

## **ROAD SECTOR MAINTENANCE STRATEGY**

### **A. Introduction**

1. The highway network managed by YHAB is a vital asset which supports the development of Yunnan and the reduction of poverty. It is one of the largest assets owned by the Yunnan Provincial Government, with a replacement value in the range of CNY60 billion (\$10 billion). YHAB, with an annual budget of CNY1.5 to 2 billion for road maintenance, and a total active staff of 15,000 and pensioned staff of 21,000, is also one of the largest public organizations of Yunnan. This draft road maintenance strategy takes as its objective the long-term sustainability of the highway assets, in a cost-efficient manner, for the safe and convenient movement of the road users.

2. This draft strategy was prepared under the Yunnan Sustainable Road Maintenance Project Preparatory Technical Assistance. It was elaborated by adapting international principles in road highway asset management to the Yunnan context. Its technical analysis is based on a technical and economic optimization using the Highway Development and Management Version IV software.

3. The strategy includes the following sections: (i) principles; (ii) operational priorities; (iii) maintenance plan; and (iv) expected results and risks.

4. The strategy was finalized and approved by YHAB in September 2012. The strategy may be reviewed and adjusted in function of budget availability and changes in the network structure. The rolling investment plan should be updated annually, based on an updated knowledge of the network condition. A revised strategy will be prepared in 2016.

### **B. Strategy Principles**

#### **5. Sustainability of maintenance:**

- (i) Highways are productive economic assets; the objective of their maintenance is the long-term sustainability of the highways assets, in a cost-efficient manner, for the safe and convenient movement of the road users.
- (ii) New road construction is planned and designed while taking into consideration future maintenance needs, with the objective to minimize life-cycle costs.
- (iii) Periodic maintenance (intermediate maintenance) works are planned so that the part of the network that carries the highest traffic does not fail before the end of its design life.
- (iv) Investments in rehabilitation (heavy maintenance) are planned for roads that are no more maintainable with routine maintenance only when future maintenance can be assured.
- (v) The effective routine maintenance (minor maintenance) of the maintainable roads is a necessity; it comes with a priority secondary to periodic maintenance and rehabilitation, because it is insufficient to preserve in the long-run the quality of the assets.

#### **6. Financial sustainability:**

- (i) Maintenance budgets increase to gradually fill the maintenance gap, being given priority over new investments.
- (ii) Road user fees are gradually mainly used for road maintenance works.

- (iii) Road maintenance is delivered in the most cost-efficient way possible. Outsourced intermediate and heavy maintenance will be implemented on ADB-financed roads, and performance-based road maintenance piloted during the next five years. An evaluation study will assess the benefits and impacts of these new maintenance modalities.

**7. Economic sustainability:**

- (i) Maintenance works are prioritized on those roads where the costs to the users of no maintenance are particularly high.
- (ii) Planning is based on up-to-date and comprehensive information of the road network characteristics, condition, and traffic, and uses modern maintenance planning systems.
- (iii) The design of periodic maintenance and rehabilitation works emphasizes solutions that have reasonable life-cycle costs, take into account actual traffic load, and are affordable at the network level.

**8. Safety:**

- (i) Making roads trafficable and safe to the users is a common objective to all maintenance works.
- (ii) Periodic Maintenance and Rehabilitation works are used as an opportunity to raise the safety of the road network in a cost-efficient manner.
- (iii) Safety treatments aim at limiting road safety risks to a moderate level for all users and local communities, they are proportionate to the safety risk of the road.

**9. Environmental and social sustainability:**

- (i) Potential negative impacts of maintenance works on environment are assessed, minimized and residual impacts are mitigated.
- (ii) The negative social impacts of maintenance works are minimized.
- (iii) Opportunities to enhance the positive social impacts of maintenance on the local communities are identified and carried out as part of the civil works or coordinated by YHAB.
- (iv) Consultation of stakeholders is carried out at all stages of works preparation, implementation and evaluation.

**10. Sustainability of capacity:**

- (i) Internal guidelines and procedures for planning, road safety, and environmental and social management will gradually be developed and mainstreamed by YHAB.
- (ii) Data collection exercises and tools to monitor and program maintenance will be implemented.
- (iii) YHAB will enhance its staff skills in effective planning, asset management, road safety, social and environmental management, through recruitments and trainings.

