CHAPTER 14

ROAD NETWORK IMPLEMENTATION PLAN

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14.1 PROCESS OF PROGRAM FORMULATION

The projects of the Road Network Development Plan described in Section 10.1 are the projects required to be implemented up to the target year 2030. To establish the implementation program of the whole plan, these projects need to be divided into five groups depending on their priority in order to form five future Five-Year Road Development Plans (5YDP), which are:

- Short Term Plan (7th 5-Year Plan): 2006 – 2010
- Medium Term Plan (8th 5-Year Plan and 9th 5-Year Plan): 2011 – 2020
- Long Term Plan (10th 5-Year and 11th 5-Year Plan): 2021 – 2030

Figure 14.1-1 presents the workflow of the prioritization process in which projects are scheduled into the planning period up to the year 2030.

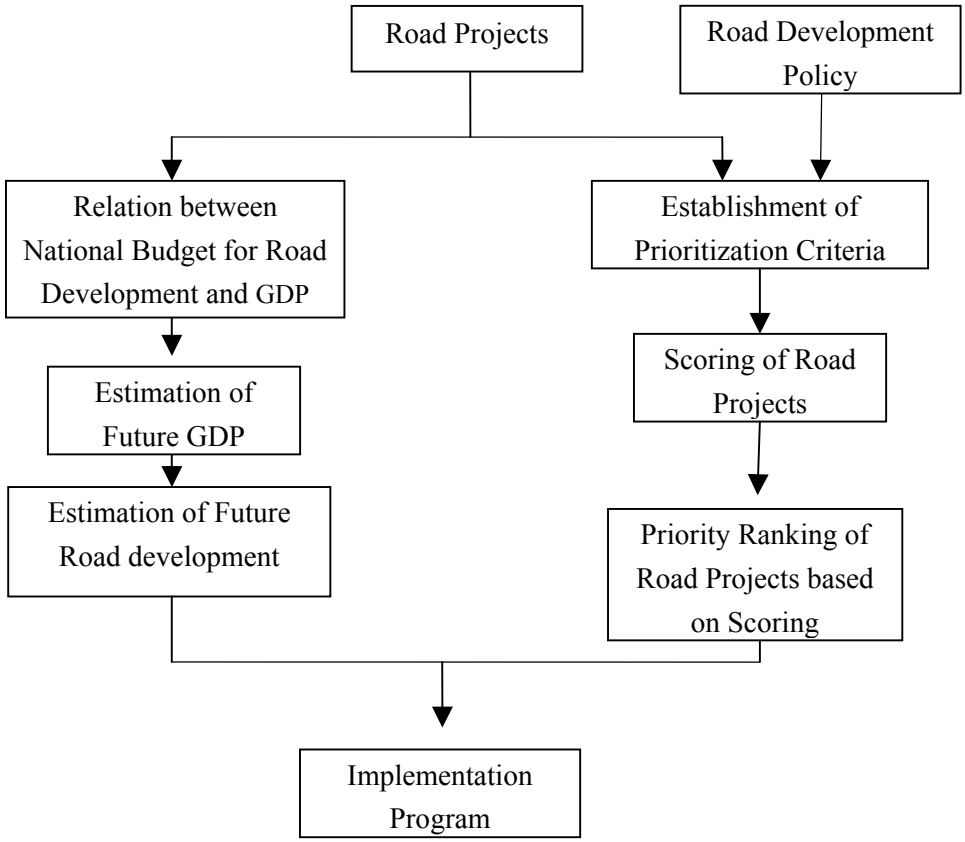

Figure 14.1-1 Process of Formulation of Implementation Program

14.2 FINANCIAL FRAMEWORK

(1) Relation between Road Budget and GDP

Past records of the budget and expenditures of DGR are summarized in Table 14.2-1. It should be noted that the current 6th Plan is still ongoing and there are possibilities for supplementary funds for additional projects.

Table 14.2-1 Previous Investments in Road Projects (m RO)

Plan	5th Plan	6th Plan
Allocated Budget	60	81
Supplementary Budget	138	88
Investment in Road Projects – Total	198	169
GDP	31,043	37,447
Allocated Budget / GDP	0.19%	0.22%
Road Investment / GDP	0.64%	0.45%

Notes: - The supplementary budget for 6th Plan is based on data until June 2004.
- Budgets transferred from previous plans are 22RO million (5th Plan) and 63RO million (6th Plan)

(2) Future GDP

The future GDP is estimated in Chapter 6 based on the scenario of New Oman Vision Development as follows:

Year	GDP	Growth Rate (%)
2005	8,888.3	3.5
2010	10,578.7	3.7
2020	15,267.4	4.3
2030	23,371.0	

(3) Future Share of Road Development Fund to GDP

According to the past statistical budgetary data prepared by DGR, the share of the road investment fund in regard to GDP was decreased from 0.64 % for 5th plan to 0.45% for 6th plan. Applying the same trend for the future planning period from the 7th plan (2006 –2010) to 11th plan (2026-2030), it is concluded that the share of road investment fund to GDP will gradually decrease from a level of about 0.5% to 0.2% in the period from the 7th plan to 11th plan. Through comprehensive discussions with DGR, it is agreed that such budgetary levels are considered reasonable in the road development planning process due to the normal practice of utilizing variable supplementary budgets when available.

(4) Estimation of Future Investment Funds

As a result, the future investment funds for primary and secondary road development are estimated as shown in Table 14.2-2. It is expected to require a total investment fund for the period of 25 years from 2006 to 2030 at about RO 1,395 million, in addition to the fund required to construct and maintain access and local roads (construction of 200km/year with an estimated cost of about RO 10.0 million/year and average annual maintenance cost of about RO 3.6 million).

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Estimated Investment Funds for Road Development (million RO):

Short Term (2006 – 2010)	292
Medium Term (2011 – 2020)	613
Long Term (2021 – 2030)	490
Total (2006 – 2030)	1,395

Table 14.2-2 Estimated Future Investments of Road Projects

Plan	Years	GDP (million RO)	Road Investment (million RO)
7th 5-Year Plan	2006 - 2010	49,395	292.1
8th 5-Year Plan	2011 - 2015	58,957	346.2
9th 5-Year Plan	2016 - 2020	70,904	266.7
10th 5-Year Plan	2021 - 2025	86,952	221.7
11th 5-Year Plan	2026 - 2030	107,554	268.0

14.3 PRIORITIZATION OF PROJECTS

The Optimum Road Network was developed in Chapter 10, based on the evaluation results of different alternatives, as the most appropriate future road network for Oman. Road development projects in the development plan are identified to include road widening (1 project), dualizaion (11 projects), new construction 4-lanes (1 project), new construction 2-lanes (41 projects), bypasses (8 projects) and grade-separation structures for vehicles (8 projects) in addition to other minor and improvement projects.

To establish an optimum implementation plan for all the developed projects for a period extends to five 5-year development plans during the period from 2006 to 2030, a prioritization process is developed and applied in this section. Under this process, roads are divided into two groups as follows:

Group 1 Roads: are mainly inter-zonal roads for which traffic volume assignment results are used to generate parameters in the prioritization process.

Group-2 Roads: are mainly intra-zonal roads that are not subject to the assignment procedure of OD zonal trips.

14.3.1 Basic Policy and Prioritization Process

The following prioritization factors for each of the road projects are set up in line with the objectives of the road network development;

a) Road project which will strengthen accessibility to GCC countries
b) Road project which will contribute to the national economic development and economy diversification,
   - To promote manufacturing industry development
   - To promote service industrial development
c) Road project which will enhance the standard of living of the peoples,
d) Road project which will reduce regional imbalance
e) Road project which will promote north-south integration and Musandam integration,

In addition, the following three (3) more factors are established:

f) Economic efficiency of the project
g) Increase in traffic efficiency, and
h) Urgency of the project

The procedure for prioritization of the road projects is shown in Figure 14.3-1. Table 14.3-1 shows the relationship between the objectives of the Master Plan and each of the implementation phasing. Table 14.3-2 shows prioritization factors considered for each road project.

Table14.3-1 Development Objectives and Implementation Phasing

No.	Objective	Short Term	Medium Term	Long Term	Remarks
1	Strengthening of International Road Network	◎	○	○	To complete International road network within 7th plan
2	Contribution of economic development and diversification	◎	◎	○	
3	Enhancement of standard living of peoples	○	◎	◎	
4	Reduction of regional imbalance	○	◎	◎	
5	To promote north-south and Musandam integration	◎	◎	○	

Note: ◎ Major policy is considered in each period
○ Supporting policy is a little considered in each period

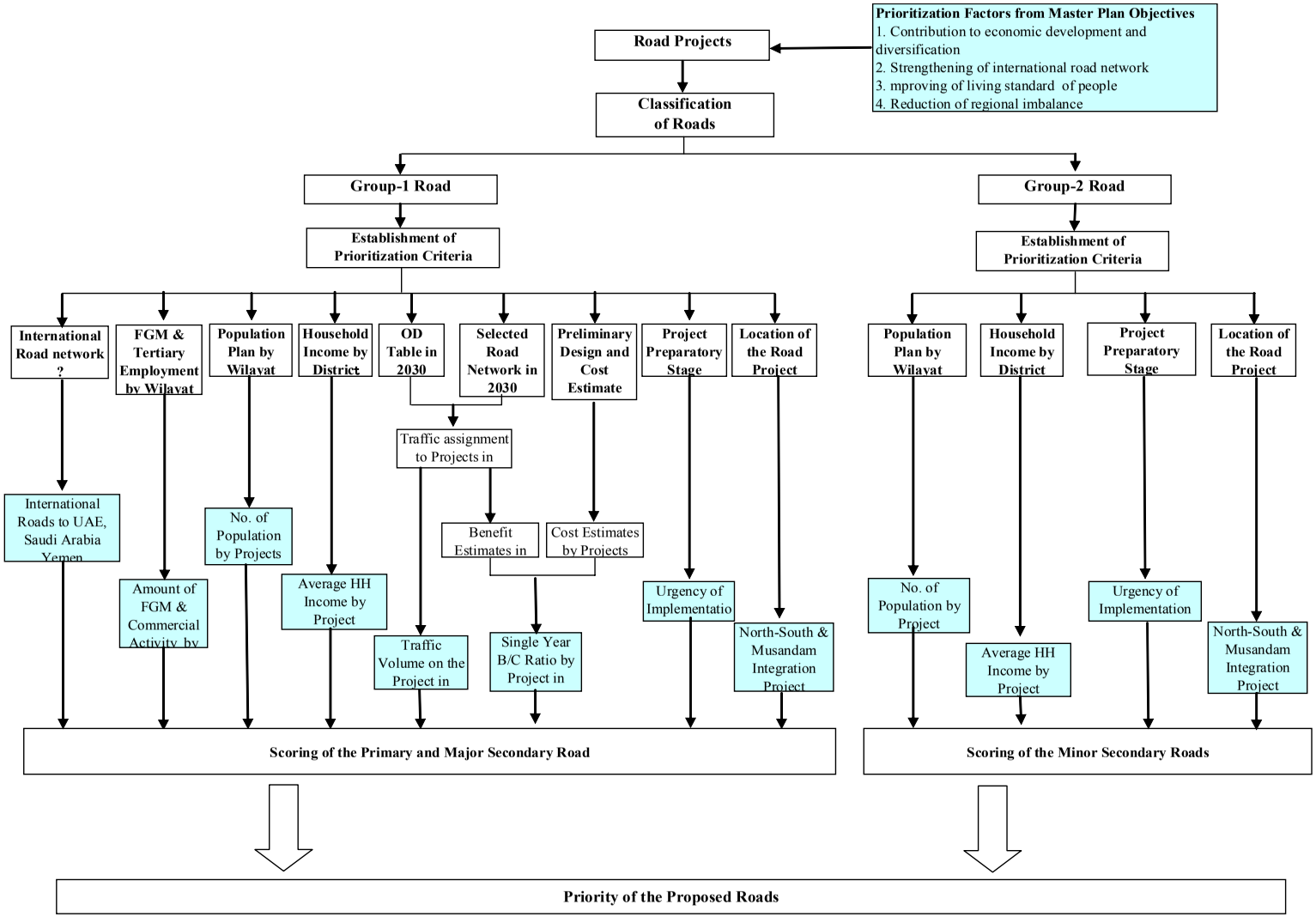


Figure 14.3-1 Procedure for Prioritization of Road Projects

Table14.3-2 Prioritization Factors Considered for Road Projects

	Strengthening of International Road network	Economic Develop-ment	Increase of Standard Living of People	Reduction of Regional Imbalance	Consideration on North-South Integration and Musandum	Economic Indicator	Traffic Efficiency	Urgency
Group-1 Roads	○	○	○	○	○	○	○	○
Group-2 Roads	×	×	○	○	×	×	○	○

Note: ○ Factors considered in the evaluation
× Factors not considered in the evaluation

14.3.2 Prioritization Criteria

(1) Selection of Prioritization Factors

In order to prioritize the road projects, the following prioritization parameters which consist of eight (8) factors and eight (8) indicators mentioned in 14.3.1 are selected as shown in Table 14.3-3.

Table 14.3-3 Prioritization Factors and Indicators

	Factors	Indicators	How to Measure
1	International Road Network	International Road	・ International road network or not
2-1	Manufacturing industry development	Amount of Final Goods Manufactured (FGM)	・Final Goods Manufactured (FGM) in the influence area of each project road using estimated 2030 FGM by Wilayat
2-2	Service industry development	Number of employment of tertiary industry (commerce, service, etc)	・Number of the tertiary sector employment in the influence area of each project road using estimated 2030 tertiary industrial employment by Wilayat
3	Enhancing standard of living of the people	Number of Population	・Number of population in the influence area of each project road using estimated 2030 tertiary industrial employment by Wilayat
4	Reduction of regional imbalance	Household income	・Household income in the direct influenced region of each project road using estimated HH income by District
5	Regional disparities	North-South integration Musandum integration	・Road project for north – south integration ・Road project for Musandum integration
6	Economic indicators	Single year B/C ratio	・Economic analysis of each road project
7	Traffic efficiency	Traffic volume in 2030	・Average traffic volume of project road in 2030
8	Urgency for road development	Project preparatory stage	・Feasibility study stage, design stage, tender stage or committed implementation in 6th 5-year plan

(2) Weighted Factor and Score

The scores of each factor as well as the weight of each factor are established as shown in Table 14.3-4. As there are two economic factors under the objective of economic development, the weighted factor is divided for both factors.

