CHAPTER 20

AL HIJ - FLIM ROAD

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20.1 OBJECTIVE OF THE PROJECT

Al Hij - Flim road (Project No. N47-1, Al Wusta Region), which is the only access to Mahawt Island, has unpaved earth surface but the road is passable up to Flim for ordinary passenger car as well as large trucks. This road is expected to support the activation of the fishery industry, as well as promotion of tourism, of the area.

Taking into account the importance of this road, the Government intends to improve this Al Hij - Flim road.

Meanwhile, design of this road has not been started yet. Therefore, DGR requested the Study Team to carry out the pre-feasibility study of this project. The objectives of the project are:

a) To provide proper all weather road for people who are living in Flim, including Mahawt Island, and
b) To promote fishery and tourism of the area.

Location map is shown in Figure 20.1-1.

Figure 20.1.1 Location of the Project Site

20.2 ALIGNMENT AND PRELIMINARY DESIGN

20.2.1 Physical Feature of the Project Site

Al Hij - Flim road is the only access for the village of Flim and Mahawt Island. The project road passes through the desert area with several small gravelly hills. Beside of the road, Wadi Halfayn and its offshoots flow down to the sea and across the road many times, but it is difficult to specify the exact stream line due to the flat topography there.

The village of Flim is located at low land which experiences the submergence frequently in particular during the spring tide. So the residents of the village banked few hundreds meters in length and about 1 meter in height near the coast line

Generally the physical feature of the project site is same and flat for whole stretch.

20.2.2 Existing Road Condition

Al Hij - Flim road starts from the junction in the town of Hij which is connected to NR 32 by a paved road. The paved road continues few hundreds meters beyond the town of Hij towards Flim. Then road becomes earth surface which is kept smooth by the motor grader. The road traverses the large flat area and sometimes passes through a space between small hills.

Originally, the area is the gravelly desert and gravel is occasionally seen on the surface of the road, but the gravel does not thickn enough to be called “layer”. It means that the existing road is just an earth road and cannot be called gravel road.

At present there are no any drainage facilities, even side ditch. The road has been maintained by scraping the surface. Actually the elevation of the road surface is lower than adjacent land at most of that stretch. It is suspected that the flood stream flow down on the road at some sections. At the most of the wadi crossing, except a few locations, depths of the wadis are very shallow, less than 1 meter. Vehicles can pass such wadi sections as smoothly as ordinary section. At Chainage 13.0 kilometer, the road passes the bottom of a shallowly concave place which may become a pond during flood.

From beginning to the end of the project road, the road condition is more or less uniform. The condition of the existing road is shown in Figure 20.2-1.

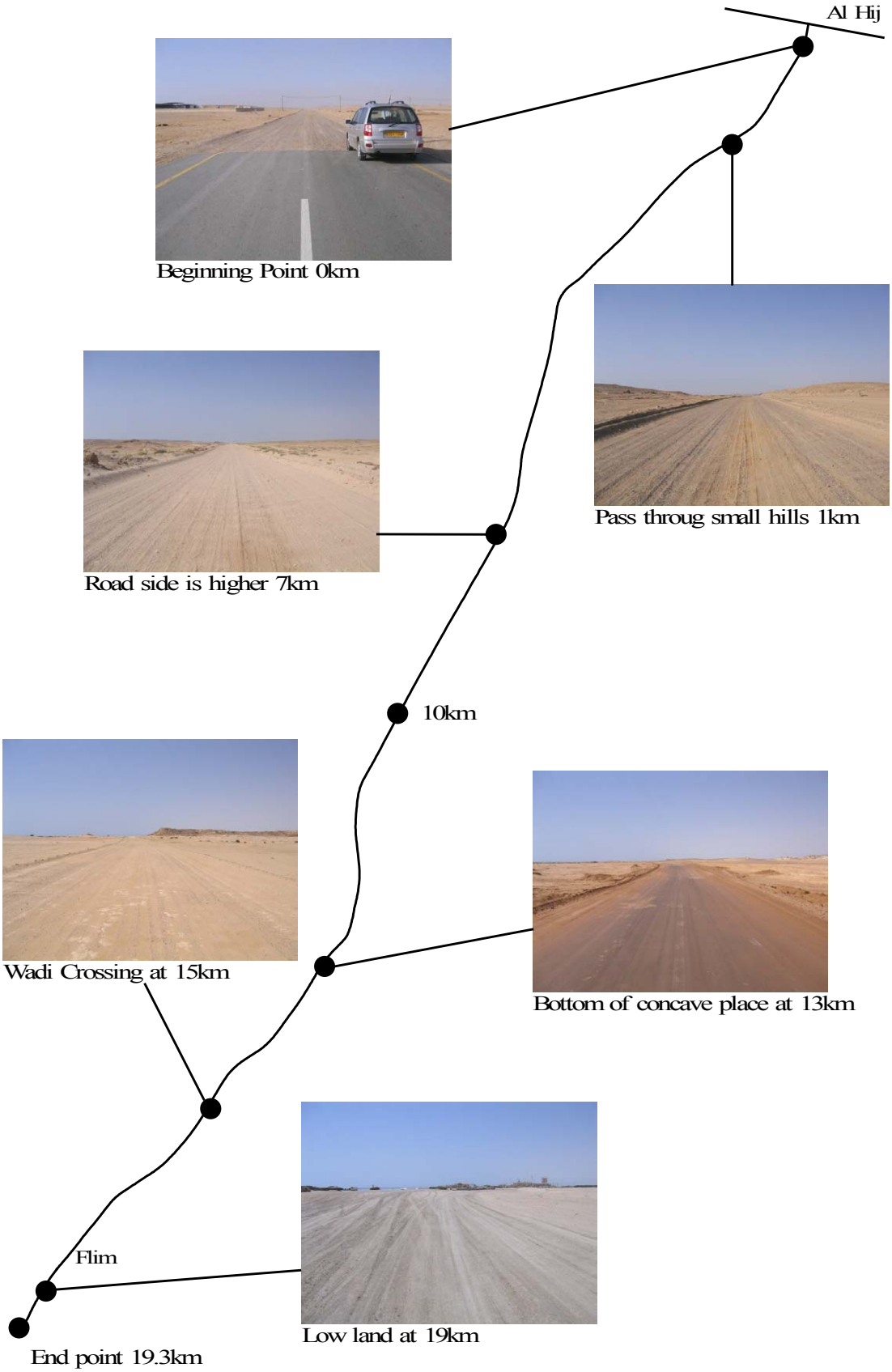


Figure 20.2-1 Existing Road Condition

20.2.3 Proposed Road Alignment

Generally, the alignment of the existing road has very little problems. Therefore, the proposed alignment basically follows the existing alignment. Further, if there will be any necessity for improvement of alignment after detailed survey, there will be very little ristriction by the topography and preferable geometric elements can be easily adopted.

On the other hand it is necessary to consider the vertical grade as mentioned in the prior paragraph. The road elevation shall be raised up 0.5 meter in average because of the height of the existing road is lower than the adjacent land. At Chainage 13.0 kilometer, the road passes the bottom of a shallow concave place and the road bed needs to be embanked about 1.0 meter in height in order not to be submerged. Also proper cross drainage is required there. From the Chainage 18.5 kilometer to the 19.3 kilometer, the end point of the project road, the road is raised up about 1.5 meters so that the road surface is higher than the high tide level.

The proposed road alignment is shown in Figure 20.2-2.

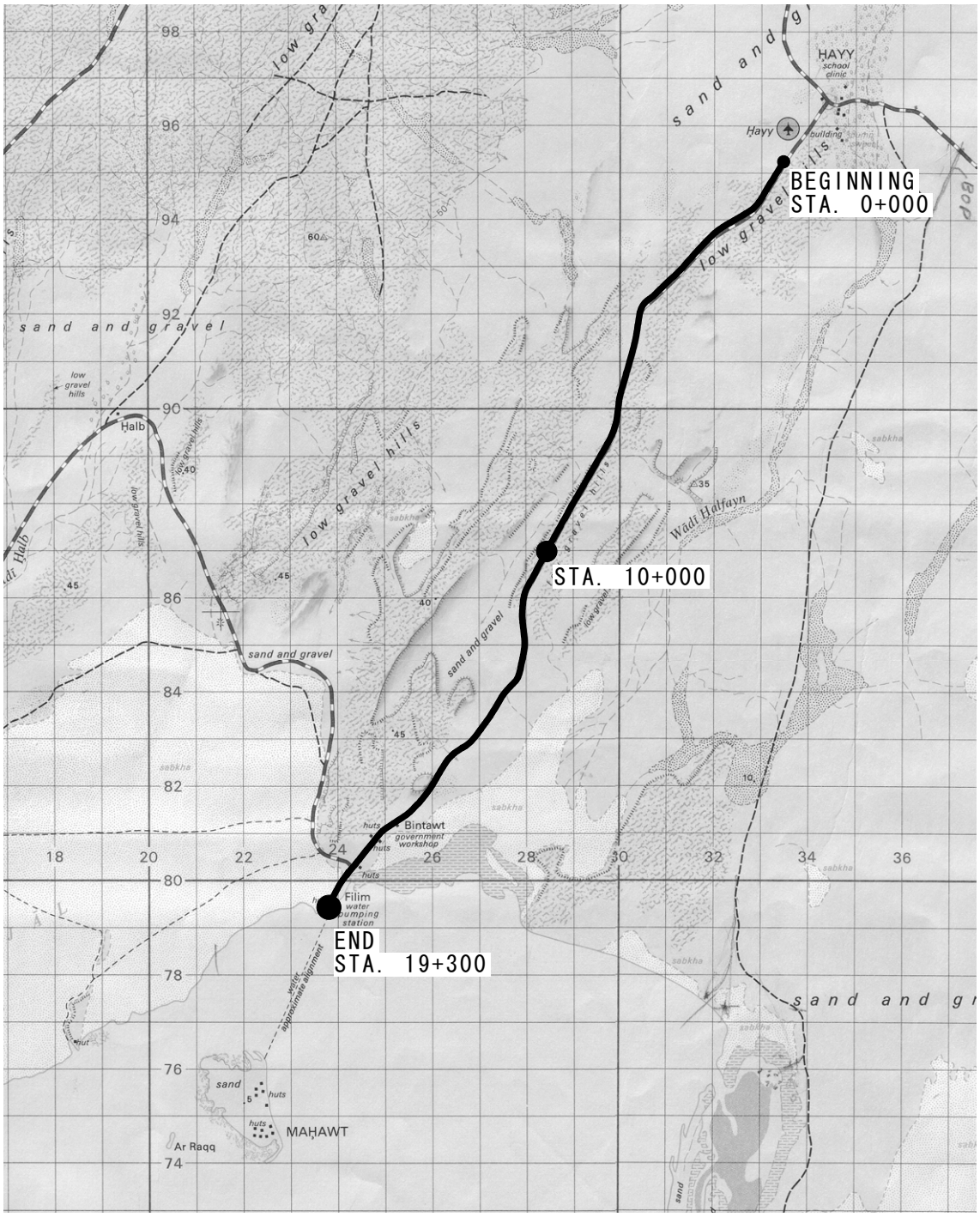


Figure 20.2.2 Proposed Alignment

20.2.4 Preliminary Design

The proposed cross sections follow HDM. As mentioned in HDM, the carriageway of secondary road shall be 7.0 meters and paved shoulder of 1.5 meters in width shall be provided on both sides in this project. In accordance with HDM, the verge of 2.0 meters in width shall be secured on both sides in whole of the stretch.

