularly the primary national network, must have first priority with construction of new roads being a secondary consideration. Expansion of the network, in terms of route length or traffic capacity, should not consume a significant proportion of available funds until substantial progress has been made rehabilitating existing roads and bridges.

At present, the need for road and bridge investments is being addressed by both the Government of Afghanistan (GoA) directly and by numerous donors and NGOs active in the road sector. However the current lack of funds available to the GoA means that almost all current road projects in Afghanistan are funded from non-government sources, principally multilateral agencies (World Bank, ADB, EU), neighbouring and regional countries (eg. Pakistan, Iran, India, Saudi Arabia) and elsewhere (eg. USA, Italy, Sweden). This situation will change only slowly over the next few years. The issue of road funding sources is addressed further in a separate report under the Transport Sector Review.

7. Capital Works - Donor Funded Projects

In March 2002 ADB and the World Bank jointly undertook a Comprehensive Needs Assessment (CNA - ADB 2002) of the transport sector in Afghanistan. The CNA recommended a programme of road rehabilitation works that focussed on:

- Restoring key sections of the primary network
- Removing bottlenecks such as damaged bridges and the Salang Tunnel
- Improving road links to neighbouring countries
- Improving key secondary and tertiary roads to connect district centres with the primary network, using a mainly labour based approach

The works recommended in the CNA were to initially (ie. within 2.5 years) restore most of the primary ring road, (ie. Apart from the Herat – Shiberghan section), key links to Pakistan, Iran, Turkmenistan, Tajikistan and Uzbekistan and to undertake emergency repairs and winter maintainance on a stopgap basis until the larger rehabilitation projects get underway. The second priority, within 5 years, is to complete the ring road and the east-west route (Herat-Chaghcharan-Kabul) and restore the secondary and tertiary network to provide access to all major population centres

Road Infrastructure
Operational Budgets and Financing

and rural communities. This consultant concurs with the approach set out in the CNA and supports the prioritisation rationale adopted for the works.

Since the CNA was published in August 2002 donors have pledged funds to undertake various projects. Appendix 1 lists currently available information about the proposed donor funded road works programme. The data has been sourced from the government budget (AACCA, 12 March 2003), other information held by AACCA and discussion with individual donor agencies. Where specific details could not be obtained from the donors, some data in the table has been estimated or interpolated. Although adjustments have been applied in the amount and timing of expenditure on some projects the table is considered to give an overall picture of where and when donor funds are expected to be invested in the road network of Afghanistan over the next few years. A summary of the donor programme is given in the following table.

Table 2 Summary of Donor Programme

Year	Kms	USD
2003-04	693	183,969,603
2004-05	1473	453,665,119
2005-06	1263	342,299,032
2006-07	495	156,010,688
2007-08	442	142,010,688
2008 +	383	113,021,376
Total	4749	1,390,976,506

The overall donor programme of about USD 1.4 billion will rehabilitate approximately 4,700km of the road network. This equates to an overall average of USD293,000/km of road rehabilitated. In practice the standard to which the routes are rehabilitated will vary between projects. In the case of Kabul-Kandahar (500km) the road will be restored to a two lane paved highway with a speed environment of at least 100km/hr for an average cost of USD417,000/km. However for Taloqan-Faizabad (170km) the rehabilitation, which will cost an average of USD136,000/km, is expected to repair only the most critically damaged or at-risk road sections, pave selected sections through villages and undertake maintenance backlog work on as much as possible of the rest of the route. Much work will remain to be done in later years to upgrade the road to a secure, fully paved standard with all water courses bridged.

The budgeted amount of USD 1.4 billion is divided between the different road classifications as follows:

Table 3 Donor Programme by Road Classification

Year	Kms	USD
Primary	3,429	986,179,522
Secondary	1,269	358,554,159
Other	52	16,242,825
Total	4,750	1,360,976,506

8. Capital Works – Non Donor Funded Projects

Although the donor funded road works outlined above will address the highest priority (mainly national) road links they cover only 4,750km road length in total, of which 4,698km is on the national network (national primary and national secondary roads). Of the 6,171km total length of national roads approximately 34% (ie. 2,098km) are

Road Infrastructure Operational Budgets and Financing

judged to be already in good or fair condition. As this is more than the amount of national road omitted from the current donor projects (6,171km, minus 4,698km donor-funded national road projects, equals 1,472km), it can be assumed that all of the national road network (national primary and national secondary roads) will be rehabilitated with donor funds if and when the expected programme is fully implemented.

The above length figures imply that some donor projects will ostensibly be “rehabilitating” road sections that are already in good or fair condition. This is not an inconsistency and just reflects the fact that there are short lengths of good road located within larger routes being rehabilitated by donors. Two examples are the first 40km from Kabul on the Kanadahar Road and the Doshi to Pul-e-Khomri section (47km) of the Kabul-Shirkhan Road. Both road sections are in quite good condition and need little more than routine maintenance work. Although they have been included in the list of donor projects in Appendix 1, they will be treated appropriately when the projects are implemented.

Although the national roads are now being addressed by donors, rehabilitation required on the provincial roads (14,925km total length), feeder roads (about 17,000km) and urban roads (estimated at 2,000km) must be funded either from government sources or by seeking additional donor funds.

The MoPW and AACA have prepared lists of these government funded or unfunded second priority rehabilitation projects. A list from ACCA, based on the Public Investment Programme (March 2003) is included in Appendix 2. A list from MoPW of unfunded project requirements is shown in Appendix 3. The AACA list includes donor projects, government funded works and works that are currently unfunded. To reduce the overlap with Appendix 1, the donor funded projects have been flagged and totaled separately at the bottom of the table. However the totals in Appendix 2 are not consistent with the totals for donor funded projects in Appendix 1. The latter was modified by the consultant after discussion and clarification with most of the major donors.

Looking at the right hand side (Funded Component) of the table in Appendix 2, and separating out the line items known to be in proposed donor projects, the following table indicates the anticipated level of works that ACCA has designated as being “funded” over the next 4 years.

Table 4 Funded Works (See Appendix 2)

Year	Total “Funded” Works	Donor Projects	Non- Donor (Gov)
2003	13.35	9.20	4.15
2004	205.10	181.10	24.00
2005	279.60	213.60	66.00
2006	172.80	109.70	63.10
Total	670.85	513.60	157.25

It is understood that works referred to as “non-donor” in Table 3 and Appendix 2 are intended to be funded from government sources.

Because of the significant inconsistencies between the data in Appendices 1, 2 and 3 it is difficult to present a clear picture of the funding needs for rehabilitation of the provincial, feeder and urban components of the road network. A simple method is to

Road Infrastructure
Operational Budgets and Financing

make an estimate using average costs per km to rehabilitate the length of road in each classification that is in poor condition. This is shown in the following table.

Table 5 Rehabilitation Needs

Classification	Total Length	Percent in Poor Condition	Average cost (USD/km)	Budget
National Roads	6,171	66%	(Appendix 1)	1,400,000,000
Provincial Roads	14,925	80%	100,000	1,194,000,000
Rural Feeder Roads	17,000	80%	10,000	136,000,000
Urban Roads	2,000	80%	30,000	48,000,000
Total	40,096			2,778,000,000

The data in Table 4 indicates a total budget requirement of some USD2.8billion to rehabilitate the entire Afghanistan road network. Of this some USD1.4billion appears to have been committed by donors and a small amount is (USD157m) is considered as being funded from government sources over the next four years. The current shortfall is therefore approximately USD1.3billion.

9. Investment Programme

It will take several years of rehabilitation works before all the roads have been rehabilitated. Estimates have been made of the annual budget required for road network rehabilitation. This is based on the following assumptions:

- The donor programme will be implemented generally as set out in Appendix 1 above. This will improve the full National road network (6,171km) up to at least fair or good condition by 2007.
- Although currently under-funded, it is assumed that money will be found to rehabilitate the Provincial road network so that all of it (14,925km) will be in fair condition or better by 2011.
- Similarly the feeder and urban roads will be progressively rehabilitated until by 2013 they are all in fair condition or better.

Base on these assumptions, the road length to be rehabilitated in each year, together with the investment budget has been estimated for years up to 2013. These are shown in Tables 6 and 7 below.