Table 14.3-4 Indicators Score

No.	Factors	Range of Indicator	Weighted Factor	Score
1	International road network	・Direct connection with neighborhood countries ・International road ・Others	5	5 3 0
2.1	Manufacturing industry development	Estimated FGM (Final Goods Manufactured) in 2030 ・ FGM>5000 mil RO/km ・ 5000 > FGM > 3000 ・ 3000 > FGM > 1000 ・ 1000 > FGM > 500 ・ 500 > FGM	2.5	5 4 3 2 1
2-2	Service activity development	Estimated No of Tertiary Employment in 2030 ・ TE >1000 employment/km ・ 1000 > TE > 500 ・ 500 > TE > 300 ・ 300 > TE > 100 ・ 100 > TE	2.5	5 4 3 2 1
3	Enhancing the standard of living of the people	Estimated No of Population in 2030 ・ POP >1000 population/km ・ 1000 > POP > 500 ・ 500 > POP > 300 ・ 300 > POP > 100 ・ 100 > POP	5	5 4 3 2 1
4	Reduction of regional imbalance	Estimated HH Income in 2030 ・ 400 < HHI < 450 RC/Mth/HH ・ 450 < HHI < 500 ・ 500 < HHI <600 ・ 600 < HHI <700 ・ 700 < HHI	5	5 4 3 2 1
5	Regional disparities	・North – south integration project ・Musandum project ・Project in Dhofar and Al-Wusta region ・Other projects	5	5 5 3 0
6	Economic indicators	Single year Benefit Cost Ratio in 2030 ・ B/C > 3.00 ・ 3.00 > B/C > 1.00 ・ 1.00 >B/C > 0.75 ・ 0.75 > B/C > 0.50 ・ 0.50 > B/C	5	5 4 3 2 1
7	Traffic efficiency	Average traffic volume of the project road in 2030 ・ TV > 30,000 vehicles ・ 30,000 > TV > 10,000 ・ 10,000 >B/C > 5,000 ・ 5,000 > B/C > 1,000 ・ 1,000 > B/C	5	5 4 3 2 1
8	Urgency for road development	・Committed project under 6th 5-year plan DD + TD ・Committed project under 6th 5-year plan FS + DD ・Almost committed under 8th plan ・Other project	5	5 5 4 0

14.3.3 Priority Ranking and Scheduling

Based on the above prioritization criteria, implementation priority of all road projects are evaluated as shown in Table 14.3-5 for group-2 road projects and Table 14.3-6 for group-1 road projects, while the applied data of prioritization factors of each project are presented in Table 14.3-7 and Table 14.3-8 for the two groups of roads, respectively.

Tables 14.3-5 and 14.3-6 show the implementation scheduling, either under the short-, medium- or long term planning of both groups of road projects.

Table 14.3-5 Priority Scores for Group-2 Projects

No.	Pr. No.	Improvement	Project	Region	Wilayat	1 Standard of Living of People	2 Reduction of Regional Imbalance	3 Regional Disparity	4 Project Preparation Stage	Total Score	Scheduling
1	N5	New Construction	Lima Link - Khasab	Musandam	Khasab	5	4	5	5	19	S
2	N11	New Construction	Rakhyut - Dhalkut Coastal Road	Dhofar	Rakhyut & Dalkut	5	4	0	0	9	M
3	N13	New Construction	Hujaif - Jahnin - Asir	Dhofar	Salalah	2	2	3	0	7	L
4	N14	New Construction	Teetam - Qaftat Road 9	Dhofar	Salalah	5	2	3	5	15	S
5	N15	New Construction	Haluf - Masahilah	Dhofar	Salalah	4	2	3	0	9	M
6	N17	New Construction	Wadi Haruf - Shasr	Dhofar	Thumrayt	1	3	3	0	7	L
7	N19	New Construction	Al Mazyunah - Tusnat - Habrut - Aydam	Dhofar	Dulkut/Maqsin	1	4	3	0	8	M
8	N20	New Construction	Shahb Asayb - Rakgyut	Dhofar	Salalah/Rakhyut	1	3	3	0	7	L
9	N21	New Construction	Dalkut - Khadrafi - Salfait	Dhofar	Dulkut	2	4	3	0	9	M
10	N22	New Construction	AL Mazyunah - Mitan	Dhofar	Muqshin	1	4	3	0	8	M
11	N23	New Construction	Hajaif - Masahilah - Haruf	Dhofar	Thumrayt	1	3	3	0	7	L
12	N25	New Construction	Haylat - Ar Rakah	Dhofar	Thumrayt	1	3	3	0	7	L
13	N29	New Construction	Yanqul - Murry	A'Dhahira	Yanqul	3	5	0	0	8	L
14	N30	New Construction	Madha - Dafta	Musandam	Madha	4	5	3	5	17	S
15	N34	New Construction	Tawi Attair-Jibjat-Sibr	Dhofar	Marbat	1	4	3	0	8	M
16	N47	New Construction	Film - Mahowt	Al -Wusta	Mirbat	5	4	5	5	19	S
17	N49	New Construction	Al Ghaba - Ramlet Khaylah (Saudi Border)	Al Wusta	Haima	1	1	3	0	5	L

Note: S: Short term plan, M: Medium term plan, and L: Long term plan

14.3.4 Prioritization of Local Roads

The scope of the Study includes only the development of primary and secondary road networks. However, as local and access roads represent a major issue in their planning process, a prioritization criterion for local roads is developed as presented in Appendix 14.1. As a case study, the criterion is applied on local roads that require improvement and pavement works in Northern Oman. Table 14.3-6 presented the high priority roads which are shown in the location map of Figure 14.3-2.

Table 14.3.6 High Priority Local Roads in Northern Oman

Road	Length (km)	Cost (RO million)
Wadi Sahtan Road	30	4.1
Wadi Bani Kharus Road	40	6.1
Wadi Mistal Road	35	3.7

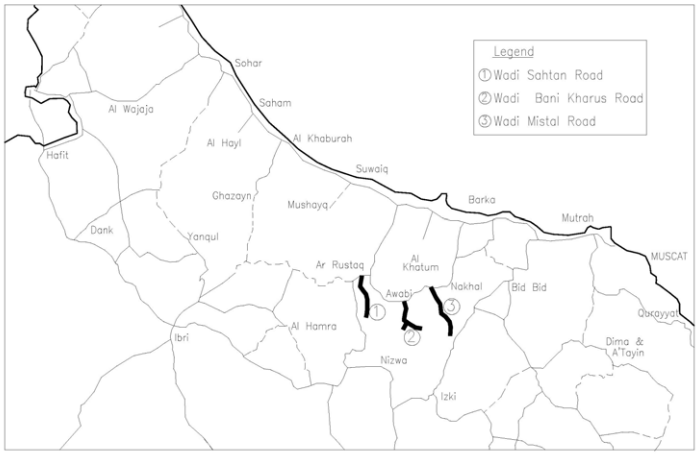


Figure 14.3-2 High Priority Local Roads in Northern Oman

14.4 FIVE-YEAR ROAD DEVELOPMENT PLANS

14.4.1 Implementation Framework

Based on the applied prioritization ranking process and considering the required investments in the road sector, the scheduling program of project implementation is established for the five Five-Year Development Plans (5YDP) from 7th Plan to 11th Plan. This program gives information on the work and investments required in future to develop the nationwide road network. Table 14.4-1 presents the result of prioritization process for the Master Plan Projects on regional base for easy implementation in the future with the strengthening of the Regional Offices of DGR. Projects with highest priority and urgency are included in the 7th 5-Year Development Plan (7th 5YDP).

Table 14.3-7 Priority Scores for Group-1 Projects

No.	Improvement Type		Road No.	Project	Region	Length km	1 International Road	2.1 Promotion of Industrial Development	2.2 Promotion of Service Industry Development	3 Provision of Basic Infrastructure to People	4 Reduction of Social Imbanace	5 North-South Integration	6 Economic Efficiency	7 Traffic Efficeincy	8 Project Preparation	Total Score	Term
	W	**Widening**															
1	W1	Widening	1	Bait Al Barakah - Al Muladdah	Batinah	54	**0**	**2.5**	**2.5**	**5**	**4**	**0**	**5**	**5**	**0**	**24**	**S**
	D	**Dualization**															
1	D2	Dualization	23	Bidbid - Sur	A'Sharqiya	277	**0**	**2.5**	**0.5**	**2**	**5**	**0**	**1**	**4**	**0**	**15**	**M**
2	D3	Dualization	21	Nizwa - Ibri	A'Dakhliyah	107	**0**	**1.5**	**1**	**5**	**3**	**0**	**2**	**3**	**5**	**20.5**	**S**
3	D4	Dualization	31	Kousha – Salalah	A'Dakhliyah	841	**3**	**0.5**	**0.5**	**2**	**3**	**5**	**1**	**3**	**0**	**18**	**M**
4	D5	Dualization	7	Majis (Sohar) - Buraimi	Batina/Dhahi	99	**5**	**1**	**0.5**	**3**	**3.5**	**0**	**1**	**4**	**5**	**23**	**S/M**
5	D6	Dualization	25	Mizbar – Wadi Al Taiyyn	A'Sharqiya	30	**0**	**0.5**	**1**	**2**	**5**	**0**	**5**	**3**	**0**	**16.5**	**M**
6	D7	Dualization	49	Ma'mura- Taqah	Dhofar	20	**0**	**1.5**	**1.5**	**5**	**2**	**3**	**2**	**3**	**5**	**23**	**S**
7	D8	Dualization	11	Dualization of Maladah-Hazm Road	Batinah	24	**0**	**0.5**	**1**	**5**	**4**	**0**	**5**	**4**	**5**	**24.5**	**S**
8	D9	Dualization		Dualization of Quriyat – Sur Road Phase III	A'Sharqiya	18	**0**	**2.5**	**1.5**	**4**	**5**	**0**	**5**	**5**	**5**	**28**	**S**
9	D10	Dualization	13	Dualization of Barka – Rustaq Road	Batinah	82	**0**	**0.5**	**0.5**	**3**	**4**	**0**	**2**	**4**	**5**	**19**	**S**
10	D11	Dualization	9	Dualization of Ibri – A,Dariz Road	A'Dhahira	19	**0**	**1**	**1**	**5**	**3**	**0**	**5**	**4**	**0**	**19**	**S**
11	D12	Dualization	49	Taqah - Mirbat	Dhofar	16	**0**	**0.5**	**1**	**4**	**2**	**3**	**3**	**2**	**0**	**15.5**	**M**
12	D13	Dualization		Raysut - Rakhyut	Dhofar	22	**0**	**1.5**	**0.5**	**2**	**2**	**3**	**3**	**2**	**0**	**14**	**M**
13	D14	Dualization		Rakhyut–Yemen Border	Dhofar	45	**0**	**0.5**	**9.5**	**1**	**2**	**3**	**1**	**2**	**0**	**19**	**L**
14	D15	Dualization		Dawkah- Al Mazunah	Dhofar	226	**0**	**0.5**	**0.5**	**1**	**2**	**3**	**1**	**1**	**0**	**9**	**L**
	N	**New Construction**															
1	N1	New Construction	4	New Batianh Expressway	Batinah	277	**3**	**2**	**2.5**	**5**	**4**	**0**	**5**	**4**	**5**	**30.5**	**S**
2	N3	New Construction		Bait Al Barakah - Khatmet Milahah	Batinah	255	**0**	**1.5**	**2.5**	**3**	**4**	**0**	**1**	**1**	**0**	**13**	**M**
3	N4	New Construction	2	Diba - Khasab	Musandam	103	**0**	**0.5**	**0.5**	**2**	**5**	**5**	**1**	**1**	**5**	**20**	**S**
6	N6	New Construction		Al Ashkharah - Shanna	A'Sharqiya	180	**0**	**1**	**1**	**3**	**5**	**0**	**4**	**1**	**5**	**20**	**S**
7	N7	New Construction	49	Hasik - Shuwaymiyah	Dhofar	80	**0**	**0.5**	**0.5**	**1**	**2**	**3**	**4**	**1**	**0**	**12**	**L**
8	N9	New Construction	41	Marmul-Shelim-Sharbithat-Sawqrah	Dhofar	159	**0**	**1**	**1**	**3**	**3**	**3**	**3**	**1**	**5**	**20**	**S**
9	N10	New Construction	42	Shelim-Shuaymiyah	Dhofar	48	**0**	**0.5**	**0.5**	**2**	**3**	**3**	**5**	**1**	**5**	**20**	**S**
11	N12+24	New Construction		Madinat AL Haq-Nashib Jibjat - Barbazum	Dhofar	93	**0**	**0.5**	**0.5**	**2**	**2**	**3**	**4**	**1**	**5**	**18**	**S/M**
15	N16	New Construction		Dawkah-Shasr-Qafaa	Dhofar	156	**0**	**0.5**	**0.5**	**1**	**2**	**3**	**1**	**1**	**0**	**9**	**L**
17	N18	New Construction		Mudayy-Aybut-Aydam	Dhofar	71	**0**	**0.5**	**0.5**	**1**	**2**	**3**	**1**	**1**	**0**	**9**	**L**
24	N26	New Construction		Thumrait - Marmul	Dhofar	148(1)	**0**	**0.5**	**0.5**	**2**	**3**	**3**	**5**	**1**	**5**	**20**	**S**
25	N27	New Construction		Hatt - Rustaq Road Stage (4)	Bat/Dhakh	30	**0**	**1**	**0.5**	**3**	**4**	**0**	**5**	**3**	**5**	**21.5**	**S**
26	N28	New Construction		Yanqul-Fida-Dank	A'Dhahira	41	**0**	**2**	**1**	**3**	**3**	**0**	**5**	**1**	**5**	**20**	**S**
29	N31	New Construction		Amal - Muqshin	Dhofar	180	**0**	**0.5**	**0.5**	**1**	**2**	**3**	**1**	**1**	**0**	**9**	**L**
30	N32	New Construction		Marmul - Dawkah	Dhofar	140	**0**	**0.5**	**0.5**	**1**	**2**	**3**	**4**	**2**	**0**	**13**	**L**
31	N33+36	New Construction		Tiwi - Bani Khalid	A'Sharqiya	60	**0**	**1**	**1**	**2**	**5**	**0**	**2**	**2**	**5**	**18**	**S/M**
33	N37	New Construction		Ash Sharq - Adh Dhahir - Mintarib (Al Wasil)	A'Sharqiya	55	**0**	**0.5**	**0.5**	**3**	**5**	**0**	**5**	**2**	**0**	**16**	**M**
34	N38	New Construction		Al Mazari - Ghubrat at Tam	Muscat*/Shar	80	**0**	**0.5**	**0.5**	**1**	**3**	**0**	**1**	**1**	**0**	**7**	**L**
35	N40	New Construction		Wadi Saa - Ajran - Al Feth - Dank	A'Dhariyah	80	**0**	**0.5**	**0.5**	**2**	**3**	**0**	**1**	**1**	**0**	**8**	**L**
36	N41	New Construction		Al Feth - As Sunaynah	A'Dhakhliyah	45	**0**	**0.5**	**2.5**	**2**	**3**	**0**	**2**	**2**	**0**	**12**	**M**
37	N43	New Construction		Al Wajajah - Ash Shwayhah	A'Dhakhliyah	80	**0**	**0.5**	**0.5**	**1**	**3**	**0**	**2**	**1**	**0**	**8**	**L**
38	N44+45	New Construction		Murri - Ar Rumaylah - Al Ayn	A'Dhakhliyah	30	**0**	**1**	**1**	**1**	**3**	**0**	**5**	**1**	**0**	**12**	**L**
39	N46	New Construction		Bahja -Amal	A'Dhakhliyah	170	**0**	**0.5**	**0.5**	**1**	**3**	**0**	**3**	**1**	**0**	**9**	**L**

