Chapter 15

Economic and Financial Evaluation

Chapter 15 Economic and Financial Evaluation

15.1 Econmic Evaluation

15.1.1 Premises

Economic benefit is calculated as the difference of Vehicle Operating Cost (VOC) + Rail Operating Cost (ROC) + Travel Time Cost (TTC) with project(s) and VOC + ROC + TTC without project(s). The road network is improved in accordance with the road network development plan.

15.1.2 Rail Operating Unit Cost (ROUC)

(1) Characteristics of Representative Train

The train served between Damascus and Aleppo is chosen as the representative train of passenger transport and the train transported Phosphate from Al-Sharqia to Tartous as the representative train of freight transport.

The representative passenger train for the Do Nothing case is composed of one locomotive and 8 cars. That for the Master Plan case is composed of five (5) diesel cars. Details of the composition are shown below (locomotives and coach types are explained in section 3.2 Rolling stock and workshop, of Chapter 3 of this report);

Locomotive: LDE1800 x 1
Mail Car: DPEM or DPOST x 1
Second Class Car: BM or BMH or BH x 2
Dining Car: WR x 1
First Class Car:AP x 3
Sleeping Car: Sleeping Car x 1

The representative freight train is composed of one locomotive and 16 wagons. Details are given below;

Locomotive: LDE2800 x 1 (Do Nothing Case)
LDE3200 x 1 (Master Plan Case)
Wagon: Flatcars x 16

(2) Fuel and Lubricant Costs

No empirical study is available for the fuel and lubricant consumption of locomotives. Data from routine operation of the representative passenger train between Damascus and Aleppo and the freight train between Al-Sharqia and Tartous are collected and shown in Table l5.1.1. DC and LDE3200 date are estimates of the expert of the Study Team.

Table 15.1.1 Fuel and Lubricant Costs

Items/Type of Train	Unit	Representative Passenger Train		Representative Freight Train	
Locomotive		LDE1800	DC	LDE2800	LDE3200
Consumption					
Diesel Fuel	Liter	1500	1751	1500	1380
Lubricant	Liter	200	195	200	166
Financial Cost					
Diesel Fuel	SP/liter	6.5	6.5	6.5	6.5
Lubricant	SP/liter	43.9	43.9	43.9	43.9
Government Share (Tax)					
Diesel Fuel	SP/liter	0.84	0.84	0.84	0.84
Lubricant	SP/liter	6.05	6.05	6.05	6.05
Economic Cost					
Diesel Fuel	SP/liter	5.66	5.66	5.66	5.66
Lubricant	SP/liter	37.85	37.85	37.85	37.85
Running Distance (km)	Km	389	389	276	276
Unit Economic Cost					
Diesel Fuel	SP/km	21.83	25.47	30.76	28.30
Lubricant	SP/km	19.46	18.93	27.43	22.71

(3) Repair / Maintenance Costs

GESR data are collected and summarized in Table 15.1.2.

Table 15.1.2 Repair and Maintenance Costs

	Unit	LDE 1800	DPEM	BM	WR	AP	SC	LDE 2800	Flat -cars	LDE 3200	DC
RMCost	TSP/yr	370	95	53	109	99	45	370	2	370	99
Ave. Run. km	Tkm/yr	76	180	180	180	180	180	34	65	34	180
RM Cost	SP/km	4.87	0.53	0.29	0.60	0.55	0.25	10.90	0.04	10.90	0.55

Note: DPEM represents DPEM/DPOST, BM; BM/BHM/BH and SC; Sleeping Car

TSP: 1000SP, Tkm: 1000km

Costs of LDE3200 and DC are estimates of the Study Team

(4) Depreciation Costs

The Study Team adopted the lives of rolling stocks as locomotive/diesel car: 28 years and car/freight car: 50 years. The results of calculation are shown in Table 15.1.3.

Table 15.1.3 Depreciation Costs

	Unit	LDE 1800	DPEM	BM	WR	AP	SC	LDE 2800	Flatcars	LDE 3200	DC
Purchase Price	TSP	8,191	2,729	1,705	6,674	5,907	7,172	13,014	2,004	92,000	46,000
Purchase Year	Year	1,976	1,978	1,978	1,983	1,982	1,982	1,984	1,992	2,002	2,002
Inflator*		12.13	9.68	9.68	6.55	7.04	7.04	6.15	1.48	1.00	1.00
Present Price	TSP	99,356	26,420	16,503	43,718	41,588	50,495	80,034	2,966	92,000	46,000
Life	Year	28	50	50	50	50	50	28	50	28	28
Depreciation	%	3.6	2.0	2.0	2.0	2.0	2.0	3.6	2.0	3.6	3.6
Depreciation	TSP	3,548	528	330	874	832	1,010	2,858	59	3,286	1,643
Subject to use	TSP	2,484	370	231	612	582	707	2,001	42	2,300	1,150
Subject to time	TSP	1,065	159	99	262	250	303	858	18	986	493
Ave. Runnings	Tkm/yr	76	180	180	180	180	180	34	65	34	180
Deprec. Cost	SP										
Subject to use	Sp/km	32.68	2.05	1.28	3.40	3.23	3.93	58.85	0.64	67.65	6.39
Subject to time	SP/hr	121.52	18.10	11.30	29.94	28.49	34.59	97.89	2.03	112.52	56.26

Note: Price of DC is estimated by the Study Team

(5) Capital Opportunity Cost

The Capital Opportunity Costs were calculated assuming capital opportunity of 12% p.a. The breakdown of the Capital Opportunity Cost is shown in Table 15.1.4

Table 15.1.4 Capital Opportunity (CO) Cost

	Unit	LDE 1800	DPEM	BM	WR	AP	SC	LDE 2800	Flat -cars	LDE 3200	DC
Present Price	TSP	99,356	26,420	16,503	43,718	41,588	50,495	80,034	2,966	92,000	46,000
CO	% pa	12	12	12	12	12	12	12	12	12	12
CO Cost	SP/hr	1,361	362	226	599	570	692	1,096	41	1,260	630

Note: Price of DC is estimated by the Study Team

(6) Crew Cost

The passenger train crew is composed of a crew captain, a driver, an assistant driver and six (6) conducters, and the freight train is handled by a driver and an assistant driver only for the Do Nothing Case. In the Master Plan Case, the DC train is handled by a driver and two (2) conductors, and the freight train is operated by a driver. Average salary including service allowance of a train driver/other crew is 84,500 SP/year. Crew costs by type of

train per km are calculated based on the average annual onboard hours and summarized in Table 15.1.5.

Table 15.1.5 Crew Cost

Items/Type of the Train	Unit	Representative Passenger Train		Representative Freight Train	
		Do Nothing	Master Plan	Do Nothing	Master Plan
Average Crew Salary	SP/crew/year	84,500	84,500	84,500	84,500
No. of Crew	Person	9	3	2	1
Annual Cost	SP/year	760,500	253,550	169,000	84,500
Ave. Annual Working Hours	Hr/year	196.7	196.7	196.7	196.7
Hourly Cost	SP/hr	3,866.29	1,288.76	859.18	429.59

(7) Summary of ROUC

ROUC of each car is compiled in a train formation. Results are summarized in Table 15.1.6.

Table 15.1.6 Summary of ROUC (Train)

Items/Type of the Train		Representative Passenger Train		Representative Freight Train	
	Cars	Present	M/P	Present	M/P
ROUC subject to Distance (SP/train km)		104.11	79.08	138.79	140.41
Fuel and Lubricant (SP/train km)		41.29	44.40	58.19	51.01
Fuel	-	21.83	25.47	30.76	28.30
Lubricant	-	19.46	18.93	27.43	22.71
Repair and Maintenance (SP/train km)		8.49	2.74	11.50	11.50
Diesel Car	5	0.00	2.74	0.00	0.00
LDE1800	1	4.87	0.00	0.00	0.00
DPEM/DPOST	1	0.53	0.00	0.00	0.00
BM/BHM/BH	2	0.59	0.00	0.00	0.00
WR	1	0.60	0.00	0.00	0.00
AP	3	1.65	0.00	0.00	0.00
Sleeping Car	1	0.25	0.00	0.00	0.00
LDE3200	1	0.00	0.00	0.00	10.90
LDE2800	1	0.00	0.00	10.90	0.00
Flatcars	16	0.00	0.00	0.61	0.61
Depreciation Costs (SP/train km)		54.34	31.94	69.10	77.90
Diesel Car	5	0.00	31.94	0.00	0.00
LDE1800	1	32.68	0.00	0.00	0.00
DPEM/DPOST	1	2.05	0.00	0.00	0.00
BM/BHM/BH	2	2.57	0.00	0.00	0.00
WR	1	3.40	0.00	0.00	0.00
AP	3	9.70	0.00	0.00	0.00
Sleeping Car	1	3.93	0.00	0.00	0.00
LDE3200	1	0.00	0.00	0.00	67.65
LDE2800	1	0.00	0.00	58.85	0.00
Flatcars	16	0.00	0.00	10.25	10.25
ROUC subject to Time (SP/train hr)		9,353.28	4,720.76	2,736.06	2,485.03
Depreciation Costs (SP/train hr)		312.21	281.31	130.40	145.03
Diesel Car	5	0.00	281.31	0.00	0.00
LDE1800	1	121.52	0.00	0.00	0.00
DPEM/DPOST	1	18.10	0.00	0.00	0.00
BM/BHM/BH	2	22.61	0.00	0.00	0.00
WR	1	29.94	0.00	0.00	0.00
AP	3	85.46	0.00	0.00	0.00
Sleeping Car	1	34.59	0.00	0.00	0.00
LDE3200	1	0.00	0.00	0.00	112.52
LDE2800	1	0.00	0.00	97.89	0.00
Flatcars	16	0.00	0.00	32.51	32.51
Capital Opportunity Cost (SP/train hr)		5,174.78	3,150.60	1,746.49	1,910.41
Diesel Car	5	0.00	3,150.60	0.00	0.00
LDE1800	1	1,361.04	0.00	0.00	0.00
DPEM/DPOST	1	361.91	0.00	0.00	0.00
BM/BHM/BH	2	452.13	0.00	0.00	0.00
WR	1	598.87	0.00	0.00	0.00
AP	3	1,709.11	0.00	0.00	0.00
Sleeping Car	1	691.71	0.00	0.00	0.00
LDE3200	1	0.00	0.00	0.00	1,260.27
LDE2800	1	0.00	0.00	1,096.35	0.00
Flatcars	16	0.00	0.00	650.14	650.14
Crew Cost (SP/train hr)		3,866.29	1,288.76	859.18	429.59

15.1.3 Vehicle Operating Unit Cost (VOUC)

(1) Characteristics of Representative Vehicles

Representative vehicles for passenger car, microbus, regular size bus, light truck and heavy truck are chosen based on roadside traffic count data. These are Mazda 323 (passenger car), Mazda E2000 (microbus), Man (Regular Bus), Daihatsu (Light Truck) and Mercedes (Heavy Truck) for the year 1999 (all figures discussed in this section are summarized in Table 15.1.6). Prices of these vehicles were collected in Beirut due to poor information available in Damascus because of the strict import controls imposed in Syria. Average annual running distances were obtained from hearings conducted in Damascus.

(2) Fuel and Lubricant Costs

Fuel and Lubricant costs in 2000 were collected. Fuel consumption is highly dependent on running speed and vehicle type. There are some empirical studies to explore that relationship, known as the Kenyan study, the Brazilian study, the Caribbean study and the Indian study. The study team used formulas of the Indian study. Indian experimental formulas are simplified to apply to flat and good surface conditions roads as follows;

Passenger car	$F= 10.31+1676/V+0.0133V^2$
Diesel jeep	$F= 30.83+2258/V+0.0242V^2$
Light truck	$F= 49.84+319/V+0.0035V^2$
Medium truck	$F= 85.07+3905/V+0.0206V^2$
Where,	F= Fuel consumption (litter/1000km)
	V= Velocity (km/hr)

The estimated results were modified by field data collected in Damascus.

Strictly speaking the lubricant consumption rate is also dependent on vehicle speed. However, the team used a flat function on lubricant consumption to vehicle speed because no empirical study to clarify vehicle speed and lubricant consumption relationship was found.

(3) Tire Cost

Bridgestone tires are the standard in the SAYYARAT price list. Actually Bridgestone tires are installed with 8% discounted price of the SAYYARAT standard.

(4) Repair / Maintenance Costs

Repair / maintenance costs are considered as 6% of the new car price per year based on the experience of the Study Team. The repair/maintenance costs per km are induced for convenience of economic evaluation.

(5) Depreciation Costs

The rate of depreciation was assumed as 7.0% per annum, which comes from the assumption of 10 years depreciation period and 30% residual value. Depreciation cost is broken down to; a) Subject to use and b) Subject to time.

(6) Capital Opportunity Cost

The expected gains when the investment in this project is used for other projects is defined as the capital opportunity cost. The capital opportunity cost was calculated assuming 12% p.a. which is generally applied.

(7) Crew cost and overhead cost

Interviews on driver's income were done by vehicle type. Overhead cost was estimated at 50% of crew cost in cases of microbus and light truck, and 100% of crew cost for regular size bus and heavy truck. Because most passenger cars were driven by owner, crew cost and overhead cost of passenger car was considered as zero (0). Hourly costs are calculated assuming 25 days of 12 hours work.

(8) Summary of VOUC

The unit VOC was obtained as a summation of the cost items mentioned in the preceding sections in the two different categories of distance related cost and time related cost (refer to Table 15.1.6).

Table 15.1.6 Vehicle Operating Unit Cost

Item	Unit	Passenger Car	Microbus	Regular Bus	Light Truck	Heavy Truck
Representative Vehicles / Make / Model		Mazda323 2000	Mazda E2000 2000	Man 2000	Daihatsu 2000	Mercedes 2000
Characteristics of Vehicles						
Price	SP	496,800	496,800	5,478,480	563,040	2,838,840
Average Running Length	km/yr	14,600	53,000	53,000	31,000	47,000
No. of Tires	Tire	4	4	6	4	10
Fuel Type		Gasoline	Diesel	Diesel	Gasoline	Diesel
Fuel and Lubricant Costs						
Fuel Unit Cost	SP/Lit	4.9	5.7	5.7	4.9	5.7
Lubricant Unit Cost	SP/Lit	37.9	37.9	37.9	37.9	37.9
Fuel Consumption Cost						
Speed (km/hr) 5	SP/km	1.69	0.56	4.94	0.56	4.94
10	SP/km	0.88	0.40	2.72	0.40	2.72
20	SP/km	0.49	0.33	1.64	0.33	1.64
30	SP/km	0.38	0.31	1.33	0.31	1.33
40	SP/km	0.36	0.31	1.23	0.31	1.23
50	SP/km	0.38	0.32	1.22	0.32	1.22
60	SP/km	0.42	0.33	1.28	0.33	1.28
70	SP/km	0.49	0.35	1.38	0.35	1.38
80	SP/km	0.57	0.37	1.51	0.37	1.51
90	SP/km	0.67	0.40	1.68	0.40	1.68
Lubricant Consum. Cost	SP/km	0.07	0.10	0.22	0.10	0.31
Tire Cost						
Tire Cost per unit	SP	2,798	2,935	10,381	2,313	12,916
Change Cycle	Km	50,000	60,000	60,000	60,000	60,000
Tire Consumption Cost	SP/km	0.22	0.20	1.04	0.15	2.15
Repair and Maintenance Cost						
Repair and Maint. Cost	SP/yr	29,808	29,808	328,709	33,782	170,330
Repair and Maint. Costs	SP/km	2.04	0.56	6.20	1.09	3.62
Depreciation and Opportunity Cost						
Vehicle Cost excl.Tires	SP	485,610	485,058	5,416,197	553,789	2,709,685
Depreciation	% p.a.	7	7	7	7	7
Depreciation Amount	SP	33,993	33,954	379,134	38,765	189,678
Of which, subject to use	SP	16,996	23,768	265,394	27,136	132,775
subject to time	SP	16,996	10,186	113,740	11,630	56,903
Unit Depreciation Cost						
Of which, subject to use	SP/km	1.16	0.45	5.01	0.88	2.82
subject to time	SP/hr	1.94	1.16	12.98	1.33	6.50
Capital Opportunity	% p.a.	12	12	12	12	12
Capital Opportunity Cost	SP/hr	6.65	6.64	74.19	7.59	37.12
Crew Cost and Overhead Cost						
Annual Cost						
Crew Cost	SP/yr	0	109,500	131,400	109,500	219,000
Assistant Cost	SP/yr	0	0	42,720	0	0
Overhead Cost	SP/yr	0	54,750	174,120	54,750	219,000
Hourly Cost						
Crew Cost	SP/hr	0.00	30.00	36.00	30.00	60.00
Assistant Cost	SP/hr	0.00	0.00	11.70	0.00	0.00
Overhead Cost	SP/hr	0.00	15.00	47.70	15.00	60.00
Total Hourly Cost	SP/hr	0.00	45.00	95.41	45.00	120.00
Summary of VOUC						
VOUC subject to Distance						
Speed (km/hr) 5	SP/km	5.19	1.86	17.41	2.78	13.85
10	SP/km	4.38	1.71	15.19	2.62	11.63
20	SP/km	3.99	1.64	14.11	2.55	10.56
30	SP/km	3.88	1.62	13.80	2.53	10.24
40	SP/km	3.86	1.62	13.70	2.53	10.14
50	SP/km	3.88	1.62	13.69	2.54	10.14
60	SP/km	3.92	1.64	13.75	2.55	10.19
70	SP/km	3.99	1.66	13.85	2.57	10.29
80	SP/km	4.07	1.68	13.98	2.59	10.43
90	SP/km	4.17	1.71	14.15	2.62	10.59
VOUC subject to Time	SP/hr	8.59	52.81	182.59	53.91	163.61

15.1.4 Travel Time Unit Cost (TTUC)

(1) Passenger

Travel time unit cost is estimated using household income data obtained from the home interview survey (refer to "The Study on Urban Transportation Planning of Damascus City in The Syrian Arab Republic", Final Report) applying 100% of overhead cost. Costs are obtained by car user and public transport user, and adjusted to a year 2000 salary scale (refer to Table 15.1.7).