**11. Results-based management:**

- (i) YHAB will regularly monitor and communicate upon the performance of its maintenance program.

- (ii) Management will emphasize achieving actual results, through the definition of performance measures, the setting of targets, the monitoring of performance, and the evaluation of results.
- (iii) Results-based management principles will remain applied at all levels of YHAB.

### C. Operational Priorities

12. This strategy sets operational priorities according to the traffic level and the road condition, as measured by the international road roughness index (IRI), or its Chinese equivalent, the Roughness Quality Index (RQI). This indicator is the best proxy for road user costs. Other factors, such as the road class, or the Pavement Condition Index (PCI) were found during strategy preparation to be less suitable indicators for the prioritization of the roads.

13. Three levels of priorities have been defined after a network-level analysis carried out on HDM-IV on data covering a representative subset of 12,000 km of YHAB's network (about 24,000 km).

- (i) Priority 1 (P1): works to be prioritized during the first five years plan (2012-2016).
- (ii) Priority 2 (P2): works to be prioritized during the second five years plan (2017-2021), and which can be considered in the first plan when their improvement creates long continuous sections of roads in good condition.
- (iii) Priority 3 (P3): works which may only become priority after 2021.

**Table 1: Strategy to be applied on Asphalt Pavement**

II.	Pavement Condition in 2012			
	3.5 ≤ IRI (1)	3.5 < IRI(1) ≤ 5	5 < IRI (1) ≤ 7.5	7.5 < IRI (1)
ADT ≤ 1000 (1)	Heavy when IRI reaches 11	Heavy when IRI reaches 11	Heavy when IRI reaches 11	Heavy when IRI reaches 11
1000 < ADT ≤ 2000 (1)	Intermediate when IRI reaches 5	Intermediate when IRI reaches 5	Heavy when IRI reaches 11	Heavy when IRI reaches 11
2000 < ADT ≤ 4000(1)	Intermediate when IRI reaches 5	Intermediate when IRI reaches 5	Heavy when IRI reaches 7.5	Heavy when IRI reaches 9
4000 < ADT (1)	Intermediate when IRI reaches 5	Intermediate when IRI reaches 5	Heavy when IRI reaches 7.5	Heavy when IRI reaches 9

**Table 2: Strategy to be applied on Surface Treatment (Simple Pavement)**

	Pavement Condition in 2012			
	3.5 ≤ IRI (1)	3.5 < IRI(1) ≤ 5	5 < IRI (1) ≤ 7.5	7.5 < IRI (1)
ADT ≤ 1000 (1)	Intermediate when IRI reaches 5	Intermediate when IRI reaches 5	Routine	Routine
1000 < ADT ≤ 2000 (1)	Intermediate when IRI reaches 5	Intermediate when IRI reaches 5	Routine	Routine
2000 < ADT ≤ 4000(1)	Intermediate when IRI reaches 5	Intermediate when IRI reaches 5	Heavy when IRI reaches 7.5	Heavy when IRI reaches 9
4000 < ADT (1)	Intermediate when IRI reaches 5	Intermediate when IRI reaches 5	Heavy when IRI reaches 7.5	Heavy when IRI reaches 9

P1 2013-2016      P2 2017-2021      P3 2022-2026

14. Overall, priority is given to the maintenance of the roads with traffic above 2,000 ADT. For asphalt pavement, in the next five years, overlays (intermediate maintenance) should be carried out on all roads with traffic above 2,000 before their condition reaches a "fair" condition (IRI=5),

which is associated with the beginning of a quick deterioration of the pavement. Roads with heavy traffic which are already in poor condition should be rehabilitated. Only those roads with traffic between 1,000 and 2,000 ADT in very poor condition should be given priority for rehabilitation. Other roads should only receive routine maintenance in the next five years with more intensive maintenance provided in the next 5-year period.

15. These operational priorities are valid only under given budget assumptions. They optimize the use of the likely budget of YHAB. Technical solutions to be applied should be based on a detailed analysis of the road condition (e.g. cracking, deflection, roughness) and traffic (volumes, growth, overloading), with the objective to provide a 10 year design life to pavements, following the Ministry of Transport's guidance on pavement design. Further details are in the OM.