Note: S: Short term plan, M: Medium term plan, and L: Long term plan

Table 14.3-8 Priority Scores for Each Indicator for Group-2 Projects

No.	Project No.	Improvement Type	Project	Region	Wilayat	Length km	Population	Pop./km	FGM	FGM/km	Service Activity	Service Activity /km	Income
5	N5	**New Construction**	Lima Link - Khasab	Musandam	Khasab	25	6,692	268	734	29	1,718	69	140
10	N11	**New Construction**	Rakhyut–Dhalkut Coastal Road	Dhofar	Rakhyut & Dalkut	25	5,386	215	3,427	137	852	34	143
12	N13	**New Construction**	Hujaif-Jahnin-Asir	Dhofar	Salalah	22	2,076	94	32,136	1,461	5,498	250	179
13	N14	**New Construction**	Teetam-Qaftat Road 9	Dhofar	Salalah	12	2,491	208	48,204	4,017	8,247	687	179
14	N15	**New Construction**	Haluf-Masahilah	Dhofar	Salalah	14	2,284	163	38,563	2,754	6,597	471	179
16	N17	**New Construction**	Wadi Haruf-Shasr	Dhofar	Thumrayt	83	1,964	24	1,371	17	710	9	163
18	N19	**New Construction**	Al Mazyunah-Tusnat- Habrut-Aydam	Dhofar	Dulkut/Maqsin	120	421	4	1,469	12	212	2	144
19	N20	**New Construction**	Shahb Asayb – Rakgyut	Dhofar	Salalah/Rakhyut	16	168	11	3,948	247	793	50	161
20	N21	**New Construction**	Dalkut-Khadrafi-Salfait	Dhofar	Dulkut	14	673	70	734	52	158	11	143
21	N22	**New Construction**	AL Mazyunah - Mitan	Dhofar	Muqshin	96	168	2	979	10	72	1	146
22	N23	**New Construction**	Hajaif-Masahilah-Haruf	Dhofar	Thumrayt	25	982	39	1,028	41	533	21	163
23	N25	**New Construction**	Haylat - Ar Rakah	Dhofar	Thumrayt	25	982	39	343	14	178	7	163
27	N29	**New Construction**	Yanqul – Murry	A'Dhahira	Yanqul	26	2,055	79	408	16	236	9	111
28	N30	**New Construction**	Madha - Dafta	Musandam	Madha	15	2,433	162	2,448	163	408	27	116
32	N34	**New Construction**	Tawi Attair-Jibjat-Sibr	Dhofar	Marbat	41	1,964	35	270	7	312	8	143
40	N47	**New Construction**	Film - Mahowt	Al -Wusta	Mirbat	6	1,428	238	245	41	129	21	140
41	N49	**New Construction**	Al Ghaba - Ramlet Khaylah (Saudi Border)	Al wusta	Haima	298	307	1	147	0	53	0	209

Table 14.3-9 Data Applied in Prioritization of Group-1 Projects

Improvement	Road No.	Name	Region	Length km	Population in 2030	Population per KM	FGM in 2030	FGM per KM	Service Activity in 2030	Service Activity per KM	Traffic Volume in 2030	Benefit (a)	Finance Cost (b)	Economic Cost (c=b*.975)	Capital Recovery Factor (d)	Single Cost (e=c*d)	B/C (f=a/e)	Remarks
Widening																		
Widening	1	Bait Al Barakah - Al Muladdah	Batinah	54	179,780	3,329	469,163	8,688	54,481	1,009	41,041	42,816	4,752	4,633	0.08	371	115.51	
Widening		New Bathinah Expressway	Batinah	127		0	0		0	0		13,346	15,334	14,951	0.08	1,196	11.16	
Dualization																		
Dualization	17	Al Amrat - Qurayyat	Muscat*	63	56,325	894	25,855	410	8,471	134								Out of Study Area
Dualization	23	Bidbid - Sur	A'Sharqiya	277	152,809	552	6,527,594	23,565	24,504	88	10,388	404	29,713	28,970	0.08	2,318	0.17	
Dualization	21	Nizwa - Ibri	A'Dakhliyah	107	154,009	1,439	145,664	1,361	24,529	229	7,123	1,269	26,500	25,838	0.08	2,067	0.61	
Dualization	31	Kousha – Salalah	A'Dakhliyah	841	142,390	169	192,294	229	32,118	38	5,438	1,716	74,008	72,158	0.08	5,773	0.30	
Dualization	7	Majis (Sohar) - Buraimi	Batina/Dhahi	99	100,991	1,020	488,898	4,938	28,588	289	12,612	1,500	43,838	42,742	0.08	3,419	0.44	
Dualization	25	Mizbar – Wadi Al Taiyyn	A'Sharqiya	30	37,671	1,256	3,891	130	4,166	139	7,707	9,397	4,620	4,505	0.08	360	26.08	
Dualization	49	Ma'mura- Taqah	Dhofar	20	35,348	1,767	48,693	2,435	8,881	444	5,364	79	1,760	1,716	0.08	137	0.58	
Dualization	11	Dualization of Maladah- Hazm Road	Batinah	24	46,514	1,938	4,411	184	4,343	181	20,008	369	2,112	2,059	0.08	165	2.24	
Dualization		Dualization of Quriyat – Sur Road Phase III	A'Sharqiya	18	19,757	1,098	3,215,958	178,664	5,859	326								On-Going
Dualization	13	Dualization of Barka – Rustaq Road	Batinah	82	63,929	780	23,567	287	7,020	86	24,344	497	9,042	8,816	0.08	705	0.70	
Dualization	9	Dualization of Ibri – A,Dariz Road	A'Dhahira	19	35,413	1,864	6,737	355	4,073	214	5,254	523	1,672	1,630	0.08	130	4.01	
Dualization	49	Taqah - Mirbat	Dhofar	16	15,079	942	1,960	123	2,352	147	2,890	105	1,408	1,373	0.08	110	0.96	
Dualization		Raysut - Rakhyut	Dhofar	22	23,285	1,058	33,360	1,516	5,904	268	1,308	231	3,388	3,303	0.08	264	0.87	
Dualization		Rakhyut–Yemen Border	Dhofar	45	5,330	118	3,672	82	933	21	1,386	105	6,930	6,757	0.08	541	0.19	
Dualization		Dawkah- Al Mazunah	Dhofar	226	5,330	24	2,938	13	979	4	22	16	19,888	19,391	0.08	1,551	0.01	
New Construction																		
New Construction	4	New Batianh Expressway	Batinah	277	318,817	1,151	856,817	3,093	71,740	259	25,872	40,508	111,000	108,225	0.08	8,658	4.68	
New Construction	17	Al Amrat – Mizbar (W. Ahda – W. Taiyan)	Muscat *	50	28,194	564	17,148	343	4,129	83								Out of Study Area
New Construction		Bait Al Barakah - Khatmet Milahah	Batinah	255	96,697	379	266,132	1,044	18,116	71	911	498	19,635	19,144	0.08	1,532	0.33	
New Construction	2	Diba - Khasab	Musandam	103	27,421	266	6,610	64	6,249	61	268	424	25,441	24,805	0.08	1,984	0.21	
New Construction		Al Ashkharah - Shanna	A'Sharqiya	180	28,777	160	2,518	14	3,237	18	241	1,707	15,000	14,625	0.08	1,170	1.46	
New Construction	49	Hasik - Shuwaymiyah	Dhofar	80	4,348	54	1,647	21	714	9	284	3,309	21,600	21,060	0.08	1,685	1.96	
New Construction	41	Marmul-Shelim-Sharbithat- Sawqrah	Dhofar	159	4,295	27	1,696	11	538	3	392	521	6,800	6,630	0.08	530	0.98	
New Construction	42	Shelim-Shuaymiyah	Dhofar	48	1,403	29	717	15	230	5	374	784	3,265	3,183	0.08	255	3.08	
New Construction		Madinat AL Haq-Nashib Jibjat - Barbazum	Dhofar	93	10,099	109	1,298	14	1,570	17	326	2,197	25,110	24,482	0.08	1,959	1.12	
New Construction		Dawkah-Shasr-Qafaa	Dhofar	156	2,946	19	1,028	7	533	3	22	46	12,012	11,712	0.08	937	0.05	
New Construction		Mudayy-Aybut-Aydam	Dhofar	71	3,451	49	1,273	18	614	9	86	164	9,585	9,345	0.08	748	0.22	
New Construction		Thumrait - Marmul	Dhofar	148	9,819	66	1,696	11	1,499	10	380	2,892	5,438	5,302	0.08	424	6.82	
New Construction		Hatt - Rustaq Road Stage (4)	Bat/Dhakh	30	16,131	538	2,896	97	1,576	53	7,271	9,605	8,100	7,898	0.08	632	15.20	
New Construction		Yanqul-Fida-Dank	A'Dhahira	41	12,239	299	2,068	50	1,361	33	44	2,115	11,070	10,793	0.08	863	2.45	
New Construction		Amal - Muqshin	Dhofar	180	1,010	6	920	5	174	1	13	359	13,860	13,514	0.08	1,081	0.33	
New Construction		Marmul - Dawkah	Dhofar	140	1,010	7	920	7	174	1		1,251	10,780	10,511	0.08	841	1.49	
New Construction		Tiwi - Bani Khalid		60	30,752	513	2,758	46	3,362	56		200	22,275	21,718	0.08	1,737	0.12	
New Construction		Ash Sharq - Adh Dhahir - Mintarib (Al Wasil)	A'Sharqiya	55	27,487	500	1,570	29	1,233	22	722	2,574	11,955	11,656	0.08	932	2.76	
New Construction		Al Mazari - Ghubrat at Tam	Muscat*/Sha r	80	22,313	279	3,753	47	3,001	38		487	21,600	21,060	0.08	1,685	0.29	
New Construction		Wadi Saa - Ajran - Al Feth - Dank	A'Dhariyah	80	37,661	471	80,296	1,004	9,857	123	481	261	21,600	21,060	0.08	1,685	0.16	
New Construction		Al Feth - As Sunaynah	A Dhakhliyah	45	8,190	182	1,505	33	926	21	1,149	357	7,230	7,049	0.08	564	0.63	
New Construction		Al Wajajah - Ash Shwayhah	A Dhakhliyah	80	973	12	979	12	163	2	165	1,227	21,600	21,060	0.08	1,685	0.73	
New Construction		Murri - Ar Rumaylah - Al Ayn	A Dhakhliyah	30	23,459	782	6,011	200	2,652	88		4,958	16,200	15,795	0.08	1,264	3.92	
New Construction		Bahja -Amal	A Dhakhliyah	170	2,399	14	979	6	353	2	374	791	13,090	12,763	0.08	1,021	0.77	

Table 14.4-1 Prioritization of Road Network Projects (1/2)

Project No.	Project	Improvement Type	Length (km)	Cost (1,000 RO)
	On-going Major Road Projects			
	Rustaq - Miskin (to 2006)	2-L	[76]	*[9,504]*
	Quriyat - Sur II-1 (to 2007)	4-L	[60]	*[33,493]*
	Quriyat - Sur II-2 (to 2006)	4-L	[30]	*[22,737]*
N6	Al Ashkharah - Shanna	2-L	[164]	*[15000]*
N9	Marmul - Shelim - Sharbithat - Sawqrah	2-L	[140]	*[6800]*
N10	Shelim - Shuwaymiyah	2-L	[48]	*[3265]*
N26	Thumrait - Marmul	2-L	[86]	*[5438]*
N34	Tawi Attair-Jibjat	2-L	[41]	*[11,070]*
Muscat*				
1. Roads				
D	**Dualization**			
DM1	Al Amrat - Qurayyat	2-L to 4-L	[63]	
N	**New Construction**			
NM1	Southern Expressway	4/6-L	[54]	
NM2	Mutrah - Quriyyat, Coastal	4-L	[70]	
NM3	Sultan Qaboos Port Highway	4-L	[8]	
NM4	Amrat - Mizbar	4-L Tunnel	[26]	
Batianh				
1. Roads				
U	**Upgrading**			
U1	Batinah Highway	Culverts	270	29,120
W	**Widening**			
W1-1	Bait Al Barakah - Barka	4-L to 6-L	21	1,848
W1-2	Barka - Al Muladdah		33	2,904
D	**Dualization**			
D5-1	Majis (Sohar) - Az Zarub	2-L to 4-L	81	*42,430*
D8	Muladdah- Hazm		24	2,112
D10	Barka - Rustaq		84	9,042
D18-1	Sohar - Ibri		52	[16,016]
N	**New Construction**			
N1-1	New Batianh Expressway - 1	4-L	58	32,991
N1-2	New Batianh Expressway - 2		60	31,288
N1-3	New Batianh Expressway - 3		53	27,975
N1-4	New Batianh Expressway - 4		26	13,830
N1-5	New Batianh Expressway - 5		49	25,924
N3-1	Bait Al Barakah - Barka, Coastal	2-L	17	1,309
N3-2	Barka - Suwayq, Coastal		53	4,081
N3-3	Suwayq - Saham, Coastal		71	5,467
N3-4	Soham - Sohar, Coastal		30	2,310
N3-5	Sohar - Khatmet Malahah, Coastal		84	6,468
N27	Hamra - Rustaq, Phase 4		28	8,417
2. Structures	[Grade Separation - Batinah Highway]			
G1	Naseem Garden	4-L	1	3,623
G2	Baraka Roundabout		1	3,688
G3	Al Muladdah Junction		1	3,609
G4	Khaburah Roundabout		1	3,812
G5	Saham Roundabout		1	3,849
G6	Sohar Roundabout		1	4,161
G7	Falaj Al Qabail		1	4,232
G8	Aqr Roundabout		1	3,298
P1-P12	Pedestrian Crossing 1 - Batinah Highway	12 Locations		1,380
P13-P22	Pedestrian Crossing 2 - Batinah Highway	10 Locations		1,150
Musandam				
1. Roads				
N	**New Construction**			
N4	Diba - Khasab	2-L	105	*52,000*
N5	Lima Link - Khasab		15	*5,000*
N30	Madha - Dafta		15	5,146
Adh Dhahira				
1. Roads				
D	**Dualization**			
D3-2	Bahla - Ibri	2-L to 4-L	85	*15,000*
D5-2	Az Zarub - Buraymi		16	1,408
D11	Ibri - Ad Dariz		19	1,672
D17	Ibri - Saudi Arabia Border		143	[22,022]
D18-2	Sohar - Ibri		110	[33,880]
D19-2	Rustaq - Ibri		16	[5,120]
N	**New Construction**			
N28	Yanqul - Fida - Dank	2-L	41	9,990
N29	Yanqul - Murry		26	7,020
N40	Wadi Saa - Al Feth - Dank		80	21,600
N41	As Sunaynah - Al Feth - Al Wqba		45	7,230
N43	Al Wajajah - Ash Shwayhah		80	21,600
N44	Murri - Ar Rumaylah - Al Ayn		30	8,100
N45	Al Ayn - Sint - Al Wadi Al Ala		30	8,100
B	**Bypass**			
B2	Ibri South Bypass	300m Tunnel	13	2,002
B5	Ibri East Bypass	4-L	10	1,540

Table 14.4-1 Prioritization of Road Network Projects (2/2)