In Table 15.1.8, Travel costs of years 2000, 2005, 2010, 2015 and 2020 are projected in accordance with the forecast of per Capita GDP of the same years as mentioned before.

Table 15.1.7 Present Hourly Income and Travel Time Unit Value (TTUV)

Item	Car Owner	Non Car Owner	Note
Family Income	12,620	8,312	SP/Month
Income Earners	1.9	1.7	Person/household
Working hour	8	8	Hours/person
Working days	25	25	Days/month
Hourly income	33.2	24.4	SP/hour/person
Travel Time Unit Value (TTUV)			
Business Trip	33.2	24.4	SP/hour/person
Other Trip	16.6	12.2	SP/hour/person
Trip Composition (based on passenger mode selection survey)			
Business Trip	8.3	8.0	%
Other Trip	91.7	92.0	%
Average TTUV (1998)	18.0	13.2	SP/hour/person
Adjustment to 2000	1.067	1.067	*1
Average TTUV (2000)	19.2	14.1	SP/hour/person
Car Owning Rate	8	92	%
Ave. TTUV adjusted by Car Owning Rate		14.5	SP/hour/person

Note *1: Average increase rate of 2 years during 1989 and 1998

Table 15.1.8 Travel Time Unit Cost (years 2000, 2005, 2010, 2015, 2020)

Item/Year	Unit	2000	2005	2010	2015	2020
GDP (2000) /Capita	SP/year/psn	48,191	57,318	67,309	77,152	87,744
Index to 2000 in GDP/Capita		1.00	1.19	1.40	1.60	1.82
Travel Time Unit Cost	SP/hour/psn	14.5	17.2	20.2	23.2	26.4

(2) Freight

Weighted average value of 32 commoditiy items are calculated from using the 1999 Statistic Abstract data. Time cost of freight is defined as capital opportunity cost of the

freight. Time costs of these commodities are summarized in Table 15.1.9. In the Table, 12% p.a. is assumed as a capital opportunity cost.

Table 15.1.9 Freight Time Unit Costs

Item	Yearly Time Cost (MSP/ton/yr)	Hourly Time Cost (SP/ton/hr)	Note
1-crude oil	0.00384	0.43829	
2-petroleum products	0.00384	0.43829	
3-natural gas	0.00868	0.99139	
4-cement	0.00344	0.39228	
5-construction materials	0.00769	0.87818	
6-phosphate	0.00095	0.10846	
7-iron	0.00590	0.67340	
8-coal and coke	0.00095	0.10846	In conformity to phosphate
9-other minerals	0.00095	0.10846	In conformity to phosphate
10-wheat	0.00867	0.98996	
11-cereals	0.00961	1.09728	
12.1-Vegetables	0.00633	0.72291	
12.2-Fruit	0.04421	5.04658	
13-Suger Beet	0.00123	0.14037	10% of Sugar
14-Rice	0.01377	1.57193	
15-Cotton	0.03627	4.14064	
16-Livestock	0.07642	8.72418	
17-Animal Products	0.14398	16.43593	
18-Agriculture Products	0.06365	7.26608	
19-Suger	0.01230	1.40374	
20-Food Oil	0.02807	3.20435	
21-Animal Fodders	0.01237	1.41234	
22-Beverages	0.01872	2.13663	
23-Other Food Products	0.00356	0.40671	
24-Chemical Products	0.04112	4.69439	
25-metal products	0.03419	3.90282	
26-textiles and clothes	0.09583	10.93954	
27-fertilizer	0.00767	0.87550	
28-paper	0.02235	2.55110	
30-manufactured commodities	0.22051	25.17220	
31-mixed commodities	0.02419	2.76144	Including house use commodities
32-cork and wood	0.01496	1.70826	

Note: MSP= Million SP in 1995 prices adjusted changing rate at the time

15.1.5 Investments

Improvement costs are discussed in Chapters 9 through 11, and budget allocation in conformity to each plan is discussed in Chapter 14. The investments schedule and residual values based on these discussions are summarized/calculated in Table 15.1.10.

Table 15.1.10 Investments Schedule and Residual Value Calculation in 2020 (MSP) Investment

Year	Land	Buildings	Machinery	Comm-unication	Cables	Signals	Roadbed	Rails	Engineering	Total
2001	505	1,100	30	206	220	391	2,597	1,179	286	6,514
2002	709	3,200	630	207	221	392	3,860	2,753	563	12,535
2003	608	2,700	430	207	221	392	4,141	3,423	576	12,698
2004	423	2,200	490	207	221	392	3,591	3,587	534	11,645
2005	240	1,600	270	209	225	396	2,783	3,186	433	9,342
2006	303	0	0	212	221	427	3,832	2,299	350	7,644
2007	228	150	0	212	221	427	4,283	3,632	446	9,599
2008	138	1,200	150	212	221	427	4,198	4,131	527	11,204
2009	35	800	50	212	221	427	2,494	4,032	412	8,683
2010	0	0	0	215	222	431	243	4,179	265	5,555
2011	59	0	0	112	44	123	284	710	64	1,396
2012	51	500	0	112	44	123	277	989	102	2,198
2013	38	2,000	400	113	44	123	246	1,026	198	4,188
2014	35	1,500	200	113	44	124	237	897	156	3,306
2015	0	0	0	115	47	125	169	1,019	74	1,549
2016	44	0	0	95	9	98	79	312	30	667
2017	80	0	0	95	9	98	224	352	39	897
2018	4	0	0	95	9	98	463	547	61	1,277
2019	4	0	0	95	9	98	413	682	65	1,366
2020	0	0	0	96	9	100	42	773	51	1,071
Total	3,504	16,950	2,650	3,140	2,482	5,212	34,456	39,708	5,230	113,332

Residual Value Calculation

Life	infinitive	100	40	12	30	20	100	100	In prop.	
Year	Land	Buildings	Machinery	Comm-unication	Cables	Signals	Roadbed	Rails	Engineering	Total
2001	505	565	6	1	24	14	1,334	606	132	3,186
2002	709	1,702	130	1	27	17	2,053	1,464	270	6,374
2003	608	1,488	97	1	30	20	2,281	1,886	288	6,699
2004	423	1,255	121	2	34	24	2,049	2,047	278	6,233
2005	240	946	72	3	39	29	1,645	1,883	235	5,091
2006	303	0	0	4	43	37	2,345	1,407	198	4,336
2007	228	95	0	5	48	44	2,715	2,302	263	5,700
2008	138	788	52	6	54	52	2,756	2,712	323	6,882
2009	35	544	19	9	61	62	1,696	2,742	263	5,430
2010	0	0	0	12	69	75	171	2,943	176	3,445
2011	59	0	0	8	15	25	207	518	44	877
2012	51	378	0	11	17	30	209	747	74	1,517
2013	38	1,565	217	15	19	36	192	803	149	3,033
2014	35	1,215	118	20	22	43	192	727	122	2,494
2015	0	0	0	27	26	52	142	855	60	1,162
2016	44	0	0	30	6	49	69	271	25	493
2017	80	0	0	40	6	58	202	317	34	737
2018	4	0	0	53	7	69	432	510	56	1,131
2019	4	0	0	71	8	82	399	658	62	1,285
2020	0	0	0	96	9	100	42	773	51	1,071
Total	3,504	10,540	832	411	566	917	21,131	26,171	3,103	67,175

GESR enjoys 100% return of taxes from the Government. Unemployment rate is low in labor force because the Syrian economy is based on the Social Economy. Because of these reasons the Study Team does not apply financial to economic cost conversion.

15.1.6 Administration and Operation Costs

Major portion of Administration and Operation Costs (AOC) is personnel costs excluding crew costs. Crew costs, rolling stocks (investments and maintenance) and fuel/lubricant costs are not counted in AOC because they are counted in ROC. Personnel costs are calculated by the formula; Personnel cost in MSP = number of personnel x 84,500 / 1,000,000.

Due to restructuring efforts of GESR in the first half of the planning period expected in the Master Plan, the Master Plan shows smaller AOC than the Do Nothing case in the first half, but it shows increase of AOC in the second half of the Planning Period due to expansion of business scale. Another item of AOC is maintenance costs of tracks and communication lines, which is a function of operation activities. The formula; Maintenance costs of tracks and communication lines in MSP = passenger-ton km / year x 0.096 / 1,000,000, is applied for the estimates.

For the EIRR calculation the difference of AOC between the Master Plan and the Do Nothing Case is needed. This difference is calculated and tabulated in Table 15.1.11.

Table 15.1.11 Difference of Administration and Operation Costs between Master Plan and Do Nothing Cases

Year	Difference in No. of Employees (exc. Crew)	Difference in Salary (MSP/year)	Other Operating Exp. (MSP/year)	Difference in AOC (MSP/year)
2000	0	0	0	0
2001	-187	-16	0	-15
2002	-373	-32	1	-31
2003	-560	-47	1	-46
2004	-746	-63	2	-62
2005	-933	-79	2	-77
2006	-830	-70	2	-68
2007	-728	-61	3	-59
2008	-625	-53	3	-50
2009	-523	-44	4	-41
2010	-420	-35	4	-31
2011	-234	-20	5	-15
2012	-49	-4	6	2
2013	137	12	7	18
2014	322	27	8	35
2015	508	43	9	52
2016	742	63	10	73
2017	977	83	11	94
2018	1,211	102	13	115
2019	1,446	122	14	136
2020	1,680	142	15	157

15.1.7 Benefit

Benefit results from the difference in ROC, VOC and TTC of the present network and those of the proposed network when the same OD volume is assigned. Benefits of the Master Plan are calculated for each five (5) year period as shown in Table 15.1.12. Because the total demand is the same in the same year, when the rail improvement causes increase in passengers/freight transported by rail, consequently road transport loses the same amount of demand. This means that the rail improvement increases ROC subject to km and decreases VOC subject to km. If the unit costs of rail transport is more expensive than the unit costs of road transports, total cost of transport becomes larger, and vice versa.

Regarding ROC subject to hr, it has the same structure as mentioned above, but it is compensated by the improvement in travel speed.

Table 15.1.12 Benefits of Years 2005, 2010, 2015 and 2020 (unit: SP/year)

Item	Master Plan Network	Do Nothing Network	Do Nothing-Master Plan
2005			
VOC sum	54,165,106,568	56,948,153,764	2,783,047,196
VOC km	43,928,626,923	43,986,557,828	57,930,905
VOC hour	10,236,479,645	12,961,595,936	2,725,116,291
ROC sum	2,192,429,858	1,724,918,203	-467,511,655
ROC km	1,356,036,354	947,362,603	-408,673,751
ROC hour	836,393,504	777,555,601	-58,837,903
TTC	6,014,040,985	6,858,797,486	844,756,501
TTC Passenger	3,450,936,023	3,435,003,921	-15,932,102
TTC Freight	2,563,104,962	3,423,793,565	860,688,603
Total Benefits	62,371,577,411	65,531,869,453	3,160,292,042
2010			
VOC sum	76,580,527,177	86,858,331,850	10,277,804,673
VOC km	61,654,290,103	63,068,002,342	1,413,712,239
VOC hour	14,926,237,074	23,790,329,508	8,864,092,434
ROC sum	3,197,781,394	2,354,511,429	-843,269,965
ROC km	2,052,942,140	1,318,346,521	-734,595,618
ROC hour	1,144,839,254	1,036,164,907	-108,674,347
TTC	6,875,468,162	10,257,633,744	3,382,165,583
TTC Passenger	4,973,957,150	4,986,481,673	12,524,523
TTC Freight	1,901,511,012	5,271,152,072	3,369,641,060
Total Benefits	86,653,776,733	99,470,477,023	12,816,700,291
2015			
VOC sum	113,225,513,250	138,105,287,187	24,879,773,937
VOC km	90,433,484,039	94,447,582,830	4,014,098,791
VOC hour	22,792,029,211	43,657,704,357	20,865,675,146
ROC sum	5,155,996,935	3,245,709,040	-1,910,287,896
ROC km	3,397,193,563	1,856,821,782	-1,540,371,781
ROC hour	1,758,803,372	1,388,887,258	-369,916,114
TTC	9,987,496,022	15,699,060,058	5,711,564,036
TTC Passenger	7,327,103,802	7,380,471,074	53,367,273
TTC Freight	2,660,392,221	8,318,588,984	5,658,196,763
Total Benefits	128,369,006,207	157,050,056,285	28,681,050,077
2020			
VOC sum	168,097,373,013	216,419,822,203	48,322,449,190
VOC km	133,422,006,514	142,394,408,916	8,972,402,402
VOC hour	34,675,366,499	74,025,413,287	39,350,046,788
ROC sum	7,775,933,466	4,649,425,736	-3,126,507,729
ROC km	5,265,277,105	2,695,129,436	-2,570,147,668
ROC hour	2,510,656,361	1,954,296,300	-556,360,061
TTC	15,212,200,880	24,193,043,007	8,980,842,127
TTC Passenger	10,983,684,233	11,125,126,805	141,442,572
TTC Freight	4,228,516,648	13,067,916,202	8,839,399,555
Total Benefits	191,085,507,359	245,262,290,947	54,176,783,588

15.1.8 Economic Analysis

(1) Master Plan Case

Economic IRR was calculated based on the abovementioned conditions. Results, which are shown in Table 15.1.13, were EIRR; 16.9%, NPV; 28,461 MSP and B/C; 1.43 under 12% discount rate.

Budget allocation is extremely front-loaded. Needless to say, this causes low IRR. In spite of that the plan shows a good figure of 16.9%. This means that the selected projects have high productivity.

Table 15.1.13 Economic IRR, NPV, B/C of Master Plan (unit: MSP)

Year	Initial Invest.	Diff. of Maint. C.	Costs Total	Benefit	B-C	Discounted Values		
						Cost	Benefit	B-C
2001	6,514	-15	6,499	632	-5,867	6,499	632	-5,867
2002	12,535	-31	12,504	1,264	-11,240	11,165	1,129	-10,036
2003	12,698	-46	12,652	1,896	-10,755	10,086	1,512	-8,574
2004	11,645	-62	11,584	2,528	-9,056	8,245	1,800	-6,446
2005	9,342	-77	9,266	3,160	-6,105	5,888	2,008	-3,880
2006	7,644	-68	7,576	5,092	-2,484	4,299	2,889	-1,410
2007	9,599	-59	9,541	7,023	-2,518	4,834	3,558	-1,276
2008	11,204	-50	11,154	8,954	-2,200	5,046	4,050	-995
2009	8,683	-41	8,642	10,885	2,243	3,490	4,396	906
2010	5,555	-31	5,523	12,817	7,294	1,992	4,622	2,630
2011	1,396	-15	1,381	15,990	14,609	445	5,148	4,704
2012	2,198	2	2,200	19,162	16,962	632	5,509	4,876
2013	4,188	18	4,206	22,335	18,129	1,080	5,733	4,653
2014	3,306	35	3,341	25,508	22,167	766	5,846	5,080
2015	1,549	52	1,601	28,681	27,081	328	5,869	5,541
2016	667	73	740	33,780	33,041	135	6,172	6,036
2017	897	94	991	38,879	37,888	162	6,342	6,180
2018	1,277	115	1,392	43,978	42,587	203	6,405	6,203
2019	1,366	136	1,502	49,078	47,576	195	6,382	6,187
2020	1,071	157	1,228	54,177	52,949	143	6,290	6,148
R.V.	67,175			67,175	67,175	0	7,800	7,800
Total						65,630	94,091	28,461
IRR:	16.9%	B/C:	1.43	NPV:	28,461	MSP under Discount Rate		12%

Note: R.V.= Residual Value

(2) Sensitivity Analysis

Sensitivity analysis shows that the 12% of EIRR is assured up to the conditions were benefits are reduced to 0.3 times of the standard case or costs increase to 1.4 times of the standard case. The results are shown in Table 15.1.14.