#### **A. Maintenance Plan**

16. Under the strategy, it is anticipated that:

- (i) YHAB will increase its financing for intermediate and heavy maintenance, so that with the two ADB loans, the total financing for intermediate and heavy maintenance reaches CNY500 million annually between 2013 and 2015.
- (ii) YPDOT will gradually make a larger share of the fuel tax available to YHAB for maintenance, and these additional revenues will be allocated to intermediate and heavy maintenance; it is assumed that by 2017, YHAB receives 36% of fuel tax resources, against 27% in 2011.
- (iii) YHAB financing was set so that it targets a intermediate and heavy maintenance works network coverage of 2% in 2013-2015, 3% by 2016 and 4% by 2017.<sup>1</sup>

17. Based on the assignment of minor maintenance costs by class of roads, expected increases in staff and pension revenues, and the optimized ratio of intermediate to heavy maintenance of 40%, reaching the targets imply that YHAB fuel tax resources increase from CNY1,700 million in 2011 to CNY 3,333 million in 2017. YPDOT and YHAB may consider other financing sources, including World Bank or commercial bank loans, and reductions in staff costs to reach the targets. **Table 3** summarizes the financial plan and physical targets.

#### **B. Expected Results and Risks**

18. **Results.** The application of the strategy and maintenance plan is expected to:

- (i) Raise the proportion of roads in good condition (according to RQI classes) from 37% in 2011 to approximately 50% in 2017 and to 60% in 2021.
- (ii) Stabilize the proportion of roads in very poor condition at 31% in 2011 until 2017, and then reduce it to 30% by 2021.

19. Risks associated with this strategy are that:

- (i) YPDOT fails to make available the expected maintenance budget to YHAB or YHAB fails to make available enough budget to intermediate and heavy maintenance.

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<sup>1</sup> This financial plan does not consider upgrading works carried out in parallel by YPDOT. In 2011, it is estimated that about 550 km of new road pavement was created through upgrading.

- (ii) YHAB is tasked with managing a large number of new roads in poor condition without receiving enough financing to maintain them.
- (iii) Upgrading works planned by YPDOT do not target priority highways with heavy traffic and in poor condition.
- (iv) YHAB is forced to divert its budget to low-priority road maintenance works.

**Table 3: Financial and Physical Maintenance Plan**

Item	2011	2012	2013	2014	2015	2016	2017
<b>Total Fuel Tax Revenue – Yunnan</b>	6,200	6,572	6,966	7,384	7,827	8,297	8,795
<b>YHAB Revenue</b>							
1 Fuel Tax (YHAB share)	1,700	1,802	2,090	2,215	2,348	2,672	3,166
2 Tolls	20	21	22	23	24	26	27
3 Overloading Fees	370	389	408	428	450	472	496
4 Loans	-	42	168	168	126	126	-
5 Other revenues	107	109	111	114	116	118	120
<b>Total</b>	<b>2,197</b>	<b>2,363</b>	<b>2,799</b>	<b>2,948</b>	<b>3,064</b>	<b>3,414</b>	<b>3,809</b>
<b>Expenditures</b>							
1 Pensions	715	765	819	876	937	1,003	1,073
2 Management costs	150	156	162	169	175	182	190
3 Salaries and bonuses	766	804	845	887	931	978	1,027
4 Minor maintenance	371	390	409	429	451	474	497
5 Emergency maintenance	50	51	51	52	52	53	53
6 Intermediate/Heavy maintenance	145	197	514	535	518	724	969
<b>Total</b>	<b>2,197</b>	<b>2,363</b>	<b>2,799</b>	<b>2,948</b>	<b>3,064</b>	<b>3,414</b>	<b>3,809</b>
<b>Work quantities (km)</b>							
1 Minor maintenance	24,100	24,100	24,100	24,100	24,100	24,100	24,100
2 Intermediate/Heavy maintenance	145	197	514	535	518	724	969
<b>Work quantities (% of network)</b>							
1 Minor maintenance	100%	100%	100%	100%	100%	100%	100%
2 Intermediate/Heavy maintenance	0.6%	0.8%	2.1%	2.2%	2.1%	3.0%	4.0%

**Figure 1: Expected Proportion of Network According to Road Quality Index Classes (2012–2021)**