The earth ditch shall be considered to install for the proper drainage depending on the topography. The left side slope of the embankment at the raised up section, from Chainage 18.5 kilometer to 19.3 kilometer, where the land is submerged frequently, is protected by the grouted riprap from the wave of the sea.

As the result of the above consideration, the typical cross section is proposed as shown in Figure 20.2-3.

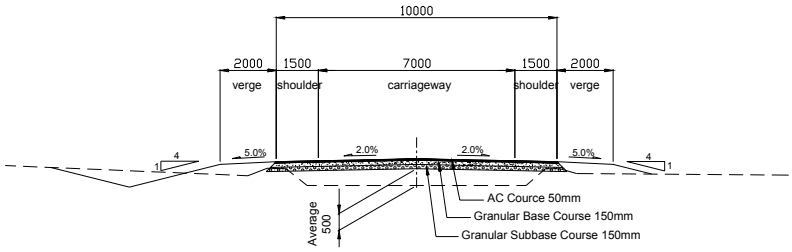


Figure 20.2-3 Typical Cross Section

20.2.5 Pavement Design

The detail study for the pavement structure is not carried out in this Study because the traffic is forecasted to be small and bearing capacity of the subgrade seems to be high. Accordingly, the pavement structure similar to other secondary road may be adopted. In this Study, the same pavement structure with Al Hamra - Rustaq road is adopted.

20.2.6 Structure Design

HDM shows the standard drawings for the several types of structures and they are used commonly in the projects whether they are under designing, construction or completed. In this Study, the structures are designed in accordance with HDM. For this project road, required structures are only pipe culverts, Irish crossings and riprap slope protection and they are standardized already in HDM. Therefore, the standard drawings of HDM will be adopted.

20.2.7 Drainage and Cross Drainage Facilities

Through the inventory survey carried out in this Study, the necessary drainage facilities were studied and listed as shown in Table 20.2-1.

Table 20.2-1 List of the Drainage Facilities

	Chainage	Drainage		Chainage	Drainage
1	0km+700	Pipe 1-900	15	9km+900	Pipe 1-900
2	1km+500	Pipe 1-900	16	10km+400	Pipe 1-900
3	2km+000	Pipe 1-900	17	11km+200	Pipe 1-900
4	2km+200	Pipe 1-900	18	11km+700	Pipe 1-900
5	2km+400	Pipe 1-900	19	12km+140	Irish Crossing (80m)
6	2km+940	Irish Crossing (80m)	20	12km+500	Pipe 1-900
7	3km+115	Irish Crossing (30m)	21	13km+000	Pipe 1-900
8	4km+000	Pipe 1-900	22	13km+500	Pipe 1-900
9	5km+000	Pipe 1-900	23	13km+700	Pipe 1-900
10	5km+500	Pipe 1-900	24	14km+400	Pipe 1-900
11	5km+630	Irish Crossing (60m)	25	15km+025	Irish Crossing (50m)
12	7km+200	Pipe 2-900	26	16km+400	Pipe 1-900
13	7km+500	Pipe 1-900	27	17km+300	Pipe 1-900
14	8km+000	Pipe 1-900	28	19km+300	Pipe 1-900

20.3 Preliminary Cost Estimation

20.3.1 Procedure of Project Cost Estimate

The procedure of project cost estimation is shown in Figure 20.3-1. The estimate is made based on the unit prices of construction material, labor costs and equipment costs which are obtained from the survey of the current market prices. The unit costs of major construction items were decided after comparing the estimated unit cost with latest bid prices.

The prices of items needed in the project, but not listed in the table are quoted from those available in Japan and converted to RO using the exchange rate of ; US$ 1.0 = RO 0.385 = JPY 108.

Engineering services cost is estimated as the percentage of the construction cost.

ROW acquisition cost for new roads and widening are not estimated because there is no necessity of new land acquisition for roads.

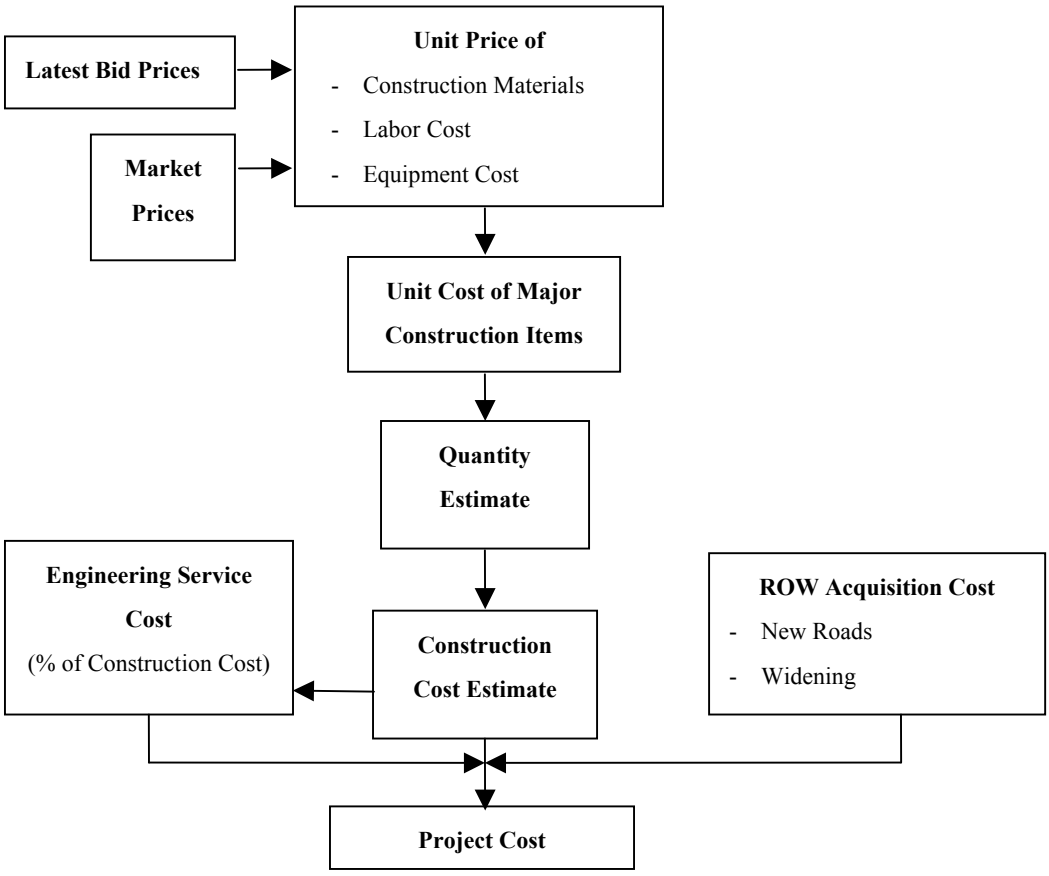


Figure 20.3-1 Procedure of Project Cost Estimate

20.3.2 Unit Price and Cost of Major Construction Items

Unit prices of major construction materials, labor cost and equipment cost, which are determined based on the investigation of the latest market prices, are shown in Tables 20.3-1, 20.3-2 and 20.3-3, respectively.

The major construction items are defined from "The Sultanate of Oman, General Specification for Roads, April 1994" and their unit costs of the road is presented in Table 20.3-4.

Table 20.3-1 Average Prices of Major Construction Materials (2004 Prices)

No.	Material Description	Unit	Unit Price (RO)
1	Aggregates for granular sub-base course	Cu.m.	3.000
2	Aggregate for aggregate base course	Cu.m.	3.000
3	Aggregates for bituminous base course	Cu.m.	3.000
4	Fine aggregate for concrete	Cu.m.	4.000
5	Coarse aggregate for concrete	Cu.m.	3.500
6	Stone for drainage, masonry and slope protection	Cu.m.	3.000
7	Asphalt cement, grade 60-70 on site	Ton	90.000
8	Asphalt cement, grade 50-60 on site	Ton	80.000
9	Emulsified asphalt, grade RS-1 on site	Ton	100.000
10	Cutback asphalt, MC and RC type on site	Ton	100.000
11	Portland cement on site	Ton	25.000
12	Deformed billet steel bars, AASHTO M31 grade 60 (High Yield) of any diameter	Ton	250.000
13	Deformed billet steel bars, AASHTO M31 grade 40 (High Yield) of any diameter	Ton	225.000
14	Highway signs	Sq.m.	50.000
15	Highway sign support	Nr.	25.000
16	Timber plank, on site	Cu.m	150.000
17	Timber props, on site	Cu.m.	150.000
18	Wire mesh gabion, on site	Ton	225.000
19	Explosive, on site	Kg	50.000
20	Gas oil, on site	Liter	0.500
21	Gasoline, Premium	Liter	0.120
22	Gasoline, Regular	Liter	0.114
23	Diesel	Liter	0.102

Source: Study Team Survey

Table 20.3-2 Labor Cost (2004 Prices)

No.	Labor Category	Unit	Unit Rate (RO)
1	Supervisor	Hour	3.000
2	Site Surveyor	Hour	3.000
3	Foreman	Hour	2.000
4	1st Class Operator	Hour	2.000
5	2nd Class Operator	Hour	1.800
6	Mechanic	Hour	1.700
7	Driver	Hour	1.800
8	Skilled Labor	Hour	1.200
9	Semi-skilled Labor	Hour	1.000
10	Mason	Hour	1.200
11	Painter	Hour	1.200
12	Carpenter	Hour	1.200
13	Steel Fixer	Hour	1.200
14	Electrician	Hour	1.200

Source: Study Team Survey

Table 20.3-3 Hourly Cost of Major Construction Equipments (2004 Prices)