Table 15.1.14 Sensitivity Analysis Results

Benefit / Cost	1	0.95	0.9	0.8	0.7
1	16.9	16.1	15.4	13.7	11.9
1.05	16.2	15.4	14.7	13.1	11.3
1.1	15.5	14.8	14.0	12.4	10.7
1.2	14.3	13.6	12.8	11.3	9.6
1.3	13.2	12.5	11.8	10.3	8.6
1.4	12.2	11.5	10.8	9.4	7.7

15.2 Financial Analysis

15.2.1 Objectives and Method of Analysis

The purpose of financial analysis is to verify how much the project is profitable and can contribute to improvement of financial standings of the enterprise. As index for the analysis, Financial Internal Rate of Return (FIRR) is used. FIRR is calculated by following formula from the cash flow consisting of revenue, operating cost and investment.

$$0 = \sum_{t=1}^{n} \frac{CashFlow_t}{(1+FIRR)^{t-1}}$$

In the above equation,

n = Time Period of Analysis

$CashFlow_t$ = Cash Flow of Each Year

Cash Flow = Operating Profit + Depreciation – Investment

(Salvage value to be added as negative investment in the last year of the project life)

15.2.2 Main Prerequisites

In principle the same prerequisites are applied as in economic analysis with some exceptions.

(1) Period of the Analysis (Project Life)

The evaluation of the project is made for 40 years from 2001 (the starting year of the construction work) until 2040 (20 years after the completion of the Master Plan).

(2) Demand Forecast

The traffic demand is assumed to keep the same level in and after 2020, the final year for which the forecast is conducted.

(3) Inflation

Inflation is disregarded in the analysis. It is difficult to estimate future inflation rate and price hike is assumed to be neutral to the analysis because it makes same effects on both revenue and expense.

(4) Revenue

1) Fare Revenue

Fare revenue is calculated by multiplying unit fare price by the transport volume increased by implementation of the Master Plan.

Unit fare prices per kilometer are as follows.
Freight: Syrian Pounds 0.8869 / ton
Passenger: Syrian Pounds 0.1755 / person

2) Miscellaneous Revenue

Miscellaneous revenue is mainly sales of shops and restaurants in stations. In this analysis it is assumed to be 3% of the fare revenue taking the past records of GESR into consideration.

(5) Investment Cost

In financial analysis investment cost is indicated in market price.

(6) Depreciation

GESR's rule provides that depreciation of fixed assets should be made by straight-line method and yearly depreciation (percentage on purchase price) is established for various kinds of equipment.

However, the equipment is usually used during its physical durable years as far as it can be operated economically. In this analysis, it is assumed that the assets are used to twice as long as its legal or financial durable years taking the present situuation of GESR and the examples of JR into consideration. In this case depreciation is continued after the amount of the purchase price is fully accumulated, but the rate of depreciation per year is reduced to half accoding to the rule established by Syrian Ministry of Finance.

Facilities for signal and telecommunication to be introduced in this project are mostly of new type making use of the latest technology. Therefore referring to JR's rule in Japan, appropriate rates of depreciation and durable years are set and it is assumed that the replacement is made at the end of the financial durable years. Table 15.2.1 shows the rates of yearly depreciation and the physical durable years.

Table 15.2.1 Rates of Depreciation and Durable Years of Fixed Assets

Item	Rates of Depreciation per Year		Physical Durable Years
	Up to 100% of Purchase Price	Over 100% of Purchase Price	
Buildings & Structures	2%	1%	100 years
Machinery & Equipment	5%	2.5%	40 years
Rolling Stock			
Locomotives & Diesel Cars	7%	3.5%	28 years
Coaches, Wagons & Tankers	4%	2%	50 years
Signals & Telecommunications			
Computors & Electric Equipment	8.33%		12 years
Signals & Warnings for Crossing ets.	5%		20 years
Cables	3.33%		30 years

(7) Fund Raising

1) Financing in Foreign Currency

Foreign currency portion of the initial investment cost of the project will be financed by foreign currency loan from international or overseas financial institution with the most favorable terms and conditions applicable to Syria. Following two types of loans are assumed in the analysis. It has been confirmed by the lending institutuions concerned that the following terms and conditions are applicable to Syria.

① Loan Condition 1

Interest: 2.2% p.a.

Grace: 10 years

Repayment: 30 years semiannual equal installment

② Loan Condition 2

Interest: 0.75% p.a.

Grace: 10 years

Repayment: 35 years from 11th to 20th year: 2.5% of total loan amount

from 21st to 35th year: 5% of total loan amount

2) Financing in Local Currency

The balance of the investment cost is covered by funds in local currency. It is assumed that Syrian Government will pay the total amount of local funds as equity. Funds from

the Government on national budget are called loans from Public Debt Funds. According to GESR, however, the funds are actually supplied with no interest and without repayment schedule and are to be transferred to capital account after the completion of the project.

15.2.3 The Results of the Analysis

Based upon the above prerequisites, the results of the analysis for the base case are shown in Appendix 15.2.4~7. Appendix 15.2.1~3 show the investment cost for each year during the project life including the reinvestment after the useful life.

(1) Financial Internal Rate of Return (FIRR)

There are two kinds of FIRR, i.e. Return on Investment (ROI) and Return on Equity (ROE). ROI is the rate of return on total investment and indicates the profitability of the project. It is not influenced by terms and conditions of loan. On the other hand, FIRR (ROE) is the rate of return on equity and is calculated from the cash flow for ROI plus borrowing of the loan less repayment and interest payment. If weighted average interest rate of total funds is less than ROI, the project is considered to be feasible and ROE will be higher than ROI.

In addition to the base case the sensitivity analysis is made for the following five cases. In sensitivity analysis, the project is verified whether it is bearable to unfavorable fluctuation of uncertain and variable data, for example investment cost and revenue etc.

Case 1 5% Increase of Total Investment Cost
Case 2 10% Increase of Total Investment Cost
Case 3 5% Decrease of Total Revenue
Case 4 10% Decrease of Total Revenue
Case 5 10% Increase of Total Investment Cost and 10% Decrease of Total Revenue at the same time

Main indices of the analysis including FIRR are shown in Table 15.2.2.

Table 15.2.2 Main Indices of Financial Analysis

(Unit: Million Syrian Pounds)

Case	Loan Condition	ROI	ROE	Local Funds	
				Peak(2003)	Cumulative
Base Case	1	2.0%	2.0%	7,148	56,153
	2		4.2%	6,903	47,101
Investment 5% up	1	1.8%	1.5%	7,530	60,580
	2		3.7%	7,274	49,964
Investment 10% up	1	1.5%	1.1%	7,913	65,209
	2		3.3%	7,644	52,828
Revenue 5% down	1	1.7%	1.4%	7,181	58,356
	2		3.5%	6,937	47,769
Revenue 10% down	1	1.3%	0.7%	7,215	60,988
	2		2.9%	6,970	48,437
Investment 10% up Revenue 10% down	1	0.9%	-0.1%	7,980	75,430
	2		2.0%	7,711	54,464

FIRR (ROI) of this project for the base case is 2.0%. It cannot be denied that this figure is not on sufficiently high level, but if the loan with favorable condition (Loan Condition 1 or 2) is available and the local portion of the project is financed by Syrian Government with no interest the project is feasible. The results of the sensitivity analysis show that decrease of revenue gives bigger impact on the project than increase of investment cost. The project is feasible even in the worst case for Loan Condition 2 (increase of investment cost is 10% and decrease of revenue is also 10%) and unfeasible in case of Loan Condition 1. The results of the sensitivity analysis show that even small change for the worse of the prerequisites will decrease the feasiblety of the Master Plan. In this connection cost overrun must be carefully controlled and much effort must be made for increasing demand.

(2) Indices for Management Analysis

The following four indices for management analysis are shown in Appendix 15.2.4 and 15.2.6.

Rate of Return on Equity

Rate of Return on Operating Revenue

Transport Revenue on Employee

Passenger/Ton Km per Employee

Table 15.2.3 shows the forecast of the transport volume per personnel compared with the records in 1999 of the countries in which the railway has performed important role. By implementing the Master Plan, productivity of GESR is expected to improve to the international standard level.

Table 15.2.3 Passenger/Ton･Km per Employee

(Unit: '000 Ton･Km)

Year	1999	2005	2010	2015	2020
GESR	164	314	495	790	1,143
Korea	1,281				
Japan	1,428				
Russia	1,790				
Canada(CN)	3,715				
Canada(CP)	4,970				
South Africa	1,005				
France	566				
Sweden	980				

(3) Profitability

Table 15.2.4 shows the years in which the profit and loss accounts of the Project turn from deficit into surplus. It must be noted that the low interest rate of loans in foreign currency has contributed to relatively early change into profit.

Table 15.2.4 The Years Turning from Deficit into Surplus

(Unit: Million Syrian Pounds)

Case	Loan Condition	Year Turning into Profit	
		Yearly	Cumulative
Base Case	1	2018	2029
	2	2016	2021
Investment 5% up	1	2019	2031
	2	2016	2022
Investment 10% up	1	2019	2033
	2	2016	2024
Revenue 5% down	1	2019	2032
	2	2016	2023
Revenue 10% down	1	2020	2035
	2	2017	2026
Investment 10% up Revenue 10% down	1	2025	2040
	2	2019	2031

(4) Cash Flow

In the assumption of the financial analysis, it is expected that the foreign currency portion of the initial investment equivalent to 104,915 million Syrian Pounds will be covered by loans from overseas or international financial institution for economic cooperation and

local currency portion will be supplied by Government budget. Necessary amount of local currency funds are 56,153 (in case of loan condition 1) or 47,101 (loan condition 2) million SP respectively according to the difference of interest rate and repayment schedule.

The total of GESR budget from 2001 to 2020 amounts to 169,269 million SP (2000 constant price, the estimate by the Study Team Chapter 6, Table 6.3.3) which enough cover the amount of investment including both foreign and local currency funds required during the master plan period. Looking into details, however, annual amount of budget is not always sufficient for the investment cost of the year especially at the beginning stage of construction. Therefore to avoid the temporary shortage of funds it is important to pay attention to the following two points.

1. To take up the urgent and efficient projects preferably and to put off others as soon as possible taking the priority of investment into consideration
2. To look for the loan with as favorable condition as possible

(5) Evaluation and Recommendation

The Master Plan on the Development of Syrian Railway is feasible if forign currency loan with favorable condition is available and the local portion not covered by forign loan is supported by government, but the level of FIRR is not high enough. Therefore it is important to take care of control of the investment cost and to attract passengers and cargo increasing fare revenue as much as possible. It is also necessary to look for loans with as favorable terms and conditions as possible. The terms and conditions of loan presented in 15.2.2. (7) are applicable to any country in the same developing stage as Syria. It has been confirmed by the lending institutions concerned.

Chapter 16

Improvement Plan of GEHR

Chapter 16 Improvement Plan of GEHR

16.1 Future Role of Hidjaz Railways

GEHR has proposed for the Hidjaz Railways the following four roles; (1) Long-haul to Amman, (2) Tourism promotion, (3) Transport means to the Damascus Airport and (4) Transport service inside Damascus City. Two of these; long haul to Amman and tourism promotion to Surghaya are presently in operation (refer to Table 16.1.1) while the other two are under study or design.

Table 16.1.1 Annual Passengers of Hidjaz Railways

Year	Passengers (Damascus – Daraa)	Passengers (Damascus – Surghaya)	Passengers (Damascus - Qatana)	Total Passengers
1990	111,204	124,252	0	235,456
1991	95,405	67,949	0	163,354
1992	23,838	0	0	23,838
1993	10,169	453	0	10,622
1994	3,276	13,266	0	16,542
1995	8,283	54,647	0	62,930
1996	4,835	61,360	12,727	78,922
1997	1,853	29,948	4,005	35,806
1998	3,423	96,286	10,845	110,554
1999	9,895	74,044	7,930	91,869

Each of the four roles is considered separately hereafter.

(1) Long-haul to Amman

Presently GEHR operates two trains a week to Amman in cooperation with the Jordanian Hidjaz Railways. The GEHR train travels from Damascus to Daraa and waits there for the respective train arriving from Amman. At Daraa the locomotives are exchanged and the GEHR locomotive pulls the cars coming from Amman back to Damascus, with the Jordanian locomotive returning to Amman with the cars originating in Damascus. In this sense the operation of the Damascus – Amman line is implemented by both the countries at the same time.

As indicated in Table 16.1.1, the number of passengers between Damascus and Daraa has in the last ten years fallen by one tenth that of 1990. From Damascus most of the passengers are Jordanians going back to Amman. This has been verified by the following

two surveys implemented in Damascus (no similar survey was implemented on the Daraa side for Daraa – Damascus passengers):

- On July 27th, 2000: Total 22 passengers were on board. Breakdown of the passengers was 2 Syrians to Daraa, and 1 German, 1 Japanese and 18 Jordanians to Amman.
- On July 31st, 2000: Total 19 passengers were on board. Breakdown of the passengers was 4 Syrians to Daraa, and 1 Chinese and 14 Jordanians to Amman.

Rehabilitation on the Jordanian side of the Hidjaz Railways is being implemented but at a slow pace. GEHR, in collaboration with Jordan Railways, is planning to convert the meter-gauged line to standard gauged line between Damascus ~ Jordan border to be connected to Jordan's standard gauged line (to be converted from meter gauge). In addition, the construction of tracks of standard gauge is on going on the Syrian side by GESR. New investments to the said long-haul business must be examined from economic and financial view point. However the importance of this route for linking two Arab countries should not be overlooked.

(2) Tourism Promotion

The major purpose of the train trips to Surghaya is for having picnics outdoors, especially during the Summer Season. The year 1990 showed a large amount of passengers compared to the other years. This is one year before Law No. 10, which encouraged investments, was promulgated. Up to that year the Hidjaz Railways could attract passengers and had an advantage over the private tourism sector, which was hampered due to the prohibition of import of modern buses. An additional blow was dealt by the drainage work in the Dummar area, which caused the Hidjaz Railways operation in the Dummar-Surghaya section to be suspended.

The company decided to sell some of the old cars and rehabilitate the remaining cars using the money from the sales of the old cars. This decision had a negative effect on the Damascus - Surghaya operation bringing the number of passengers down significantly as observed in the Table 16.1.1.

As an example of the recent operation, during 22~28 of July of 2000, the Hidjaz Railways operated seven trains. Breakdown of the operation is shown in Table 16.1.2.

Table 16.1.2 Breakdown of Damascus-Surghaya Operation

(July 22～28, 2000)

Date	Passenger Numbers	Sales (SP)
July 22	83	1,425
July 23	238	5,267
July 24	148	2,545
July 25	357	6,661
July 26	117	2,585
July 27	103	1,810
July 28	405	8,860

Source: Hidjaz Railways

Surveys on July 28 and 30 in 2000 show that most of the passengers were Syrian; on the 28th there were 400 Syrians and 2 Arab families, and on the 30th there were 300 Syrians and 6 Syrian families living outside the country. This figures show that Surgaya area is a local tourism spot.

Demand on the Surgahya line is forecast under the condition that the rate of mobilization of Damascus Citizens to the line is the same rate recorded in 1990.

This mobilization rate in 1990 was 0.08665; which denotes the 124,252 persons of the Surghaya line passengers over 1,434,000 persons, which was the population of Damascus at that time. Using this rate and the population forecast in the Master Plan Study of the Urban Transport in the Damascus City reported by JICA in 1999, the demand on the Surgahya line was forecast annually up to the year 2020, as shown in Table 16.1.3. It is expected that this line may play an important role in domestic tourism because of the scenic area it serves in and the poor road conditions there.

Table 16.1.3 Demands of the Surghaya Line Passengers

Year	Damascus Citizens	Surghaya Line Passengers
2000	1,456,630	126,217
2001	1,481,684	128,388
2002	1,507,169	130,596
2003	1,533,092	132,842
2004	1,559,461	135,127
2005	1,586,284	137,452
2006	1,613,568	139,816
2007	1,641,321	142,220
2008	1,669,552	144,667
2009	1,698,268	147,155
2010	1,727,478	149,686
2011	1,757,191	152,261
2012	1,787,415	154,880
2013	1,818,159	157,543
2014	1,849,431	160,253
2015	1,881,241	163,010
2016	1,913,598	165,813
2017	1,946,512	168,665
2018	1,979,992	171,566
2019	2,014,048	174,517
2020	2,048,690	177,519

Source: Statistical Abstract & Hidjaz Railways

(3) Transport Mean to Damascus Airport

There are plural transport demand sources to the Damascus Airport Line; one is by the passengers using the airport, the second by the employees working in the Airport, and the third by possible commuters to Damascus city along the line.