Road Infrastructure
Operational Budgets and Financing

Table 6 Estimated Road Length Rehabilitated Each Year

Road Classification	Total Length (kms)	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-9	2009-10	2010-11	2011-12	2012-13
National	6171	693	1,436	1,249	387	309	-	-	-	-	-	-
Provincial	14,925	-	746	746	1,493	1,493	2,985	2,985	1,493	-	-	-
Rural Feeder Roads	17,000	-	1,700	1,700	1,700	1,700	1,700	1,700	1,700	850	850	-
Urban Roads	2,000	-	200	200	200	200	200	200	200	100	100	-

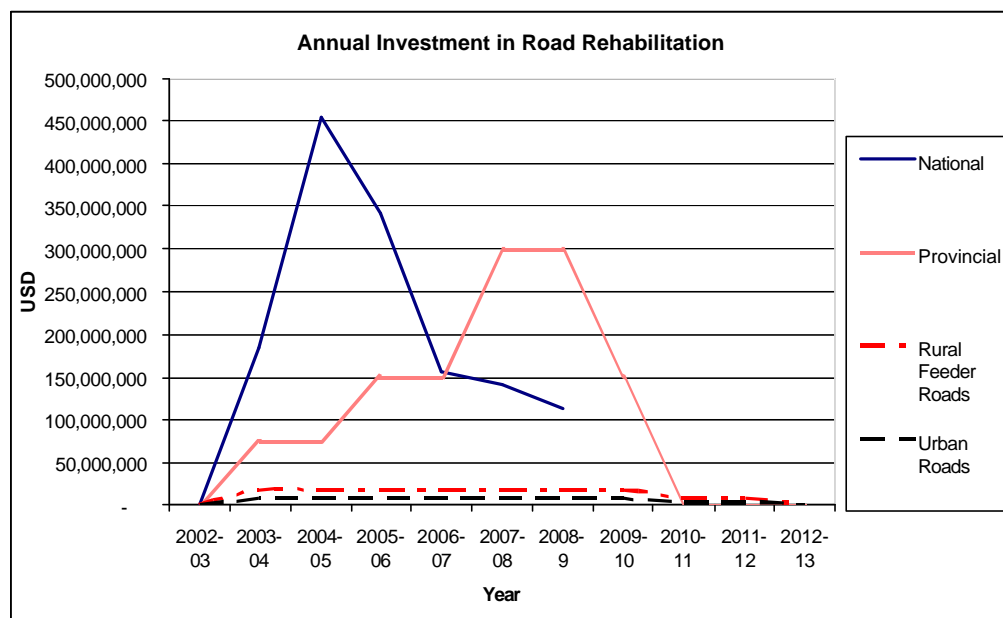
Table 7 Annual Investment Budget for Road Rehabilitation 2002-2013 (USD Millions)

Road Classification	Total Length (kms)	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-9	2009-10	2010-11	2011-12	2012-13
National	6,171	0.0	184.0	453.7	342.3	156.0	142.0	113.0	0.0	0.0	0.0	0.0
Provincial	14,925	0.0	74.6	74.6	149.3	149.3	298.5	298.5	149.3	0.0	0.0	0.0
Rural Feeder Roads	17,000	0.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	8.5	8.5	0.0
Urban Roads	2,000	0.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	3.0	3.0	0.0

Road Infrastructure Operational Budgets and Financing

The investment programme is shown as a chart below.

Figure 1 Annual Investment in Road Rehabilitation



10. Road Maintenance

A road is a physical asset and like all physical assets will deteriorate over time and with use. Maintenance work will be necessary to restore the road to a satisfactory state. This statement embodies the following issues:

- Road deterioration due to age, weathering and natural events (ie. does not depend on traffic volumes)
- Road deterioration (i.e. damage) due to traffic activity – comprising damage caused by different vehicle types.

A newly constructed road or bridge starts to deteriorate from the day it is built. The accumulation of incrementally minor weather and traffic damage will inevitably eventually destroy the asset if it is not actively maintained. It is therefore crucial that an adequate programme of road and bridge maintenance should have first call on the scarce government resources available for the road sector in Afghanistan.

It is often a common misconception among both road users and even among road sector officials in many countries that new roads need no maintenance, or at least not for several years after their construction or reconstruction. This is not correct. Minor maintenance works (eg. Drain cleaning and vegetation clearance) may be needed within only a few weeks after the contractor has left the site. In addition to normal wear and tear, road damage and even potholes can also arise quite quickly especially following unusual weather or road accidents.

Major road construction contracts usually include provision for a “maintenance” or “defects liability” period (typically 12 months) during which the contractor must repair any defects in his work. However such provisions usually only make the

contractor liable for defects in his own workmanship and not for routine maintenance items such as drain cleaning. Arrangements for planned maintenance should be in place from the day the construction contractor leaves the site, and are the responsibility of the road's owner or controlling authority.

Another common fallacy is that when funds are scarce budgets for maintenance can be cut relatively painlessly. One study of roads in Africa (Heggie 1995) found that "When a road is not maintained, and is allowed to deteriorate from good to poor condition, each dollar saved on road maintenance increases the vehicle operating costs by US\$2 to US\$3. Far from saving money, cutting back on road maintenance increases the costs of road transport and raises the net cost to the economy as a whole."

Poor road maintenance also raises the long term cost of maintaining the road network. Heggie noted that the average cost of maintaining a paved road in Africa for 15 years was about US\$60,000/km (1995). However, if the road was not maintained but allowed to deteriorate it would then cost some US\$200,000/km to rehabilitate it. The scenario is similar for gravel roads. Over a 10 year period a gravel road may cost US\$10,000 to US\$20,000/km (1995 costs) for a sustainable maintenance regimen, depending on traffic, climate and other factors. However leaving it without maintenance for 10 years would incur a cost of US\$40,000/km (1995) to rehabilitate the road at the end of that period. In NPV terms and discounted at 12%pa, Heggie's study found that relying on rehabilitation, rather than sustainable maintenance practices, was more expensive by 35% for paved roads and by between 14% and 128% for gravel roads over the long term. This level of unnecessary expenditure is something that poorer countries, especially those in such dire straits as Afghanistan, must strenuously strive to avoid.

This importance of road maintenance may be summed up in the truism:

You pay for good roads whether you have them or not!

A caveat could perhaps also be added – "But you pay less if you do have them!" Saving money by not undertaking a properly planned and optimised road maintenance programme is simply false economy. It will always end up costing road users, tax payers and donors more over the long term.

This is an important issue for Afghanistan given that a large part of the primary road network is about to be rehabilitated. To retain the value of the road investments now being made (which consist of both donor grant funds and loans which must eventually be repaid by the Government of Afghanistan) funds must be allocated and management arrangements instituted for long term maintenance of the road network.

11. Maintenance Activities

Road maintenance may be divided into categories depending on the type of maintenance activity and frequency with which it is carried out. Three categories commonly used are routine maintenance, periodic maintenance and emergency works. Winter maintenance work may be considered as a sub-category of routine maintenance.

12. Routine Maintenance

Routine maintenance, for maintenance management purposes, comprises of the work undertaken, generally on a responsive basis, or with a relatively short planning horizon throughout the year. It consists of minor and usually simple road maintenance activities, typically undertaken one or more times each year on any given road section. It can also include preventative maintenance.

Routine maintenance typically includes:

- Cleaning and removal of silt and debris from roads, road side drains, offshoot drains, culverts, fords, bridges and associated water ways;
- Repairing erosion damage including filling scours in waterways, drains, embankments and cuttings;
- Repairing all minor structural damage to pavements such as potholes, bitumen edge breaks and cracks;
- Spot re-gravelling of gravel roads and gravel shoulders to repair potholes and other surface defects;
- Repairing all minor structural damage to culverts, fords, retaining walls, bridges and other minor and major structures including;
- On bridges, cleaning the deck, scuppers, joints, replacement of deck planks, etc;
- Repair of scour protection works such as gabions and groynes;
- Clean up after small rock and earth slides – particularly where material is on the road or in drains;
- Cleaning and repairing damage to, including replacement of, road signs guard rails, parapet rails and similar features;
- Repainting road lines and markings as necessary to maintain their visibility;
- Cutting back or trimming all road side vegetation before it affects sight distance or road width;
- Bridge and ford maintenance such as minor repairs to expansion joints, deck surfaces, river training works and protective painting of steel work on guard rails, bridge structures, parapet rails and similar features;
- Minor clean up and related work required following a crash, storm, flood or other event;
- Clearance of broken down vehicles – This should properly be the responsibility of the vehicle owner, rather than the road controlling authority. However, in Afghanistan vehicle owners can often not be relied upon to promptly remove immobilised vehicles that are blocking a roadway. This can be a serious problem where trucks break down and completely block very narrow road sections such as mountain passes and tunnels, particularly in winter time. In Afghanistan road controlling authorities (mainly MPW) should have some immediate response capability to clear break downs from critical locations.