No.	Construction Equipment	Hourly Cost (RO)
1	Motor grader from 100 HP to 120 HP	12.000
2	Motor grader from 120 HP to 150 HP	15.000
3	Tractor from 60 HP to 100 HP	12.000
4	Bulldozer with ripper from 100 HP to 150 HP	12.000
5	Bulldozer with ripper from 150 HP to 200 HP	16.000
6	Bulldozer with ripper from 200 HP to 250 HP	18.000
7	Bulldozer with ripper from 250 HP to 300 HP	20.000
8	Wheel Tractor up to 50 HP	8.000
9	Wheel Tractor over 50 HP	9.000
10	Motor scraper capacity up to 18 cu.m.	18.000
11	Motor scraper capacity 18 to 24 cu.m.	22.000
12	Sheeps foot roller from 5 to 10 ton	7.000
13	Vibratory compactor with prime mover up to 5 ton	5.000
14	Pneumatic compactor with prime mover from 30 to 50 ton	5.000
15	Pneumatic self-propelled roller from 15 to 20 ton	6.000
16	Tandem roller up to 8 ton	5.000
17	Tandem roller from 8 to 12 ton	7.000
18	Triaxle roller from 10 to 15 ton	8.000
19	Light frog-rammer 0.1 ton	1.000
20	Heavy frog-rammer 0.5 ton	1.500
21	Wheel loader 1.2 to 1.6 cu.m.	6.000
22	Wheel loader 1.6 to 2.5 cu.m.	8.000
23	Excavator up to 0.8 cu.m.	6.000
24	Excavator from 0.8 to 1.2 cu.m.	9.000
25	Bituminous mixing plant with batching apparatus up to 80 ton/hr	20.000
26	Bituminous mixing plant with batching apparatus 80 to 150 ton/hr	30.000
27	Finisher up to 80 ton/hr	10.000
28	Finisher from 80 to 120 ton/hr	12.000
29	Bitumen sprayer up to t ton	7.500
30	Tanker truck up to 6 cu.m.	5.500
31	Dump truck up to 10 ton	5.000
32	Dump truck from 10 ton to 15 ton	6.000
33	Screening plant from 80 to 100 ton/hr	18.000
34	Crushing plant up to 40 ton/hr	13.000
35	Crushing plant from 40 to 60 ton/hr	15.000
36	Air compressor up to 6000 l/m	2.500
37	Air compressor over 6000 l/m	4.000
38	Mechanical broom	4.000
39	Power water pump	1.500
40	Steel cutting machine	1.000
41	Steel bending machine	1.000
42	Belt conveyor	2.000
43	Concrete mixer up to 0.5 cu.m.	2.500
44	Concrete mixer over 0.5 cu.m.	4.000
45	Automatic concrete batch plant without mixing	16.000
46	Transmixer up to 5 cu.m.	15.000
47	Concrete vibrators	1.000
48	Crane up to 5 ton	5.000
49	Crane with boom and jib from 5 to 10 ton	10.000
50	Crane with boom and jib over 10 ton	15.000
51	Generator 60 ~ 75 Kw	2.500
52	Generator 100 Kw	5.000
53	Generator 150 ~ 200 Kw	9.000
54	Drilling Equipment	10.000
55	Gravel strewer	5.000
56	Asphalt cutter	2.000
57	Vehicle for foreman and surveyor	5.000

Source: Study Team Survey

Table 20.3-4 Unit Cost of Major Construction Items

No.	Description	Unit	Unit Cost (RO)	Foreign component		Local Component		Taxes	
	200 EARTHWORKS								
203	**Earthworks Excavation**								
	Suitable excavation to embankment	Cu. m.	1.660	0.882	53%	0.734	44%	0.044	3%
	Suitable excavation to waste	Cu. m.	1.546	0.815	53%	0.690	45%	0.041	3%
	Borrow excavation to embankment	Cu. m.	3.660	1.300	36%	2.295	63%	0.065	2%
206	**Excavation and Backfilling for Structures**								
	Structural excavation in soils to a depth of 2m.	Cu. m.	1.351	0.713	53%	0.602	45%	0.036	3%
	Structural excavation in rock to a depth of 2m.	Cu. m.	2.665	1.408	53%	1.187	45%	0.070	3%
	300 GRANULAR AND STABILIZED SUBBASE, BASECOURSE AND STABILIZED SUBGRADE								
302	**Granular Subbase**								
	Class A Subbase	Cu. m.	5.000	2.094	42%	2.801	56%	0.105	2%
	Class B Subbase	Cu. m.	4.000	1.675	42%	2.241	56%	0.084	2%
303	**Aggregate Basecourse**								
	Class A Basecourse	Cu. m.	5.000	2.112	42%	2.783	56%	0.106	2%
	Class B Basecourse	Cu. m.	4.000	1.689	42%	2.226	56%	0.084	2%
	400 BITUMINOUS PAVEMENT								
401	**Bituminous Prime Coat and Tack Coat**								
	Prime Coat such as MC70	Kg	0.120	0.078	65%	0.039	32%	0.004	3%
	Tack Coat such as RC250	Kg	0.150	0.097	65%	0.048	32%	0.005	3%
402	**Bituminous Basecourse**								
	Bituminous Basecourse	Cu. m.	17.000	10.893	64%	5.563	33%	0.545	3%
405	**Bituminous Wearing Course**								
	Bituminous Wearing Course	Cu. m.	17.000	10.893	64%	5.563	33%	0.545	3%
	500 CONCRETE AND CONCRETE STRUCTURES								
504	**Concrete for Structures**								
	Concrete Class 28/20	Cu. m.	40.000	13.954	35%	25.348	63%	0.698	2%
509	**Reinforcing Steel**								
	High yield steel bars	ton	250.000	153.428	61%	88.901	36%	7.671	3%
	Mild steel bars	ton	250.000	152.690	61%	89.676	36%	7.634	3%
	800 DRAINAGE AND SERVICE DUCTS								
801	**Pipe Culverts**								
	Reinforced Concrete Pipe Culvert 600 mm	Lin. m.	35.000	18.270	52%	15.817	45%	0.914	3%
	Reinforced Concrete Pipe Culvert 900 mm	Lin. m.	75.000	39.150	52%	33.893	45%	1.958	3%
	Reinforced Concrete Pipe Culvert 1500 mm	Lin. m.	155.000	80.910	52%	70.045	45%	4.046	3%
	900 SLOPE PROTECTION AND STABILIZATION								
901	**Rip Rap**								
	Loose stone riprap Class A	Cu. m.	6.000	2.477	41%	3.399	57%	0.124	2%
	Loose stone riprap Class B	Cu. m.	6.000	2.477	41%	3.399	57%	0.124	2%
	Mortared stone riprap	Cu. m.	15.000	4.438	30%	10.340	69%	0.222	1%
902	**Gabions**								
	Gabions	Cu. m.	13.000	4.977	38%	7.774	60%	0.249	2%
906	**Ditch lining**								
	Ditch lining (150mm thick)	Sq. m.	2.000	0.573	29%	1.399	70%	0.029	1%
	1200 SIDEWALKS, PAVED AREAS AND CURBS								
1202	**Curbs**								
	Precast concrete curb, Class 28/20 non-mountable type	Lin. m.	5.000	1.744	35%	3.169	63%	0.087	2%
	Precast concrete curb, Class 28/20 mountable type	Lin. m.	5.000	1.744	35%	3.169	63%	0.087	2%
	Precast concrete curb, Class 28/20 lip type	Lin. m.	5.000	1.744	35%	3.169	63%	0.087	2%
	1300 SAFETY BARRIERS, DELINEATORS AND FENCES								
1301	**Corrugated Steel Beam Safety Barrier**								
	Safety barrier beam (Class B, W-section)	Lin. m.	5.000	3.610	72%	1.210	24%	0.180	4%
	Safety barrier post (Type C) including foundation	Nr.	12.000	8.664	72%	2.903	24%	0.433	4%
	End anchorage (ramp down), including post (Type C) and foundation	Nr.	25.000	18.050	72%	6.048	24%	0.902	4%
	W-beam terminal section								
	Re-fixing of safety barrier beam	Nr.	15.000	10.830	72%	3.629	24%	0.541	4%
	Re-fixing of safety barrier post including foundation	Lin. m.	0.500	0.361	72%	0.121	24%	0.018	4%
	Re-fixing of end anchorage (ramp down) including posts	Nr.	3.000	2.166	72%	0.726	24%	0.108	4%
	Re-fixing of W-beam terminal section	Nr.	16.000	11.552	72%	3.870	24%	0.578	4%
1302	**Concrete safety barrier**								
	Concrete safety barrier (Type A)	Lin. m.	55.000	19.186	35%	34.854	63%	0.959	2%
	Concrete safety barrier (Type B)	Lin. m.	30.000	10.465	35%	19.011	63%	0.523	2%
1303	**Reflectorized Markers for safety barriers**								
	Reflectorized markers (red) attached to Guardrail	Nr.	4.000	2.888	72%	0.968	24%	0.144	4%
	Reflectorized markers (red) attached to concrete barrier	Nr.	3.000	2.166	72%	0.726	24%	0.108	4%
1304	**Delineators**								
	Flexible delineators	Nr.	12.000	8.664	72%	2.903	24%	0.433	4%
	Irish crossing markers	Nr.	35.000	25.270	72%	8.467	24%	1.263	4%
	Irish crossing water depth gauges	Nr.	42.000	30.324	72%	10.160	24%	1.516	4%
	1400 HIGHWAY SIGNS AND ROAD MARKINGS								
1401	**Highway Signs**								
	Triangular, side 900mm	Nr.	25.000	18.050	72%	6.048	24%	0.902	4%
	Triangular, side 1100mm	Nr.	30.000	21.660	72%	7.257	24%	1.083	4%
	Triangular, side 1200mm	Nr.	40.000	28.880	72%	9.676	24%	1.444	4%
	Circular, diameter 900mm	Nr.	30.000	21.660	72%	7.257	24%	1.083	4%
	Circular, diameter 1200mm	Nr.	85.000	61.370	72%	20.562	24%	3.068	4%
	Rectangular sign	Sq.m.	50.000	36.100	72%	12.095	24%	1.805	4%
	Kilometer post (sign No. 323)	Nr.	25.000	18.050	72%	6.048	24%	0.902	4%
	Sign post support assembly, (Type 1A)	Nr.	25.000	18.050	72%	6.048	24%	0.902	4%
	Sign post support assembly, (Type 1B)	Nr.	54.000	38.988	72%	13.063	24%	1.949	4%
	Sign post support assembly, (Type II)	Nr.	68.000	49.096	72%	16.450	24%	2.455	4%
	Sign post support assembly, (Type IIIA)	Nr.	150.000	108.299	72%	36.286	24%	5.415	4%
	Sign post support assembly, (Type IIIB)	Nr.	155.000	111.909	72%	37.495	24%	5.595	4%
	Re-fixing of removed highway sign (any size with single post)	Nr.	20.000	14.440	72%	4.838	24%	0.722	4%
	Re-fixing of removed highway sign (any size with multiple post)	Nr.	25.000	18.050	72%	6.048	24%	0.902	4%
1402	**Road Markings**								
	Traffic lines (mechanically sprayed)	Sq. m.	1.600	1.155	72%	0.387	24%	0.058	4%
	Curb painting (black and yellow)	Sq. m.	1.000	0.722	72%	0.242	24%	0.036	4%
	Reflecting road studs (double face)	Nr.	3.500	2.527	72%	0.847	24%	0.126	4%

20.3.3 Construction Cost

Estimated construction cost is presented in Table 20.3-5. Detailed cost estimate is shown in Annex 20-1. The construction cost was estimated at RO 1,651,000, composed of 55.5% of a foreign currency component (or RO 916,000), 41.7% of a local currency component (or RO 688,000) and 2.8% of a tax component (or RO 47,000). Indirect costs (contingency) was assumed at 10% of direct cost, referring to the latest bid prices.