The annual numbers of passengers from 1989 to 1998 for domestic and international flights are shown in Table 16.1.4. Average rates of increase are international departures at 3.3% p.a. (1989 - 1997), international arrivals 1.1% p.a. (1989 - 1997), domestic flight departures/arrivals 6.2%, and overall average rate of annual increase is 3.1%.

Table 16.1.4. Average Rates of Increase

Year	International Flights		Domestic Flights	Total
	Departures	Arrivals		
1989	218,990	311,307	150,985	681,282
1990	228,158	317,226	182,998	728,382
1991	228,594	206,326	94,318	529,238
1992	226,557	263,366	115,511	605,434
1993	249,731	259,702	184,215	693,648
1994	283,473	237,333	231,757	752,563
1995	259,780	271,264	225,310	756,354
1996	289,912	324,881	231,907	846,700
1997	254,448	354,628	239,579	848,655
1998	292,661	343,345	259,173	895,179
Rate of Annual Increase				
1989-1998	1.033	1.011	1.062	1.031

Using the increase rate of 3.1% p.a. the future air passengers numbers were estimated and are shown in Table 16.1.5. From this table around 60 - 70 flights are expected daily in 2020. One example of an airport access MRT in China is as follows; 25 km distance, 15 stops including both ends and 123 flights a day transporting 2034 MRT passengers on daily average. It is difficult to estimate accurate figure of number of passengers expected for Damascus airport railway line but we can estimate it at about less than 2000 passengers/day after the year 2020.

Table 16.1.5 Future Air Passengers at Damascus Airport

Year	Annual Passengers	Daily flight with 30 pax average	Daily flight with 40 pax average	Daily flight with 50 pax average
2000	912,926	42	37	25
2005	1,062,466	49	37	29
2010	1,236,500	57	43	34
2015	1,439,043	66	50	40
2020	1,674,762	77	58	46

The estimations in the table do not include the people traveling to the airport to receive or sent off the passengers and the staff of the airport as well as possible commuters to Damascus along the line. GEHR is planning to construct standard gauged airport line connecting Hedjaz Station, Kadam Station and the airport. JICA Study Team has been informed by GEHR that design between Hedjaz and Kadam has been partially started. The railway route to the airport should be studied in combination with the surface road network, but the demand along that route is expected to continue to grow.

(4) Transport Service inside Damascus City

Minibuses provide public transport services in Damascus City. The only competing rail base transport mode was the tramway which was taken out and it seems quite difficult to revive it again. However Damascus city is a very large populated area. Accordingly for effective urban transport, not only bus and automobile services, but also rail based guided transport system would surely be necessary in due time.

In this regard introduction of some appropriate guided transport system including railway system having exclusive right-of-way should be studied carefully within the framework of integrated urban transport system.

In case it is decided to introduce such a guided transport system, GEHR may be a candidate to operate that system. It should be noted that guided urban transport system is generally unfeasible from the viewpoint of financial viability, because amount of investment cost is very large, fare must be kept low for public use, and the demand fluctuates very sharply during a day causing uneconomically large number of vehicles to cope with the peak hours of the day. In this regard, in constructing and operating a guided transport system, appropriate financial support by the Government must be duly considered.

Further it should be added that Qatana line is located in a rather suitable position to serve suburban transport for Damascus city. In case Qatana line is upgraded for frequent and speedy services, and the planning for the development of Qatana city proceeds as scheduled in the existing land use plan, this line has a potential to contribute to suburban transport in Damascus city.

The Study on Urban Transportation Planning of Damascus City (JICA, 1998) has proposed four urban rail transport routes to be developed in the city involving use of existing lines and new line construction. Although the economic evaluation at that time found the four lines to produce a high benefit, the financial evaluation found that only line no. 4, serving Qatana new city is feasible under the condition that the population in that city increases as predicted in the land use plan.

Taking into consideration the argument described above on the need for rail based

transport system in large cities such as Damascus and the evaluation results of the JICA study, it is considered necessary to start the study of the innovation of the existing railway or construct guided transport system in the near future in Damascus in order to determine the role of urban rail service and guided transport system in the city and the role of GEHR in operating that service.

(5) Conclusion

The GEHR predicted role is summarized as follows:

- Damascus – Amman: Economic and financial feasibility of new investments to the said long-haul business must be carefully examined, however the importance of this route for linking two Arab countries should not be overlooked.

- Tourism Promotion: It is expected that the Surghaya line may play an important role in domestic tourism because of the scenic area it serves in and the poor road conditions there.

- Transport Mean to Damascus Airport: The standard gauged railway route to the airport should be studied in combination with the surface road network traffic conditions and the similar project proposed by GESR, but the demand along that route is expected to continue to grow.

- Transport Service inside Damascus City: The abolition of rail base tram lines and increase in bus numbers makes it difficult to revive the same tramway again. However the scale of Damascus city, the importance of urban rail or guided transports service, and the costs associated with introduction and operation of such a service makes it necessary to study this matter in a detailed way, in order to determine the role of urban rail service or new guided transport system in the City and the role of GEHR in operating that service.

16.2 Improvement Policy of GEHR

GEHR is now seriously planning to modernize its railway system through gauge conversion from the current meter gauge to the standard gauge, the same gauge as that of GESR.
Its major plans are as follows:

(1) Construction of Damascus Airport Line

The line is to be constructed by standard gauge. The construction will be implemented in two parts. The 1st part is the section between Hedjaz station and Kadam station. The 2nd part is the section between Kadam station and the Airport. This section will be constructed in pararell with GESR track or may use part of GESR track. According to GEHR, design of the section between Hedjaz and Kadam has partly started.

(2) Construction of standard gauged line between Kadam and Jordan Border

GEHR's study estimated about 1.47 billion SP for this project. According to GEHR, the survey for the project is started and related expenditures are being paid. The discussion with Jordan side is undergoing. Coordination with GESR will be carried out in due course.

The advantage of such conversion will be (1) to be able to combine GESR and GEHR as the same gauged unified railway network all over Syria, and (2) to promote intra-and inter-regional railway transport when connected with neighbouring Jordan or Lebanon's standard gauged (converted from the current meter gauge) railway lines in future.

However it should be noted that conversion to standard gauge from meter gauge requires considerable amount of investment.

In this regard, gauge conversion must be carefully examined from the view point of national economy and financial viability of railway enterprise.

Bearing in mind the above discussion, JICA Study Team has proposed the improvement plan of existing lines with minimum investment to ensure the operation safety in the section 16.3.
However, in view of advantages of gauge conversion to standard gauge, JICA Study Team also presented its views on modernization of GEHR through gauge conversion in the section 16.4.

16.3 Improvement plan of Existing Lines

16.3.1 Policy of the improvement plan of existing lines

Basic policy of the GEHR improvement plan is intended to ensure a safety operation of trains with the minimum investment based on the existing conditions of railway facilities and provisions.

As to track facilities, therefore, it is limited to make only the minimum rehabilitation.

Concerning traffic signals and telecommunication facilities, it is intended to upgrade the safety operational level by provision of new signal and telecommunication facilities at stations which have no signal and telecommunication facilities. In addition, warning installations are to be planned as a countermeasure at the level crossings where a traffic volume of vehicles is a lot for decreasing accidents and dissolving a slow-down of trains at the level crossings.

Regarding a rolling stock, nondestructive inspection devices for important accessories are to be prepared to prevent occurrence of such a critical accident, as axle breakage of diesel motor cars, spring breakage of passenger trains and so forth.

16.3.2 Track facilities

(1) Improvement of the track facilities and a construction plan of new line

The GEHR held a committee meeting on the following projects in compliance with the instructions of the Minister of Transportation, mapped out a framework of railway rehabilitation, discussed construction projects and decided order of priority of projects.

① Rehabilitation of the existing track

② Route alteration plan of the track between Al-Qadam and Al-Hidjaz (length: 4.2 km)

③ Construction plan of a new line from Damascus to Air Port

④ Possibility of the establishment for track routes of new tramway in Damascus.

The following are the outline of the discussed items and the order of priorities fixed by the GEHR

1) The first priority project

Rehabilitation of the track facilities in the Daraa line (length: 128 km) and the re-routing of line between Al-Qadam and Hidjaz stations are picked out as the first priority project.

As to the re-routing of line between the two stations mentioned above (about 4.2km), the re-routing of line is to be planned as a route partly altered through a tunnel reaching Al-Hidjaz station.

The re-routing of line is able to solve the problems of more than 20 railway level crossings between the Daraa & Qatana lines with the main & other roads.

The project is indicated to entail the deliberation in cooperation with the GESR.
(The plan should be established with due consideration of a future condition of the Surgaya line.)

2) The second priority project

Rehabilitation of the track facilities for the Surgaya line (length: 58 km)

3) The third priority project

Rehabilitation of the track facilities for the Qatana line (length: 24km) and the other lines such as the Bosra (length : 41km) and Muzeireeb (length : 26km) lines.

4) A new line construction plan for Air Port

Concerning the Air Port new line construction project, discussions are being made by officers concerned on kinds of a permanent way, a routing line, locations of stations and so on.

5) Examination on tram routing lines

Routes of line, connections with the existing stations, formulation of a network etc., are being discussed by officers concerned on possibility of the establishment of new

tramway lines.

(2) Principles for the improvement of track facilities

The GEHR thinks of the following method for structures of track, procurement of construction materials and the like.

Structure of track
- Rail : 30 kg/m
- Sleeper : two-block type concrete sleepers and PC sleepers
- Number of sleepers : 1,500 sleepers/km
- Track bed : ballast

Procurement of materials
- Rail : Old rails of the GESR will be bought and be utilized again.
- Sleeper : The GEHR stocks of sleepers are used first and deficient sleepers are purchased afresh.

Implementation of construction
- Construction is implemented and supervised directly by personnel of the GEHR.

(3) Investment amount for the improvement of track facilities

Table 16.3.1 shows a rough estimate of the investment amount necessary for the minimum rehabilitation of the railway (track).

Table 16.3.1 Rough Estimate of Investment Cost

(Unit: Million Syrian Pound)

Project		Line section	Length (km)	Cost			
				Rail accessories	Sleeper(*)	Ballast	Sum
1	Daraa line Rehabilitation	Al-Hidjaz to Daraa	128	343	182	64	589
2	Surgaya line Rehabilitation	Al-Hidjaz to Surgaya	58	155	83	29	267
3	Other Lines Rehabilitation	Bosra line, Muzeireeb line(**)	67	179	95	34	308
Total sum & Grand total				677	360	127	1,164

(*) Two block concrete sleepers have been assumed to be adopted.
(**) Qatana Line is equipped with PC sleepers. Accordingly, rehabilitation of Qatana line is excluded.

16.3.3 Signal and Telecommunication Facilities

(1) Basic Policy

Signal and telecommunication equipment is to be equiped mainly in the stations.

For less than 30 train operations a day, it is not necessary to have plural block sections between adjacent stations.

(2) Signal and telecommunication equipment

1) Signalling Equipments

The color light signals are to be equipped in all stations.

Home signals and starting sinals are to be equipped in every station.

In addition, electric interlocking devices is to be introduced for safety in every station.

Tokenless block system is to be adopted in all lines.

2) Telecommunication Cable and Devices

Telecommunication cables are to be installed in all lines.

Cable carrier terminal and telephone set are to be equiped in all stations.

3) Level Crossing Equipments

Level crossing protection devices are to be installed at the level crossing, after considering volume of road traffic, volume of railway traffic, and the distance of unobstructed view from the road.

Warning Devices with Automatic Barriers：13

Warning Devices only：31 (0.1 devices per 1km)

4) Train Detection Equipments

Axle counters are to be installed at the home signal in all stations to detect train going/coming between adjacent stations .

No train detection devices to be equiped within a station.

(3) Maintenance Standards

Signal and telecommunication facilities is to increase, so the maintenance standards is to be prepared,and maintenance staff is to be increased.

(4) Investment Cost

Investment cost is shown in the Table 16.3.2.

Table 16.3.2 Construction Cost for Safty and Improvement

Unit:million SP

Item		Surgaya		Daraa		Qatana & others		Sub Total
Number of Stations	Unit cost (per station)	9		13		15		
Tokenless Block System	0.35	9	3.2	13	4.6	15	5.3	13.1
Interlocking Device	0.46	9	4.2	13	6.0	15	6.9	17.1
Axle counter	0.09	18	1.6	26	2.3	30	2.7	6.6
Color Light Signal	0.44	36	15.8	52	22.9	60	26.4	65.1
Switch	0.05	22	1.1	66	3.3	43	2.2	6.6
Power Supply	0.43	9	3.9	13	5.6	15	6.5	16.0
Cables in the Station	0.43	9	3.9	13	5.6	15	6.5	16.0
Warning device for L.C.	1.96	6	11.8	14	27.4	11	21.6	60.8
Electric Barriers	0.65	6	3.9	7	4.6	0	0	8.5
Telecommunication Cable	0.3	59	17.7	131	39.3	93	27.9	84.9
Carrier Terminal	1.3	9	11.7	13	16.9	15	19.5	48.1
Telephone Set	0.65	9	5.9	13	8.5	15	9.8	24.2
Ground Total			84.7		147.0		135.3	367.0

[Remarks] L.C.:level crossing

16.3.4 Rolling stock

For protecting the axle shaft breaking, spring breaking, the non destructive test like the ultrasonic flaw detector and magnetic flaw detector should be introduced. It will contribute to safer operation of rolling stock for the passengers and also for improvement of reliance of GEHR.

Amounts of cost of investment for rolling stock are shown in Table 16.3.3.

Table 16.3.3 Amounts of cost of investment for rolling stock

(Unit : Million SP)

Test equipment name	Quantity	Price
Ultrasonic flaw detector	1	2
Magnetic flaw detector	1	3
Amounts		5

16.3.5 Total amount of investment cost

The GEHR improvement plan is expected to require roughly about 1,677 million Syrian Pound as a necessary cost for rehabilitation of the first and the second priority projects (refer to 16.3.2 (1)) as shown in Table 16.3.4.

In that total amount, the renewal of track facilities and the rehabilitation necessitate 1,367 million SP and 296 million SP for signaling & telecommunication facilities.
Inspection devices for important parts of rolling stocks cost 5 million SP approximately.

A rough-estimated amount necessary for the re-routing of line between Al-Qadam and Al-Hidjaz is predicted to be 584 million SP.

It is suggested that 1st & 2nd priority projects should be executed in the first place. After completion of rehabilitation of priority 1 & 2 projects, priority 3 (rehabilitation of Qatana, Bosra, Myzeireeb lines) should be promoted. These rehabilitation cost will be about 443 million SP. as shown in Table 16.3.4.

It is envisaged, however, that the GEHR should examine the re-routing of line between Al-Qadam and Al-Hidjaz in cooperation with the GESR because the GESR has a construction plan of a new line in the same section.

Table 16.3.4 Total Amount of the Investment Cost for 1st & 2nd Priority Projects

(Unit: Million Syrian Pound)

Project		Line section	Length	Cost			
				Track facilities	Signaling& telecom-mun ication facilities	Rolling stock test devices	Sum
1	Daraa line Rehabilitation	Al-Hidjaz to Daraa	128	589	147		736
	Qadam to Al-Hidjaz Route change	Qadam to Al-Hidjaz	4.2	520	64		584
2	Surgaya line Rehabilitation	Al-Hidjaz to Surgaya	58	267	85		352
3	Qatana line & others' Rehabilitation	Qatana line, Bosra line, Muzeireeb line	91	(308)	(135)		(443)
Test of important parts of rolling stocks		Non-destructive test devices				5	5
Total sum				1,376 (308)	296 (135)	5	1,677 (443)

(Remarks) 1. Respective-lengths are calculated based on the length of the GEHR plan.

2.The cost for re-routing of line between Qadam～Al-Hidjaz is estimated as the same amount as the GESR planned cost.

3.Excluded is the urban traffic line (the Air Port new line and the new tram line) from the objective projects.

4.The figures in ( ) indicate the investment for 3rd priority projects.

16.3.6 Management and Operations

(1) Organization and Staff

In the GEHR's staff composition, Railway Transport Sector accounts for about 50%, however, the revenue is less than 7%. In view of this fact, it is essential to carry out management with strict cost control.

A due consideration should be given to deteriorated facilities and rolling stock or to various factors for investments for safety measures.

(2) Prevention of Accidents

Most of the roads have crossed the railway at grade, and level crossing facilities are not in favorable conditions.

As safety precautions, the following measures are conceivable:

① Provision of protection devices for level crossing (barriers and warning signs).