The repair of major damage is usually treated as a distinct item that is investigated and planned under a separate rehabilitation project or projects.

Routine maintenance is normally undertaken in line with intervention standards that specify when maintenance work should be undertaken. For example, “clean a culvert barrel when the waterway is blocked or silted more than 15% of the cross-sectional area”.

For management purposes, routine maintenance may be subdivided into responsive and planned routine maintenance. Most items can be planned (even if on a short time horizon) if regular inspections are undertaken to discover the maintenance requirement before it becomes absolutely necessary to undertake response maintenance. For example, bituminous edge breaks can be observed and repaired before they become dangerous and thus the repair work can be planned, scheduled and undertaken accordingly. The alternative is waiting until the edge breaks become dangerous and in need of rapid response work. For good management, the responsive maintenance work should be minimized by the well resourced and managed application of planned maintenance.

13. Winter Maintenance

Winter maintenance is a special case of routine maintenance and comprises the activities required to keep roads and bridges open and serviceable when subject to snow falls and freezing conditions in the winter months. Winter maintenance includes:

- Snow removal by manual labour, snow ploughing and/or grading snow off the traffic lanes
- Clearing snow falls and avalanches
- De-icing of the road pavement and bridge decks by spreading salt or grit

Winter maintenance is necessarily reactive, it is not needed until freezing conditions or snowfall actually occurs. However it must also be planned ahead of time. Although specific snow falls can not be anticipated with accuracy, except perhaps a few hours in advance and then only with good meteorological data, historical trends of climatic conditions and winter maintenance trends provide a good overall basis to allocate funds and resources ahead of each winter season.

14. Periodic Maintenance

Periodic maintenance, for maintenance management purposes, comprises maintenance work undertaken on a scheduled or cyclic basis. It is usually planned on a year-by-year basis and sometime several years in advance. The activities are carried out at intervals of greater than 1 year on any given road section.

On bituminous surfaced road, periodic maintenance is the application of pavement wide treatments designed to preserve the bitumen surface (but not to strengthen the pavement) and includes:

- Deterioration prevention treatments such as fog seals, rejuvenation treatments and slurry seals;

Road Infrastructure Operational Budgets and Financing

- Bitumen surface dressing applications (single or double coat), with or without surface shape correction;
- Asphalt overlays (single or double layers with or without regulation course) designed to repair and/or improve the surface shape that do not add significantly to the structural strength of the pavement (that is, usually less than about 100 mm thick);
- Recycling the base and/or surface layers with a new bitumen surface;
- Stabilization of base and surface layers with a new bitumen surface;
- Reconstruction of a bituminous pavement that results in a change in the pavement strength such as removal of the existing surface, addition of new base and/or sub-base material and a new bitumen surface (asphalt or surface dressing);
- Grading (or blading) gravel shoulders to bituminous surfaced roads;
- Spot resurfacing or re-gravelling gravel shoulders to bituminous surfaced roads; and
- Resurfacing to replace lost shoulder gravel material.

On un-paved (ie. gravel) roads periodic maintenance is roadway wide treatments designed to preserve the gravel running surface and includes:

- Grading (blading) roads the roadway surface and side drains to restore smoothness and drainage flow;
- Spot resurfacing or re-gravelling; and
- Resurfacing (or “re sheeting”) to replace lost pavement surface material (earth or gravel as appropriate) designed to restore the pavement and running surface.

The strengthening, widening or other improvement to the pavement, carriageway or structures is, strictly speaking, not maintenance but improvement work. However from a management viewpoint, maintenance is often taken to include such work provided it is minor and included with other maintenance work. For example, when applying asphalt overlays, minor curve widening may be included in the maintenance activity.

15. Emergency Repairs

As indicated by the name this consists of unpredictable maintenance and repair activities to address emergency situations which close or seriously threaten a road and require urgent attention which is greater in scope than normal routine maintenance.

Emergency repairs are required after the roadway is damaged or a hazard is created by a disaster such as a flood, landslide, rockfall, high wind, vehicle crash or explosion. This work cannot be specifically identified or included in forward plans until the emergency occurs. However funds should be allocated annually as a contingency fund for emergency repairs so as to be available when required.

Minor cleanup and making safe after a disaster and minor repair work is normally included in routine maintenance. When significant repairs are required they are normally identified, designed and undertaken as special items.

16. Maintenance Management

A maintenance programme must ensure that sufficient funds and resources are allocated for each maintenance category (Routine including Winter Maintenance, Periodic, Emergency) on a sustainable basis.

Some fundamental considerations should be kept in mind when planning road maintenance and development in Afghanistan.

- a) Upgrading unsealed (gravel and earth) road sections to bitumen surfaces and improving existing bitumen surfaced and unsealed roads should only be carried out where economically warranted. Given the very poor state of the Afghanistan road network priority must be given to restoring and rehabilitating the many kilometres of previously paved roads to an acceptable condition before consideration can be given to allocating resources to improve roads significantly beyond the best condition they have been in the past.
- b) The target is to maintain the road network in what may be classed as a "fair condition". That is a condition where some road sections may have significant defects but the normal routine and periodic maintenance is sufficient to keep the road and related items (drains, culverts, bridges, signs, etc.) in a safe and trafficable condition. Fair condition should be the minimum condition of any section of the road network. There should be none, or only a very small proportion, of the network in a poor condition, where there are extensive defects and where the normal routine and periodic maintenance is inadequate to keep the road and related items in a safe and motorable state and it requires reconstruction and/or restoration of damage to bring it to a fair condition. Today more than half of Afghanistan's identified road network is in a "poor" condition and a significant part is barely trafficable even to four wheel drive vehicles.
- c) As a priority task, undertake, so called, backlog work to improve the safety and bring the network to a condition where normal ongoing routine and periodic maintenance should be capable of maintaining the network at a suitable level of service. For most of the primary road network currently planned donor funded projects are addressing the maintenance backlog in Afghanistan.
- d) After the backlog work, the first call on available money should be for routine maintenance of the road carriageway, drainage, bridges and road reserve that preserves the asset and the current level of service the road was originally designed to provide. This only applies to road sections in fair condition or better, as those in poor condition cannot be reinstated with routine maintenance alone.
- e) The next call on money should be for periodic maintenance activities on road sections and bridges in fair condition where routine maintenance activities are not the economically best way to preserve the road in a fair condition.

- f) The objectives for the maintenance program are to preserve the road asset and ensure continuing safety and reliability for road users in the economically best way.
- g) If there are any surplus funds remaining after all the maintenance work is undertaken, and the level of service provided by the road network can be maintained in a "fair" condition (i.e., the road network is sustainable), the surplus funds can be used for improvement works. They can only be justified when undertaking the improvement work does not adversely affect the ability of the road controlling authority to maintain the current road network in a sustainable fair and safe condition for road users.
- h) When considering improvement works, their effect on maintenance requirements should be taken into account. Frequently improvements reduce the maintenance requirements in the short term, but increase them in the longer term. However, this reduction in the short-term maintenance requirement does not necessarily compensate for the cost of the improvement work.
- i) A policy of retaining a bitumen surface on all existing bitumen surfaced road sections should be pursued even though this could hinder the development of an optimal road network or conflict with the most economically sound road maintenance, rehabilitation and reconstruction program. A better economic solution could, at least in theory, result from allowing some bitumen-surfaced sections with low traffic volumes to revert to gravel. However, given the poor state of Afghanistan's road network there are few if any road sections that have excessively high standards relative to their transport function and traffic volume.