Table 20.3-5 Construction Cost (RO 1,000)

	Foreign	Local	Tax	Total
Amount	916 (55.5%)	688 (41.7%)	47 (2.8%)	1,651 (100%)

20.3.4 Engineering Service and Construction Supervision Cost

The engineering services cost covering detailed design (D/D) and construction supervision cost (C/S) is estimated as a certain percent of the project construction cost. The investigation of the recent projects in the Sultanate of Oman shows that the current percents for D/D and C/S are about 3% and 4%, respectively. Estimated engineering services and construction cost is presented in Table 20.3-6.

Table 20.3-6 Engineering Services and Construction Supervision Cost (RO 1,000)

	Foreign	Local	Tax	Total
Detailed Design	40 (80.0%)	5 (10.0%)	5 (10.0%)	50 (100%)
Construction Supervision	52 (80.0%)	7 (10.0%)	7 (10.0%)	66 (100%)
Total	92 (80.0%)	12 (10.0%)	12 (10.0%)	116 (100%)

20.3.5 Summary of Project Costs

Summary of Project Cost is shown in Table 20.3-7.

Table 20.3-7 Summary of Project Cost (RO 1,000)

	Foreign	Local	Tax	Total
Detailed Design	40 (80.0%)	5 (10.0%)	5 (10.0%)	50 (100%)
Construction	916 (55.5%)	688 (41.7%)	47 (2.8%)	1,651 (100%)
Construction Supervision	52 (80.0%)	7 (10.0%)	7 (10.0%)	66 (100%)
Total	1,008 (57.0%)	700 (39.6%)	59 (3.4%)	1,767 (100%)

20.4 ENVIRONMENTAL CONSIDERATIONS AND TOR FOR EIA

20.4.1 Environmental Considerations

1) General

The objectives of environmental considerations at the stage of the "Pre-Feasibility Study (Pre-F/S)" are:

- To confirm the results of the "Initial Environmental Examination (IEE)";
- To clarify present conditions in the project site and specific environmental impacts due to proposed road construction project;
- To re-evaluate comprehensively proposed project road; and
- To provide the "Terms of Reference (TOR)" for EIA in the next "Feasibility Study".

The examined environmental considerations are examined the following items and procedures:

1. Review of result of the IEE with data and information concerning the project.
2. Environmental investigation at the project site using "Environmental Checklist" (refer to Table 12.1-1).
3. Analysis of environmental conditions and impacts.
4. Comprehensive evaluation.
5. Provision of TOR for EIA.

The content of the site investigation consists of the following environmental items:

(1) Air pollution
(2) Effluent
(3) Noise and vibration
(4) Land subsidence
(5) Topography and geology
(6) Soil and soil erosion
(7) Hydrology and groundwater
(8) Ecosystem, flora and fauna
(9) Landscape (including coastal zone)
(10) Regional development on the natural environment
(11) Hazards
(12) Other impacts on the natural environment
(13) Wastes
(14) Cultural heritage

(15) Regional development on the social environment
(16) Other impacts on the social environment

2) Environmental checklist for the project "AL HIJ - FLIM ROAD"

More detailed environmental investigation, analysis and comprehensive evaluation for the road section between Al Hij and Flim were carried out using the environmental checklist. The results of investigation and evaluation are shown in Annex 20-2.

Consequently, environmental impacts due to the proposed project are likely to occur on the environmental items of Hydrology and groundwater, Eco-system, Flora and Fauna, and Other Impacts on Social Environment.

a. Hydrology and groundwater

- Present condition:

There is no current flow along wadi, Wadi Halfayn, in the area.
Groundwater is pumped up at near beach and the pumped water is supplied by water tank to the residents at Flim and pipe water is also supplied to Mahawt Island during fishing season.

- Impacts with project:

Slight to moderate impact to groundwater, consisting of lowering of groundwater table, water contamination, is likely to occur due to increase of pumping volume and wastes by increased visitors to the area. Because, the groundwater reserve near beach in the area seems to be limited.

- Evaluation: 1~2:

Slight to moderate impact to groundwater due to increased wastes and traffic volume is evaluated.

b. Eco-system, Flora and Fauna

- Present condition:

Flora:
Rare vegetation in the area, but small amount of grass and low acacia trees are found in the area. Mangroves are locally found around lagoon and sabkha at Flim and Mahawt Island. Mangroves are very important for fishery and stopping point for migratory birds.

Fauna:

Many kind of birds, including migratory birds, stop in beach and mangroves in the area. Several mammals, consisting of Hedgehog, Red Fox, Sand Fox, Wild Cat, caracal, Nubian Ibex, Arabian Gazelle, Cape Hare, etc., are reported to make habitat in the area are.

Fishing: Surroundings of Mahawt Island are rich fishing places. Therefore, many fishermen work in Flim and Mahawt Island.

- Impacts with project:

Not so significant impact with project to the eco-system and fauna in the area is likely, in case of compare with present gravel road. However, increase of visitors as tourism in future might indirectly influence eco-system, flora and fauna along the coastal line, including mangroves.

- Evaluation: 1~2:

Slight to moderate indirect impact to eco-system, flora and fauna due to road construction. It is necessary to carry out detailed investigation concerning eco-system, flora and fauna in the area.

c. Other Impacts on Social Environment

- Present condition:

There are several villages and small settlements with farmlands and a number of domestic animals along the route shown as below.

Al Hij village:

Residential area, mosque, and workshops. Houses have enough distance, more than 30m, from boundary of the existing road. Mosque keeps about 100m away from the existing road.

Flim:

Approximately total 150 huts, government workshop (not operation), pumping station of the MHEW. The pumping station supplies drinking water to residents and Mahawt Island by water pipe. Huts, located along the foot of Low Terrace covered by thick Aeolian sand, are not permanent houses. Most of residences seasonally change to live between Flim and Mahawt Island.

Mahawt island:

There are 60 to 100 families staying island during wet season (September to April) for fishing.

- Impacts with project:

Increased chance of traffic accident due to increased traffic volume.

- Evaluation: 1~2:

Slight to moderate impact as increase of chance of traffic accidents to social environment due to road construction.

d. Other environmental items: Not significant impact.

3) Results of IEE

The comprehensive evaluation for the Al Hij - Flim Road is concluded to be 1~2 as impact rating; summarized in Table 20.4-1. Hence, the implementation of EIA before road construction is recommended.

Table 20.4-1 Results of IEE on the Al Hij - Flim Road

- Hydrology, groundwater	1~2	- Groundwater contamination due to wastes
- Eco-system, Flora and Fauna	1~2	- Damage to mangroves and eco-system
- Other Impacts on Social Environment	1~2	- Traffic accidents due to increased traffic
- Other items	1	

Comprehensive Evaluation	1~2
Recommendations *1	Recommended to carry out partial EIA on assigned items after scoping

Note *1 : Comprehensive Evaluation

1 : None to slight impacts : No need to carry out EIA or need to carry out partial EIA after scoping
1~2 : Small impacts : Recommended to carry out partial EIA on assigned items after scoping
2 : Moderate impacts : Recommended to carry out EIA
2~3 : Relatively significant impacts: Recommended to carry out EIA
3 : Significant impacts : Recommended to carry out EIA

20.4.2 Terms of Reference for the Project

Terms of reference (TOR) on the Environmental Impact Assessment of the Al Hij - Flim Road, Sultanate of Oman, are shown in Annex 20-3.

20.5 PROJECT EVALUATION

20.5.1 General

Al Hij - Flim road project starts from Al Hij and terminates to Flim in the Wilayah Muhut. This road has total length of about 19.3 kilometers and is classified as secondary road.

The objective of this section is to examine viability of the construction plan of Al Hij - Flim road from viewpoint of national economy of Oman.

In order to achieve the objective, the following steps are carried out;

- Step 1: Future socio-economic framework in the influence area of the Project Road
- Step 2: Traffic demand forecast on the Project
- Step 3: Estimation of economic benefit based on traffic demand on the Project Road and unit vehicle operating costs
- Step 4: Estimation of economic cost based on the estimated financial cost mentioned in Section 20.3.
- Step 5: Calculation of economic indicators of the Project Road using the economic benefit and economic cost.
- Step 6: Sensitivity analysis to be made by varying factors of influenced to economic indicators such as the economic benefits, economic costs and discount rate.
- Step 7: Evaluation from technical and socio-economic view points
- Step 8: Overall evaluation

Figure 19.5-1 shows procedure for project evaluation.

20.5.2 Traffic Demand Forecast

In the Master Plan, the traffic demand for inter-Wilayah was forecasted in order to formulate nationwide road network development and that demand for intra-Wilayah was not forecasted. However, it is necessary to estimate the traffic demand for intra-Wilayah due to the Project Road being influenced within Wilayah. The traffic demand forecast in this section is made as following steps:

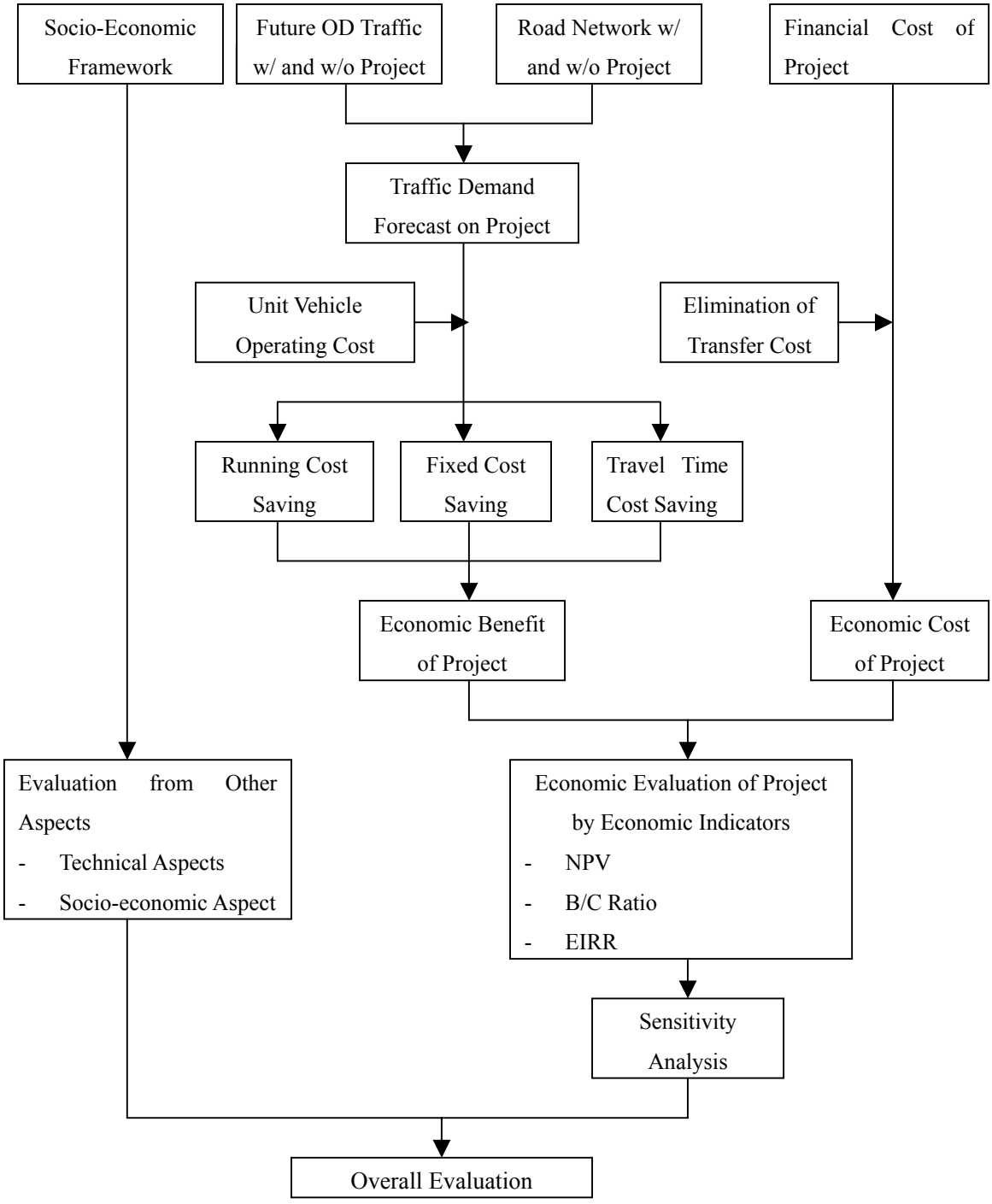


Figure 21.5-1 Procedure for Project Evaluation

1) Socio-Economic Framework in Influence Area

Based on 1993 population census, the socio economic data by towns and villages in Governorates and Regions such as number of household, housing unit, population and town and village location are presented in ' Socio-Economic Atlas[1]' The socio- economic data in

[1] Socio-Economic Atlas: Information & Documentation Center, Ministry of Development, Nov. 1997

the influence area of the Project Road in 1993 is computed on the basis of these data. Future population, number of workers and private vehicle are applied for these growth rate of Wilayah Muhut as shown in Tables 20.5-1(1), (2) and (3).

Table 20.5-1(1) Population of Direct and Indirect Influence Areas by Years (Person)

		1993[1)]	2005	2010	2020	2030
Direct Influence Area						
1	Hij	1,841	2,531	2,817	3,233	3,569
2	Flim	215	296	329	378	417
	Total	2,156	2,827	3,146	3,611	3,152
Indirect Influence Area						
3	Halibah	122	168	187	214	236
4	Tuwailah	42	58	64	74	81
5	Subgha	34	47	52	60	66
	Total	198	273	303	348	383
Other Areas						
6	Wilayah North	3,393	4,665	5,191	5,983	6,577
7	Wilayah South	1,471	2,022	2,251	2,583	2,851
	Wilayah – Total	7,369	10,131	11,275	12,939	14,284

Table 20.5-1(2) No of Secondary and Tertiary Workers in Direct and Indirect Influence Areas by Years (Worker)

		2005	2010	2020	2030
Direct Influence Area					
1	Hij	380	481	697	938
2	Flim	44	56	81	110
	Total				
Indirect Influence Area					
3	Halibah	25	32	46	62
4	Tuwailah	9	11	16	21
5	Subgha	52	66	95	128
	Total				
Other Areas					
6	Wilayah North	700	886	1,284	1,729
7	Wilayah South	303	384	557	749
	Wilayah – Total	1,520	1,924	2,789	3,754

Table 20.5-1(3) Private Vehicle Ownership of Direct and Indirect Influence Areas (Vehicle)

		2005	2010	2020	2030
Direct Influence Area					
1	Hij	311	360	461	606
2	Flim	36	42	54	71
	Total	347	402	515	677
Indirect Influence Area					
3	Halibah	21	24	31	40
4	Tuwailah	7	8	11	14
5	Subgha	6	7	9	11
	Total	34	39	51	65
Other Areas					
6	Wilayah North	572	663	850	1,116
7	Wilayah South	248	287	368	484
	Wilayah – Total	1,243	1,439	1,845	2,424

2) Trip Production and Generation

The trip production rate (number of trips per vehicle per day) is assumed to be 2.5 trips per day in 2005 3.5 in 2030 taking into account daily travel characteristics of Omanie peoples.

Therefore, number of trips in Wilayah Muhut is estimated using trip production rate and number of private vehicles as follows;

Table 20.5-2 Number of Trips in Wilayah Muhut

	2005	2010	2020	2030
Number of Private Vehicles	1,243	1,439	1,845	2,424
Trip Production Rate	2.50	3.00	3.25	3.50
Total Number of Trips	3,108	4,317	5,996	8,484

Number of trips in whole Wilayah Muhut is expected to increase from 3,108 trips in 2005 to 4,317 trips in 2010, 5,996 trips in 2020, and 8,484 trips in 2030 with an average annual grow rate of 4.1 %.

Trip generation and attraction by zones are computed using the same equation as presented in Section 7.2.2 (trip generation and attraction model).

3) OD Distribution

OD distribution model is employed as the Gravity model as follows:

$$Tij = \alpha * Ui * Vj * D\,ij^{-\gamma}$$

Where,
Tij : Future trip from zone i to zone j
Ui / Vj : Trip generation in zone i / trip attraction in zone j
D ij : Travel time or distance between zone i and j
α, γ : Parameters

OD tables in 2010 and 2030 are presented in Table 19.3-3(1) and (2).

4) Traffic Assignment to Road Network

Since road network in the influence area of the Project Road is simple, traffic assign method of 'all or nothing' is employed in this Study. As the results, assigned traffic volume on the Project Road can be computed in Table 20.5-3.

Table20.5-3 Traffic Volume on Al Hij – Flim Road (Vehicles / day)

		2005	2010	2020	2030
1	Al Hij – Flim	26	88	135	208
2	Flim – Halibah	15	46	76	126
3	Halibah – Sabgha	8	34	58	100

Tables 20.5-4 and 20.5-5 show the total vehicle kilometers and total vehicle hours of the Project Road, respectively.

Table 20.5-4 Total Vehicle Kilometers on Al Hij – Flim Road ('000 PCU-Km / Day)

	W/O Project	W/ Project	W/O-W/
2010	1,711	1,711	0
2020	2,636	2,636	0
2030	4,063	4,063	0

Table 20.5-5 Total Vehicle Hours on Al Hij – Flim Road (PCU-Hour / Day)

	W/O Project	W/ Project	W/O-W/
2010	86.3	24.5	61.8
2020	133.0	37.7	95.3
2030	204.9	58.0	146.9

20.5.3 Preliminary Economic Evaluation

1) General

a. Evaluation Period

The evaluation period is assumed to be 30 years from 2012 to 2041 taking into account the service life of Al Hij - Flim Road.

b. Implementation Schedule

Following the recommended implementation program in the Master Plan Study, the implementation schedule is assumed as follows:

- 2010 Detailed design, tendering and bidding
- 2011 Construction of Al Hij - Flim Road

c. Economic Evaluation Method and Economic Indicators

The economic evaluation method of the infrastructure project is commonly used by benefit-cost analysis. In this Study, the same benefit-cost analysis method is employed.

This method is evaluated as investment efficiency through comparison between benefit and cost derived from the Hij - Flim road project. It is expressed the benefit – cost stream during evaluation period and the economic indicators used in this study are as follows:

– Net Present Value (NPV)
– Benefit Cost Ratio, (BCR), and
– Economic Internal Rate of Return (EIRR)

2) Estimation of Benefit

By implementing Hij - Flim Road project, a variety of benefits is expected such as improvement of comfort and safety, promotion of international and inter-regional trade and promotion of regional development. Among these benefits, tangible benefits of three (3) items of vehicle operating cost are taken into account: a. Saving in running cost (distance related vehicle operating cost), b. Saving in fixed cost (time related vehicle operating cost) and c. Saving in travel time cost.

a. Unit Vehicle Operating Cost (VOC)

Detailed unit vehicle operating cost is described in Annex A9-2. Table 20.5-6 summarizes the unit VOC on paved and unpaved surface types and for vehicle groups.

Table 20.5-6 (1) Unit Running Cost by Vehicle Speed and Surface Type (RO/'000 km)

	Paved Surface			Unpaved Surface		
	Passenger Car	Bus	Truck	Passenger Car	Bus	Truck
5 km/h	66	109	116	104	177	143
20	37	69	76	65	95	94
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

Note: All unit costs are presented in 2005 prices

Table 20.5-6 (2) Unit Fixed Cost by Vehicle Types (RO/Hr)

	Fixed Cost
Passenger Car	1.088
Bus	1.835
Truck	2.661

Note: All unit costs are presented in 2005 prices

Table 20.5- 6 (3) Unit Fixed Cost by Vehicle Types (RO/Hr)

	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

3) Estimation of Benefit

The saving in vehicle operating costs and travel time cost were estimated and are shown in Table 20.5-7.

Table 20.5-7 Estimation of Benefit (RO '000 /Year)

Year	Saving in VRC	Saving in VFC	Saving in VOC	Saving in TCC	Total Saving
2010	24.3	24.6	49.0	28.7	77.7
2016	37.5	37.9	75.4	44.2	119.7
2022	57.9	58.3	116.2	68.1	184.3

4) Economic Cost

a. Construction Cost

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 of imported materials is shown in Table 20.5-6.

Table 20.5-8 Economic Cost Estimate (RO '000)

Description		Economic Cost	Financial Cost
1	Construction Cost	1,604	1,651
1.1	Labor Cost	23	23
1.2	Material Cost	789	816
1.3	Equipment	792	812
2	Consultancy	368	410
2.1	Detailed Design	45	50
2.2	Construction Supervision	59	66
	Total	1,708	1,767

b. Maintenance Cost

In this study, the maintenance cost of Al Hij - Flim Road is estimated on the basis of maintenance costs per kilometer applied to the other national roads in Al Wusta. The total amount of maintenance cost is estimated at R.O. 19,354 taking into account unit cost of maintenance per kilometer of similar road in Muhut is 541 km/year.