② Provision of telecommunication facilities (radios and others) in case of emergency.

③ Legislation of laws or acts to prevent trespassers into the Railway's right-of- way. Drastic measures should be taken.

(3) Education and Training

The GEHR does not have any educational institutions; everything is dealt with by on-the-job training. In the future a fundamental education/training for safety should be thoroughly carried out considering the aforesaid condition of facilities.

Therefore, the common use of educational institutions in collaboration with GESR will be an effective measure.

16.4 Modernization of GEHR through Gauge Conversion (meter gauge to standard gauge)

As referred to in the section 16.2, GEHR is planning to modernize its railway system by converting the current meter- gauge lines to the standard gauged lines. GEHR is especially eager to construct the standard gauged airport line connecting Hedjaz Station, Kadam Station and international airport, and to convert the current meter – gauged Hedjaz ~ Jordan border line to the standard gauged line.

In the following, JICA Study Team will present its views on these plans and gauge conversion of the other lines.

(1) Airport Line Project

As mentioned in 16.1(3), the traffic demand should be, in the first place, examined carefully, taking into consideration the selection of the route, competing road network, and traffic from various sources (airport passengers, or workers in the airport, commuters to Damascus living along the line etc.). Then economic and financial viability of the project should be examined carefully together with suitable timing of construction. It should be mentioned that the Airport Line Project is not included in the projects taken up in the JICA Study of this time. It is because, while the JICA Study is a master plan study for intercity railways, the Airport Line is a suburban railway which requires entirely different methods of demand forecast.

(2) As for the Damascus – Daraa – Jordanian Border Line, the following should be studied:

1- Integration of the GESR Plan and the GEHR plan into a single national plan.

2- In the JICA Master Plan, the standard-gauge railway construction project of GESR between Damascus, Daraa, and the Jordanian border is not given top priority and therefore is not included in the urgent projects for the feasibility study of this time. In executing this project, it is necessary to sufficiently analyze its economic and financial feasibility based on the route selection, demand forecast, cost estimation, and so forth.

3- The section between Damascus and Daraa has a significance by itself from the standpoint of the railway network within Syria, because it connects Damascus and Daraa, the capital of Daraa Governorate. However, the construction of the section between Daraa and the Jordanian border will have its meaning, only when the construction of the Jordanian – side route is executed at the same timing.

(3) Regarding the standard – gauge introduction to lines other than the above two lines.

1- The Qatana Line will play a significant role as a Damascus suburban line when the population of Qatana increases in the future. Threfore, it is advisable to modernize this line by transforming its tracks into standard gauge, at the time when the line should be revitalized as a Damascus suburban line. Depending on the traffic demand, it can be a modernized double track lines electrified and equipped with automatic signaling system.

2- As for the Surygaya Line, it is advisable for the time being to continue tourist transport after ensuring safety in transport on meter – gauge track. When a large increase in transport demand is estimated in the future or when the needs for developing Susrygaya line into international railways connecting Damascus and Beirut are recognized, it is recommended to modernize it into a standard-gauge track railway system after confirming its economic and financial feasibility.

(4) When standard –gauge tracks are introduced to some GEHR lines, these lines should be integrated with the GESR network to create a single railway network in Syria. In this case, the following two methods are considered as the ways of operating GEHR lines where standard – gauge tracks have been introduced,

1- GEHR conducts assets administration, together with business administration and operation.

2- Infrastructure (track, signal and telecommunication facilities), rolling stock, and so forth are owned by GEHR as its asset. However, their maintenance is entrusted to GESR on contract basis. Then, GEHR conducts only the passenger train operation (excluding the section between Damascus and Aleppo) and real estate business.

(Freight transport is recommended to be entrusted to GESR on contract basis.)

GEHR has historical, cultural, and social significance. Therefore, in comparing which of the above two methods is most suitable for Syria, it should be evaluated not only from economic and technological view point, but also from historical, cultural and social view points.

(5) Concluding Remarks

As discussed in the Section 16.2, the gauge conversion to standard gauge has various advantages. Accordingly, when the investment to gauge conversion of GEHR can be justified from the economic and financial view point, modernization of GEHR through the gauge conversion can replace the rehabilitation of the existing meter-gauged lines. In studying the gauge conversion project, the above mentioned comments (1)～(4) should be duly taken into consideration.

Chapter 17

Natural Conditions and the Environment

Chapter 17 Natural Conditions and the Environment

17.1 Natural Conditions and Land Use

The natural conditions of Syria are described in the Statistical Abstract Book of 1999 published by the Central Bureau of Statistics and The National Environmental Action Plan (NEAP) draft report of the World Bank/UNDP published in June 1998. The findings of these reports are briefly summarized in this report. Chapter 1 of this Report describes these conditions. In this section the conditions along the GESR and GEHR routes shall be described.

17.1.1 Geographic and Topographical Features

The GESR routes have no difficulty in following the topographic terrain in which they pass, except for the Aleppo – Lattakia, Tartous – Al-Kabir and Aleppo – Midan Ekbas routes that are characterized by passing through mountainous terrain. The level at Aleppo is 400.00 meters above sea level and the route continues in the 300.00 to 400.00 meters level up to Jisr Elshogour. At Budama the level goes up to a height of 495.50 meters above sea level and then falls in a short distance rapidly to the height of 100.00 meters above sea level at Lattakia. Tartous – Al-Kabir and Aleppo – Midan Ekbas routes include many successive large gradients (more than 20‰) and sharp curves (R $\leqq$ 400 – 500 m).

GEHR routes are passing through mild terrain in the country's southeastern region. However the Daraa – Haifa route in the south along the Jordanian border passes through the steep Wadi Yarmouk and was constructed which much engineering skill just under 100 hundred years ago. At present the Daraa – Zeizoun section is only open, a distance of 25.1 km. Levels at Daraa and Zeizoun are 529.0 and 260.2 meters above sea level respectively, i.e. a sharp 10.7/1,000 slope.

17.1.2 Geological and Soil Conditions

GESR and GEHR routes pass through areas with *alluvial*, *grumusol* and *cinnamonis* soils. It is the country's policy to protect and expand upon agricultural activity and therefore any

negative impact on these agriculture activity-supporting soils by railway operation needs to be carefully considered.

17.1.3 Land Use

(1) Agriculture

The cultivable area in Syria is around 6 million hectares, or 32% of the total land area of the country. In addition there are 8.2 million hectares of steppe and pastureland. The country may be divided into five zones (Statistical Abstract, 1999) as shown in the Appendix Figure 17.1.1.

The zones may briefly be summarized as follows:

Zone	Ave. precipitation (mm/year)	Main crops
I	350 - 600	• Cultivable area 1,750 ha (65% of total zone) • Wheat, citrus and vegetables
II	250 – 350	• Cultivable area 1,840 ha (75% of total zone) • Wheat, barley and legumes
III	> 250	• Cultivable area 832 ha (64% of total zone) • Barley, possible pulses
IV	200 – 250	• Cultivable area 874 ha (48% of total zone) • Barley and grazing land
V	150	• Cultivable area 644 ha (6% of total zone) • Natural plant cover for livestock

Source: NEAP and Statistical Abstract, 1999

In terms of source of water used in agriculture, as shown in the following table rainfall remains the dominant source.

(Unit: % of total cultivated area)

Year	Rainfall	Surface water	Groundwater
1990	87%	7%	6%
1995	78%	9%	13%

Source: NEAP

In 1998 the main crop produced was wheat at 4,112 thousand tons, followed by vegetables (2,502 thousand tons), sugar beet (1,202 thousand tons), cotton (1,018 thousand tons) and

barley (869 thousand tons).

(2) Industry and Mining

Industrial activity in Syria is located along the Damascus – Aleppo axis and the coastal axis of Lattakia – Tartous. Mining activities, especially phosphate, is in the eastern desert in Homs and crude oil and natural gases are extracted from Hassaka and Deir el-Zor (refer to Appendix Figure 17.1.2).

Environmental problems related to the existing industries cover the whole sphere of emissions to water, air and solid waste disposal.

(3) Rivers and Conservation areas

The Statistical Abstract book lists 18 rivers in Syria, of which the longest is the Euphrates River, at 2,880 kilometers. The distant second is Orontes River at 485 kilometers. The various environmental reports available at the Ministry of Environment show that most of the rivers are heavily polluted, manly by industrial wastewater drainage and also agricultural activities. Some of the listed rivers are dry most of the year, such as parts of the Barada, Al Jagiagh and Al Khabour.

In addition 8 lakes are listed, the largest is Al-assad Lake behind the Assad dam. Many of the lakes are also suffering from pollution such as Qattineh Lake near Homs.

The protected areas shown in Appendix Figure 17.1.3 are based on the Ministry of Environment data of 1998. There are 34 locations, of which 28 are identified. The areas include natural and scenic sites, as well as historic sites. A more detailed map of the antiquities and archeological excavation sites has also been obtained from the ministry of culture.

(4) Land use in the GESR and GEHR facilities surroundings

(a) GESR

The land use surrounding the GESR routes can generally be described as shown in the

following Table 17.1.1.

Table 17.1.1 Land Use along GESR Routes

No.	Route/ Land use characteristics
1.	Damascus – Homs (200 km) The route passes through desert area up to a point north of Mhine, where it passes through pastures and agricultural lands as it enters into Homs. Industries are also located north of Damascus and at the entrance of Homs.
	Homs – Hama (56 km) The route continues north passing through agricultural lands up to Hama. Some villages are located along this line.
	Hama – Aleppo (139 km) The route continues north through agricultural land where cultivation is seasonal depending on rainfall. Villages are located along the way. The route passes through the urban fabric of Aleppo and four stations serve that city.
2.	Lattakia – Aleppo (205 km) From the port city of Latakkia in the west the route travels northeast towards Aleppo. Between Lattakia and Mhambel, south of Idlib the route passes through mountainous areas and forests. The topography changes north of Mhambel station into rolling plains with agricultural activities. This condition continues to Aleppo. Cities and villages are scattered along the route. Industries are found as the route enters Aleppo.
	Aleppo – Deir el-Zor (340 km) The route travels eastwards and the first city it meets is Raqqa. From Aleppo the land use is mainly pastureland but then develops into agriculture land dependent on the Euphrates river. The route continues through agriculture land traveling north of the river. Agricultural villages are found along it.
	Deir el-Zor – Qamishli (211 km) The route travels from Deir el-Zor northeast towards Qamishli passing through mainly flat cultivable lands irrigated by the Khabour River, but of less richness then the land along the Euphrates river. Villages are hardly found along the route except for the camps associated with the oil fields.
3.	Homs – Tartous (102 km) The route from Homs, westwards towards the coastal city of Tartous passes through agricultural lands up to the city of Tel Al Kalakh. From that point to Tartous the route mainly passes through forests and some agricultural lands.
	Tartous – Lattakia (88 km) From Tartous northwards to Lattakia the route moves near the coast passing through mixed land use of agriculture, residential and industries.
4.	Mhine – Al-Sharqia (111 km) The route travels eastwards to Al-Sharqia, mainly to serve the phosphate mines located near Al-Sharqia. The area is mainly desert with some rolling terrain and low mountains.

(b) GEHR

The GEHR network is confined to the south in the three governorates of Damascus, Daraa and Soueida. The longest route of the network, the Damascus – Daraa route is 126 kilometers. The route from the north begins in Hidjaz station, passes through the urban fabric (with about seventeen surface crossings) till it reaches Al-Qadam station.

From there on it passes south through uncultivable semi-desert land reaching the city of Shinshar. From Shinshar southwards to Al Mismieh city the land use surrounding the track is mainly pasture land with some seasonal cultivation. From Al Mismieh southwards to Daraa the land is predominantly agriculture in nature. Villages are scattered along the railway and highway route.

The two routes extending from Daraa, westbound to Zeizoun and eastbound to Bosra Al Sham pass through agriculture land for about 10-15 km each side of Daraa. Then the Zeizoun line passes along a river ravine through scenic areas. The eastbound Bosra Al Sham line continues through desert land till it reaches the tourist city of Bosra Al Sham.

17.2 Environment related Institutions and Legislation

17.2.1 Institutions

The Syrian Government was the first Arab country to establish a specific ministry for the environment in 1987, which indicates the country's concern for environmental issues. The highest authority in the Syrian government responsible for implementing environmental protection resides in the Supreme Council for Environmental Protection, which is chaired by the prime minister and has as its members many of the related ministers. The General Council for Environmental Affairs (GCEA) preforms technical duties and studies, and is separate from the ministry in terms of administrative structure but affiliated to it in terms of command structure. Nine inter-sectoral committees within the ministry implement technical support from other relevant government agencies and coordination between the ministry and these agencies.

On GESR and GEHR levels the internal organization structure of both calls for the attachment of a *department for internal protection and industrial safety* to the general director's office. The duties of this department include taking necessary measures to prevent environmental pollution of any type. However this department in reality does not deal with any environmental issues as identified by the survey of existing conditions.

17.2.2 Draft Environment Protection Law

Since 1995 there have been a number of drafts for an environmental protection law prepared

by GCEA and revised based on comments received from other governmental agencies. The Study team has copies of these drafts, the latest of which was prepared in 1999. In earlier drafts the requirement of an Environmental Impact Assessment (EIA) for certain projects was stipulated. These projects were to be determined by the Minister of Environment and the EIA would be implemented under the process to be set up by the Supreme Council for Environmental Protection. The EIA would be prepared by the agency issuing the project authorization permit. In this connection GCEA was preparing 8 manuals describing guidelines for various sectors, but the transportation sector was not included.

However in a draft prepared in 1999 the article discussing the EIA was removed all together. Since then a new draft has been prepared in 2000 and the EIA requirement was once more included. This draft law is now under consideration in the parliament.

Therefore at this time there is no legal requirement for EIA or any technical guidelines. Accordingly this study shall examine the environmental impact of the proposed projects based on the JICA guidelines and other relevant literature.

17.2.3 Land Appropriation and Resettlement

Land appropriation may be required in the following railway projects:

- ⇒ Construction of new lines
- ⇒ Doubling of existing lines
- ⇒ New workshop construction

Land appropriation is possible for two types of projects:

- ⇒ Urban expansion governed by Law no. 60 for 1979
- ⇒ Projects of public benefit nature governed by law no. 20 for 1983

Transport projects are in many cases considered as public benefit projects and are subject to the provisions of law no. 20 for 1983 when property appropriation is required.

Basically two methods are applied in Syria to appropriate land for public benefit projects. These are:

- ⇒ Area Development Method (land reorganization method)
- ⇒ Project development method

Both of these methods are described hereafter:

(1) Area Development Method

Under this method, public benefit projects such as transport facility, school, hospital, etc. are implemented within a scheme to develop the whole area. This method was usually implemented in informal housing areas where the development of these areas so far has been unplanned. Owners of properties such as agricultural lands, built-up lands and buildings are identified and shares in the development are distributed according to the present values of the properties.

A development plan is prepared for the area, which includes the required public projects. The remaining area, after deducting the area required for public projects is distributed to the identified owners in accordance with their shares. The government will finance and implement the building plots.

Although such development schemes should be implemented within a fixed time period delays always occur because of difficulties share holders face in concluding agreements together or raising the required financing for the development. Therefore this method is not applied at present.

(2) Project Development Method

Under this method plans are prepared for specific public projects and ratified. Property falling within the area or route of the project is then appropriated. The procedure for appropriating property by the government is explained in Table Appendix 17.2.1.

Projects that have been implemented under this method have usually taken much time and therefore it is difficult to set a time frame for the process. The longest delay occurs in preparing the compensations whether monetary or provision of substitute housing. The late Syrian president decreed that nobody would be evacuated from his house until a suitable replacement or compensation is provided. Procedures for evaluating compensations are defined in the law.

Many road projects are delayed for years because of the difficulty to provide suitable compensation, such as the Southern bypass. GESR is facing similar difficulties in terms of delays in the case of its two new lines in the Damascus area; Adra – Kabon (project N4 in this master plan) and Damascus – Daraa (N2).

17.2.4 Environmental Pollution Standards

The Syrian Ministry of State for the Environment and Supreme Council for Environmental Protection have developed a number of standards for environmental protection which are expected to be incorporated in the Environmental Protection Law presently under deliberation. Therefore at this time the developed standards are followed on a provisional basis and are not legalized yet. The standards developed are in the fields of air quality, potable water and wastewater from industrial establishments.

17.3 Initial Environmental Examination

17.3.1 Introduction

(1) Environmental Issues on the National Level

The most recent study reports conducted by the World Bank/ UNDP have identified the priority environmental issues on the national level in order of importance as follows;

1. Soil degradation
2. Contamination and depletion of water resources
3. Poor air quality
4. Inappropriate solid waste disposal
5. Growth of illegal settlements

The country was divided into seven water basins (or regions) and surveys were made for each region and the problems in each were identified in some detail. The Studies identified the Damascus – Homs – Hama – Aleppo axis as the urban industrial axis mostly suffering from environmental problems because of the concentration of industries and various agriculture activities along this axis.