Project No.	Project	Improvement Type	Length (km)	Cost (1,000 RO)
Ad Dakhliyah				
1. Roads				
D	**Dualization**			
D3-1	Nizwa - Bahla	2-L to 4-L	40	*11,500*
D4-1	Karsha - Al Ghaba		196	17,248
D19-1	Rustaq - Ibri		120	[36,480]
N	**New Construction**			
N49	Al Ghaba - Ramlet Khaylah (Saudi Border)	2-L	298	[13,112]
B	**Bypass**			
B7	Adam Bypass		5	770
Ash Sharqiya				
1. Roads				
D	**Dualization**			
D2	Bidbid - Sur	2-L to 4-L	277	29,713
D6	Mizbar - Qaryatan - Izki		85	13,090
D9	Quriyat - Sur, Phase III		18	*4,886*
D16-1	Izki - Thumrayt Coastal Road (Izki-Hij)		263	[23,144]
N	**New Construction**			
N33	Tiwi - Ismaiyah	2-L	60	16,200
N36	Mahlah - Ghubrat at Tam - Ismaiyah		38	6,283
N37	Qaran - Maqal - Sabt - NR 23		55	11,955
N38	Al Mazari - Ghubrat at Tam (A'Sh)		80	21,600
B	**Bypass**			
B1	Sinaw Bypass	4-L	6	924
B3	Ibra Bypass		11	2,970
B8	Al Kamil North Bypass		9	1,309
B9	Al Wafi East Bypass		11	1,694
Al Wusta				
1. Roads				
D	**Dualization**			
D4-2	Al Ghaba - Hayma	2-L to 4-L	174	15,312
D4-3	Hayma - Muntasar		200	17,600
D16-2	Izki - Thumrayt Coastal Road (Hij-Sawqrah)		420	[36,960]
N	**New Construction**			
N46	Bahja - Amal	2-L	170	13,090
N47	Al Hij - Flim		19	1,767
N50	Flim - Mahowt (Box Culvert based on EIA)		6	[9,000]
Dhofar				
1. Roads				
D	**Dualization**			
D4-4	Muntasar - Thumrayt	2-L to 4-L	200	17,600
D4-5	Thumrayt - Salalah		73	*24,750*
D7	Ma'mura - Taqah		20	*3,000*
D12	Taqah - Mirbat		37	*5,500*
D13	Raysut - Rakhyut		80	[12,320]
D14	Rakhyut - Yemen Border		45	[6,930]
D15	Dawkah - Al Mazyunah		226	[19,888]
D16-3	Izki - Thumrayt Coastal Road (Sawqrah-Thumryt)		324	[49,896]
N	**New Construction**			
N7	Hasik - Shuwaymiyah	2-L	120	39,026
N11	Rakhyut - Dalkut, Coastal		25	1,925
N12	Madinat AL Haq - Nashib		28	*3,000*
N13	Hujaif - Jahnin - Asir		22	*3,000*
N14	Teetam - Qaftut		12	*3,000*
N15	Haluf - Masahilah		12	*1,000*
N16	Dawkah - Shisur - Qafaa		165	*8,000*
N17	Wadi Haruf-Shisur		83	6,391
N18	Mudayy - Aybut - Aydam		74	4,000
N19	Al Mazyunah - Tawsinat - Habrut - Aydam		120	21,600
N20	Shahb Asayb - Rakhyut		16	4,320
N21	Dalkut - Khadrafi - Sarfait		14	3,780
N22	Al Mazyunah - Mitan		96	7,392
N23	Hajaif - Masahilah		14	1,375
N24	Jibjat - Barbazum		65	17,550
N25	Haylat - Ar Rakah		25	1,925
N26	Thumrait - Marmul		86	5,438
N31	Amal - Muqshin		180	13,860
N32	Marmul - Dawkah		140	10,780
N48	Qatbit - Al Mushash (Saudi Border)		152	[6,688]
N51	Aybut - Habrut		65	3,000
B	**Bypass**			
B6	Salalah Outer Bypass		42	22,638
Others				
Improvement	Bridge Repair			751
	Shoulder Improvement - Primary			7,892
	Shoulder Improvement - Secondary			1,620
	Black-spot Improvement			3,000
Maintenance	Routine Maintenance of Roads and Bridges			141,990
	Periodical Maintenance and Rehabilitation			369,920
Total			**7,101**	**1,394,660**

Note: Cost values between Brackets [ ] are not included - *Costs in Italic are estimated by DGR / DGC*

A summary of investments required for each region during the five plans is presented in Table 14.4-2. Figure 14.4-1 shows the investments required for each 5-Year Plan with an average of about RO 280 million (without the budget required to construct/improve/ maintain other access and local roads). Higher investments are used in the first half in order to optimize benefits and to utilize higher oil revenues expected in the short- and medium terms. In addition, if foreign investments are used as loans, especially for high investments in the 8th plan, these loans can be repaid by the surplus in years to follow.

Table 14.4-2 Regional Road Investments (RO 1,000)

Region	5-Year Plan				
	7th	8th	9th	10th	11th
Batinah	54,339	130,416	47,454	17,537	30,572
Musandam	62,146	-	-	-	-
Adh Dhahira	24,990	10,100	23,602	24,970	21,600
Ad Dakhliyah	11,500	17,248	-	-	770
Ash Sharqiya	11,169	19,170	15,323	41,668	23,294
Al Wusta	1,767	15,312	17,600	-	13,090
Dhofar	21,218	48,846	64,742	49,088	49,956
Other Improvements	104,973	105,140	97,950	88,400	128,710
Total	292,102	346,232	266,671	221,663	267,992

Notes: 1. Budgets for other improvements are accumulated for all regions.
2. Investments in the table are those of primary and secondary networks only.

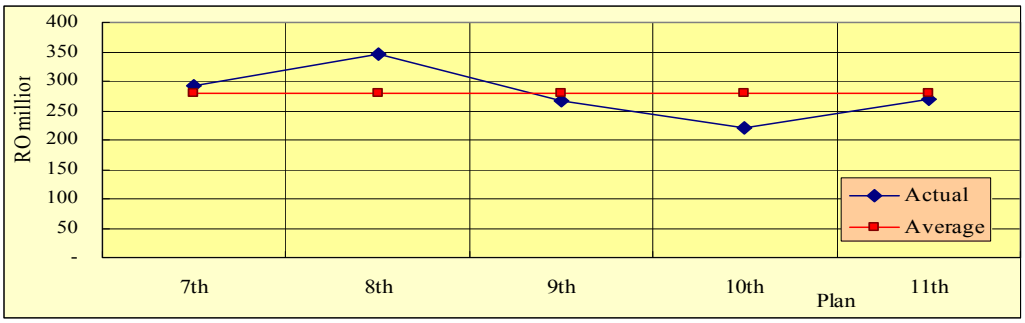


Figure 14.4-1 Road Master Plan Investments

Table 14.4-3 presents a summary for major work tasks and components of each of the five plans. Major tasks to develop the road networks are the construction of more than 3,000 kilometers of new paved roads, either on new alignments or to replace existing track roads in addition to about 1,600 kilometers of dualization. Figure 14.4-2 shows a location map for projects of each plan of the tentative planning scheme of all projects during the five development plans, while Figure 14.4-3 presents graphically the tasks and improvement work activities to be done on the road network during each of the five plans. Project Profile sheets for all projects under the planning period (2006 ~ 2030) are included in Appendix 14-2.

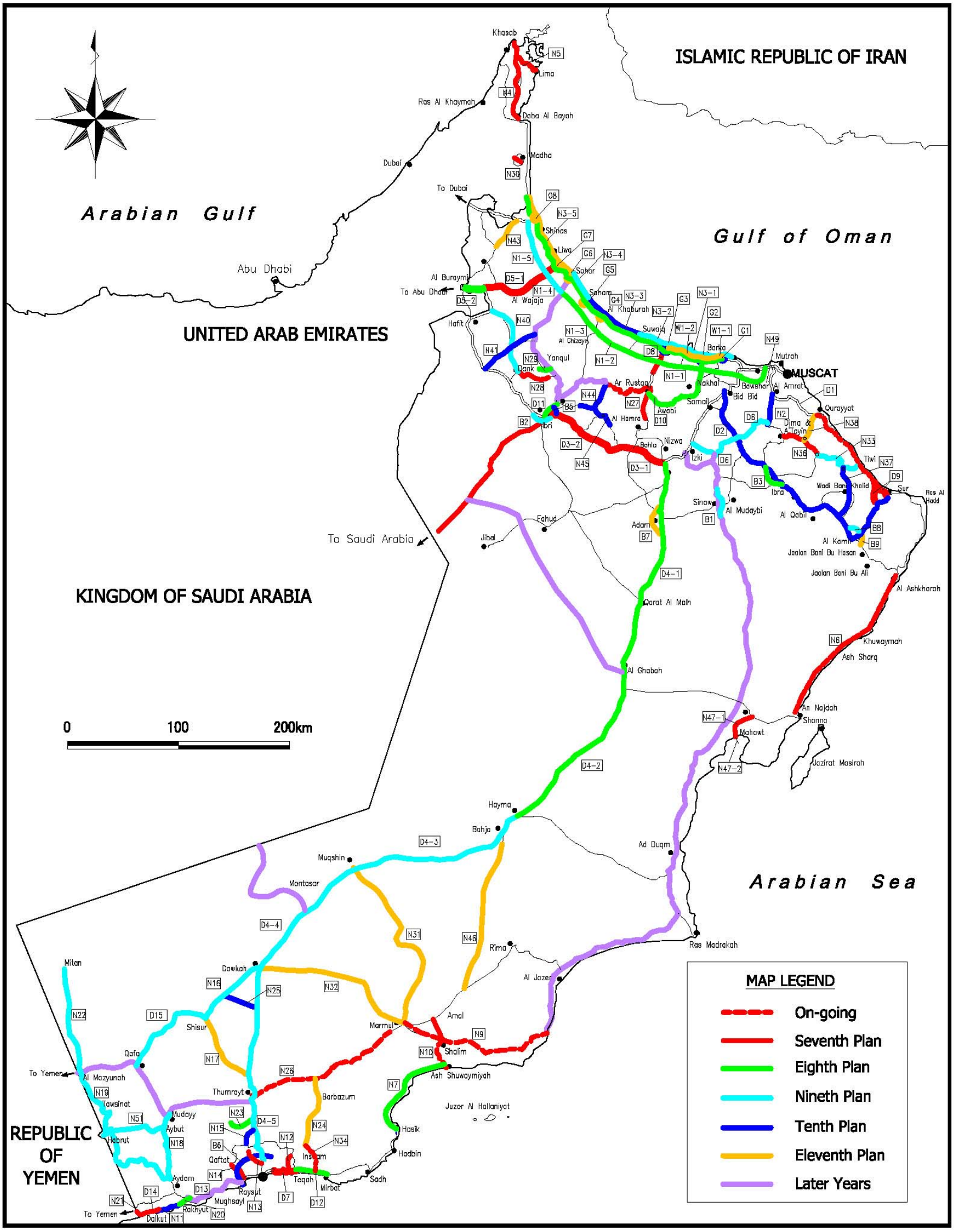
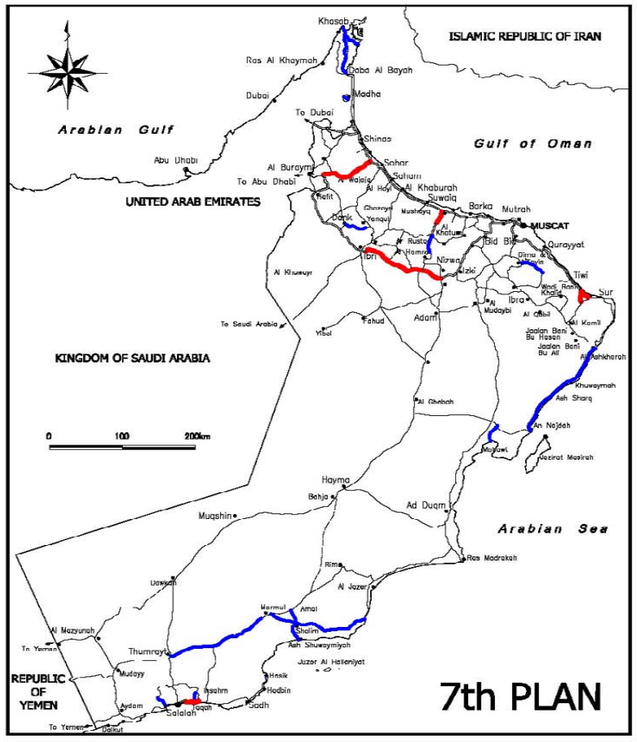
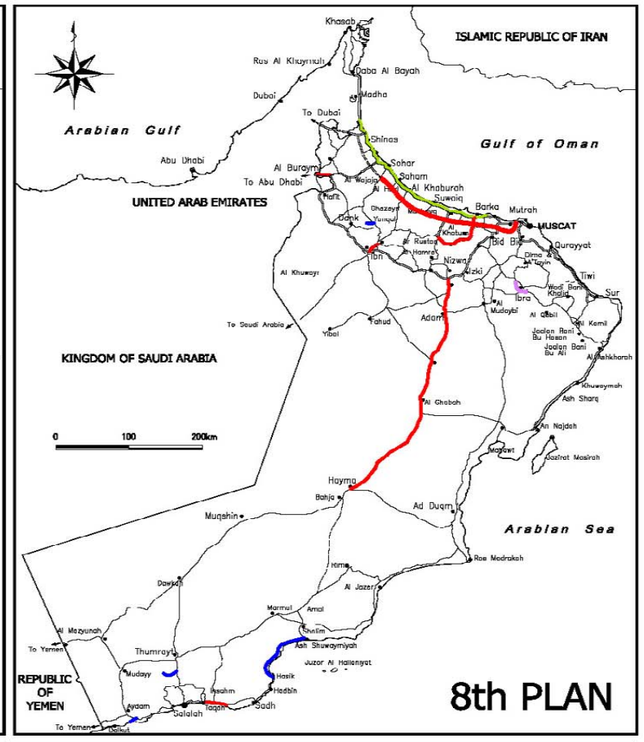
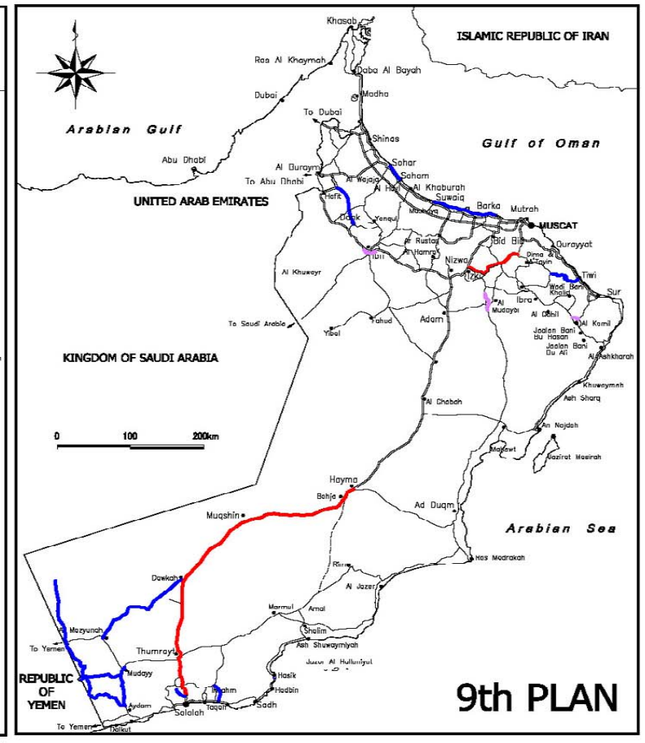
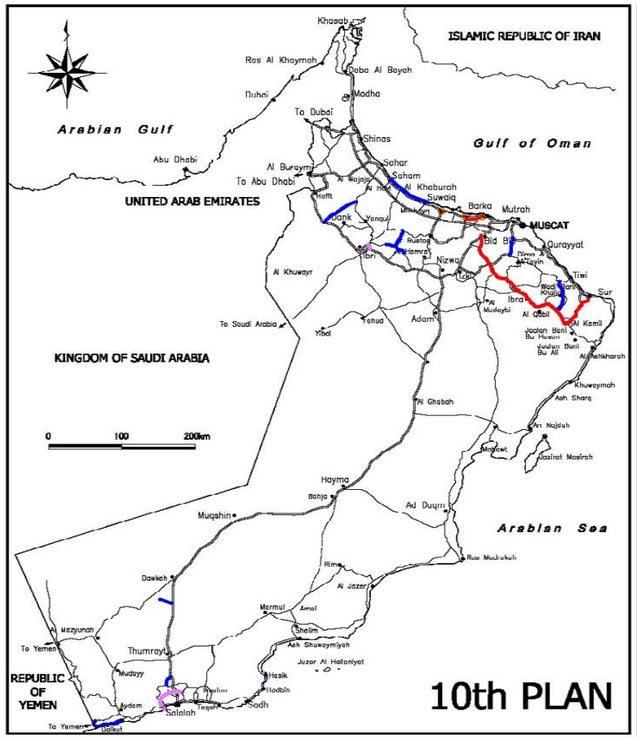