17. Indicative Maintenance Management Strategy

It is beyond the scope of this study to investigate and recommend a detailed plan of maintenance for the Afghanistan road network. However, for the non urban roads, which make up the bulk of the Afghanistan network indicative maintenance activities and standards are suggested below for:

- Bituminous Surfaced Roads
- Earth Roads
- Gravel Roads

The general description of a strategy for rural roads is as follows:

- for Bituminous Surfaced Roads
 - Pothole repair if > 1 pothole (>300mm dia) / km
 - Edge break repair if > 50m²/km (both sides of road)
 - Single Seal if > 10% damage or 10% ravelling or texture depth < 0.3mm

Road Infrastructure Operational Budgets and Financing

- AC overlay if AADT > 1000 and IRI > 6 apply 50 mm, or mill 50 mm and replace with 100 mm where damage > 40% and AADT > 1000
- for Gravel Roads
 - Grade road every 6 months if AADT<100
 - Grade road every 4 months if AADT 100-200
 - Grade road every 2 months if AADT>200
 - Regravel with 250 mm of compacted material if surface thickness is < 75 mm.
- for all Earth Roads
 - Grade road every 4 to 6 months

As a general guide the above actions will maintain the rural road network in a fair to good trafficable condition. Other miscellaneous routine maintenance activities (drainage repairs, bridge repairs, vegetation clearance, sign repairs etc) are also required on an ongoing basis.

18. Maintenance Budget

An indicative maintenance budget for the entire Afghanistan road network has been estimated and is shown in Appendix 3. The budget assumes that the roads have been restored to at least fair condition throughout and indicates the level of annual funding likely to be required to sustain the network indefinitely. The analysis follows the method outlined in Annexes 3 and 4 of Heggie (1995). The main steps are summarised as follows:

- Subdivide the road network into homogeneous categories based on road type and traffic volumes
- Estimate maintenance needs for each category using tables in Annex 4 of Heggie and adjusting to represent current Afghanistan conditions
- Sum the costs per km of maintaining the different road and traffic categories multiplied by the road length in each category to arrive at overall budget figure.

Due to the lack of base data about the road network and traffic in Afghanistan this analysis is necessarily very broad and contains several far reaching assumptions. These include:

- Assumed network conditions and road lengths, as shown in Table 1 above
- “Normal” truck composition (20% trucks)
- Fleet composition and loading categories assumed similar to typical data for Africa (Heggie 1995)

Road Infrastructure Operational Budgets and Financing

- Unit rates for maintenance items in Afghanistan have been assumed equivalent to worldwide averages drawn from the World Bank ROCKS database (2000)
- ROCKS prices have been escalated at 2.5% pa for three years to approximate Afghanistan prices as at 1 June 2003
- Optimal maintenance costs taken from Heggie Annex 4, adjusted by a combined cost factor proportional to the ROCKS item costs plus escalation to 2003.
- Total maintenance costs have been apportioned between fixed (non vehicle-dependant) and variable (traffic and load dependant) components using typical ratios from Heggie (1995). This can be used to indicate what proportion should be deemed recoverable from road users so that heavy vehicles cover their variable costs.

The estimated funds required to sustainably maintain Afghanistan's rehabilitated road network is approximately USD 117m pa, which is divided as shown in Table 3. Additional details are shown in Appendix 3.

Road Infrastructure
Operational Budgets and Financing

Table 8 Maintenance Costs

**Annual Cost of Maintaining the Afghanistan Road Network
(After Rehabilitation)**

Road Classification	Length (km)	AADT	Routine Maintenance (USD millions)	Periodic Maintenance (USD millions)	Total
National Roads					
Paved	3,300	1,000	10,977,865	12,323,140	23,301,004
Gravel	2,671	300	2,687,126	8,629,125	11,316,251
Earth	200	50	187,384	0	187,384
Sub Total	6,171		13,852,374	20,952,264	34,804,639
Provincial Roads					
Paved	200	300	551,427	339,743	891,170
Gravel	10,994	300	11,060,125	35,517,199	46,577,324
Earth	3,731	50	3,495,874	0	3,495,874
Sub Total	14,925		15,107,426	35,856,942	50,964,368
Rural Feeder Roads					
Paved	0	-	0	0	0
Gravel	2,550	50	2,537,370	6,045,029	8,582,399
Earth	14,450	50	13,538,460	0	13,538,460
Sub Total	17,000		16,075,829	6,045,029	22,120,858
Urban Roads					
Paved	300	1,000	997,988	509,614	1,507,602
Gravel	1,700	300	1,710,264	5,492,142	7,202,406
Earth	0	-	0	0	0
Sub Total	2,000		2,708,252	6,001,757	8,710,008
Totals	40,096		47,743,881	68,855,992	116,599,873

**Total Annual Maintenance Cost (Routine + Periodic + Winter +
Emergency)
= USD 116,599,873 pa**

The average cost of maintaining each road surface type is therefore as shown in Table 4.

Road Infrastructure
Operational Budgets and Financing

Table 9 Average Maintenance Costs

Surface Type	Total kms	Average Cost USD	Difference USD
Paved	3,800	6,763/km-yr	2,650/km-yr
Gravel	17,915	4,113/km-yr	3,176/km-yr
Earth	18,381	937/km-yr	
Whole Network Average	40,096	2,908/km-yr	

It can be seen, based on the given assumptions, that improving earth roads to a gravel surface incurs an extra maintenance cost of USD3,200/km-year and from gravel to a paved surfaced costs a further USD2,650/km-yr. The above incremental costs are indicative only but provide approximate the maintenance cost increases attributable to road improvements. Road upgrading projects should only be undertaken on the basis of a life cycle analysis to confirm the economic benefits of the investment.

Note that the costs in Tables 3 and 4 assume that an optimum maintenance programme is being applied to roads that have been rehabilitated and are thus already in good or fair condition. They do not include any allowance for improving poor roads to a better condition.

19. Maintenance Programme

It will take several years of rehabilitation works before all the roads have been improved to the level at which an optimal programme of normal road maintenance (ie. Routine, periodical, winter plus emergency maintenance) can sustain them in a fair to good condition. Estimates have been made of the minimum budget required for road maintenance in the intermediate years while the network is being rehabilitated. This is based on the following assumptions:

- The donor programme will be implemented generally as set out in Section 7 above. This will improve the full National road network (6,171km) up to at least fair condition by 2007.
- Although currently under-funded, it is assumed that money will be found to rehabilitate the Provincial road network so that it is all (14,925km) in fair condition or better by 2011.
- Similarly the feeder and urban roads will be progressively rehabilitated until by 2013 they are all in fair condition or better.

Base on these assumptions, the percentage of road length to receive normal maintainance, and the maintenance budget required have been estimated for the intermediate years up to 2013. These are shown in Tables 5 and 6 below.

Road Infrastructure
Operational Budgets and Financing

Table 10 Percentage of Road Length in Good or Fair Condition 2002-2013

Road Classification	Total Length (kms)	Percent in "Good" or "Fair" Condition										
		2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
National	6,171	34%	45%	68%	89%	95%	100%	100%	100%	100%	100%	100%
Provincial	14,925	20%	20%	25%	30%	40%	50%	70%	90%	100%	100%	100%
Rural Feeder Roads	17,000	20%	20%	30%	40%	50%	60%	70%	80%	90%	95%	100%
Urban Roads	2,000	20%	20%	30%	40%	50%	60%	70%	80%	90%	95%	100%

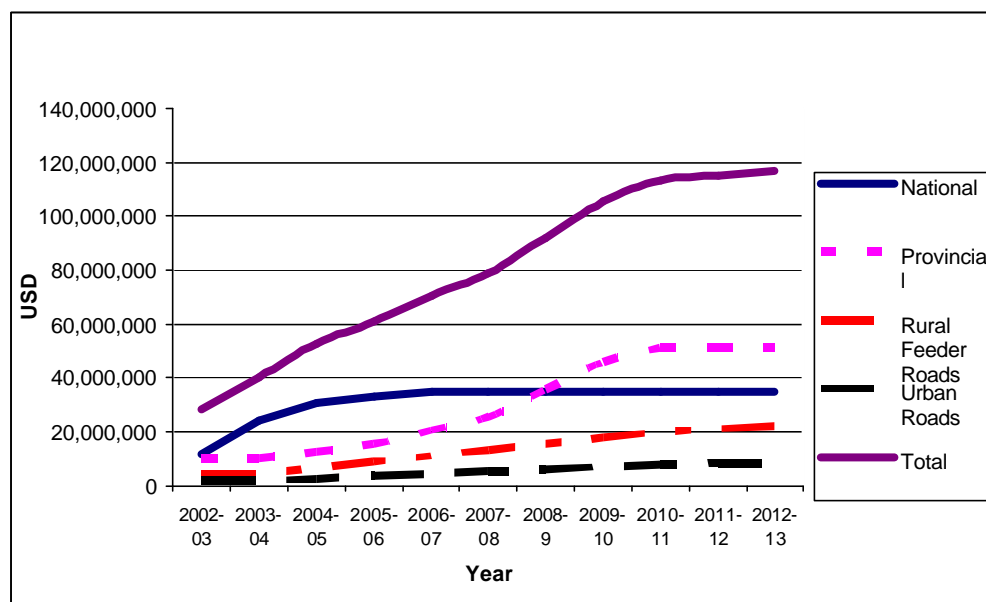
Table 11 Annual Maintenance Budgets 2002-2013 (USD Millions)