The railway projects proposed in the master plan should not aggravate the identified environmental issues further through such negative actions as described in Table 17.3.1, which need to be considered in the development plans prepared.

Table 17.3.1 Further Aggravation of Environmental Issues

Issue/ Negative actions to be avoided in railway projects
1. Soil degradation • Deforestation for construction of new railway routes
2. Contamination of Water Sources • Contamination of groundwater or surface waters by wastewater discharged from railway stationary facilities; workshops, depots and stations
3. Poor air quality • Older and poorly maintained locomotives and diesel cars
4. Solid waste disposal • Waste generated during facilities construction • Poor waste management at the railway stationary facilities
5. Illegal settlements • Attraction of illegal settlements by railway facilities

(2) Environmental Problems generated from the present Syrian Railway service

While the purpose of this examination is to determine the impacts that may be generated by the proposed projects on the environment, it is also necessary to evaluate if the proposed projects will contribute to mitigating some of the present negative impacts.

Based on site visits some existing environmental issues with respect to GESR and GEHR operation are summarized in Tables Appendix 17.3.2 and 17.3.3 respectively.

Issues are quite similar but the lesser nature of the GEHR service makes the issues less severe. On the other hand the cultural and historical significance of the GEHR lines lends weight to impact on cultural assets.

17.3.2 Master Plan Projects

The master plan projects are for both GESR and GEHR. The GESR projects may be classified into five project groups as discussed elsewhere in this report. The five project groups and a brief description of their components relevant to the environmental examination are shown in Table 17.3.5.

Table 17.3.5 Master Plan GESR Project Groups

GESR Project Group	
Brief description	Environmental Benefits and Concerns
Group 1 – Rehabilitation, Modernization of Existing Lines	
• 8 lines are targeted (almost all the existing network) • Works include construction of signal stations, laying of double track portions, replacement of some tracks, improvement of crossings and structures, and telecommunications and signalization works	• Improvement of train operation safety will reduce chance of accident occurrences • Increase of rail carrying capacity and reliability of service will reduce road transport and associated air pollution from road traffic • Allocation of land for new stations and laying double tracks not a problem as long as these lands are inside existing railway ROW
Group 2 – New Line Construction	
• 5 new lines are planned to serve international and domestic rail transport • Works include track laying and stations construction as well as telecommunications and signalization works	• Construction of the new lines will provide a more comprehensive Syrian railway network to serve both domestic and international traffic and decrease reliance on road traffic. • Importance of route selection and effect selected route has on surrounding socioeconomic conditions, land appropriation and resettlement, ease of construction, scenery, etc. • Environmental impacts generated during construction and noise during operation
Group 3 – Workshop Improvement	
• Construction of Jubrin locomotive and diesel car workshop • Construction of Aleppo passenger coach workshop • Construction of Jubrin freight wagons work shop	• New workshops will ensure more reliable and safer service and better working conditions • Modernized facilities will improve present waste management systems • Measures to mitigate environmental effects during construction (generated waste) and operation (waste discharged and noise) need to be considered during design and implementation
Group 4 – Rolling Stock	
Introduction of the following rolling stock: • Locomotives: 286 units • Diesel cars: 240 units • Passenger coaches: 39 units • Freight wagons: 13,343 units	• Availability of rolling stock will ensure more reliable and safer service • The new rolling stock should be of technical superiority to have minimum possible air pollutant emissions and noise • The freight wagons should be of technical superiority to provide safe loading and unloading conditions and prevent leakages and spoilage of hauled goods
Group 5 – Freight Information System	
Introduction of computer system linking all the GESR freight stations in order to input and provide real time data on loading/ unloading and storage conditions at each station and freight movement along each link of the network.	• Provision of more efficient service will attract more freight transport to rail from road and improve wagon capacity utilization • No negative environmental effects predicted. Therefore Group 5 is excluded from further environmental consideration at this time.

There are four projects that are considered in the improvement plan for GEHR. Table 17.3.6 describes these projects and environmental benefits and impacts that may be expected from them.

Table 17.3.6 Master Plan GEHR Projects

GEHR Projects	
Brief description	Environmental Benefits and Concerns
Project 1 – Rehabilitation of Damascus – Daraa line (including Hidjaz station – Al-Qadam underground section)	
• This line is 128 km long and has 13 stations • Works include improvement of tracks and level crossings, and telecommunications and signalization works • A 4.2 km tunnel is considered between Hidjaz and Al-Qadam stations to avoid 20 at-grade crossings	• Improvement of train operation safety will reduce chance of accident occurrences which is important as this line passes through populated areas • Rehabilitation works at existing stations must not effect their historical value
Project 2 – Rehabilitation of Surghaya line	
• This line is 58 km long and has 9 stations • Works include improvement of tracks and level crossings, and telecommunications and signalization works	• Increase of rail carrying capacity and reliability of service will reduce road transport and associated air pollution from road traffic in this scenic area
Project 3 – Rehabilitation of Qatana, Bosra and Muzeireeb lines	
• The line lengths are; Qatana 24 km, Bosra 41 km, and Muzeireeb 26 km and total number of stations is 15 • Works include improvement of tracks and level crossings, and telecommunications and signalization works	• Increase of rail carrying capacity and reliability of service will reduce road transport and associated air pollution from road traffic
Project 4 – New Rail service to Damascus airport	
• This project is expected to provide rail transport between the city center and airport within a distance of 30 km • Works include construction of new line and all associated works	• Will provide an alternate mode for the present sole road connecting to the airport and reduce road congestion as traffic demand increases • Importance of route selection and effect the selected route has on surrounding socioeconomic conditions, land appropriation and resettlement, ease of construction, scenery, etc. • Environmental impacts generated during construction and noise during operation

17.3.3 Screening and Scooping

The purpose of each of the screening and scoping activities are as follows:

Screening:

Environmental aspects are screened in order to identify environmental impacts and social issues which should be examined in more detail if a full-scale environmental impact assessment is deemed necessary.

Scoping:

The purpose of scoping is to clarify the significant environmental impacts, which may be

caused by the project.

In the absence of any Syrian guidelines and standards the JICA guidelines for initial environmental examination of railway projects were adopted and are used hereafter.

(1) Screening

The screening exercise is shown in Table 17.3.7 for GESR project groups of the Master Plan. The result shows that further environmental examination is required for Group 2 projects (new line construction) and Group 3 projects (new workshop construction).

Table 17.3.7 Screening of Master Plan GESR Project Groups

Environmental Item	Description	Group 1	Group 2	Group 3	Group 4	Remarks
Social Environment						
1. Resettlement	Resettlement due to occupancy of proposed land	N	Y	N	N	New lines in urban area will require land allocation and resettlement
2. Economic Activities	Loss of productive opportunity such as land or nearby market	N	Y	N	N	New lines and stations may occupy productive lands, or separate farmers and shepherds from their farms and grazing lands
3. Traffic and public facilities	Influence on existing traffic such as congestion	N	Y	N	N	New stations attract traffic and effect surrounding road and public transport networks
4. Split of communities	Split of communities by obstruction of railway line	N	Y	N	N	New lines may separate communities
5. Cultural property	Loss of cultural property and falling of values	N	Y	N	N	Some of the proposed new lines pass through important cultural areas such as Palmyra (N3) and ancient ruins along Euphrates River (N1).
6. Water rights and rights of common	Obstruction of fishing rights, water rights, and common rights of forest	N	N	N	N	This problem does not exist
7. Public health condition	Deterioration of hygienic environment and poor working areas	N	N	Y	N	New workshop facilities may discharge/emit pollutants dangerous to health
8. Waste	Occurrence of waste dumps and solid waste	Y	Y	Y	N	Construction waste generated during rehabilitation and new construction
9. Hazards (risks)	Increase of possibility of danger of landslide, structure failure and accidents	N	N	N	N	Rehabilitation of existing lines will help prevent this risk

Environmental Item	Description	Group 1	Group 2	Group 3	Group 4	Remarks
Natural Environment						
10. Topography and geology	Change of valuable topography geology by excavation or filling works	N	N	N	N	No new lines will be constructed on difficult topography
11. Soil erosion	Surface soil erosion by rainwater after land development (vegetation removal)	N	N	N	N	No vegetation removal anticipated in new lines routes
12. Groundwater	Interference with groundwater characteristics by large scale excavation	N	N	N	N	Large scale excavations not anticipated
13. Hydrological situation	Changes in river discharge and river bed conditions due to landfill and drainage inflow	N	Y	N	N	Line N1 to be constructed adjacent to the Euphrates River
14. Coastal zone	Coastal erosion and sedimentation due to landfill or change in marine condition	N	N	N	N	Lines R5 and R6 inland from the coast
15. Flora and fauna	Obstruction of breeding and extinction of species due to change of habitat condition	N	Y	N	N	New lines (N1) and (N3) may effect surrounding flora and fauna
16. Meteorology	Change of temperature, precipitation, wind, etc. due to large development	N	N	N	N	No large scale development
17. Landscape	Change of topography and vegetation by land development and harmonious obstruction by structural objects	N	Y	Y	N	New constructions may have this effect
Pollution						
18. Air pollution	Pollution caused by exhaust gas or toxic gas from vehicles and factories	N	N	N	Y	Emissions from new rolling stock
19. Water pollution	Pollution by inflow of silt and effluent into rivers and groundwater	N	Y	Y	N	This problem may result during construction
20. Soil contamination	Contamination of soil by dust and chemicals	N	N	N	N	No activities with chemicals
21. Noise and vibration	Noise and vibration generated by railway	Y	Y	Y	Y	Noise generated during operation
22. Land subsidence	Deformation of land and land subsidence due to lowering of groundwater	N	N	N	N	No groundwater pumping out works are expected
23. Offensive odor	Generation of exhaust gas and offensive odor by facility construction and operation	N	N	Y	N	Proper ventilation of new workshops should be carefully considered in the design
Overall Evaluation	Environmental Impact Assessment (EIA) required (Y/N)	N	Y	Y	N	EIA is required for project groups 2 and 3

In the case of the GEHR projects the screening activity is shown in Table 17.3.8. The result of the screening identified a number of potential impacts in the case of implementation of projects 1 and 4 and further environmental consideration is deemed necessary for that project.

Table 17.3.8 Screening of Master Plan GEHR Projects

Environmental Item	Description	Project 1	Project 2	Project 3	Project 4	Remarks
Social Environment						
1. Resettlement	Resettlement due to occupancy of proposed land	N	N	N	Y	Route of airport railway from Hidjaz station to airport highway may need land allocation and resettlement
2. Economic Activities	Loss of productive opportunity such as land or nearby market	N	N	N	N	Airport railway proposed in already developed area
3. Traffic and public facilities	Influence on existing traffic such as congestion	N	N	N	Y	Airport railway may effect surrounding traffic
4. Split of communities	Split of communities by obstruction of railway line	N	N	N	N	Airport railway in already developed area
5. Cultural property	Loss of cultural property and falling of values	Y	N	Y	Y	Stations along Damascus – Daraa route and Bosra monument must be protected
6. Water rights and rights of common	Obstruction of fishing rights, water rights, and common rights of forest	N	N	N	N	Airport railway proposed in already developed area
7. Public health condition	Deterioration of hygienic environment and poor working areas	N	N	N	N	Not an issue
8. Waste	Occurrence of waste dumps and solid waste	Y	Y	Y	Y	Waste expected from rehabilitation and new construction works
9. Hazards (risks)	Increase of possibility of danger of landslide, structure failure and accidents	N	N	N	Y	Railway line complete segregation from surrounding traffic necessary
Natural Environment						
10. Topography and geology	Change of valuable topography geology by excavation or filling works	Y	N	N	N	Tunnel section between stations of Hidjaz and Qaddam is required. Airport railway proposed in already developed area
11. Soil erosion	Surface soil erosion by rainwater after land development (vegetation removal)	N	N	N	N	Airport railway proposed in already developed area
12. Groundwater	Interference with groundwater characteristics by large scale excavation	Y	N	N	Y	Tunnel sections are required in urban areas for both projects 1 and 4.
13. Hydrological situation	Changes in river discharge and river bed conditions due to landfill and drainage inflow	N	Y	N	N	Rehabilitation work may effect river adjacent to Surghaya railway route

Environmental Item	Description	Project 1	Project 2	Project 3	Project 4	Remarks
14. Coastal zone	Coastal erosion and sedimentation due to landfill or change in marine condition	N	N	N	N	No coastal area involved
15. Flora and fauna	Obstruction of breeding and extinction of species due to change of habitat condition	N	N	N	N	Airport railway proposed in already developed area
16. Meteorology	Change of temperature, precipitation, wind, etc. due to large development	N	N	N	N	Airport railway proposed in already developed area
17. Landscape	Change of topography and vegetation by land development and harmonious obstruction by structural objects	N	N	N	Y	Effect of structures related to new railway line on harmony of surrounding environment
Pollution						
18. Air pollution	Pollution caused by exhaust gas or toxic gas from vehicles and factories	N	N	N	N	No impact anticipated
19. Water pollution	Pollution by inflow of silt and effluent into rivers and groundwater	N	N	N	N	No impact anticipated
20. Soil contamination	Contamination of soil by dust and chemicals	N	N	N	N	No activities with chemicals
21. Noise and vibration	Noise and vibration generated by railway	Y	Y	Y	Y	Noise generated during operation
22. Land subsidence	Deformation of land and land subsidence due to lowering of groundwater	N	N	N	Y	Effect of structures related to new railway line on groundwater table
23. Offensive odor	Generation of exhaust gas and offensive odor by facility construction and operation	N	N	N	N	No impact anticipated
Overall Evaluation	Environmental Impact Assessment (EIA) required (Y/N)	N	N	N	Y	EIA is required for the Airport Railway line project

(2) Scoping

The scoping exercise for the GESR project groups shows serious environmental concerns for social environmental issues that may be generated by land allocation and resettlement for the new lines. Results are shown in Table 17.3.9.

Table 17.3.9 Scooping of Master Plan GESR Project Groups

Environmental Item	Group 1	Group 2	Group 3	Group 4	Remarks
Social Environment					
1. Resettlement	D	A	D	D	Group 2: Large resettlement may be required for projects N2, N4, N7 and N8 Group 3: New workshops to be constructed on GESR property
2. Economic Activities	D	C	D	D	Group 2: New lines N3 and N5 may separate farmers and shepherds from their farms and pastures
3. Traffic and public facilities	D	B	D	D	Group 2: Passenger and freight traffic will be attracted to new stations and these will effect surrounding traffic especially in urban areas for all new lines
4. Split of communities	D	C	D	D	Group 2: Ethnic communities residing along the proposed new lines N2 and N6 and Bedouin communities freely roaming in the area of N3 may be effected
5. Cultural property	D	A	D	D	Group 2: N3 route must be carefully considered so as not to impact the world heritage site of Tadmor, and proposed new lines in ancient cities of Damascus and Aleppo must avoid antiquities above and under ground.
6. Water rights and rights of common	D	D	D	D	Group 2: New lines are not expected to obstruct any water rights or rights of common.
7. Public health condition	D	D	C	D	Group 3: Health of workers in the new workshops and surrounding residents must be carefully considered in the facility design and operation plan
8. Waste	C	C	B	D	Groups 1 & 2: Management plan must be prepared for collection and disposal of construction wastes generated during rehabilitation and new construction works, taking into consideration nature of the wastes. Group 3: In addition to the above comment a management plan for the waste generated during the operation is also necessary
9. Hazards (risks)	D	D	D	D	Groups 1 to 3: Works will be prepared with high design standards to reduce operational risks Group 4: New rolling stock with high technical standards needs to be selected
Natural Environment					
10. Topography and geology	D	D	D	D	Group 2: New lines are not planned in areas with exceptional topographical and geological conditions Group 3: New workshops will be constructed within existing GESR ROW where conditions have already been developed for railway operation
11. Soil erosion	D	D	D	D	Group 2: New lines are planned in areas where no large deforestation activity is required and also in already developed areas. Group 3: New workshops will be constructed within existing GESR ROW where conditions have already been developed for railway operation
12. Groundwater	D	D	D	D	Group 2: New lines are planned in areas where no groundwater disturbance is expected Group 3: New workshops will be constructed within existing GESR ROW where conditions have already been developed for railway operation
13. Hydrological situation	D	C	D	D	Group 2: Any effect of N1 on the adjacent Euphrates River must be considered in the route design and operation phases.
14. Coastal zone	D	D	D	D	Group 1: Lines R4 and part of R5 shall be rehabilitated but these works are not predicted to have an impact on the distant coastal line.