Figure 14.4-2 Five-Year Plans of Master Plan Projects (7th Plan – 11th Plan)









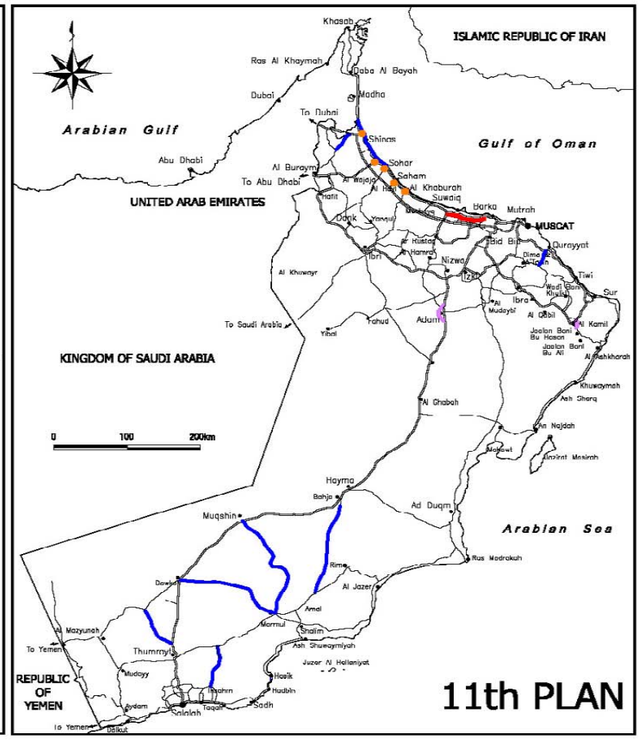


Figure 14.4-3 Tasks of Road Development Projects by Plan

Table 14.4-3 Major Components of Projects

Improvement Type	5-Year Plan					Total
	7th	8th	9th	10th	11th	
Upgrading - km	-	270	-	-	-	270
Widening (4-L to 6-L) - km	-	-	-	-	54	54
Dualization (2-L to 4-L) - km	268	526	558	277	-	1,629
New Construction (4-L) - km	-	171	75	-	-	246
New Construction (2-L) - km	423	162	640	413	896	2,534
Bypass (4-L) - km	-	11	28	52	16	107
Grade Separation – Nos.	-	-	-	3	5	8
Pedestrian Crossing – Nos.	12	-	-	10	-	22

14.4.2 Annual Investment Framework

In preparing Implementation Framework, due attention is paid to the following aspects:

- Nearly constant nation-wide investment among 5 Year Development Plan (5YDP) periods as well as among each fiscal year of 5YDPs.
- Constant investment among 5YDP periods and among each fiscal year for each Region/ Governorate.

The constant investment approach is important to attain stable economic growth. In many countries, the government expenditure occupies large share of the total national expenditure and greatly affects the economic growth of the nation. Thus, investment for public works, including those for roads, is used as a tool to adjust or stimulate the national economy. For this reason, annual amounts and the amounts for 5YDP periods of road development should be maintained at constant level. In addition, the amount of investment for each region should be maintained at constant level as much as possible.

14.5 ANNUAL IMPLEMENTATION PROGRAM

During the total period of implementing the projects of the Master Plan, from 2006 to 2030, the annual investments are distributed to be nearly equal to the average of the budget required in each plan as presented in Table14.2-2. Based on the results of the prioritization process, the annual implementation schedule for each project under the plan that provides optimum distribution for the required annual road investments is established as presented in Table 14.5-1. Figure 14.5-1 shows the development of the road network for each 5-Year Plan up to 2030 as well as the future network including projects in later years.

A low investment of about RO 32.6 million is required in the first year of the 7th Plan to cover only the cost of design, advance payment and mobilization works. There will be, however, other construction activities for on-going projects of the 6th Plan for which the cost is not included.

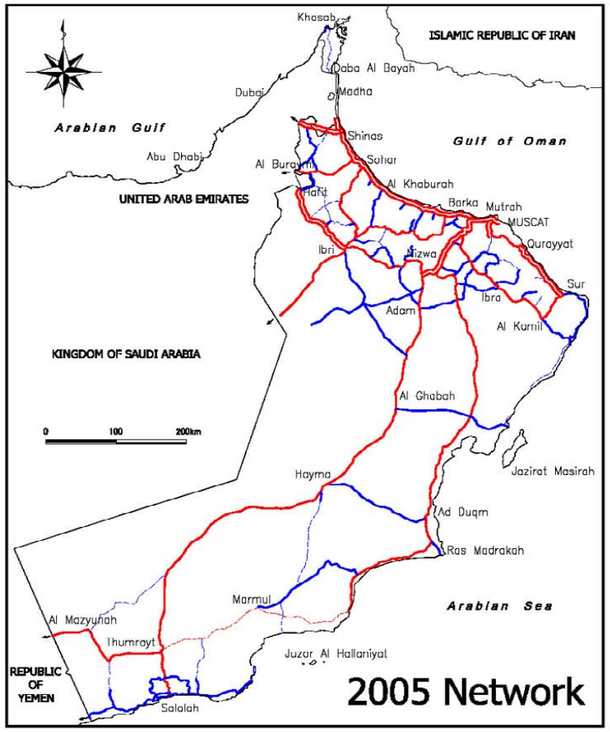
Table 14.5-1 Annual Investment and Implementation Schedule (1/2)

Project No.	Project	Plan	7th Plan					8th Plan					9th Plan					10th Plan					11th Plan				
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Batianh																											
1. Roads																											
U	**Upgrading**																										
U1	Batinah Highway	8																									
W	**Widening**																										
W1-1	Bait Al Barakah - Barka	11																									
W1-2	Barka - Al Muladdah	11																									
D	**Dualization**																										
D5-1	Majis (Sohar) - Az Zarub	7																									
D8	Muladdah- Hazm Road	7																									
D10	Barka - Rustaq Road	8																									
N	**New Construction**																										
N1-1	New Batianh Expressway -1	8																									
N1-2	New Batianh Expressway -2	8																									
N1-3	New Batianh Expressway -3	8																									
N1-4	New Batianh Expressway -4	9																									
N1-5	New Batianh Expressway -5	9																									
N3-1	Bait Al Barakah - Barka, Coastal	9																									
N3-2	Barka - Suwayq, Coastal	9																									
N3-3	Suwayq - Saham, Coastal	10																									
N3-4	Soham - Sohar, Coastal	9																									
N3-5	Sohar - Khatmet Malahah, Coastal	11																									
N27	Hatt - Rustaq, Phase IV	7																									
2. Structures	[Grade Separation - Batinah Highway]																										
G1	Naseem Garden	10																									
G2	Baraka Roundabout	10																									
G3	Al Muladdah Junction	10																									
G4	Khaburah Roundabout	11																									
G5	Saham Roundabout	11																									
G6	Sohar Roundabout	11																									
G7	Falaj Al Qabail	11																									
G8	Aqr Roundabout	11																									
	Pedestrian Crossing 1 - Batinah Highway	7																									
	Pedestrian Crossing 2 - Batinah Highway	10																									
Musandam																											
1. Roads																											
N	**New Construction**																										
N4	Diba - Khasab	7																									
N5	Lima Link - Khasab	7																									
N30	Madha - Dafta	7																									
Adh Dhahira																											
1. Roads																											
D	**Dualization**																										
D3-2	Bahla - Ibri	7																									
D5-2	Az Zarub - Buraymi	8																									
D11	Ibri - Ad Dariz Road	8																									
N	**New Construction**																										
N28	Yanqul-Fida-Dank	7																									
N29	Yanqul – Murry	8																									
N40	Wadi Saa - Al Feth - Dank	9																									
N41	As Sunaynah - Al Feth - Al Wqba	10																									
N43	Al Wajajah - Ash Shwayhah	11																									
N44	Murri - Ar Rumaylah - Al Ayn	10																									
N45	Al Ayn - Sint - Al Wadi Al Ala	10																									
B	**Bypass**																										
B2	Ibri South Bypass	9																									
B5	Ibri East Bypass	10																									
Ad Dakhliyah																											
1. Roads																											
D	**Dualization**																										
D3-1	Nizwa - Bahla	7																									
D4-1	Karsha - Al Ghaba	8																									
B	**Bypass**																										
B7	Adam Bypass	11																									

Table 14.5-1 Annual Investment and Implementation Schedule (2/2)

Project No.	Project	Plan	7th Plan					8th Plan					9th Plan					10th Plan					11th Plan				
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Ash Sharqiya																											
1. Roads																											
D	**Dualization**																										
D2	Bidbid - Sur	10																									
D6	Mizbar - Qaryatan - Izki	9																									
D9	Quriyat - Sur Phase III	7																									
N	**New Construction**																										
N33	Tiwi - Ismaiyah	9																									
N36	Mahlah - Ghubrat at Tam - Ismaiyah	7																									
N37	Qaran - Maqal - Sabt - NR 23	10																									
N38	Al Mazari - Ghubrat at Tam (A'Sh)	11																									
B	**Bypass**																										
B1	Sinaw Bypass	9																									
B3	Ibra Bypass	8																									
B8	Al Kamil North Bypass	9																									
B9	Al Wafi East Bypass	11																									
Al Wusta																											
1. Roads																											
D	**Dualization**																										
D4-2	Al Ghaba - Hayma	8																									
D4-3	Hayma - Muntasar	9																									
N	**New Construction**																										
N46	Bahja - Amal	11																									
N47-1	Al Hij - Flim	7																									
Dhofar																											
1. Roads																											
D	**Dualization**																										
D4-4	Muntasar - Thumrayt	9																									
D4-5	Thumrayt - Salalah	9																									
D7	Ma'mura - Taqah	7																									
D12	Taqah - Mirbat	8																									
N	**New Construction**																										
N7	Hasik - Shuwaymiyah	8																									
N11	Rakhyut - Dalkut Coastal Road	10																									
N12	Madinat AL Haq - Nashib	7																									
N13	Hujaif - Jahnin - Asir	7																									
N14	Teetam - Qaftut	7																									
N15	Haluf - Masahilah	10																									
N16	Dawkah - Shisur - Qafaa	9																									
N17	Wadi Haruf - Shisur	11																									
N18	Mudayy - Aybut - Aydam	9																									
N19	Al Mazyunah - Tawsinat - Habrut - Aydam	9																									
N20	Shahb Asayb - Rakhyut	8																									
N21	Dalkut - Khadrafi - Sarfait	7																									
N22	Al Mazyunah - Mitan	9																									
N23	Hajaif - Masahilah	11																									
N24	Jibjat - Barbazum	11																									
N25	Haylat - Ar Rakah	10																									
N26	Thumrait - Marmul	7																									
N31	Amal - Muqshin	11																									
N32	Marmul - Dawkah	11																									
N51	Aybut - Habrut	9																									
B	**Bypass**																										
B6	Salalah Outer Bypass	10																									
Others																											
Improvement	Bridge Repair	7																									
	Shoulder Improvement - Primary	7																									
	Shoulder Improvement - Secondary	8																									
	Black-spot Improvement	7																									
Maintenance	Routine Maintenance of Roads and Bridges	7-11																									
	Periodical Maintenance and Rehabilitation	7-11																									
	Annual Investment (RO 1,000)		32,631	61,109	59,234	56,602	58,511	58,121	67,418	68,506	74,100	65,511	51,039	58,042	59,043	49,590	46,046	44,918	50,931	50,461	47,870	46,394	56,012	58,751	58,966	58,385	56,468

Note: Design / Tendering Construction



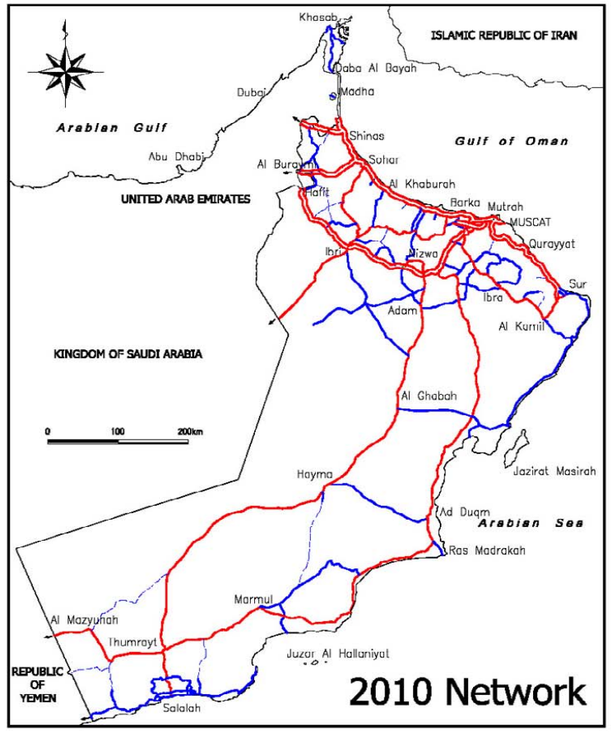
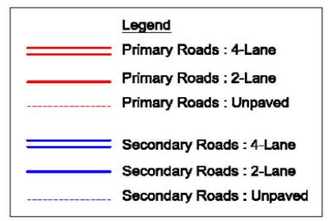
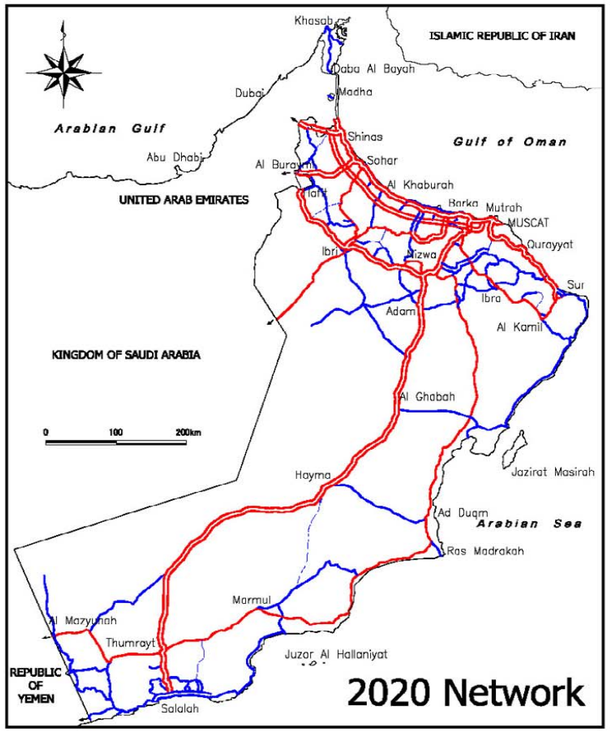
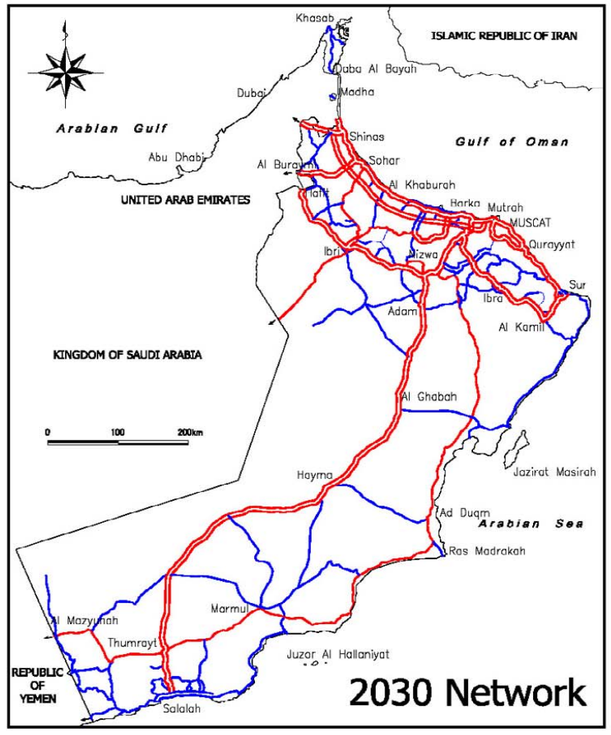
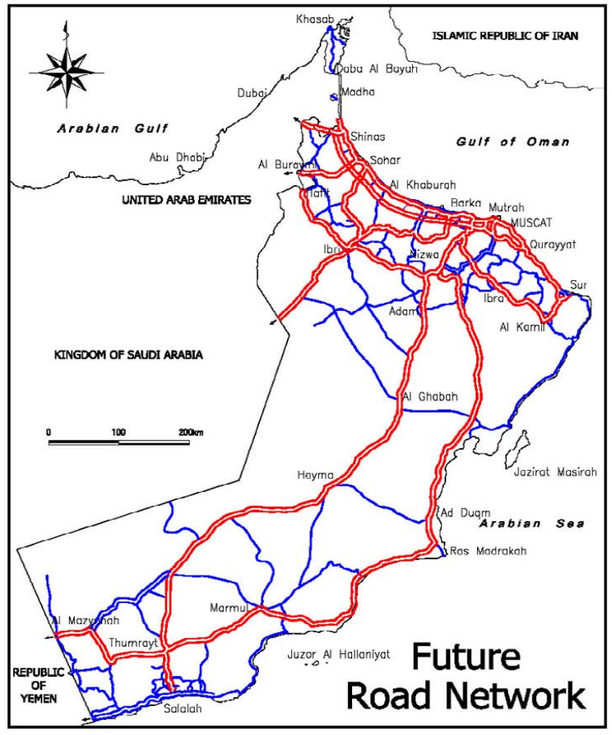