5) Benefit Cost Analysis

Based on the above mentioned benefits and cost estimations, the economic analysis of the Project was made. Table 20.5-7 show the benefit – cost analysis of Al Hij - Flim Road Construction Project during project life period of 30 years and Table 20.5-8 shows the benefit cost stream. The results of the economic analysis show that a Net Present Value (NPV) of RO – 74,000 and BCR of 0.95 over 30 years life of the Road using discount date of 6 % which is designated by the Ministry of National Economy. The Economic Internal Rte of Return (EIRR) was compiled at 5.5 %.

Table 20.5-9 Economic Indicators of Benefit Cost Analysis

Net Present Value	RO - 74,000
BCR	0.95
EIRR	5.5 %

Note: 1) Project life is assumed to be 30 years
2) Discount rate is assumed to be 6%

6) Sensitivity Analysis

The sensitivity analysis is conducted under a worse case scenario incorporating increase and/or decrease of the estimation of cost and benefit. Table 20.5-9 shows the results of the sensitivity analysis.

Table 20.5-10 Benefit - Cost Stream of Al Hij - Flim Road Construction Project

Undiscounted Benefit Cost Stream

RO '000

Sq	Year	Construction Cost	O & M Cost	Cost Total	Benefit	Cost-Benefit
1	2005	0.0	0.0	0.0	0.0	0.0
2	2006	0.0	0.0	0.0	0.0	0.0
3	2007	0.0	0.0	0.0	0.0	0.0
4	2008	0.0	0.0	0.0	0.0	0.0
5	2009	0.0	0.0	0.0	0.0	0.0
6	2010	45.0	0.0	45.0	0.0	-45.0
7	2011	1,663.0	0.0	1,663.0	0.0	-1,663.0
8	2012	0.0	19.4	19.4	84.7	65.3
9	2013	0.0	19.4	19.4	88.4	69.0
10	2014	0.0	19.4	19.4	92.4	73.0
11	2015	0.0	19.4	19.4	96.5	77.1
12	2016	0.0	19.4	19.4	100.7	81.3
13	2017	0.0	19.4	19.4	105.2	85.8
14	2018	0.0	19.4	19.4	109.8	90.4
15	2019	0.0	19.4	19.4	114.6	95.2
16	2020	0.0	19.4	19.4	119.6	100.2
17	2021	0.0	19.4	19.4	125.0	105.6
18	2022	0.0	19.4	19.4	130.4	111.0
19	2023	0.0	19.4	19.4	136.3	116.9
20	2024	0.0	19.4	19.4	142.3	122.9
21	2025	0.0	19.4	19.4	148.5	129.1
22	2026	0.0	19.4	19.4	155.1	135.7
23	2027	0.0	19.4	19.4	162.0	142.6
24	2028	0.0	19.4	19.4	169.1	149.7
25	2029	0.0	19.4	19.4	176.6	157.2
26	2030	0.0	19.4	19.4	184.3	164.9
27	2031	0.0	19.4	19.4	188.4	169.0
28	2032	0.0	19.4	19.4	192.5	173.1
29	2033	0.0	19.4	19.4	196.8	177.4
30	2034	0.0	19.4	19.4	201.1	181.7
31	2035	0.0	19.4	19.4	205.5	186.1
32	2036	0.0	19.4	19.4	210.1	190.7
33	2037	0.0	19.4	19.4	214.7	195.3
34	2038	0.0	19.4	19.4	219.5	200.1
35	2039	0.0	19.4	19.4	224.3	204.9
36	2040	0.0	19.4	19.4	229.3	209.9
37	2041	0.0	19.4	19.4	234.3	214.9
	Total	1,708.0	580.6	2,288.6	4,758.0	2,469.4

Discounted Benefit Cost Stream

RO '000

Sq	Year	Discounted	Construction Cost	O & M Cost	Cost Total	Benefit	Cost-Benefit
1	2005	1.000	0.0	0.0	0.0	0.0	0.0
2	2006	1.060	0.0	0.0	0.0	0.0	0.0
3	2007	1.124	0.0	0.0	0.0	0.0	0.0
4	2008	1.191	0.0	0.0	0.0	0.0	0.0
5	2009	1.262	0.0	0.0	0.0	0.0	0.0
6	2010	1.338	33.6	0.0	33.6	0.0	-33.6
7	2011	1.419	1,172.3	0.0	1,172.3	0.0	-1,172.3
8	2012	1.504	0.0	12.9	12.9	56.3	43.4
9	2013	1.594	0.0	12.1	12.1	55.5	43.4
10	2014	1.689	0.0	11.5	11.5	54.7	43.2
11	2015	1.791	0.0	10.8	10.8	53.9	43.1
12	2016	1.898	0.0	10.2	10.2	53.0	42.8
13	2017	2.012	0.0	9.6	9.6	52.3	42.7
14	2018	2.133	0.0	9.1	9.1	51.5	42.4
15	2019	2.261	0.0	8.6	8.6	50.7	42.1
16	2020	2.397	0.0	8.1	8.1	49.9	41.8
17	2021	2.540	0.0	7.6	7.6	49.2	41.6
18	2022	2.693	0.0	7.2	7.2	48.4	41.2
19	2023	2.854	0.0	6.8	6.8	47.8	41.0
20	2024	3.026	0.0	6.4	6.4	47.0	40.6
21	2025	3.207	0.0	6.0	6.0	46.3	40.3
22	2026	3.400	0.0	5.7	5.7	45.6	39.9
23	2027	3.604	0.0	5.4	5.4	45.0	39.6
24	2028	3.820	0.0	5.1	5.1	44.3	39.2
25	2029	4.049	0.0	4.8	4.8	43.6	38.8
26	2030	4.292	0.0	4.5	4.5	42.9	38.4
27	2031	4.549	0.0	4.3	4.3	41.4	37.1
28	2032	4.822	0.0	4.0	4.0	39.9	35.9
29	2033	5.112	0.0	3.8	3.8	38.5	34.7
30	2034	5.418	0.0	3.6	3.6	37.1	33.5
31	2035	5.743	0.0	3.4	3.4	35.8	32.4
32	2036	6.088	0.0	3.2	3.2	34.5	31.3
33	2037	6.453	0.0	3.0	3.0	33.3	30.3
34	2038	6.841	0.0	2.8	2.8	32.1	29.3
35	2039	7.251	0.0	2.7	2.7	30.9	28.2
36	2040	7.686	0.0	2.5	2.5	29.8	27.3
37	2041	8.147	0.0	2.4	2.4	28.8	26.4
		Total	1,205.9	188.1	1,394.0	1,320.0	-74.0

Discount Rate	6.0%

NPV (RO '000)	**-74.0**
B/C Ratio	**0.95**
EIRR	**5.5**

Cost	1
Benefit	1

Table 20.5-9 Sensitivity Analysis regarding Cost and Benefit of AL HIJ - FLIM Road Construction Project

			Benefits		
			20% down	**Base Case**	**20% up**
Costs	20% down	NPV (RO '000)	-59.0	205.0	468.7
		B/C Ratio	0.95	1.18	1.42
		EIRR (%)	5.5	7.5	9.2
	Base Case	NPV (RO '000)	-338.0	-74.0	212.2
		B/C Ratio	0.76	0.95	1.14
		EIRR (%)	3.7	5.5	7.1
	20% up	NPV (RO '000)	-616.2	-352.2	-88.5
		B/C Ratio	0.63	0.79	0.95
		EIRR (%)	2.4	4.1	5.5

Note: Project life of the project is assumed to be 30 years

7) Summary of Economic Analysis

The implementation of Al Hij - Flim Road construction project can not be fully justified from view of national economic point since the economic indicators of some cases show less than a discount rate of 6 % in Oman.

20.5.4 Technical Evaluation

The results of the technical analysis of Al Hij - Flim Road show that the construction of the Project Road is technically feasible. There are no major technical issues at all.

20.5.5 Other Impacts

1) Improvement of Standard Living of Peoples

Construction of the Project Road is expected to contribute improvement of standard living of peoples, especially Omani peoples. At present, it is estimated that 330 peoples in 2010 and 420 peoples in 2030 are living within the influence areas of the Project Road as shown in Table 21.5-12, which can not be accessible without four (4) wheel drive vehicles.

After completion of the Project Road, the Project will contribute to

- More opportunities to access various basic facilities, such as religious facilities, hospitals, markets,

- Achievement of easier daily travel to offices for employed peoples, and schools for school children,
- More chances of developing un –utilized potential lands,
- Contribution to effective land use and a unity of nation

Table 20.5-10 Number of Population, Employed Population and School Children in the Influence Area of Al Hij - Flim Road

	2005	2010	2020	2030
Direct Influence Area				
Population	296	329	378	417
No. of Employed Population	44	56	81	110
No. of School Children (below 15 ys old)	63	60	66	64
Indirect Influence Area				
Population	273	303	348	383
No. of Employed Population	41	52	75	100
No. of School Children (below 15 ys old)	58	55	61	59

(2) Regional Development

Improved road system would greatly contribute to regional 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;

a. Fishery industry

- Higher fishing prices → higher income for fisherman → Upgrading their living standards → Incentive for fisherman to produce → Regional economic growth

c. Tourism industry

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

20.5.6 Overall Evaluation

As mentioned above, the implementation of the Al Hij - Flim road construction project can be justified from view of economic, technical, and social impact points.