Environmental Item	Group 1	Group 2	Group 3	Group 4	Remarks
15. Flora and fauna	D	C	D	D	Group 2: The effect on the surrounding flora and fauna in the cases of lines N1 and N3 need to be considered
16. Meteorology	D	D	D	D	Large-scale works that may affect meteorological conditions are no planned.
17. Landscape	D	C	D	D	Group 2: Stations associated with new lines should be designed so as not to conflict with surroundings
Pollution					
18. Air pollution	D	D	D	C	Group 4: The new rolling stock should be selected to limit air pollutant emissions
19. Water pollution	D	C	C	D	Group 2: Pollution of nearby rivers and groundwater during construction needs to be avoided. Group 3: In addition to the above comment the operation plan must also be prepared to avoid groundwater contamination
20. Soil contamination	D	D	D	D	No chemicals shall be used during rehabilitation, construction and operation activities
21. Noise and vibration	B	B	B	B	All the project groups will result in larger operation capacity and faster speeds, which will generate noise and vibration. These conditions must be considered in the design and operation standards and purchase of new rolling stock
22. Land subsidence	D	D	D	D	Groups 1 & 3: Projects in already developed lands Group 2: New line design standards shall protect against land subsidence
23. Offensive odor	D	D	C	D	Group 3: Design and operation plans should consider ventilation and worker safety against odors generated during maintenance works in the new workshops.
Notes: Evaluation categories: A: Serious impact is predicted, B: Some impact is predicted, C: Extent of impact is unknown, examination is needed, D: No impact is predicted, EIA is not necessary					

In the case of GEHR projects there are valid environmental concerns surrounding the Hidjaz – Al-Qadam stations underground section of the Damascus – Daraa rehabilitation line, and the Airport railway project. These include protection of historic assets, land allocation problems, and harmony in traffic management between the road traffic and the proposed new project sharing the same route. Results are given in Table 17.3.10.

Table 17.3.10 Scoping of Master Plan GEHR Projects

Environmental Item	Project 1	Project 2	Project 3	Project 4	Remarks
Social Environment					
1. Resettlement	D	D	D	B	Project 4: Airport railway line from Hidjaz station to the airport highway will require some land allocation and resettlement
2. Economic Activities	D	D	D	D	No negative impacts on economic activities are predicted.
3. Traffic and public facilities	D	D	D	C	Project 4: Airport railway line will affect road traffic and must be completely segregated at crossings with the roads. Also stations of the new line will attract traffic and may affect the surrounding road traffic.
4. Split of communities	D	D	D	C	Project 4: Airport railway line shall be completely segregated and depending on route may split certain communities
5. Cultural property	C	D	C	C	Project 1: The historic stations along the Damascus – Daraa line must be protected during any rehabilitation works Project 3: The Bosra line rehabilitation route must take into consideration the ancient theater of Bosra Project 4: In the Hidjaz station area the antiquities above and under the ground should be considered during the route selection and construction
6. Water rights and rights of common	D	D	D	D	Project 4: New airport line will be constructed in an already developed area where this item is not an issue
7. Public health condition	D	D	D	D	All projects are not predicted to impact public health conditions
8. Waste	C	C	C	C	Projects 1 to 4: Management plan must be prepared for collection and disposal of construction wastes generated during rehabilitation and new construction works, taking into consideration nature of the wastes.
9. Hazards (risks)	D	D	D	C	Project 4: New airport line crossings with the road traffic must be well designed and operated to avoid accidents
Natural Environment					
10. Topography and geology	C	D	D	D	Project 1: Effect of large scale excavation for tunnel needs to be studied further Project 4: New airport line is planned in already developed area
11. Soil erosion	D	D	D	D	Project 4: New airport line is planned in already developed area
12. Groundwater	C	D	D	C	Project 1: Effect of large scale excavation for tunnel needs to be studied further Project 4: New airport line structures in urban area my involve excavation and affect groundwater
13. Hydrological situation	D	C	D	D	Project 2: Rehabilitation plan for Surghaya line must protect the adjacent river
14. Coastal zone	D	D	D	D	All projects are not in the vicinity of the coastal area.
15. Flora and fauna	D	D	D	D	All projects are not predicted to have an impact on flora and fauna
16. Meteorology	D	D	D	D	Large-scale works that may affect meteorological conditions are not planned.
17. Landscape	D	D	D	C	Project 4: New airport line structures in urban area may affect the landscape
Pollution					
18. Air pollution	D	D	D	D	All projects are not predicted to have an impact on air pollution

Environmental Item	Project 1	Project 2	Project 3	Project 4	Remarks
19. Water pollution	D	D	D	D	All projects are not predicted to have an impact on water pollution
20. Soil contamination	D	D	D	D	No chemicals shall be used during rehabilitation, construction and operation activities
21. Noise and vibration	B	B	B	B	All the project groups will result in larger operation capacity and faster speeds, which will generate noise and vibration. These conditions must be considered in the design and operation standards.
22. Land subsidence	D	D	D	D	Project 4: New line design standards shall protect against land subsidence
23. Offensive odor	D	D	D	D	All projects are not predicted to generate an offensive odor
Notes: Evaluation categories: A: Serious impact is predicted, B: Some impact is predicted, C: Extent of impact is unknown, examination is needed, D: No impact is predicted, EIA is not necessary					

17.4 Overall Evaluation

(1) Environmental Impact Assessment Requirement

As explained in this chapter the EIA is required for the following projects of the master plan:

1) GESR:

- Construction of new lines; Eight projects
- Construction of Workshops (including Depots); Three projects

2) GEHR:

- Construction of underground section between Hidjaz and Al-Qadam stations
- Construction of new Airport line

(2) Environmental Issues associated with New Line Projects

GESR has already developed plans for implementation of new lines and these have been adopted in this Master Plan. The new line projects are actually in different phases of implementation; some are plans on paper while implementation has already started in others. It is also understood that no comprehensive environmental studies were done in association with these projects.

Four issues should be studied in the EIA for new lines; railway option viability, route selection, construction implementation and operation plan.

1) Railway Viability

The railway viability option has to be examined in relation to other competing transport modes. In the case of Syria road transport is the major competing mode. Table 17.4.1 provides a comparison between both from environmental viewpoints. The financial and economic comparison of both modes has been discussed elsewhere in this report. As the table shows railway transport provides more environmental friendly transport mode.

Table 17.4.1 Rail and Road Comparative Transport Characteristics

Characteristic	Rail		Road	
A. Mode of movement				
Dimensions of movement	One (rail guided)		Two (steered)	
Traffic signals	Fully applicable		Partial (at some junctions)	
Automatic control	Widely practiced		Seldom practicable	
Accidents	Rarely serious		Frequent, some fatal	
B. Operational Performance				
Speed	High between stations		Moderate; slow in congestion	
Direct access for people or freight at all points	Poor		Very good	
Unit carrying capacity	High		Low for private, high for public	
C. Commercial Performance				
Inter-city	Fast, direct		Variable	
Rural	Few services available		Very suitable	
Commuters	Efficient		Public transport effective	
Freight	Bulk and long distance		Medium distance distribution	
D. Environmental Performance				
Energy efficiency	High if well loaded		High for buses, low for cars	
Use of land resources	Narrow but not very flexible		Wider but more flexible	
Noise	Loud but nearby only, intermittent		Moderate but common and continuous	
Air pollution	Low		Medium/ high	
Passenger (g/pax-km)	Diesel	Electric	Car	Bus
CO2	80	80	150	40
Nox	1.5	0.5	2.0	1.0
SO2	0.2	1.0	0.05	0.1
CO	0.2	0.02	10.0	0.5
HC	0.1	0.001	1.5	0.1
VOC	0.5	0.001	2.0	0.5
Freight (g/ton-km)	Diesel	Electric	Truck	Trailers
CO2	40	40	250	100
Nox	0.7	0.2	4.0	3.0
SO2	0.1	1.0	0.3	0.2
CO	0.15	0.01	2.0	0.2
HC	0.1	0	0.5	0.3
VOC	0.1	0.01	1.0	NA
Source: The Environmental Impact of Railways, T. G. Carpenter, 1994				

2) Route Selection

Route selection primarily considers joining two or more points as economically as possible through the most direct practicable alignment. The selection process also considers the route most suited for providing the required operating capacity and speed, minimizing construction costs and last but not least protecting the environment.

As mentioned earlier most of the routes of the new lines have already been selected by GESR, more or less taking into consideration the above points, but most likely with the exclusion of considerations on environmental protection. It is therefore necessary to perform a full-scale environmental study in order to propose countermeasures to mitigate potential negative impacts.

Potential environmental impacts from construction of new lines have been identified in the screening and scooping process. Basically the main concerns are land allocation and resettlement and noise and vibration. There are four main environmental issues in routing that will be checked during the EIA process:

- Avoidance of valuable features of heritage, habitat or landscape
- Avoidance of centers or population not served by the new line
- Taking into account existing regional development and land use plans
- Making use, as much as possible of existing transport corridors (roads, railways, canals, etc.) or sharing corridors with newly planned roads

3) Operation Plan

The adopted operation plan may have positive impact on the environment. Examples are as follows:

- Electrification of the line would provide more positive impacts than diesel locomotive operation in terms of reductions in use of fuel resources, air pollution emissions (refer to Table 17.4.1) and noise. However electrification of the line should be considered in tandem with the traffic demand because of the associated high costs.
- Increase in carrying capacities and speeds would increase competitive edge of the railway over the road alternative.
- Introduction of combined transport freight between road/rail transfer stations relying more on containers and modernized loading/unloading facilities will also attract more

freight transport to the more environmental friendly rail mode and lower dependence on truck transport.

- Improvement of rail passenger transport through operation under suitable time schedules, provision of more comfortable passenger coaches, and more user-friendly stations.

4) Design and Construction of New Line

The design of the new line should take into consideration limiting the environmental impacts as much as possible. These are once more repeated as minimization of land acquisition during route selection study, reduction of noise through noise barriers erection, reduction of effect on landscaping and taking adequate measures to ensure worker and property safety during construction.

Construction will involve having large numbers of people and equipment working on the project. Because of the limited new line ROW intervention on adjacent lands is unavoidable. Access to the construction sites has to be maintained as well as provision of construction materials and equipment. Some of the construction activities and their potential environmental impacts to the workers and surrounding environment are as follows:

- Land acquisition and clearance: Social impact is severe and this step requires social survey and provision of necessary compensations under the regulations. The process can be time consuming.
- Earthworks and tunnels: Environmental impacts include landscape and visual impacts, dust, land settlement and working on hazardous ground.
- Structures: Pollution of land and water and generation of noise.
- Construction traffic: Noise generation, delays and congestion in roads, rail and pedestrians traffic and accidents generation.

Therefore the design must include countermeasures to ensure worker and environmental safety as well as adequate construction methods to mitigate potential environmental problems during construction.

Chapter 18

Conclusion and Recommendation

Chapter 18 Conclusion and Recommendation

18.1 Conclusion

18.1.1 **GESR**

(1) Outline of the Master Plan and Staged Development Plan

A master plan for the development of Syrian Railways has been drawn up with the target year of 2020. In order to realize the master plan, staged development plans of a short term (2005), medium term (2010), and long terms (2015 and 2020) have also been drawn up, based on the study having been made regarding the order of priority of investment for the projects which constitute the master plan, such as the rehabilitation and modernization of existing facilities and new line construction projects of GESR.

(2) Rehabilitation and Modernization of Existing Facilities of GESR

The rehabilitation and modernization of the existing railway facilities has been planned, with the aim of ensuring safe and stable transport with the minimum amount of investment possible. The rehabilitation and modernization projects are shown in Table 18.1. An outline of the major contents of these rehabilitation and modernization projects is as follows.

① An adequate train operation system will be established, and facilities for ensuring train operation safety (such as signal facilities) will be reinforced.

② Such measures as the new construction of signal stations and double tracking will be taken, in order to operate the necessary number of trains for meeting the transport demand, and also to ensure track capacity which enables the increase in the number of trains.

③ Rolling stock will be additionally introduced according to the train operation plan and based on the transport demand.

④ Rolling stock maintenance workshops will be modernized, in order to enhance the

productivity of rolling stock.

⑤ Tracks and level crossing facilities will adequately be established or reinforced, taking into consideration such factors as the speedup of trains and increase in the number of trains.

⑥ As for the telecommunication facilities, optical fiber cables will be laid, and telecommunication systems centering on the optical fiber electric transmission system will be established.

⑦ As for the freight services which will still be a basic elements of commercial activities in the future, a freight information system will be established by utilizing the optical fiber electric transmission system which is to be separately developed, in order to enhance the railway reliability to consignors and to improve the railway into a user-friendly one. The freight information system to be newly established will aim at the correct forecast of the arrival date and time of freight; administration of the results of freight transport; and so forth.

⑧ As for the passenger services, improvement of train operation will be made in order to satisfy the demand of users, such as the enhancement of their convenience. The main measures to be taken include the increase in the train operation frequency during daytime by introducing diesel car trains; and the operation of locomotive-hauled sleeper car trains.

The staged development plans of the rehabilitation and modernization of existing facilities projects are also shown in Table 18.1. This table was prepared based on the results of consultation with the Syrian side with due consideration on priority of the projects, international traffic and efficiency of project implementation. In giving priorities to the projects, comprehensive evaluation has been made from various aspects, such as benefit/cost aspect, socio-economic factors, number of trains, railway facilities, and the priority rank which the Syrian side is giving.

Table 18.1 Staged Development Plan
(Rehabilitation and Modernization of Existing Facilities)

No.	Project	Short-term	Medium-term	Long-term	
		2001～2005	2006～2010	2011～2015	2016～2020
1	Midan Ekbas ～Aleppo				
2	Aleppo～Damascus				
3	Aleppo～Lattakia				
4	Lattakia ～Tartous				
5	Tartous ～Homs～Mhine～Al Sharqia				
6	Aleppo ～Deir el-zor				
7	Deir el-zor～Qamishli				
8	Qamishli～Al Yaroubiye				
9	Loco Workshop				
10	Aleppo PC Workshop				
11	Jublin FC Workshop				
12	Freight Information system				
13	Rolling stock procurement				

Legend :

- Substantial Work
- Auxiliary Work
- Signal and telecommunication facilities improvement already committed
- Signal station construction or double tracking conducted to cope with the shortage of the shortage of track capacity due to the increase traffic demand

(3) New Line Construction of GESR

Establishment of the railway network shown in Fig 18.1 has been planned, taking into consideration such factors as the international transport between Syria and neighboring countries, and well balanced transport routes within Syria.

Main projects of new line construction are the construction between Deir el-zor and Al Bukamal (about 145km); one between Damascus and the Jordan border (about 100km); and one between Al Sharqir and Deir el-Zor (about 240km). New line construction projects of GESR are shown in Table 18.2.

The staged development plans of the new line construction projects are also shown in Table18.2.

This table was prepared based on the results of consultation with the Syrian side with due consideration on priority of the projects, and efficiency of project implementation. In giving priorities to the projects, comprehensive evaluation has been made from various aspects, such as benefit/cost aspect; socio-economic factors, number of trains, railway network planning and the priority ranks which the Syrian side is giving.