Road Classification	Total Length (kms)	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
National	6,171	11.8	23.8	30.9	33.1	34.8	34.8	34.8	34.8	34.8	34.8	34.8
Provincial	14,925	10.2	10.2	12.7	15.3	20.4	25.5	35.7	45.9	51.0	51.0	51.0
Rural Feeder Roads	17,000	4.4	4.4	6.6	8.8	11.1	13.3	15.5	17.7	19.9	21.0	22.1
Urban Roads	2,000	1.7	1.7	2.6	3.5	4.4	5.2	6.1	7.0	7.8	8.3	8.7
Total	40,096	28.2	40.2	52.9	60.7	70.6	78.8	92.1	105.3	113.5	115.1	116.6

Road Infrastructure Operational Budgets and Financing

The following figure shows the annual maintenance budget in chart form.

Figure 2 Annual Maintenance Costs 2002-2013



Note that after the entire road network is rehabilitated in about 2013 there will continue to be further growth in the maintenance costs as the network is expanded and roads continue to be upgraded in response to increasing traffic demands and economic growth.

20. Financing

The donor funded programme (Appendix 1) may be separated into loan and grant funded components, as shown in the table below.

Table 12 Financing of Donor Projects

Type of Finance	Road Length Kms	Amount USD
Loan	2,433	528,000,000
Grant	1,838	703,319,862
Not known or not funded	480	159,656,644
Total	4,751	1,390,976,506

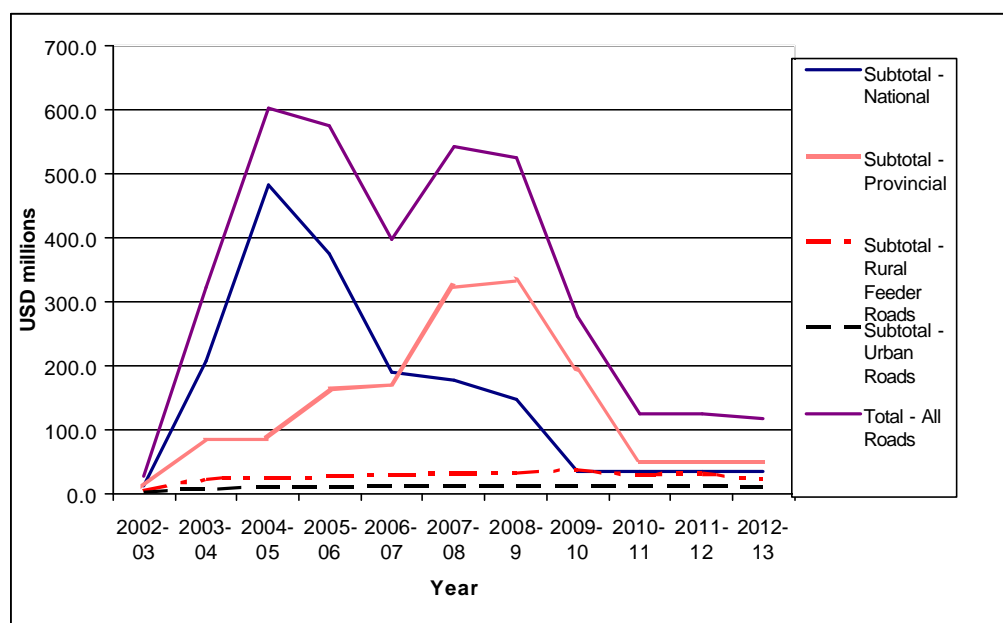
At this stage the bulk of the donor funds are being made available as grant money. As this is consumed and rehabilitation projects are completed over the next few years it is probable that new donor funds will increasingly come as loans. It is understood that the loans currently under negotiation, and considering the very difficult

Road Infrastructure Operational Budgets and Financing

circumstance of Afghanistan, they are being offered on very soft terms. Some examples of the latter include 40 year repayment periods, capitalisation of principal and interest with no repayments within the first 10-years and interest rates as low as 0.5% pa..

The total budget requirements to rehabilitate and maintain the network are summarised in Table 12 and the data is presented graphically on the chart below.

Figure 3 Total Annual Cost of Afghanistan Road Network



The chart illustrates the initial priority being given to rehabilitation of the national roads, with the major effort being expended up to about 2005 and then trailing off. It has been assumed that the provincial network will take considerably longer to be fully rehabilitated. This may take until 2011. The urban roads and rural feeder roads can be rehabilitated with a more uniform annual effort. By 2012 it is assumed in Figure 3 that all rehabilitation is completed and the only ongoing effort thereafter is for maintenance of the network (about USD116m pa). This is a simplification because investment projects will still be required to replace older infrastructure (eg. bridges) and upgrade roads to cope with increasing traffic volumes due to normal economic development.

Road Infrastructure
Operational Budgets and Financing

Table 13 Summary of Required Road Budget

Road Classification & Type of Road Works		2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
National	Maintenance	23.8	30.9	33.1	34.8	34.8	34.8	34.8	34.8	34.8	34.8
National	Rehabilitation	184.0	453.7	342.3	156.0	142.0	113.0	0.0	0.0	0.0	0.0
Subtotal – National Roads		207.8	484.5	375.4	190.8	176.8	147.8	34.8	34.8	34.8	34.8
Provincial	Maintenance	10.2	12.7	15.3	20.4	25.5	35.7	45.9	51.0	51.0	51.0
Provincial	Rehabilitation	74.6	74.6	149.3	149.3	298.5	298.5	149.3	0.0	0.0	0.0
Subtotal - Provincial		84.8	87.4	164.5	169.6	324.0	334.2	195.1	51.0	51.0	51.0
Rural Feeder Roads	Maintenance	4.4	6.6	8.8	11.1	13.3	15.5	17.7	19.9	21.0	22.1
Rural Feeder Roads	Rehabilitation	17.0	17.0	17.0	17.0	17.0	17.0	17.0	8.5	8.5	0.0
Subtotal - Rural Feeder Roads		21.4	23.6	25.8	28.1	30.3	32.5	34.7	28.4	29.5	22.1
Urban Roads	Maintenance	1.7	2.6	3.5	4.4	5.2	6.1	7.0	7.8	8.3	8.7
Urban Roads	Rehabilitation	6.0	6.0	6.0	6.0	6.0	6.0	6.0	3.0	3.0	0.0
Subtotal - Urban Roads		7.7	8.6	9.5	10.4	11.2	12.1	13.0	10.8	11.3	8.7
Total - All Roads		321.8	604.2	575.2	398.9	542.3	526.6	277.6	125.0	126.6	116.6

Road Infrastructure Operational Budgets and Financing

By combining data from Table 2 (Donor funding), Table 4 (likely government funding and Table 13 (total required road budget) the current budget shortfall can be estimated as shown in the following table.

Table 14 Overall Road Budget Financing (USD millions)

	Donor	Government	Shortfall	Total - All Roads
2003-04	184.0	24.0	113.8	321.8
2004-05	453.7	66.0	84.5	604.2
2005-06	342.3	63.1	169.8	575.2
2006-07	156.0	69.4	173.4	398.9
2007-08	142.0	76.4	323.9	542.3

The large donor contributions (grants and loan funds) currently flowing into Afghanistan are, of course, only intended as a temporary measure to help the country back on its feet. Further sustainable sources of funds are still required to complete the necessary road rehabilitation, for road maintenance, and to a lesser extent for new construction over the long term. Despite the current donor contributions there will be a large shortfall to be financed by the government directly or from other sources. The issue of road funding sources and mechanisms in Afghanistan has been addressed in detail in the separate TSR consultation paper “2.3 Funding” which forms another part of this Road Infrastructure Report. Recommendations regarding institutional arrangements for administration of the different levels of the road network are also contained therein.