Annex 20-1

Detailed cost estimate of Al Hij – Flim Road

Item No.	Description	Unit	Unit Price (RO)	Quantity	Cost (RO)	Cost Component					
						Lab.	Mat.	Equip.	For.	Local	Tax
	Earthworks										
203	**Earthworks Excavation**										
203.1	Suitable excavation to embankment	Cu. m.	1.660	50,467	83,768	1,340	3,830	78,597	44,489	37,055	2,224
203.2	Suitable excavation to waste	Cu. m.	1.546	14,970	23,150	306	705	22,139	12,208	10,332	610
203.4	Borrow excavation to embankment	Cu. m.	3.660	70,942	259,649	1,110	88,788	169,751	92,211	162,828	4,611
206	**Excavation and Backfilling for Structures**										
206.1	Structural excavation in soils to a depth of 2m.	Cu. m.	1.351	327	442	11	16	416	234	197	12
206.3	Structural excavation in rock to a depth of 2m.	Cu. m.	2.665	4,204	11,204	207	476	10,520	5,919	4,988	296
	Subbase and Base course										
302	**Granular Subbase**										
302.1	Class A Subbase	Cu. m.	5.000	0	0	0	0	0	0	0	0
302.2	Class B Subbase	Cu. m.	4.000	41,357	165,429	3,398	36,720	125,310	69,276	92,688	3,464
302.3	Class C Subbase	Cu. m.	3.000	0	0	0	0	0	0	0	0
303	**Aggregate Basecourse**				0						
303.1	Class A Basecourse	Cu. m.	5.000	0	0	0	0	0	0	0	0
303.2	Class B Basecourse	Cu. m.	4.000	30,098	120,392	2,517	26,010	91,866	50,847	67,003	2,542
303.3	Class C Basecourse	Cu. m.	3.000	0	0	0	0	0	0	0	0
	Bituminous Pavement										
401	**Bituminous Prime Coat and Tack Coat**										
401.1	Prime Coat such as MC70	Kg	0.120	193,000	23,160	67	22,886	206	14,976	7,435	749
401.2	Tack Coat such as RC250	Kg	0.150	0	0	0	0	0	0	0	0
405	**Bituminous Wearing Course**										
405.1	Bituminous Wearing Course	Cu. m.	17.000	19,847	337,398	835	315,474	21,089	216,188	110,400	10,809
	Concrete and Concrete Structures										
504	**Concrete for Structures**										
504.1	Concrete Class 28/20	Cu. m.	40.000	412	16,489	1,296	8,282	6,911	5,752	10,449	288
504.2	Concrete Class 32/20	Cu. m.	45.000	0	0	0	0	0	0	0	0
504.3	Concrete Class 36/20	Cu. m.	50.000	0	0	0	0	0	0	0	0
509	**Reinforcing Steel**										
509.1	High yield steel bars	ton	250.000	20	4,978	196	4,348	434	3,055	1,770	153
509.2	Mild steel bars	ton	250.000	5	1,319	57	1,143	119	805	473	40
	Drainage										
801	**Pipe Culverts**										
801.1	Reinforced Concrete Pipe Culvert 600 mm	Lin. m.	35.000	0	0	0	0	0	0	0	0
801.2	Reinforced Concrete Pipe Culvert 750 mm	Lin. m.	50.000	0	0	0	0	0	0	0	0
801.3	Reinforced Concrete Pipe Culvert 900 mm	Lin. m.	75.000	336	25,200	907	5,821	18,472	13,154	11,388	658
801.4	Reinforced Concrete Pipe Culvert 1050 mm	Lin. m.	100.000	0	0	0	0	0	0	0	0
801.5	Reinforced Concrete Pipe Culvert 1500 mm	Lin. m.	155.000	0	0	0	0	0	0	0	0
	Slope Protection										
901	**Rip Rap**										
901.1	Loose stone riprap Class A	Cu. m.	6.000	1,722	10,332	286	2,483	7,563	4,265	5,854	213
901.2	Loose stone riprap Class B	Cu. m.	6.000	0	0	0	0	0	0	0	0
901.3	Mortared stone riprap	Cu. m.	15.000	1,910	28,653	1,756	15,693	11,204	8,478	19,751	424
902	**Gabions**										
902.1	Gabions	Cu. m.	13.000	0	0	0	0	0	0	0	0
906	**Ditch lining**										
906.1	Ditch lining (150mm thick)	Sq. m.	2.000	0	0	0	0	0	0	0	0
	MSCELLANEOUS STRUCTURES(1300 SAFETY BARRIERS, DELINEATORS AND FENCES, 1400 HIGHWAY SIGNS AND ROAD MARKINGS, AND OTHER ITEMS, 10% of SECTION 200 to SECTION				111,156	4,641	85,355	21,160	80,254	26,889	4,013
	MEASURED WORKS TOTAL (SECTION 200 to 1900)				1,222,716	18,930	618,029	585,757	622,110	569,500	31,106
	SECTION 100 PRELIMINARIES (25% of SECTION 200 to SECTION 1800)		------		305,679	2,526	137,375	165,778	226,108	68,266	11,305
	SUB TOTAL				1,528,395	21,456	755,404	751,535	848,218	637,766	42,411
	CONTINGENCY (10% of SECTION 200 to SECTION 1800)		------		122,272						
	Total				1,650,667						

Annex 20-2

ENVIRONMENTAL CHECKLIST (AL HIJ TO FLIM ROAD)

Road Section: From Al Hij to Flim, Existing road condition: Track road

Project Road No.: N47, Planning road: Metalled 2-lane road, Distance: 19.3 km

Environmental Items	Present environmental condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Remarks Predicted traffic volume in 2030: 1,000 veh/day
Air Pollution	- Air pollution at present is not significant except dust. Dust occasionally occurs by car.	1	- Air pollution will be not significant, because low traffic volume of future is predicted. - Dust will decrease due to road pavement.
Effluent and Water contamination	- Project road runs along low terrace and low-hilly land and small wadi.	1	-Project area is very low precipitation and flat area. Rainwater on the road surface will smoothly be discharged.
Noise and Vibration	- The pollution of noise and vibration is insignificant so far. Residential area is limited at Al Hij and Flim.	1	- Noise and Vibration: Slight impact by project road, because low traffic volume and low receptors in future are predicted.
Land Subsidence	- No existing so far. Soft ground zone (e.g. Sabkha area, etc.) is not found along project road.	1	- Not existing with project.
Topography and Geology	(1) 0~7.0 km: - Middle and Low Terraces and low hilly land. Terraces and hills consist of mainly End-Cretaceous limestone of shelf farcies. And the terraces are mostly covered by consolidated gravel and sand.	1	- Not significant impact with project, because road alignment will be mostly followed existing road alignment.

	(2) 7.0~12.8 km: - Low terraces and wadi, flat zone. Wadi is mostly filled by alluvial wadi sediments, consisting of sand and gravels, (3) 12.8~19.3 km: - Wadi and sand shoal, flat zone. Wadi along the project road is small tributary of Wadi Halfayn. Alluvial wadi sediments, consisting of sand and gravels, mostly fill wadi. - The area is widely covered by thin Aeolian sand originated from the beach sand. The sand locally forms small sand dunes. Near end point at Flim, the existing road runs along foot of the lower terrace beside Sabkha. Beach of Flim forms shallow beach, sabkha and lagoon.		 Photo: Low Terrace and wadi plain  Photo: Mahawt Island and Water pipe
Soil	- Little surface soil is developed in the area.	1	- Not significant impact with project.
Hydrology and groundwater	- There is no current flow along wadi, Wadi Halfayn, in the area. - Groundwater is pumped up at near beach and the pumped water is supplied by water tank to the residents at Flim and pipe water is also supplied to Mahawt island during fishing season.	1~2	- Hydrology: Not significant impact with project. - Groundwater: Slight to moderate impact to groundwater, consisting of lowering of groundwater table, water contamination, is likely to occur due to increase of pumping volume and wastes by increased visitors to the area. Because, the groundwater reserve near beach in the area seems to be limited.
Eco-system, Flora and Fauna	- There are no protected areas near the existing route. - Flora: Rare vegetation in the area, but small	1~2	- Eco-system, flora and Fauna: Not significant impact with project to the eco-system and fauna in the area, in case of compare with

	amount of grass and low acacia trees are found in the area. Mangroves are locally found around lagoon and sabkha at Flim and Mahawt island. Mangroves are very important for fishery and stopping point for migratory birds. - Fauna: Many kind of birds, including migratory birds, stop in beach and mangroves in the area. Several mammals, consisting of Hedgehog, Red Fox, Sand Fox, Wild Cat, caracal, Nubian Ibex, Arabian Gazelle, Cape Hare, etc., are reported to make habitat in the area are. - Fishing: Surroundings of Mahawt island are rich fishing places. Therefore, many fishermen work in Flim and Mahawt island.		present gravel road. However, increase of visitors as tourism in future might indirectly influence eco-system, flora and fauna along the coastal line, including mangroves.  Photo: Mangroves and Sabkha at Flim
Landscape	- Low terrace, hilly land, sand beach and Mahawt island.	1	- Not significant impact with project.
Hazards	- Not existing so far. But sand storm and fog in early morning and night locally and seasonally occur.	1	- Not significant impact with project.
Regional Development on Natural Environment	- The area has a potential of development for Fishery and tourism.	1	- The road improvement will contribute local development.
Other Impacts on Natural environment	- Not existing so far.	1	- Likely not significant impact with project.
Cultural Heritage	- Unknown so far.	1	- Site investigation of cultural heritage needs to carry out before construction.
Wastes	- Not significant so far.	1	- Although low traffic volume is predicted, wastes along the road and Flim as a destination will certainly increase due to increased visitors.

Regional Development on Social Environment	- Not existing so far.	1	- Unknown about regional development.
Other Impacts on Social Environment	(1) 0 (Start point: Al Hij)~0.2km: - Al Hij village. Residential area, mosque, workshops. Houses have enough distance, more than 30m, from boundary of the existing road. Mosque keeps about 100m away from the existing road. (2) 0.2~18km: - No houses or huts. (3) 18 to 19,3km (End point: Flim): - Approximately total 150 huts, government workshop (not operation), pumping station of the MHEW. The pumping station supplies drinking water to residents and Mahawt island by water pipe. Huts, located along the foot of Low Terrace covered by thick Aeolian sand, are not permanent houses. Most of residences seasonally change to live between Flim and Mahawt island. - Mahawt island: There are 60 to 100 families staying island during wet season (September to April) for fishery.	1~2	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.  Water supply by W-tank Photo: Pumping station of the MHEW

Evaluation	**- Hydrology, groundwater**	**1~2**	**Groundwater contamination due to wastes**
	- Eco-system, Flora and Fauna	**1~2**	**Damage to mangroves and eco-system**
	- Other Impacts on Social Environment	**1~2**	**Traffic accidents due to increased traffic**
	- Other items	**1**	

Comprehensive Evaluation	**1~2**
Recommendations *1	**Recommended to carry out EIA on assigned items**

*1 : Comprehensive Evaluation

1	: None to slight impacts.	: No need to carry out EIA
1~2	: Small impacts.	: Recommended to carry out EIA on assigned items
2	: Moderate impacts.	: Recommended to carry out EIA
2~3	: Relatively significant impacts.	: Recommended to carry out EIA
3	: Significant impacts.	: Recommended to carry out EIA

Annex 20-3

TERMS OF REFERENCE
ON
THE ENVIRONMENTAL IMPCT ASSESSMENT
OF
THE AL HIJ – FLIM RORD,

SULTANATE OF OMAN

1. Project Title

"Environmental Impact Assessment of the Al Hij - Flim Road, Sultanate of Oman" (hereinafter referred to as "Study")

2. Executive Agency

Directorate General of Road, (hereinafter referred to as "DGR"), Ministry of Transport and Communications, Sultanate of Oman.

3. Location of Project Area

Project area is located in the north most part of the Al Wusta Region. The project road joins to road to Sanna at Al-Hij and traverses along tributaty of Wadi Halfain to Flim. Flim is located at coast and connects to Mahawt Island, as shown in Attachment-1.

4. Background of the project

The Al Hij – Flim Road is designated as one of the 7th Plan (2006-2010) proposed roads. This road has an important role of directly connecting main road network to the coastal area Mahawt Island, which is a tourist spots and fishery center.

5. Objectives of the Study

The Study should carry out to accord the Royal Decree No. 10/82 and its amendments entitled "Law on Conservation of the Environment and Prevention of Pollution" as well as other relevant regulations, decisions and guidelines.