Table 18.2 Staged Development Plan (New Line Construction)

No.	Project	Short-term	Medium-term	Long-term	
		2001～2005	2006～2010	2011～2015	2016～2020
1	Deir el-zor ～Al Bukamal	━━			
2	Damascus～Kiswa	━━			
	Kiswa～Jordan Border		═══	═══	═══
3	Al Sharqia～Tadmor～Deir el- zor	━━	━━	┅┅	┅┅
4	Adra ～Kabon	━━			
5	Maarret Ikhwan ～Edlab	━━	━━	━━	
6	Akkari～Lebanon Border	━━			
7	Kadam～Hidjaz station	━━	━━		
8	West Entrance to Aleppo		═══		
9	Rolling stock Procurement	━━	━━	━━	━━

Legend :

━━ Sabstantial Work

═══ Auxiliary Work

┅┅ Signal station construction to cope with the shortage of track capacity due to the increase traffic demand

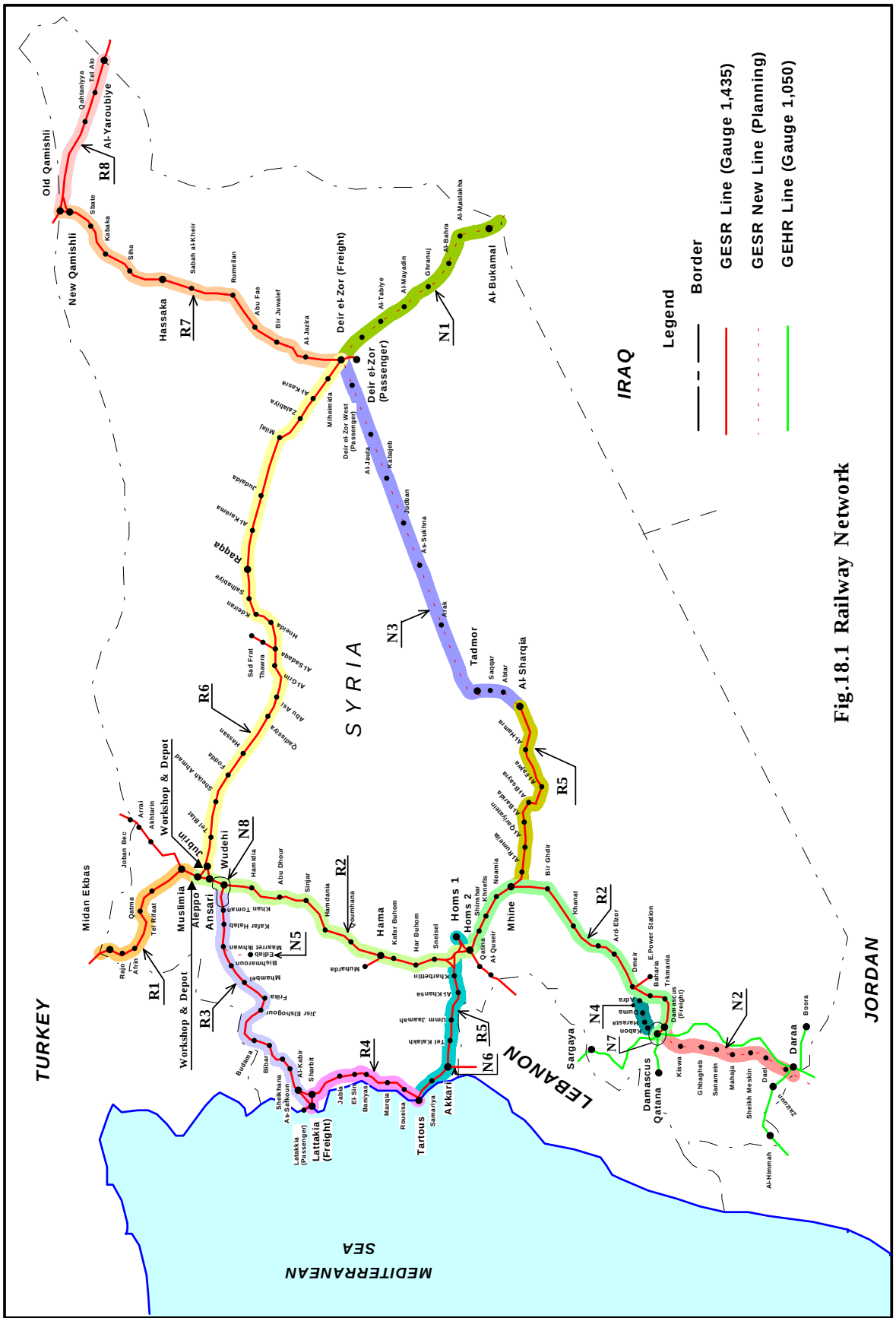

Fig.18.1 Railway Network

18.1.2 **GEHR**

The main roles of the current GEHR lines are expected to be the urban transport in Damascus City including Damascus Airport Line operation and transport of pilgrims and tourists. However, in the Study, urban transport projects including Airport line have been excluded. As such, rehabilitation of the existing line has been mainly studied.

GEHR is now seriously planning to modernize its railway system through gauge conversion from the current meter gauge to the standard gauge, the same gauge as that of GESR.
Its major plans are as follows:

(1) Construction of Damascus Airport Line
(2) Construction of standard gauged line between Kadam and Jordan Border

The advantages of such conversion will be (1) to be able to integrate GEHR and GESR into the same gauged unified railway network all over Syria, and (2) to promote intra-and inter-regional railway transport.
However, because conversion to standard gauge from meter gauge requires considerable amount of investment, it must be carefully examined from the view point of national economy and financial viability of railway enterprise. Bearing in mind the above discussion, and because the gauge conversion is not yet justified from the economic and financial view point, JICA Study Team has presented the improvement plan of existing lines with minimum investment to ensure the operation safety. However, gauge conversion can be programmed as soon as its economic and financial justification can be ensured. JICA Study Team presented its views on modernization of GEHR through gauge conversion.

Table 18.3 shows the GEHR projects for improvement of existing lines which are based on the results of the consultation with the Syrian side. As shown in the table, the projects of GEHR are mainly composed of rehabilitation projects. However, the economic and financial analysis has not been carried out and only works with the minimum investment have been planned for these rehabilitation projects which mainly aimed at the betterment of tracks, level crossings, and signal and telecommunications facilities. In this case, the history and main roles of GEHR, as well as the present situation of the facilities have been taken into consideration, and great emphasis has also been placed on safety in train operation.

Table 18.3 GEHR Projects (Improvement of existing lines)

No.	Project	Priority Ranking	Priority Order	Remark
1	Rehabilitation of Darra line and Construction of Kadam-Hidjaz station	A	1	
2	Rehabilitation lf Surgaya line	A	2	
3	Rehabilitation of Qatana line and other lines	B	3	
4	Damascus- Airport	(A)		These projects are not included in the rehabilitation program of Master Plan, but only related discussion has been provided.
5	Tramway			

18.1.3 Conclusion

(1) GESR

The total amount of investment in the GESR projects under the master plan is about SP 171 billion.

The FIRR (Financial Internal Rate of Return), which evaluates GESR's master plan for 2020 and the phased development plans from the standpoint of enterprise business operation, is 2.0 %. Low interest rate loans and governmental assistance will be necessary for GESR to achieve a sound financial state.

However, the EIRR (Economic Internal Rate of Return), which evaluates the plans from the standpoint of the national economy, is 16.9 %. This is more than 12%, the opportunity capital cost of Syria. Therefore, it can be judged that the plans are feasible in terms of the national economy.

GESR recognizes the national and economic significance of the railway as an important infrastructure for social and economic activities in this country, and is trying to make the railways to play the adequate roles by receiving necessary financial assistance from the Government.

In this respect, the operation of trunk railways in Syria should not be judged only from the financial viewpoint, but should be evaluated also from the viewpoint of the national economy.
It has a large significance to make appropriate utilization of railway transport in view of the global problem of environmental destruction by automotive exhaust gas and the efficient energy consumption.

Furthermore, in the stage of actually implementing each project which constitutes the master plan, although each project is technically feasible, it is necessary to reduce the amount of investment as much as possible, by analyzing and studying in further detail the contents of the investment of the project, and also by considering environmental preservation. This will serve for the improvement of the financial aspect of the master plan.

As described above, the implementation of master plan of GESR can be justified for the sound development of social and economic activities of Syria. Therefore, the first step toward its implementation should be taken as soon as possible.

As it could be seen from the Table 18.4, total amount of investment for Master Plan may be afforded by Syrian economy in view of its future development.

However investment amount is very much concentrated in the first 5 years. In this regard it is suggested to consider that execution period of some projects in the first 5 years may be extended and investment amount in the each 5 years period may be leveled off. In this way Master Plan's economic and financial feasibility will be more improved.

Table 18.4 Master Plan Investment for Each 5 years

million SP.

Year	Short-term	Medium-term	Long-term		Total
	2001 - 2005	2006 – 2010	2011 - 2015	2016 – 2020	
Estimated Affordable Budget of GESR (*)	27,342	44,501	48,617	48,809	169,269
Master plan investment (**)	64,575	36,366	35,668	29,452	166,061

(*) Refer to Table 6.3.3 (Budget includes estimated value for 2001)
(**) Refer to Table 14.2. Engineering cost (5,405 million SP) is excluded.

(2) GEHR

(a) Role of GEHR

Role of GEHR should be promoted in close cooperation with related Agencies and GESR and with due consideration on practical investment.

- Tourism promotion
- International transport with Jordan and Lebanon
- Possibility to contribute to Damascus urban transport in future including airport access line

(b) Gauge Conversion

GEHR is now seriously planning to modernize the existing lines through gauge conversion from meter gauge to standard gauge. Gauge conversion to standard gauge has merits of integrating all Syrian railway network into unified gauge network and of promoting international transport. However, since it needs considerable investment cost, and economic justification of gauge conversion is not yet confirmed, improvement of existing meter gauge track with minimum investment has been proposed in the Report.

(c) Improvement of existing lines

Related with tourism and international transport, minimum necessary investment for safe train operation for the 1st and 2nd priority projects (1,677 million SP) should be considered in the first place. Later investment for 3rd priority project (443 million SP) should be considered. At the same time, railway management and staff training should be improved. In case economic feasibility of gauge conversion to standard gauge will have been confirmed, improvement of existing railway can be switched to modernization of railways through gauge conversion to standard gauge.

(3) Software Aspects

For the effective implementation of the master plan, it is essential to make improvement in software aspects (administration and operation, marketing policy, maintenance technology, employee education, etc.), in addition to the improvement in hardware aspects (facilities, rolling stock, etc.).

The improvement measures in the software aspects are summarized in item 18.2 (Recommendation), and the details are described in the respective chapters concerned.

18.2 Recommendation

18.2.1 **GESR**

(1) Ensuring of railway reliability (Punctual train operation)

In the case where departure and arrival times of passenger trains and freight trains are uncertain, railway users will lose confidence in the railway and will eventually use other means of transport.

As a matter of course, it is necessary at first to prevent troubles of locomotives, tracks, signals and so forth, because most cases of train delay are caused by such troubles. However, when a trouble has occurred, it is essential to try to ensure punctuality of train operation as much as possible by adequately arranging the personnel for early restoration and by securing spare materials. Sufficient maintenance of facilities in usual time is also important.

For stable train operation, it is necessary to establish adequate organizations and systems so that the train dispatchers can sufficiently grasp the delay of trains and so forth, to investigate the cause of the delay, and to comprehensively promote countermeasures from both software and hardware aspects. Especially, measures against the delay of trains caused by software reasons such as train operation handling should urgently be implemented.

The ensuring of railway reliability will lead to the increase in railway passenger and freight traffic volume.

(2) Ensuring of convenience for railway users

1) Passenger transport

It is necessary to operate passenger trains which are convenient for and can satisfy the need of passengers by the phased reinforcement of transport capacity in accordance with the demands. Specifically, it is needed to take such measures as the frequent operation of short-consist trains in daytime; and the operation of night trains with

appropriate departure and arrival times. At the same time, service quality should be enhanced in such respects as the guidance for passengers and ticket vending at stations.

2) Freight transport

As for the freight trains, it is essential to establish appropriate marketing systems which ensure easy railway utilization by consignors. For instance, the trains to be regularly operated should be clarified by drawing up train diagrams, and a proper system of connecting loaded freight cars between trains should be established. Then, accurate forecast of the arrival date and time should be made when the railway accepts freight for transport, and the information should be conveyed to the consignor.

Furthermore, it is recommendable to accumulate various kinds of information by utilizing the freight information system which is scheduled to be developed separately under the master plan in the future. Then, based on such data, freight transport services should be further improved to enhance the convenience for consignors in such respects as the operation of freight cars. Moreover, efforts should be made to reduce the freight distribution cost by such measures as the modernization of loading and unloading systems.

(3) Maintenance of railway facilities

As described before, it is important for safe train operation to carry out adequate maintenance of rolling stock and facilities in usual time. The measures which require urgent implementation are correction of rail joint depression; aligning of turnouts; improvement of level crossing facilities; restoration of signal and telecommunication facilities which are out of order, rehabilitation/modernization of rolling stock workshops; and so forth.

As for the maintenance in the future, it is necessary to conduct data-based maintenance of rolling stock and facilities and to establish and steadily implement rational maintenance plans.

At first, it is needed to arrange registers, such as track maintenance registers. Then, it is necessary to conduct systematic inspection and accumulate relevant data in the registers. Therefore, a reasonable maintenance plan should be established on the basis of these

statistical data and from the standpoint of preventive maintenance. Lastly, the maintenance plan thus established should be steadily put into practice, in order to ensure functions of railway facilities.

At the same time, it is necessary to establish a mechanism which can ensure early restoration after the occurrence of a trouble.

As for the sand damage typically seen between Deir el-Zor and Hassaka, great efforts are being made to carry out normal train operation and track maintenance. However, regarding the large-scale sand damage, it is necessary for entire GESR to study adequate countermeasures (tree planting, sand barrier fence, etc.) by utilizing know-how accumulated in field organizations, and with cooperation of external institutions, and to steadily put these measures into practice for a long period.

(4) Management and Training

Strong assistance has been provided for GESR by the Syrian Government, and there is no fear concerning the fund procurement. However, it is necessary for GESR to make efforts to improve its business operation performance (revenues and expenses) and reduce financial burden of the Government, by such measures as the improvement of facilities; adequate positioning of employees; and promotion of activities for increasing revenue.

As a matter of course, the enhancement of work productivity of employees by multi-functional work execution will become important in the course of the modernization of rolling stock maintenance workshop and railway facilities. As for the organizations, on the other hand, it is necessary to study and revise the officially designated number of personnel. For instance, in carrying out such measures as the reduction of the number of station personnel by introducing CTC, it is essential to secure the necessary number of personnel in some fields of specialty which are in shortage of experts, by revising the designated number of station personnel and promoting job-transfer training.

With the progress of modernization of rolling stock and railway facilities, new technological strength will become necessary. In introducing new technologies, therefore, it is needed for GESR to request the suppliers of the technologies to supply teaching materials for training schools at the same time, so that employees can obtain new

technologies at the training schools and adequate train operation handling and sufficient maintenance of railway facilities can be ensured. Furthermore, another measure advisable is the dispatch of employees to oversea countries for undergoing training, or the execution of training in Syria by inviting instructors from abroad.

As for the reinforcement of technical power of employees, ensuring of safe transport and so forth, there are some recommendable measures for steadily enhancing quality of employees, such as systematic execution of on-the-job training; establishment of new correspondence courses and so forth; in addition to the intensive training in training schools.

(5) Principle for promoting the projects in the future

For ensuring the successful implementation of the master plan, the following measures are recommended as ones which require urgent execution.

As for the GESR projects to be started in the 1st stage (short-term: 2001-2005), a feasibility study should be made for the Rehabilitation and Modernization of Existing Facilities projects and the new line construction projects. Then, after the confirmation of their feasibility, fund procurement and construction works should be started.

Investment amount in the first 5 years seems very large compared with that of other 5 years period. It is suggested to consider that execution of some projects in the first 5 years may be prolonged and investment amount of each five years may be leveled off.

As for the tasks in software aspects, necessary measures should be taken, starting from those practicable, by obtaining advice from experts of foreign countries which are advanced in railway technology and also by making internal analysis within GESR.

18.2.2 **GEHR**

(1) Gauge conversion

As a measure for promoting the development of GEHR, there is a method of enabling railway modernization by converting the track gauge from the present 1,050mm to 1,435mm. However, since this method requires a large amount of investment, it is

advisable to convert the existing meter-gauge railway tracks into standard-gauge ones after sufficiently analyzing the demand, profitability, and so forth.

(2) Ensuring of safety in train operation (Improvement of existing lines)

The GEHR projects are aiming at the development of tracks, level crossings, and signal facilities, and emphasis is placed on the safety in train operation. Therefore, it is recommendable for GEHR to study and implement concrete measures which can be realized at smallest amount of investment possible. These measures should urgently be taken, starting from those practicable.

To say nothing of the importance of safety training for employees, utmost efforts should also be made to prevent accidents. Effective preventive measures should urgently be established, on the basis of through analysis of past accidents including the probe into their causes. At that time, it should be sufficiently recognized that accident prevention cannot be perfectly realized by the dependence on human attentiveness alone.

In case economic feasibility of gauge conversion to standard gauge will be confirmed, rehabilitation/modernization of existing lines of meter gauge can be switched off to that through gauge conversion to standard gauge.

(3) Urban railway transport

GEHR is playing a role in local tourism. Another role of GEHR is the urban railway transport in Damascus City. In planning urban railway projects, it is necessary for GEHR to hold sufficient consultations with Damascus City, so that the projects can fully be coordinated with urban development plans and road transport. Furthermore, it is also advisable for GEHR to obtain financial assistance from the Government and Damascus City for realization of the projects.

(4) Management and Training

In recent years, GEHR has been placing emphasis on railway sectors. Therefore, it is necessary to expand the transport division of GEHR carefully, taking into consideration the profit produced by the real estate division and so forth. It is also important to pay attention to the control of personnel cost and other expenses. The deficit of the transport division should be kept strictly within the amount which can be covered by the total profit

of other divisions.

At present, personnel education in GEHR is depending on on-the-job training. For highly specialized railways, however, systematic training on such items as technology, safety, and customer service should be made. For this purpose, it is considered advisable for GEHR to entrust its personnel training to the GESR training institutions which have sufficient education facilities and instructors.