Figure 14.5-1 Road Network Development in Oman









CHAPTER 15

MASTER PLAN EVALUATION

CHAPTER 15

MASTER PLAN EVALUATION

15.1 ECONOMIC EVALUATION

15.1.1 Methodology of Economic Evaluation

Evaluation of the Master Plan projects is done in three stages during the planning process with different purposes. The first stage is to select the optimum alternative by comparing between different approaches of developing the network (Chapter 9). The second stage belongs to the investment scheduling procedure to determine relative priority among projects (Chapter 14). The last one is to evaluate economic feasibility of the plan in accordance with the proposed implementation schedule. In the three stages, the economic evaluation is carried out by conducting comparative analysis between benefits and costs. The process of economic evaluation of master plan is shown in Figure 15.1-1.

The evaluation period is assumed to be 30 years from the starting year of operation for the improvement project.

The economic evaluation method principally employs benefit-cost analysis which is evaluating the investment efficiency through comparison between costs and benefits derived from the road network development plan. It expresses the benefit-cost stream during the evaluation period. The economic indicators used in this study are:

a) Net Present Value (NPV),
b) Benefit Cost (B/C) Ratio, and
c) Economic Internal Rate of Return (EIRR).

The cost and benefit accruing from a project are measured in terms of economic prices. The benefits derived from the Master Plan can be defined principally for the two cases of *with* and *without* Master Plan. There are various benefits based on the results of assigned traffic volumes. Among them, the following tangible ones are considered:

a) Savings in vehicle operating costs (VOC)
   - reduction in running cost
   - reduction in fixed cost
b) Savings in travel time costs (TTC)

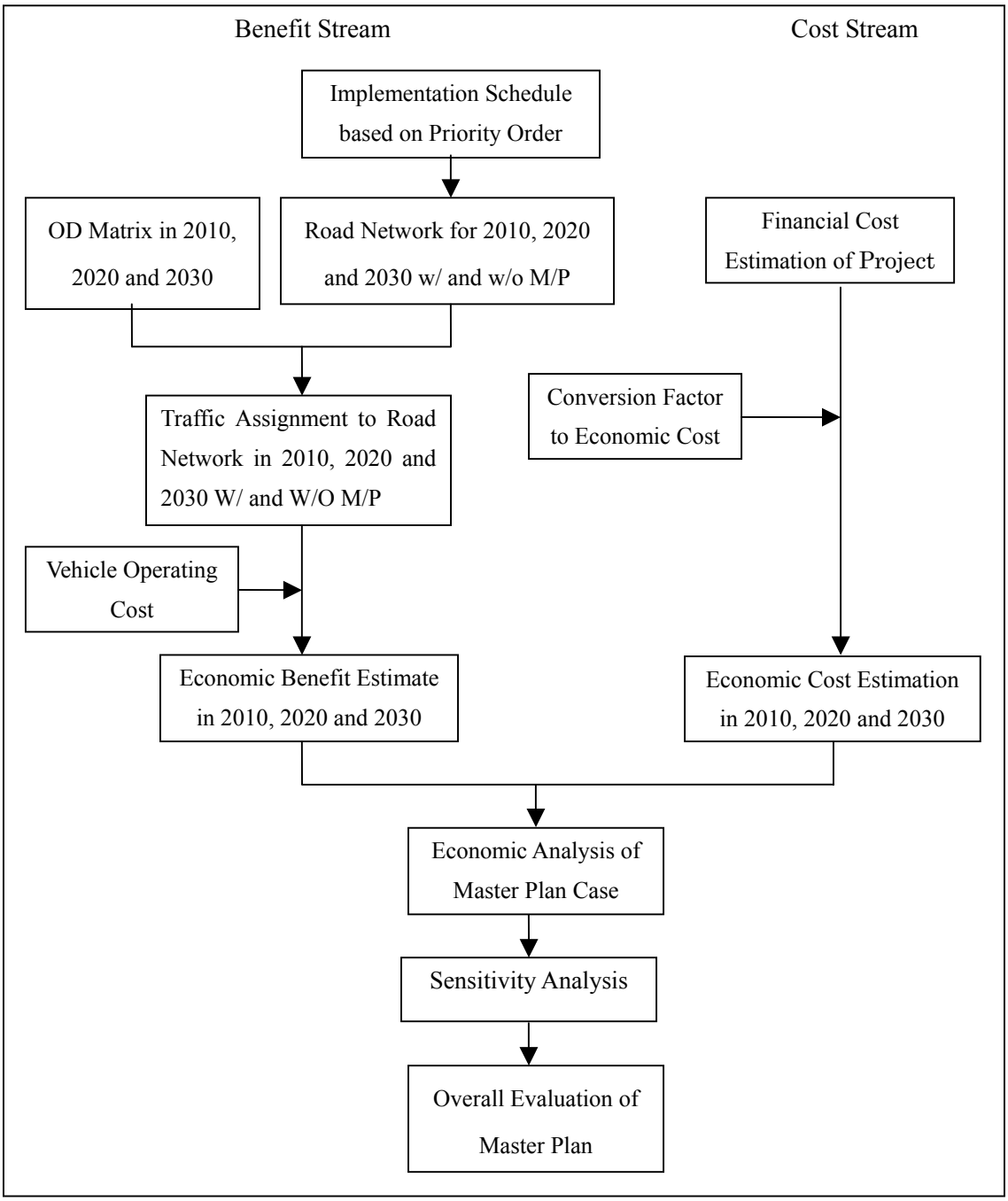


Figure 15.1-1 Procedure for Evaluation of Master Plan

15.1.2 Traffic Analysis

1) Traffic Demand Forecast

The traffic assignment results are presented in Figure 15.1-2 for the “Do Nothing” and “Master Plan” cases in the years 2010, 2020 and 2030. This figure shows that “Do Nothing” case provides reduction on of the LOS in some of primary roads in the Northern region, especially along Muscat-Batinah and Muscat-Sur corridors.

2) Traffic Parameters

The traffic system performance of the M/P is assessed as shown in Table 15.1-1 based on savings in traffic parameters and traffic cost between the two cases of “Do Nothing” and “Master Plan”. The M/P will provide savings in PCU-kilometers (traveled distances on the network) of 7.58 million per day and in PCU-hours (traveled hours spent on the network) of 382 thousand per day in 2030**.**

Table 15.1-1 Traffic Parameters

Indicator	Case	2010	2020	2030
PCU-Kilometer ('000)	Do Nothing (A)	19,089.3	29,314.5	61,244.7
	Master Plan (B)	18,035.6	27,399.0	53,661.9
	B/A	0.94	0.93	0.88
PCU-Hour ('000)	Do Nothing (A)	260,077	408,708	1,013,126
	Master Plan (B)	230,675	331,187	631,016
	B/A	0.87	0.80	0.61

Other traffic efficiency measures are the average travel speed, average traffic congestion ratio (V/C ratio) on the whole network and level of service which are shown in Tables 15.1-2 and 15.1-3. Results show large improvement in efficiency of the network either in the increased average speed or decreased V/C ratio or maintained the level of service.

Table 15.1-2 Travel Speed and Traffic Congestion with and without the M/P

Indicator	Case	2010	2020	2030
Average Travel Speed (km/hour)	Do Nothing (A)	73.4	71.7	60.5
	Master Plan (B)	78.1	82.7	85.0
	B/A	1.04	1.24	1.38
Average V/C Ratio	Do Nothing (A)	0.15	0.22	0.46
	Master Plan (B)	0.11	0.12	0.20
	B/A	0.73	0.55	0.43

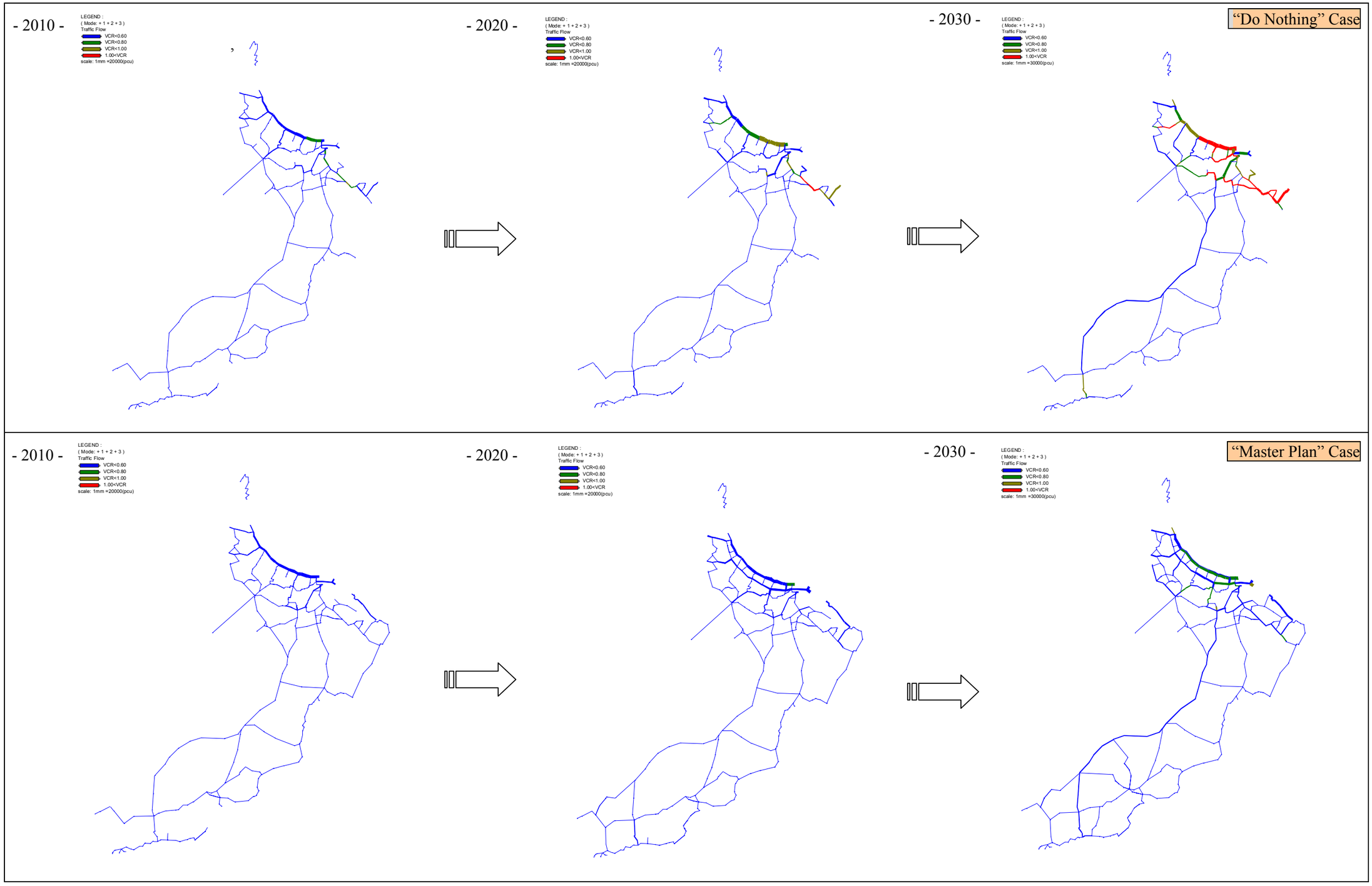


Figure15.1-2 Traffic Assignment Comparison

Table 15.1-3 Level of Service (LOS) for "Do Nothing" Case and with "Master Plan"

Level of Service (LOS)	2010		2020		2030	
	Do Nothing	With M/P	Do Nothing	With M/P	Do Nothing	With M/P
A – B – C	5,705 km 96.3%	6,527 km 100 %	5,431 km 91.7 %	7,195 km 99.7 %	4,492 km 75.8 %	7,542 km 94.4 %
D	204 km 3.4%	0 km 0 %	192 km 3.2 %	23 km 0.3 %	374 km 6.3 %	327 km 4.1 %
E	15 km 0.3%	0 km 0 %	170 km 2.9 %	0 km 0 %	363 km 6.1 %	117 km 1.5 %
F	0 km 0 %	0 km 0 %	0 km 0 %	0 km 0 %	697 km 11.8 %	0 km 0 %

15.1.3 Economic Evaluation

1) Estimation of Economic Benefits

a. Unit Vehicle Operating Cost (VOC)

Table1s 5.1-4(1), (2) and (3) presents summery of unit VOC on paved and unpaved surface roads.

Table 15.1-4(1) Running Cost by Vehicle Speed and Surface Type (RO/'000 km)

Speed	Paved Surface			Unpaved Surface		
	Passenger Car	Bus	Truck	Passenger Car	Bus	Truck
5 km/h	66	109	116	104	177	143
30	34	43	49	53	69	61
50	33	41	47	53	66	58
70	36	44	50	57	70	62
90	41	49	55	64	79	69
110	47	57	63	73	92	78
130	54	67	73	85	108	91
150	63	79	85	99	127	105

Note: All unit costs are presented in 2005 prices

Table 15.1-4(2) Unit Fixed Cost by Vehicle Types (RO/Hr)

Vehicle	Fixed Cost
Passenger Car	1.088
Bus	1.835
Truck	2.661

Note: All unit costs are presented in 2005 prices

Table 15.1-4(3) Unit Fixed Cost by Vehicle Types (RO/Hr)

Vehicle	TTC (Person Base)	TTC (Vehicle Base)
Passenger Car	0.58	1.27
Bus	0.47	5.75
Truck	0	0

Note: All unit costs are presented in 2005 prices

b. Estimation of Benefits

The saving in vehicle operating costs and travel time cost were estimated and are shown in Table 15.1-5.