21. Conclusion

This paper has reviewed and presented preliminary work programmes and developed budget estimates to first rehabilitate and then maintain the Afghanistan road network. The Budget estimates have been separated into four main network components (ie. National, Provincial, Rural Feeder Roads and Urban Roads) . The budget has also been separated into estimates for rehabilitating existing roads (including bridges) to restore them to fair condition or better and the costs of optimum maintenance works that will sustain each network component at the required condition into the future. Cost estimates for these items are shown in Tables 11 and 12 above.

Due to the dearth of accurate or current data about the condition of the Afghanistan’s roads, and the lack of recent unit rates and tender prices, many assumptions and approximations have been adopted in preparing this report. For this reason the costs in this paper can only be considered as “ball park” estimates and should be reviewed and refined as development of the road sector takes place and new data comes to hand in the future. Two of the top priorities should be to review and update the current functional classification system for roads and to carry out a thorough condition survey of all roads and bridges, starting with the national roads but extending to all levels of the road hierarchy. These will provide the base data to assess much more accurately the true extent of road rehabilitation and maintenance required for Afghanistan.

A further, and most critical, priority is to put in place adequately resourced arrangements to sustainably maintain the road infrastructure and thus preserve the

benefits of the current investments in road rehabilitation. Without proper maintenance the roads will inevitably deteriorate resulting in huge costs to road users and the need for further major rehabilitation efforts within less than 10 years.

References

Afghanistan Assistance Coordination Authority, Transport Programme, 1382 Public Investment Programme, 12 March 2003

Afghanistan Construction and Logistics Unit (ACLU) and USAID, Afghanistan Road Condition Survey (ARCS) database, 1991-94

Asian Development Bank (ADB) Comprehensive Needs Assessment for Rehabilitation and Reconstruction in the Transport Sector – Afghanistan, August 2002

Heggie, Ian G. Managing and Financing of Roads - An Agenda for Reform, World Bank Technical Paper Number 275, Africa Technical Series, 1995

Interim Afghanistan Administration (IAA), Draft Afghanistan National Development Framework (NDF), April 2002.

United Nations Environment Programme (UNEP), Afghanistan Post-Conflict Environmental Assessment, 2003. ISBN 92-1-158617-8

World Bank Roads and Highways Thematic Group, ROCKS – Road Costs Knowledge System, Version 2.01, 9 September 2002

Appendix 1

Donor Funded Road Rehabilitation Projects

No.	From			To			Description	Length km	Donor	Finance	Total Value USD	Cashflow Estimate					
	Location	Province	Via	Location	Province	Road Type						2003-04	2004-05	2005-06	2006-07	2007-08	2008 +
1	Kandahar	Kandahar		Kandahar	Kandahar	Urban		9	Japan	Grant	1,242,825		1,242,825				
2	Kabul	Kabul		Sarobi		Primary		68	EU	Grant	55,000,000	10,000,000	45,000,000				
3	Sarobi			Jalalabad		Primary		74	EU	Grant	38,000,000		38,000,000				
4	Jalalabad			Torkham	Nangarhar	Primary		80	Pakistan	Grant	40,000,000			40,000,000			
5	Kabul	Kabul		Sur Pol	Wardak	Primary	Minor rehab only	43	USA	Grant	15,000,000		10,000,000	5,000,000			
6	Sur Pol (south of Maidanshar)	Wardak		Salar	Wardak	Primary	km 43 to 92 on K-K road	49	USA	Grant	33,000,000	16,000,000	17,000,000				
7	Salar	Wardak		Ghazni	Ghazni	Primary	km 92 to 142 on K-K Road	50	USA	Grant	29,000,000	20,000,000	9,000,000				
8	Ghazni	Ghazni		W of Shar-e-Safa	Zabul	Primary	km 142 to 442 on K-K Road	300	USA	Grant	103,000,000	55,000,000	40,000,000	8,000,000			
9	W of Shar-e-Safa	Zabul		Kandahar	Kandahar	Primary	km 442 to 492 on K-K Road	50	Japan	Grant	25,000,000	10,000,000	15,000,000				
10	Kandahar	Kandahar		Gereshk	Helmand	Primary	km 0 to 116 on K-H Road	116	USA	Grant	35,000,000	10,000,000	15,000,000	10,000,000			
11	Gereshk (Km116)	Helmand		Herat	Herat	Primary	km 116 to 588 on K-H Road	472	USA/Japan/Saudi ?	Grant	186,196,121		36,196,121	50,000,000	50,000,000	50,000,000	
12	70km W of Kandahar	Helmand		Lashkar-Gar	Helmand	Provincial		43	USA	Grant	15,000,000		10,000,000	5,000,000			
13	Kandahar	Kandahar		Spin-Boldak	Kandahar	Primary		105	ADB	Grant	11,000,000	8,000,000	3,000,000				
14	Pul-e-Khumri	Baghlan		Mazar-e-Sharif	Balkh	Primary		203	ADB	Loan	35,000,000	5,300,000	16,000,000	13,700,000			
15	Mazar-e-Sharif	Balkh		Shiberghan	Jowzjan	Primary		150	ADB	Loan	36,000,000	2,000,000	17,000,000	17,000,000			
16	Shiberghan	Jowzjan		Andkhoy	Faryab	Primary		82	ADB	Loan	19,000,000		5,000,000	10,000,000	4,000,000		
17	Andkhoy	Faryab	Meymanah	Herat	Herat	Primary		540	ADB	Loan	150,000,000		10,000,000	50,000,000	50,000,000	40,000,000	

No.	From			To			Description	Length km	Donor	Finance	Total Value USD	Cashflow Estimate				
	Location	Province	Via	Location	Province	Road Type						2003-04	2004-05	2005-06	2006-07	2007-08
18	Andkhoy	Faryab		Aquina	Faryab	Primary	to Turkmenistan Border	40	ADB	Loan	9,000,000					9,000,000
19	Naibabad	Balkh	Chagcharan	Hairatan	Balkh	Primary	to Termez, Uzbek border	55	ADB	Loan	7,000,000			7,000,000		
20	Bamian	Bamian		Herat	Herat	Secondary		732	ADB	Loan	150,000,000			30,000,000	30,000,000	30,000,000
21	Herat	Herat		Islam Qala	Herat	Primary	to Iran border	123	Iran	Grant	20,020,544	10,010,272	8,008,218	2,002,054		
22	Delaram	Nimroz		Zaranj	Nimroz	Primary	to Iran border	216	Iran & India	Grant	35,155,911	8,788,978	17,577,955	8,788,978		
23	Charikar	Parvan		Bamian	Bamian	Secondary	Alt route Kabul to Bamian		Italy or World Bank?	Grant	20,000,000		10,000,000	10,000,000		
24	Maidanshar	Kabul	Syahkhak	Gardan Diwal	Wardak	Secondary		40	Italy	Grant	41,704,461	2,000,000	25,000,000	14,704,461		
25	Gardan Diwal	Wardak		Bamian	Bamian	Secondary	Not funded ?	100	Italy/Iran ???	?	88,042,752				22,010,688	22,010,688
26	Kabul	Kabul		Doshi	Baghlan	Primary		177	World Bank	Loan	21,840,000	10,000,000	11,840,000			
27	Doshi	Kabul		Pol-e-khomri	Baghlan	Primary		47	World Bank	Loan	9,360,000	4,360,000	5,000,000			
28	Pol-e-khomri	Baghlan		Shirkhan Bandar	Kunduz	Primary		169	World Bank	Loan	37,800,000		17,800,000	20,000,000		
	Shirkhan Bandar	Kunduz		Tajikistan	-	Primary	Bridge to replace ferry across Amu Darya River	1	USAID	Grant	10,000,000		10,000,000			
29	Kunduz	Kunduz		Taloqan	Takhar	Secondary		68	World Bank	Loan	20,000,000		20,000,000			
30	Taloqan	Takhar		Faizabad	Badakhshan	Secondary		169	World Bank	Loan	23,000,000	6,000,000	17,000,000			
31	Jalalabad	Nangarhar	Assadabad	Kamdes	Nuristan	Secondary		160	?	?	35,806,946	6,510,354	14,000,000	15,296,592		
32	Kabul	Kabul		Khost	Khost	Primary	Not funded ?	220	?	?	35,806,946		10,000,000	25,806,946		