The principles of the Study are as follows:

- EIA is a process to help decision makers to protect, conserve and manage Oman's environment, according to the principles of sustainable development, maintaining human well-being, healthy environment and a sound economy;
- The EIA process should ensure that the individual, company or government agency, proposing a project considers its effect on health, economy and culture of surrounding community as well as its impact on air, land and water;
- The EIA should be applied as early as possible in project's planning stage and before irrevocable decisions are made; and
- Public information is an important component of an open and balanced EIA process.

And, the specified objectives of the Study are show as below:

i) To identify, predict, and assess environmental impacts due to proposed activities on the physical, biological and social environment;
ii) To propose mitigation measures for avoiding and reducing the impacts and evaluating associated risk; and
iii) To submit the Environmental Impact Assessment report and relevant documents.

6. Project Description:

The project description of the Al Hij - Flim Road shows as below:

- The project road is located in the north most part of the Al Wusta Region and adjoined to the Ash Sharqiyah Region. The project road area is topographically characterized by alluvial flat plain,
- The project road has important role of connecting main road network to fishery and tourist spots,
- The length of the project road is 19.3 km,
- The road hierarchy of the project road is designated to the secondary road that its right-of-way is 50 m, and
- The project road traverses mostly Alluvial flat terrains and along the wadis, as shown in Annex-2.

7. Scope of the Study:

This project is classified as Roads of the Group five (Service projects) in accordance of the "Guidelines for Obtaining Environmental Permits" (Directorate General of

Environmental Affaires). In addition, as results of the environmental consideration of the project are recommended that the project should be carried out EIA before project implementation, comprehensive EIA should be required.

In order to achieve the objectives mentioned above, the scope of the Study consist of following items:

1) Collect and review the existing data and information relevant to the project

- Legislative information,
- Topographical, geological and pedological data,
- Aero photographs and/or satellite images covered in and around the project area,
- Meteorological data around the project,
- Hydrological and hydro-geological data relevant to the project,
- Biological and ecological data and information,
- Information of land use and its history,
- Natural scenic spots, national park, etc.,
- Information of open-air recreation,
- Information of natural hazards,
- Sociological data and information,
- Administrative data and information,
- Socio-economic data,
- Cultural and historical heritages,
- Traffic volume data, and
- Other data and information relevant to the traffic, etc.

2) Project description

- Location,
- Road design and design criteria,
- Road capacity,
- Road section for construction,
- Pre-construction activities,
- Construction plans and scheduling,
- Staffing and support,
- Associating facilities and services,
- Operating procedures and maintenances,
- Future traffic volume,
- Land use requirement, and
- Alternative alignments, etc.

3) Site description and its environment (Baseline survey)

The content of the baseline study consists of the following environmental items:

(1) Air quality: Measuring points consist of town and settlements as well as start and end points, and number of measuring times is two, i.e. summer and winter seasons, and measuring parameters consist of SO_2, TSP, PM_{10} and fallen-dust,
(2) Water quality: measuring points consist of wells and aflaj water, and number of measuring times is two, i.e. summer and winter seasons, and analysis parameters consist of pH, Electric conductivity (EC), Water temperature, Ca, Mg, Fe, Mn, K, Na, CO_3, Hg, Pb, As, Cr, Cd, Se, SO_4 and Cl,
(3) Noise and vibration: measuring points consists of town and settlements, and number of measuring times is two, i.e. summer and winter seasons, and measuring parameter is dB(A) on the boundary of ROW,
(4) Topography and geology: Topographical and geological investigation,
(5) Soil: Pedological investigation consists of soil sections at the point of every 2 km interval and each villages and farmlands,
(6) Surface water and groundwater: Hydrological and hydro-geological investigations include measurement of pH, EC and Water temperature,
(7) Ecosystem, flora and fauna: Number of investigating times is two, i.e. summer and winter seasons,
(8) Landscape,
(9) Hazards,
(10) Communities,
(11) Wastes,
(12) Cultural heritage,
(13) Resettlement, and
(14) Traffic volume and traffic accidents: Traffic census and interviews.

While baseline survey, the proponent should be found stakeholders, related to the project, e.g. residents of local communities in the site, indigenous people, experts from government organizations, local government officer, NGO, etc., and should be collected their opinions in order to get an appropriate agreement and to reflect to the decision-making of the project.

4) Evaluation of project's impacts

The content of the evaluation of impacts with the project consists of the following items:

- Cumulative and indirect environmental impacts, likely to result from the project in combination with existing or planned projects or activities,
- Impact on socio-economic conditions,
- Impact on physical and cultural heritage, and
- Proposal and evaluation of reasonable alternatives to the project and their impacts.

The evaluation should be carried out to use the environmental standards or guidelines to establish significant of the harmful impacts. A risk assessment can be used when there are no applicable threshold standards or guidelines. The following criteria should be applied to determine significant or adverse impacts:

(1) Magnitude,
(2) Frequency and duration,
(3) Location and sensitivity of environment, and
(4) Irreversibility.

5) Mitigating measures and evaluating associated risks

The following approaches can be used to mitigate likely significant harmful impacts:

- Direct prevention by avoiding sensitive areas,
- Reduction by adjusting work schedules, pollution control devices, changes in design, etc.,
- Restoration and remediation measures, and
- Compensation.

6) Final assessment

The final assessment should be done to evaluate through a net effect analysis.

7) Documentation

Documentation I composed of reference and working documents. The former will contain a detailed record of the work done on the EIA. The latter is the document, which contain the information for action, e.g. the Environmental Impact Statement as well as Summary.

The content of the Environmental Impact Statement should be contained the following items:

- Information describing the EIA,

- Information describing the project,
- Information describing the site and its environment, shown as below:
    (1) Physical features
    (2) Legislative framework
    (3) Assessment of impacts, shown as below:
        a. Impacts on human beings, buildings and man made features,
        b. Impacts on flora, fauna and geology,
        c. Impacts on land,
        d. Impacts on water,
        e. Impacts on air and climate,
        f. Other direct and secondary effects associated with the project,
        g. Environmental management plan – Mitigating measures and risk assessment, and
        h. Conclusions and additional information.

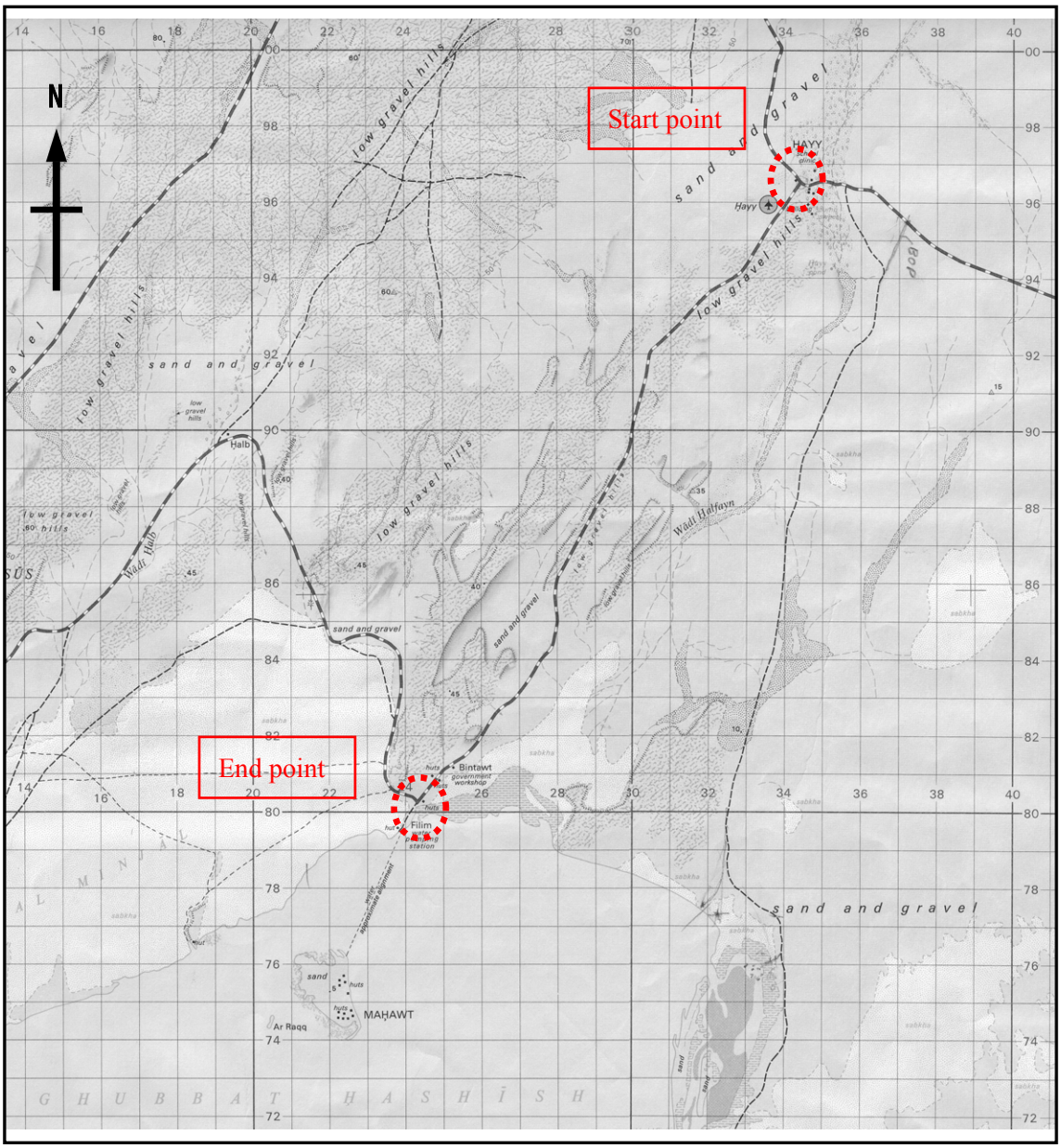
8. Study Timetable

Tentative study timetable of the project shows in Attachment-3.

Attachment:

Attachment-1 Location Map of the Project Road
Attachment-2 Topographic Map of the Project Road
Attachment-3 Tentative Study Timetable of the Project

Attachment-1 Location Map of the Project Road



0 5 km

Attachment-2 Topographic Map of the Project Area

Attachment-3 Tentative Study Timetable of the Project

Year	200 -															Remarks
Number of month	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**-**	
1. Data collection	▬															
2. 1st. Field investigation		▬	▬	▬												Summer/winter season
3. 2nd. Field investigation								▬	▬	▬						Winter/summer season
4. Data analysis			▪▪▪	▪▪▪	▪▪▪	▪▪▪	▪▪▪			▪▪▪	▪▪▪	▪▪▪	▪▪▪			
5. Reporting	1 △	○	○	○	○	○	○	○	○	○	○	○	○	2 △	3 △	

△ 1 : Inception report
2 : Draft Final report
3 : Final report
○ : Monthly report

▬ : Work in the site
▪▪▪ : Chemical analysis