Table 15.1-5 Estimation of Benefits (RO 1,000 /Day)

Year	Case	Saving in VOC Running Cost	Saving in VOC Fixed Cost	Saving in Time Cost	Total Saving
2010	W/O M/P	627,736	282,429	192,645	1,102,810
	With MP	608,640	250,994	177,233	1,036,867
	W/O – With	19,096	31,435	15,412	65,943
2020	W/O M/P	915,884	444,995	262,113	1,622,953
	With MP	867,441	360,337	222,814	1,450,592
	W/O – With	48,443	84,659	39,299	172,401
2030	W/O M/P	1,709,549	1,109,426	435,552	3,254,528
	With MP	1,626,626	690,347	293,670	2,610,643
	W/O – With	82,924	419,079	141,882	643,885

15.1.4 Estimation of Economic Costs

The project cost, which was already calculated in the previous section, is expressed as the financial cost. It is therefore to convert from financial cost to economic cost. In this study the economic cost was estimated to deduct from financial cost to government taxes and import duty is shown in Table 15.1-6.

Table 15.1-6 Economic Cost Estimate (RO million)

Description		Financial Cost	Economic Cost
1	Road		
	- Upgrading	29,120	27,667
	- Widening and dualization	207,867	197,474
	- New construction, including Bypass	599,699	569,714
	- Improvement	13,263	12,599
2	Structure		
	- Grade separation and pedestrian crossing	32,802	31,162
	Total	882,750	838,613

Maintenance Cost:

The maintenance cost, which is already calculated in the previous section, is also expressed as the financial cost, and it is converted here from financial maintenance cost to economic one.

15.1.5 Economic Analysis

1) Benefit-Cost Analysis

Based on the above mentioned benefits and costs estimation, the economic analysis of the Mater Plan is made. Table 15.1-7 shows the benefit-cost analysis of the Master Plan during a project life period of 30 years and Table 15.1-8 shows the benefit cost stream. The results of the economic analysis show that a Net Present Value (NPV) of RO 261 million and B/C of 1.71 over 30 years life of the Master Plan using a discount date of 6.0 % which is designated by the Ministry of National of Oman. The Economic Internal Rate of Return (EIRR) was compiled at 12.3%.

Table 15.1- 7 Economic Indicators of Benefit-Cost Analysis

Net Present Value	RO 261 million
B/C	1.71
EIRR	12.3 %

Notes: 1) Project life is assumed to be 30 years
2) Discount rate is assumed to be 6.0%

Table 15.1-8 Benefit – Cost Stream of Master Plan

Undiscounted Benefit Cost Stream

RO '000

Sq.	Year	Construction Cost	O & M Cost	Cost Total	Benefit	Benefit - Cost
1	2005					
2	2006	13,267		13,267	-	-13,267
3	2007	40,321	133	40,454	8,968	-31,486
4	2008	38,539	536	39,075	13,452	-25,623
5	2009	36,039	921	36,960	17,936	-19,024
6	2010	37,853	1,282	39,135	22,421	-16,714
7	2011	35,547	1,660	37,207	24,470	-12,737
8	2012	44,379	2,016	46,395	26,714	-19,681
9	2013	45,412	2,459	47,871	29,171	-18,700
10	2014	50,726	2,914	53,640	31,861	-21,779
11	2015	42,567	3,421	45,988	34,807	-11,181
12	2016	29,877	3,847	33,724	38,034	4,311
13	2017	36,530	4,145	40,675	41,569	894
14	2018	37,480	4,511	41,991	45,444	3,453
15	2019	28,500	4,885	33,385	49,690	16,305
16	2020	25,134	5,170	30,304	54,344	24,040
17	2021	25,876	5,422	31,298	60,663	29,365
18	2022	31,589	5,680	37,269	67,746	30,477
19	2023	31,142	5,996	37,138	75,688	38,550
20	2024	28,681	6,308	34,989	84,597	49,608
21	2025	27,278	6,595	33,873	94,595	60,722
22	2026	28,756	6,867	35,623	105,819	70,196
23	2027	31,359	7,155	38,514	118,423	79,909
24	2028	31,563	7,469	39,032	132,584	93,552
25	2029	31,011	7,784	38,795	148,499	109,704
26	2030	29,190	8,094	37,284	166,392	129,108
27	2031		8,094	8,094	186,514	178,420
28	2032		8,094	8,094	209,154	201,060
29	2033		8,094	8,094	234,632	226,538
30	2034		8,094	8,094	263,316	255,222
31	2035		8,094	8,094	295,618	287,524
32	2036		8,094	8,094	332,007	323,913
33	2037	-313,074	8,094	-304,979	373,012	677,991
	Total	525,542	161,929	687,472	3,388,140	2,700,668

Discounted Benefit Cost Stream

RO '000

Sq.	Year	Discounted	Construction Cost	O & M Cost	Cost Total	Benefit	Benefit - Cost
1	2005						
2	2006	1.124	11,808	-	11,808	-	-11,808
3	2007	1.191	33,854	111	33,966	7,530	-26,436
4	2008	1.262	30,526	424	30,951	10,655	-20,296
5	2009	1.338	26,930	688	27,619	13,403	-14,216
6	2010	1.419	26,685	904	27,588	15,806	-11,782
7	2011	1.504	23,641	1,104	24,745	16,274	-8,471
8	2012	1.594	27,844	1,265	29,109	16,761	-12,348
9	2013	1.689	26,879	1,456	28,335	17,266	-11,069
10	2014	1.791	28,325	1,627	29,952	17,791	-12,161
11	2015	1.898	22,424	1,802	24,226	18,336	-5,890
12	2016	2.012	14,848	1,912	16,760	18,902	2,142
13	2017	2.133	17,127	1,943	19,070	19,489	419
14	2018	2.261	16,577	1,995	18,572	20,100	1,527
15	2019	2.397	11,892	2,038	13,931	20,734	6,803
16	2020	2.540	9,894	2,035	11,929	21,392	9,463
17	2021	2.693	9,609	2,013	11,623	22,528	10,905
18	2022	2.854	11,067	1,990	13,057	23,734	10,677
19	2023	3.026	10,293	1,982	12,275	25,016	12,741
20	2024	3.207	8,943	1,967	10,910	26,378	15,468
21	2025	3.400	8,024	1,940	9,964	27,826	17,862
22	2026	3.604	7,980	1,906	9,886	29,365	19,480
23	2027	3.820	8,210	1,873	10,083	31,003	20,920
24	2028	4.049	7,795	1,845	9,640	32,745	23,105
25	2029	4.292	7,226	1,814	9,039	34,600	25,561
26	2030	4.549	6,416	1,779	8,195	36,575	28,379
27	2031	4.822	-	1,678	1,678	38,677	36,999
28	2032	5.112	-	1,583	1,583	40,917	39,333
29	2033	5.418	-	1,494	1,494	43,303	41,809
30	2034	5.743	-	1,409	1,409	45,846	44,437
31	2035	6.088	-	1,330	1,330	48,557	47,227
32	2036	6.453	-	1,254	1,254	51,447	50,193
33	2037	6.841	-45,767	1,183	-44,584	54,529	99,113
		Total	369,051	48,346	417,396	847,484	430,088

Discount Rate	6.0%

Net Present Value (Million Rial)	261
B/C Ratio	1.71
EIRR	12.3%

2) Sensitivity Analysis

The sensitivity analysis is conducted under a worse case scenario incorporating increase and/or decrease of the estimation of costs and benefits. Table 15.1-9 shows the results of the sensitivity analysis.

Table 15.1-9 Sensitivity Analysis regarding Costs and Benefits of Master Plan

Case		Economic Indicator	Benefits		
			- 20%	Base Case	+ 20%
Costs	- 20%	NPV (RO million)	206	333	460
		B/C	1.71	2.14	2.57
		EIRR (%)	12.2	16.2	20.3
	Base Case	NPV (RO million)	138	261	403
		B/C	1.37	1.71	2.04
		EIRR (%)	9.3	12.3	15.2
	+ 20%	NPV (RO million)	66	190	306
		B/C	1.14	1.42	1.71
		EIRR (%)	7.3	9.8	12.3

Notes: 1) Project life is assumed to be 30 years
2) Discount rate is assumed to be 6.0%

15.1.6 Summary of Economic Analysis

The implementation of the Master Plan of Road Network Development can be justified from view of the national economy point although some of the road projects show low B/C ratio as shown in Table 14.3-7.

15.2 IMPACT ON TRANSPORT EFFICIENCY

Most significant impacts by the Road Network Development Master Plan are to improve the transport efficiency. The transport efficiency is compared by applying the following indicators on “Do Nothing” case and “Master Plan” case.

- PCU-Kilometer (total vehicular distance on the network)
- PCU-Hour (total vehicular time on the network)
- Average travel speed
- Vehicle operating cost
- Travel time cost
- Road length by Level of Service (LOS)

Table 15.2-1 and Figure 15.2-1 show the improvement of transport efficiency by Master Plan and by areas.

The comparison results concluded as follows:

a) PCU-kilometer (or travel distance) would be reduced by 5.4 %, 6.5 % and 12.5 % in the years 2010, 2020 and 2030, respectively.
b) PCU-hour (or travel time) would be greatly reduced by 11.1 %, 19.0 % and 37.7 % in the years 2010, 2020 and 2030, respectively.
c) Vehicle operating costs including travel time costs would be reduced by 6.0 %, 8.2 % and 19.8 % in the years 2010, 2020 and 2030, respectively.

The above mentioned improvements are mainly due to the construction of missing links as well as other new links, improvement of pavement condition and dualization of single carriageway roads as well as alternative means of transport such as expressways and bypasses.

The traffic efficiency improvement such as PCU-kilometers, PCU-hours, and vehicle operating costs in north and Musandam area is indicated to be higher than that in central and south area.

Table 15.2-1 Transport Efficiency Improvement by Master Plan and by Area

Indicator		Area	Case	Short Term (2010)	Medium Term (2020)	Long Term (2030)
PCU -Kilometer ('000)		Whole Oman	Do Nothing (A)	19,089,281	29,314,477	61,244,746
			Master Plan (B)	18,054,39	27,398,97	53,611,86
			B/A	0.946	0.935	0.875
		North / Musandam	Do Nothing (A)	16,819,069	25,521,250	52,755,506
			Master Plan (B)	15,788,88	23,629,71	45,285,60
			B/A	0.939	0.926	0.858
		Central / South	Do Nothing (A)	2,270,212	3,793,227	8,489,240
			Master Plan (B)	2,265,51	3,769,25	8,326,26
			B/A	0.998	0.994	0.981
PCU -Hour		Whole Oman	Do Nothing (A)	260,077	408,569	1,012,919
			Master Plan (B)	231,27	330,96	631,01
			B/A	0.889	0.810	0.623
		North / Musandam	Do Nothing (A)	223,454	348,540	880,616
			Master Plan (B)	197,00	283,97	531,79
			B/A	0.882	0.815	0.604
		Central / South	Do Nothing (A)	36,623	60,029	132,303
			Master Plan (B)	34,27	46,98	99,22
			B/A	0.936	0.783	0.750
Average Travel Speed (km/hour)		Whole Oman	Do Nothing (A)	80.1	71.7	60.5
			Master Plan (B)	78.	82.	85.
			B/A	0.974	1.155	1.405
		North / Musandam	Do Nothing (A)	75.3	73.2	59.9
			Master Plan (B)	80.	83.	85.
			B/A	1.065	1.136	1.421
		Central / South	Do Nothing (A)	62.0	63.2	64.2
			Master Plan (B)	66.	80.	83.
			B/A	1.066	1.269	1.308
Vehicle Operating Cost (Total)		Whole Oman	Do Nothing (A)	1,102,810	1,622,953	3,254,528
			Master Plan (B)	1,036,86	1,490,59	2,610,64
			B/A	0.940	0.918	0.802
		North / Musandam	Do Nothing (A)	970,015	1,415,375	2,855,658
			Master Plan (B)	911,10	1,303,52	2,280,28
			B/A	0.939	0.921	0.799
		Central / South	Do Nothing (A)	132,795	207,578	398,870
			Master Plan (B)	125,75	187,07	330,35
			B/A	0.947	0.901	0.828
Level of Service (LOS)	A-C (0 -0.6)	Whole Oman	Do Nothing	5,658	5,384	4,445
			Master Plan	6,48	7,14	7,54
	D (0.6-0.8)		Do Nothing	204	192	374
			Master Plan		2	44
	E (0.8-1.0)		Do Nothing	15	170	363
			Master Plan			
	F (1.0-)		Do Nothing	0	131	695
			Master Plan			
Level of Service (LOS)	A-C (0 -0.6)	North / Nusandam	Do Nothing	2,975	2,701	1,838
			Master Plan	3,72	4,08	4,03
	D (0.6-0.8)		Do Nothing	204	192	361
			Master Plan		2	44
	E (0.8-1.0)		Do Nothing	0	170	296
			Master Plan			
	F (1.0-)		Do Nothing	0	130	695
			Master Plan			
Level of Service (LOS)	A-C (0 -0.6)	Central / South	Do Nothing	2,683	2,683	2,607
			Master Plan	2,75	3,06	3,46
	D (0.6-0.8)		Do Nothing	0	0	13
			Master Plan			
	E (0.8-1.0)		Do Nothing	0	0	67
			Master Plan			
	F (1.0-)		Do Nothing	0	0	0
			Master Plan			