Exchange Rates USD1.00 =
AFA 41.4724
EUR 0.8632

Totals 4,751
Average Cost 292,776 /km

1,390,976,506 183,969,603 453,665,119 342,299,032 156,010,688 142,010,688 113,021,376

Appendix 2

Donor prog?	2.1 TRANSPORT		Total proposed funding (\$USDm)					Total funded component (\$USDm)						
	Project name	kms	Ministry	1381	1382	1383	1384	Total	1381	1382	1383	1384	Total	
				2003	2004	2005	2006		2003	2004	2005	2006		
	2.1.1 ROADS													
	INFRASTRUCTURE:													
	Technical Assistance - Support/Training		AFG/ 03257	MPW				4.40					4.40	
	Technical Assistance - Support/Training		AFG/ 03001	MPW	0.50	0.60		1.10	0.50	0.60			1.10	
	1 Institutional and Policy Studies		AFG/ 03259	MPW/M CAT	0.70	0.80		1.50	0.70	0.80			1.50	
	2 Bridges, Culverts, Reconstruction, etc		AFG/ 03002	MPW	1.00			1.00	1.00				1.00	
	3 Kabul-Jalalabad - Torqum - Emergency rehab.		AFG/ 03003	MPW	0.85			0.85	0.85				0.85	
	4 Old Road of Baglan/Second line Kabul/Chahricor		AFG/ 03423	MPW		1.50		1.50						
	5 Herat-Kalau Now-Maimana MPW rehab. 15 kms	15	AFG/ 03005	MPW		0.50		0.50						
	6 Jalalabad-Asad Abad MPW rehab 15 kms	15	AFG/ 03006	MPW		1.50		1.50						
	7 Kabul-Gardaiz-Khost MPW rehab 20 kms	20	AFG/ 03007	MPW		2.00		2.00						
	8 Re-equip Dept. of Construction		AFG/ 03008	MPW	0.10	5.00		5.10	0.10				0.10	
	9 Emergency Works - 7 bridges		AFG/ 03009	MPW		1.50		1.50						
	10 Surkhakan-Lakhmon - rehab (1381 budget)		AFG/ 03010	MPW		1.70		1.70						
	11 Kandahar-Tirin Kot 173 kms - feasibility	173	AFG/ 03259	MPW	1.00	12.50	12.50	26.00						
	12 Maimana-Andkhoy-Aquina rehab - 157 kms - feasibility	157	AFG/ 03011	MPW		1.00	9.30	9.70	20.00					
	13 Pul-e-Khumri-Mazar-e-Sharif rehab 188 kms	188	AFG/ 03013	MPW		6.00	13.00	6.30	25.30	6.00	13.00	6.30	25.30	
	14 Mazar-e-Sharif-Shiberghan rehab 132 kms	132	AFG/ 03018	MPW			6.00	20.00	26.00		6.00	20.00	26.00	
	15 Shiberghan-Andkhoy rehab. 72 kms	72	AFG/ 03021	MPW		2.00	12.00	14.00			2.00	12.00	14.00	
	16 Andkhoy-Aquina rehab. 36 kms	36	AFG/ 03023	MPW		9.00		9.00			9.00		9.00	
	17 Naibabad-Hairatan rehab. 55 kms	55	AFG/ 03032	MPW		7.00		7.00			7.00		7.00	
	18 Kabul-Doshi; Pol-e-Khumri-Shirkan; Salang etc	347	AFG/ 03014	MPW		20.00	30.00	17.10	67.10	20.00	30.00	17.10	67.10	
	19 Kabul-Jalalabad-Torqum - rehab. 220 kms	220	AFG/ 03016	MPW		48.00	20.00	68.00		20.00	48.00	20.00	88.00	
	20 Kabul-Ghazni-Qalat-Kandahar rehab. 450 kms	450	AFG/ 03017	MPW	9.20	50.00	95.00	63.90	218.10	9.20	93.90	45.00	10.00	158.10
	21 Kandahar-Spin Boldak rehab. 108 kms	108	AFG/ 03026	MPW		5.70	5.00	10.70		5.70	5.00		10.70	
	22 Herat-Chagcharan-Bamian - rehab. 732 kms	732	AFG/ 03028	MPW				219.60	219.60					
	23 Bamian-Kabul rehab. 140 kms	140	AFG/ 03260	MPW		12.00	35.00	47.00		15.00			15.00	
	24 Herat-Islam Qala rehab. 123 kms	123	AFG/ 03030	MPW		4.50	9.50	4.50	18.50	4.50	9.50	4.50	18.50	
	25 Herat-Torgundi rehab. 160 kms	160	AFG/ 03029	MPW		12.00	20.00	32.00						
	26 Herat-Maimana rehab. 613 kms	613	AFG/ 03019	MPW		46.10	46.10	92.20			46.10	46.10	92.20	
	27 Kandahar to km 116 (towards Herat) & Secondary road Kashkar Gar. 116 kms and 43 kms rehab.	159	AFG/ 03027	MPW		22.00	28.00	50.00		22.00	28.00		50.00	
	28 Km 116 (Kandahar) to Herat rehab. 472 kms	472	AFG/ 03261	MPW			30.00	141.60	171.60					
	29 Delaram-Zaranj rehab. 216 kms	216	AFG/ 03031	MPW		8.10	16.20	8.10	32.40					
	30 Jalalabad-Asad Abad-Kamdish rehab. 160 kms	160	AFG/ 03020	MPW		6.00	13.50	13.50	33.00					
	31 Kabul-Khost rehab. 220 kms.	220	AFG/ 03024	MPW			6.00	27.00	33.00					
	32 Torquan-Faizabad;Charikor-Bamian rehab. Secondary roads. 329 kms	329	AFG/ 03034	MPW			11.00	27.00	38.00		11.00	27.00	38.00	
	33 Delaram-Chaghcharam rehab. 377 kms.	377	AFG/ 03428	MPW			0.15	56.60	56.75					
	34 Bamian-Mazar-e-Sharif rehab. 360 kms	360	AFG/ 03433	MPW			0.15	54.00	54.15					
	35 Bamian-Doshi rehab. 160 kms	160	AFG/ 03437	MPW			0.06	24.00	24.06					
	36 Chaghchoran-Maimana 335 kms	335	AFG/ 03445	MPW			0.07	50.30	50.37					
	37 Jabalsaraj-Panjshir-Karmanjan-Zebax rehab. 340 kms	340	AFG/ 03447	MPW			0.07	51.00	51.07					
	38 Gardes-Ghazni rehab. 85 kms	85	AFG/ 03038	MPW			0.05	12.90	12.95					
	39 Pul Alam-Ghazni rehab. 80 kms	80	AFG/ 03448	MPW			0.05	12.00	12.05					
	40 Gardiz-Sharan Orgon rehab. 115 kms	115	AFG/ 03451	MPW			0.05	17.30	17.35					
	41 Shiberghan-Sar e Pule-Bulcharagh rehabilitation 135 kms	135	AFG/ 03454	MPW			0.05	20.30	20.35					

2.1 TRANSPORT		Total proposed funding (\$USDm)					Total funded component (\$USDm)					
Donor prog?	Project name	Ministry	1381	1382	1383	1384	Total	1381	1382	1383	1384	Total
	kms		2003	2004	2005	2006		2003	2004	2005	2006	
	42 Khangean-Andarab-Khostfeng-Naren_Baghlan rehab 260 kms.	260 AFG/03455 MPW			0.05	39.00	39.05					
	43 Qurghaly-Kaghman-Noorstan rehab. 67 kms	67 AFG/03544 MPW			0.05	10.10	10.15					
	44 Shekhabad-Chak-Bahsod rehab. 110 kms	110 AFG/03463 MPW			0.05	16.50	16.55					
	45 Khost-Ghulamkhan rehab. 70 kms	70 AFG/03465 MPW			0.05	10.50	10.55					
	46 Labour Based Public Works	AFG/03039 MPW		12.20	20.00	9.80	42.00		12.20	20.00	9.80	42.00
	47 7 pre-fabricated bridges	AFG/03467 MPW	1.00				1.00	1.00				1.00
	48 Bridge Reconstruction - Zaranj	AFG/03469 MPW										
	Totals	7,806	13.35	180	473	1033.2	1699.55	13.35	205.1	279.6	172.8	670.85
	Subtotals	4,032 Donor Prog 3,774 non-Donor	9.20 4.15	128.30 51.70	364.30 108.70	573.40 459.80	1,075.20 624.35	9.20 4.15	181.10 24.00	213.60 66.00	109.70 63.10	513.60 157.25
	Average Cost/km	Donor Prog non-Donor Total	USD 2,282/km USD 1,100/km USD 1,710/km	USD 31,820/km USD 13,699/km USD 23,059/km	USD 90,352/km USD 28,802/km USD 60,594/km	USD 142,212/km USD 121,834/km USD 132,360/km	USD 266,667/km USD 165,435/km USD 217,724/km	USD 2,282/km USD 1,100/km USD 1,710/km	USD 44,916/km USD 6,359/km USD 26,275/km	USD 52,976/km USD 17,488/km USD 35,819/km	USD 27,207/km USD 16,720/km USD 22,137/km	##### USD 41,667/km USD 85,940/km
	Source: AACA May 2003											