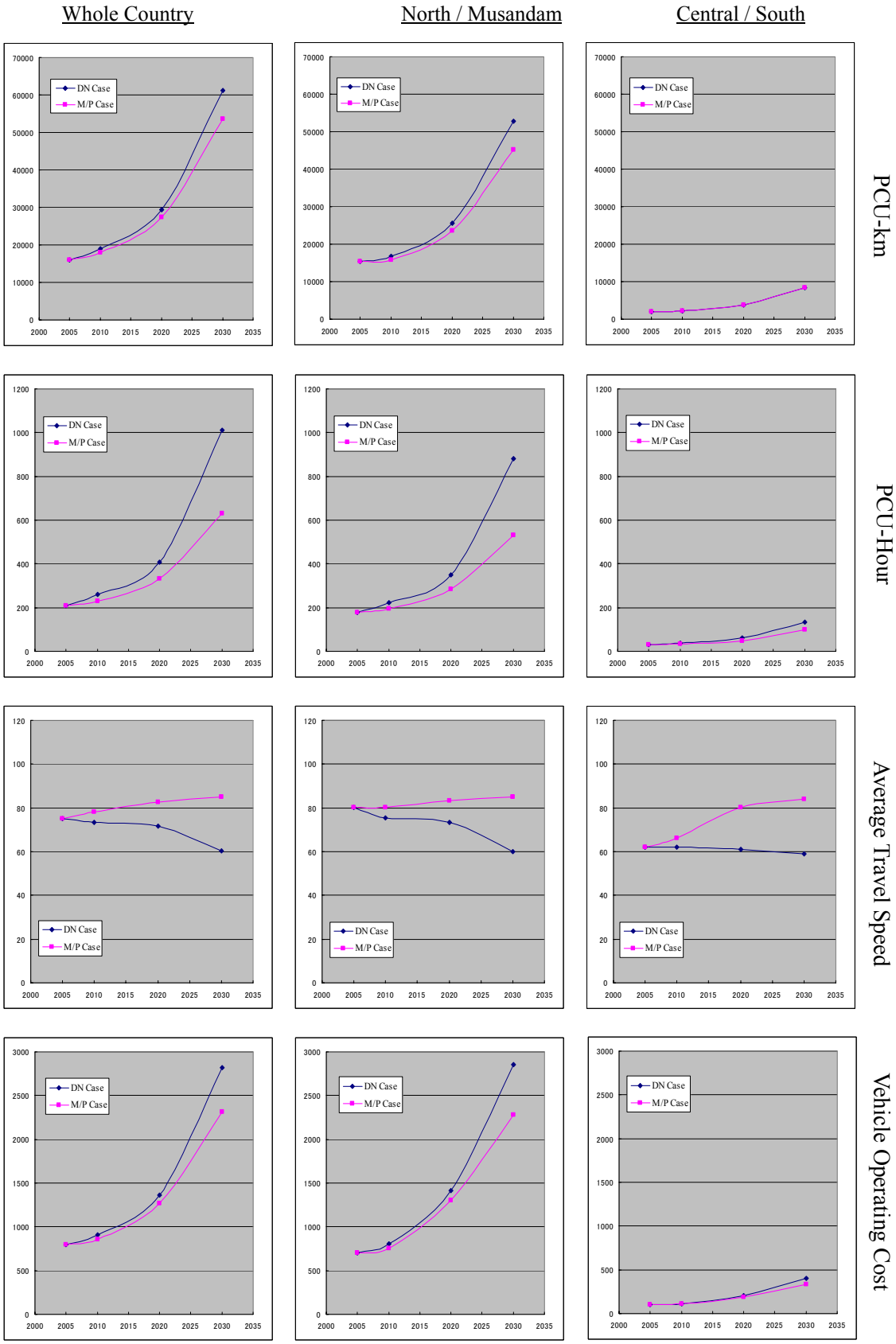


Figure 15.2-1 Transport Efficiency Improvement by Master Plan and by Area

15.3 INDIRECT BENEFITS

15.3.1 Impact on National and Regional Economy

In medium and long terms, dynamic socioeconomic changes are expected to occur on national and regional levels as a result of the road network development. Travel time reduction, transport cost reduction, accessibility improvement and safe, comfort and reliable means of transportation would be directly and indirectly impact on the following sectors;

1) Fishery and Agricultural industry
   - Higher fishing prices → higher income for fisherman → Improving their living standards → Incentive for fisherman to produce → Regional economic growth
   - Higher farm gate prices → higher income for farmers → Improving their living standards → Incentive for farmers to produce → Regional economic growth

2) Manufacturing industry
   - Cheaper factory material cost → More manufacturing products → Needs to employ more labor force → Cheaper factory gate-out price → Cheaper wholesale/retail prices → Consumers buy more → Regional economic growth

3) Commercial industry
   - Cheaper factory gate-out price → Cheaper wholesale/retail prices → Consumers buy more → Regional economic growth

4) Tourism industry
   - Cheaper transport cost / Easy accessibility to Hotels / Sightseeing spots → More tourists to visit → Regional economic growth

15.3.2 Impact on Commodity Prices

Reduction of transport cost, particularly of trucks would favorably affect commodity prices. The transport cost (in VOC per vehicle-km) of trucks would be reduced in Oman as shown in Table 15.3-1.

Table 15.3-1 Transport Cost Reduction of Trucks in Oman

		Truck Vehicle Km ('000)	Truck VOC	
			RO Million per day	VOC per 1,000 Vehicle-Km
2010	Without M/P	5,049	315,911	62.57
	With M/P	4,628	284,225	61.41
	Reduction (W/O-W) %	421 8.3 %	31,686 10.0 %	1.16 1.9 %
2020	Without M/P	8,994	567,968	63.15
	With M/P	8,226	501,583	60.97
	Reduction (W/O-W) %	768 8.5 %	66,385 11.7 %	2.18 3.5 %
2030	Without M/P	24,047	1,647,575	68.51
	With M/P	20,722	1,263,67	60.98
	Reduction (W/O-W) %	3,325 13.8 %	383,888 23.3 %	7.53 11.0 %

15.3.3 Improving Standard Living

The Master Plan is expected to contribute to improve the standard living of people, especially Omani people, by improvements in road accessibility as follows;

- At present, there are many villages in mountainous areas which are not accessible without the use of four (4) wheel-drive vehicles. At present, daily trips such as 'to work' trips for workers or 'to school' trips for school students are done by utilizing four (4) wheel-drive vehicles. After implementation of the Master Plan, most of these villagers can be enjoyed travel by ordinary passenger cars.
- More opportunities to access for various basic social facilities, such as religious facilities, hospitals, schools, markets, etc.
- More potential of developing un-utilized potential lands in remote areas.
- Contribution to effective land use and a unity of nation

CHAPTER 16

CONCLUSIONS AND RECOMMENDATIONS

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16.1 CONCLUSIONS

Plan Justification:

- The Road Network Development Master Plan is formulated in comprehensive and systematic manner to cope with present and future transport requirements and to support economic diversification and welfare of the Sultanate.

- The Plan is justified to be technically, environmentally and economically feasible with the following economic indicators (based on a discounted rate of 6 %):

EIRR (%):	12.3
NPV:	RO 264 million
B/C:	1.69

- Projects under the Master Plan are technically feasible and can be implemented by applying normal construction methods and techniques. Due to the severe topographical features in mountainous areas, few tunnelling sections are planned in order to improve the geometric design at locations with sharp curves and steep slopes.

- In addition to the indirect benefits of the Master Plan, such as promoting regional development and improving living standards, the evaluation results of the Master Plan show high efficiency parameters, such as the increase in the average travel speed of all vehicles on the network by about 40%, and decrease in the average volume/ capacity ratio by 40%. Further, the total trip length (in pcu-km) will decrease by about 12% and total travel time (in pcu-hour) by 38%.

Network Development Plan:

- The primary road network is developed to provide strategic and reliable alternative corridors in the two major transport directions of “East-West” on both sides of the northern Al Hajar Mountain ranges, and “North-South” across central and coastal areas of the Sultanate, in addition to international links to neighbouring countries.

- The secondary road network is developed to provide strong connections and access

between the primary roads and to all major present and future socio-economic development and activity centres, as well as enhancing the function of the primary road network.

- The implementation program of the Master Plan projects provides timeframe on annual base for the five 5-Year Development Plans from 2006 to 2030. In addition, more projects are proposed for later years that can be introduced as far as financial resources are secured.

- The Master Plan is developed, generally, to realize its objectives on phases in which networks for national integration and international connections will be completed in the short-term, economic diversification will continue to the medium-term, while enhancement of living standards and reduction of regional imbalance will continue to the long-term.

16.2 RECOMMENDATIONS

Plan Authorization:

- The Master Plan authorization is vital for systematic implementation of the planned projects under the authorized ministries, authorities and agencies, so that all efforts can be integrated toward the same targets at the optimum timing.

- Projects in the Master Plan should be included in the Five Year Development Plans to secure required funds and to assure the development of the road network based on the established schedule for the smooth implementation and maximum efficiency.

Plan Implementation:

- The Master Plan implementation program is formulated based on a comprehensive prioritization multi-criteria integrated with the financial resources and budgetary limitations. However, future follow-up and updating of the program are required in which projects of later years may be introduced during the plan period with securing required additional financial resources.

- To implement projects as scheduled, feasibility studies should be conducted few years before the project schedule in order to secure required fund and to avoid delay. Major projects, such as New Batinah Expressway and other large-scale projects, will require a comprehensive study that includes route selection, environmental impact assessment as well as technical, economical and financial analysis, with fund planning.

- To keep the growth of the road network under the target of 80% pavement ratio of by the year 2030, DGR should annually improve access and local roads with minimum length of about 200 kilometres, with an annual cost of about RO 10.0 million in addition to the road projects under the Master Plan. The Figure presents the growth of the network from 1970 to the later years after the planned period.

- In case of implementing projects ahead of schedule, due to supplemental financial resources for example, it is recommended to update the Master Plan by introducing projects from later plans to replace implemented projects in order to realize the targeted Future Road Network.

Road Network Classification:

- The established road network functional classification should be applied and used in all future network development activities in order to keep a well-organized network with international standards that can meet all future transport planning and utilization requirements.

Administration and Legislation:

- The existing legislation system and regulations related to road transport are generally well established. However, there are some details that should be included, such as a clear definition for the power and responsibilities of DGR and DGC.

- To introduce new concepts in road financing, management, and operation (including toll collection and roadside land development schemes), it is required to establish the legislation system that can attract private sector investments and provide high level of service for road users.

- The administration systems of DGR and DGC are based on the small-size organization principle. As there are many other agencies involved in the operation and administration activities related to road transport and network development, the establishment of a coordination body is required.

- DGR database system should include all basic information such as annual and project budgets as ell as status of projects which should be also disseminated among staff members.

- Since practical works of design, construction supervision and maintenance are contracted out, DGR and DGC should strengthen the functions of planning and policy making.

Organization and Institution:

- The Master Plan includes a large number of road and structure projects which require large investments and implementation capability. An effective organization for systematical implementation approach is the vital key for successful realization of the plan.

- Taking into account the DGR small-organization principle, the required organization should be strengthened by establishing new Engineering Department with experts for bridges and structures, transport economy, road environment and other related fields.

- A well-established database section is required to provide all departments and decision-makers with all necessary information. It should be considered to utilize expertise of foreign experts in the process of implementing the Master Plan.

- To enhance administration for the developed road network, function and capacities of DGR Regional Offices should be strengthened for regional-base road network development activities.

- The present number of engineers in both DGR and DGC is not sufficient. The number of engineers should be increased by recruiting a constant number of engineers (6 engineers) every year.

Maintenance and Management:

- The road network development with the construction of new roads and pavement of track roads will increase the tasks and activities of road Maintenance Department under DGR in the near future. This Department should be ready for the increasing tasks and work volumes by the early establishing of a road maintenance management system.

- Human capacity building programs for maintenance engineers and technicians, as well as for other fields, is a major task that should be strongly established to develop required experience through on-the-job training and other systemized training programs.

- Routine maintenance and rehabilitation of pavement are essential to maintain the sound function of the road network. Sufficient fund should be secured.

Fund Preparation Measures:

- The cost estimation and required budget in the Study are those to implement projects under the Master Plan, which deals with the primary and secondary road networks. Required budgets are generally ranging between 220 to 270 million for each 5-Year Development Plan.

- Pavement, maintenance and improving works for lower classes of roads will require an additional budget that is roughly estimated as about RO 20 million annually.

Environmental Consideration:

- The Master Plan projects aim to minimize any negative impact on both natural and social environmental conditions, and coordination with the MRMEWR is important throughout different stages of project implementation.

- Alignments with negative impact potential are modified to avoid environmentally protected areas. However, Environmental Impact Assessment (EIA) will be required for some projects and it should be prepared in advance during the design stage of each projects.

- When implementing road projects in areas where land acquisition is required, acquisition and resettlement schemes should be prepared in early stages together with the allocation of required fund.

Coordination with other related Projects and Agencies:

- Implementation of the Master Plan projects should be carried out as scheduled and in complete coordination with other infrastructure and socioeconomic development plans and major projects to provide optimum integration and maximum benefits.

- Muscat Governorate is the major trip generation/ attraction zone in the country that strongly interacts with the nationwide network especially with roads in the northern areas. An urban transport development plan for the transport network under Muscat Municipality is urgently required for the integration with the nationwide road network development plan and to deal with capacity increasing of Sultan Qaboos Port and expansion of As Seeb Airport as well as development plans of other socioeconomic sectors.

- Good understanding and supporting by policy makers and budgeting agencies, such as the Ministry of National Economy and Ministry of Finance, are indispensable for successful implementation of the Maser Plan. DGR and DGC should exert full effort to obtain understanding of those people and agencies.

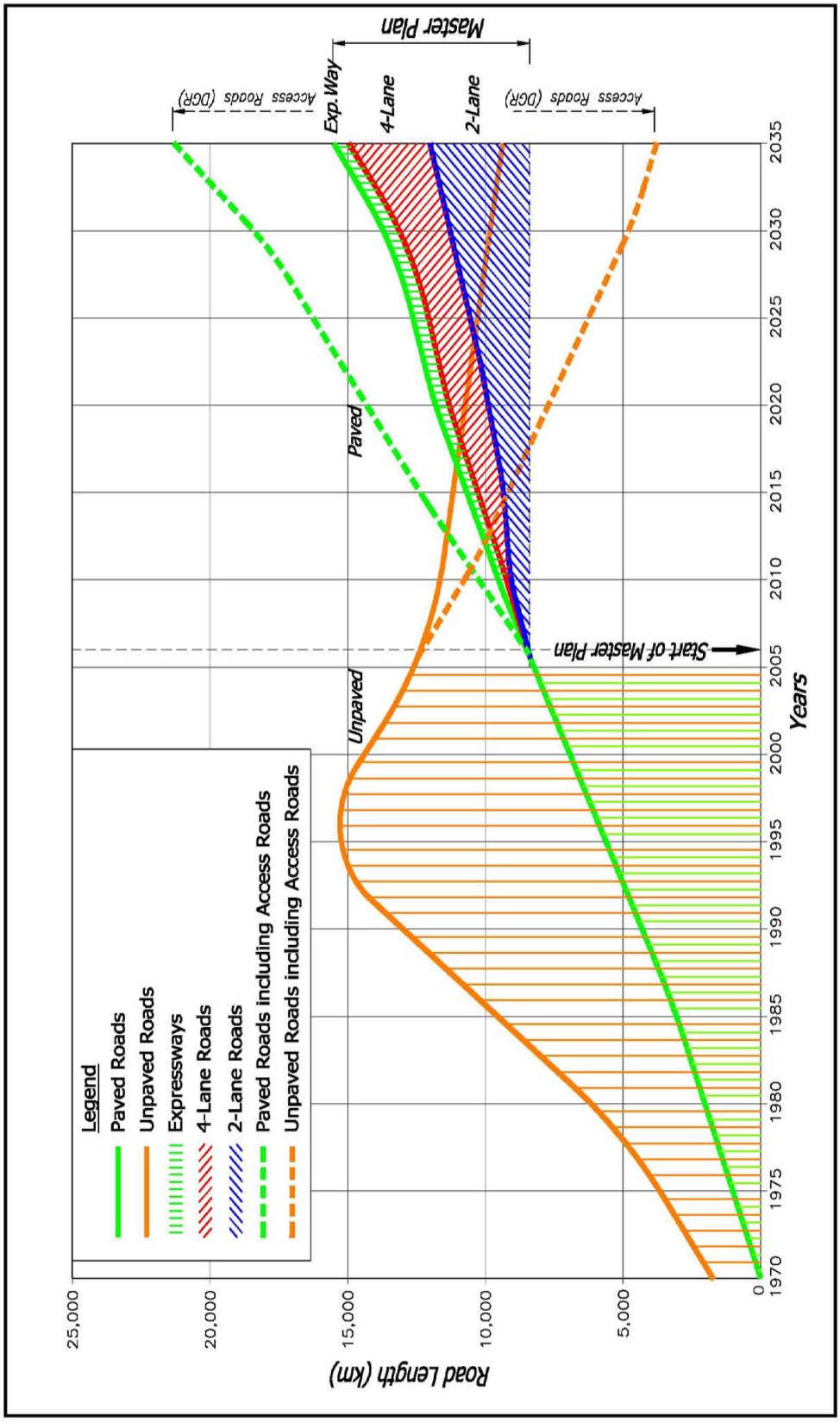

Figure 16.2-1 Growth of Road Network in Oman