Appendix 3

List of the roads have not been yet included in the index of the donor countries

	Description	Length Km	Cost USD
	(Note 1)	(Note 1)	(Note 2)
1	Kandahar-Bamyan Road	657	65,700,000
2	Bamyan-Mazare-Sharif Road	380	38,000,000
3	Doshi-Bamyan Road	160	16,000,000
4	Jabalsaraj-Panjshir-Karmanjan-Zebak Road	335	33,500,000
5	Gardez-Ghazni Road	86	8,600,000
6	Pule-Alam-Ghazni Road	80	8,000,000
7	Gardez-Shran-Orgon Road	115	11,500,000
8	Shiberghan-Sare-Pul-Belcharagh Road	135	13,500,000
9	Khinjan-Andarab-Khost-Freng-Nahrin-Baghlan Road	260	26,000,000
10	Laghman-Nooristan Road	67	6,700,000
11	Shaikhabad-Chak-Behsood Road	110	11,000,000
12	Jalalabad-Asadabad-Kamdesh Road	220	22,000,000
13	Delaram-Chaghcharan Road	377	37,700,000
14	Chaghcharan-Bamyan Road	344	34,400,000
15	Herat-Chaghcharan Road	351	35,100,000
16	Khost-Ghulam Khan Road	70	7,000,000
17	Kabul-Gardez-Khost Road	220	22,000,000
18	Herat-Turghundi Road	119	11,900,000
	Total	4,086	408,600,000

Note 1: Source: Ministry of Public Works, June 2003

Note 2: Cost based on USD100,000/km (Consultant's Estimate)

Appendix 4

Cost of Maintaining the Afghanistan Road Network (After All Routes have been Rehabilitated)

Road Classification	Length (km)	AADT	Routine Maintenance (USD millions)			Periodic Maintenance (USD millions)			Totals by Classif'n
			Fixed	Variable	Total	Fixed	Variable	Total	
National Roads									
Paved	3,300	1,000	1,646,680	9,331,185	10,977,865	7,396,196	4,926,944	12,323,140	
Gravel	2,671	300	1,237,433	1,449,693	2,687,126	3,643,802	4,985,323	8,629,125	
Earth	200	50	36,184	151,200	187,384			0	
Sub Total	6,171				13,852,374			20,952,264	34,804,639
Provincial Roads									
Paved	200	300	441,141	110,285	551,427	294,418	45,325	339,743	
Gravel	10,994	300	5,093,236	5,966,889	11,060,125	14,997,771	20,519,428	35,517,199	
Earth	3,731	50	675,049	2,820,825	3,495,874			0	
Sub Total	14,925				15,107,426			35,856,942	50,964,368
Rural Feeder Roads									
Paved	0	-			0			0	
Gravel	2,550	50	461,340	2,076,030	2,537,370	3,022,514	3,022,514	6,045,029	
Earth	14,450	50	2,614,260	10,924,200	13,538,460			0	
Sub Total	17,000				16,075,829			6,045,029	22,120,858
Urban Roads									
Paved	300	1,000	149,698	848,290	997,988	441,627	67,987	509,614	
Gravel	1,700	300	787,584	922,680	1,710,264	2,319,155	3,172,987	5,492,142	
Earth	0	-			0			0	
Sub Total	2,000				2,708,252			6,001,757	8,710,008
Totals	40,096				47,743,881			68,855,992	

Total Annual Maintenance Cost (Routine + Periodic + Winter + Emerg') = **USD 116,599,873 pa**

Surface Type	Total kms	Average Cost USD	Difference
Paved	3,800	6,763 /km	2,650
Gravel	17,915	4,113 /km	3,176
Earth	18,381	937 /km	
Whole Network	40,096	2,908 /km	

Surface Type	Maintainance Type	Total kms	Average Cost USD
Paved	Routine	3,800	3,297 /km
Paved	Periodic	3,800	3,466 /km
Gravel	Routine	17,915	1,004 /km
Gravel	Periodic	17,915	3,108 /km
Earth	Routine	18,381	937 /km
Earth	Periodic	18,381	0 /km
		40,096	

Maintenance Costs

Description	Unit	Financial Cost 1995 (Note 1)	Financial Cost 2000 (Note 2)	Cost Factor	Financial Cost 2003 (Note 3)	Add Snow Removal (Note 4)	Add Emerg' Repairs 5%	Total Financial Cost 2003	Fixed Cost	Variable Cost	Fixed %	Variable %
<i>Data Source</i>												
Maintenance Activities - Paved Roads (Note 5)					2.50% PA							
Routine Maintenance (1000 AADT)	USD/km-yr	2,200	2,600	1.18	2,800	200	327	3,327	499	2,828	15.00%	85.00%
Routine Maintenance (300 AADT)	USD/km-yr	1,850	2,186	1.18	2,354	200	203	2,757	2,206	551	80.00%	20.00%
Reseal (single)	USD/km-yr	22,400	27,700	1.24	29,830	-	-	29,830				
Asphalt Overlay (~40mm)	USD/km-yr	56,000	70,000	1.25	75,382	-	-	75,382				
Average=				1.21								
Total Maintenance Costs - Paved Roads (Note 6)												
1000 AADT	USD/km-yr	5,004	6,068	1.21	6,534	-	-	7,061	2,740	4,321	38.81%	61.19%
300 AADT	USD/km-yr	3,104	3,764	1.21	4,053	-	-	4,456	3,678	778	82.54%	17.46%
Periodic Maintenance Costs - Paved Roads (Note 7)												
1000 AADT	USD/km-yr				3,734			3,734	2,241	1,493	60%	40%
300 AADT	USD/km-yr				1,699			1,699	1,472	227	87%	13%

Note 1 Rates taken from: Heggie, Ian; Management and Financing of Roads, World Bank Technical Paper 275, 1995

Note 2 Data from World Bank ROCKS - Road Costs Knowledge System (v2.01, 9/09/02)

Note 3 Excluding snow removal & emergency repairs. 2003 costs escalated at 2.5%pa for 3 years from 2000-2003

Note 4 Consultant's estimate, Assuming USD2000/km-yr for 10% of road network

Note 5 Data from Heggie 1995, Tables A4.1 & A4.3

Note 6 Data from Heggie 1995, Table A4.2, modified Structural Number (SNC) = 3, multiplied by Average Cost Factor to get 2000 estimate

Note 7 Periodic = Total - Routine

Note 8 2003 costs escalated at 2.5%pa for 3 years from 2000-2003

					Gravel Roads						Earth Roads		
		Base Unit	2000 Rate USD/unit	2003 Rate USD/unit	300 AADT			50 AADT			50 AADT		
Average Annual Maintenance Costs					M	F	V	M	F	V	M	F	V
Routine	Grading	km	120	129	4	0	517	6	0	775	3	0	720
Routine	Other Routine Maintenance	km-yr	as shown	as shown	1	241	0	1	172	0	1	172	0
Routine	Snow Removal (assume 10% of length)	km		2,000	1	200	0	0	0	0	0	0	0
Routine	Emergency Repairs (Allow 5% of above)	km				22	26		9	39		9	36
Sub Total - Routine Maintenance						463	543		181	814		181	756
Periodic	Regravelling	km	12,000	12,923	0.25	1,364	1,866	0.11	1,185	1,185	0	0	0
Total Costs						1,827	2,409		1,366	1,999		181	756
Grand Total						4,237			3,366			937	

Notes:

Base rates from ROCKS 2000, escalated to 2003 prices @ 2.5%pa for 3 years

M = No. of treatments per year

F = Fixed costs USD/km-yr

V = Variable costs USD/km-yr