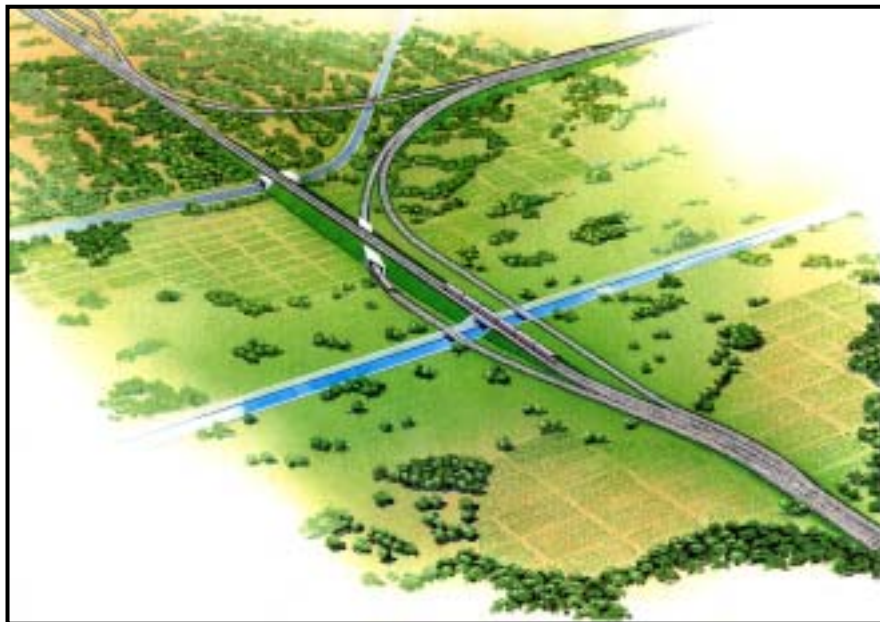


**The Master Plan Study on the Development
of Syrian Railways in the Syrian Arab Republic**

Volume II

**Feasibility Study
on
The Rehabilitation/Modernization
of
Tartous, Homs and Al-Sharqia Section**

**Final Report
(Summary)**



August, 2001

**Japan Railway Technical Service (JARTS)
Yachiyo Engineering CO., LTD. (YEC)**

SSF

JR

01-120
(5/6)

Exchange Rate of Currency

1 US\$ = 46 Syrian Pounds

1 US\$ = ¥115

1 Syrian Pound = ¥2.5

January, 2001

PREFACE

In response to a request from the Government of the Syrian Arab Republic, the Government of Japan decided to conduct a Master Plan Study on the Development of Syrian Railways in the Syrian Arab Republic and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Dr. Sadaaki Kuroda of Japan Railway Technical Service, and consist of Japan Railway Technical Service and Yachiyo Engineering Co., Ltd. to the Syrian Arab Republic, 3 times between April 2000 and August 2001.

In addition, JICA set up an advisory committee headed by Mr. Hiroshi Saeki, Director, Environmental Office, Railway Bureau, Ministry of Transport (present Ministry of Land, Infrastructure and Transport) between April 2000 and August 2001, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of the Syrian Arab Republic and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Syrian Arab Republic for their close cooperation extended to the Team.

August 2001



Kunihiko Saito

President

Japan International Cooperation Agency

August, 2001

Mr. Kunihiko SAITO
President
Japan International Cooperation Agency

Dear Sir,

Letter of Transmittal

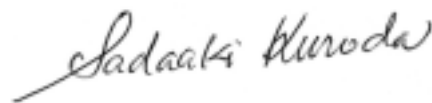
We have the pleasure of submitting herewith our Report for the Master Plan Study on the Development of Syrian Railways in the Syrian Arab Republic. The report describes the results of the Study carried out by Japan Railway Technical Service and Yachiyo Engineering Co. Ltd., as per the contract with Japan International Cooperation Agency.

The Study Team conducted field surveys three times during the period from April 2000 to August 2001. The Team held sufficient consultations with the Syrian governmental agencies concerned regarding the results of the field surveys and study activities in Japan, and drew up a master plan for the rehabilitation and modernization of the nationwide railway for the year 2020; phased rehabilitation and modernization plans for 2005 (short term), 2010 (medium term), and 2020 (long term); and two plans, as short-term urgent projects, on the rehabilitation and modernization of Tartous, Homs and Al-Sharqia section and on the locomotive workshop modernization. In close coordination with the Syrian side, the Team thereafter studied the feasibility of these plans from technical, environmental, economic, and financial aspects, and drew up this report.

From the standpoint of reinforcing the transport infrastructures necessary for the social and economic development of Syria, we would like to recommend the early implementation of the two projects: rehabilitation and modernization of the railway section between Tartous, Homs and Al-Sharqia; and locomotive workshop modernization.

We wish to express our sincere gratitude to the Japan International Cooperation Agency, the Ministry of Foreign Affairs, the Ministry of Land, Infrastructure and Transport, and the Japanese Embassy and JICA Office in Syria for the kind assistance and guidance extended to us in executing the Study.

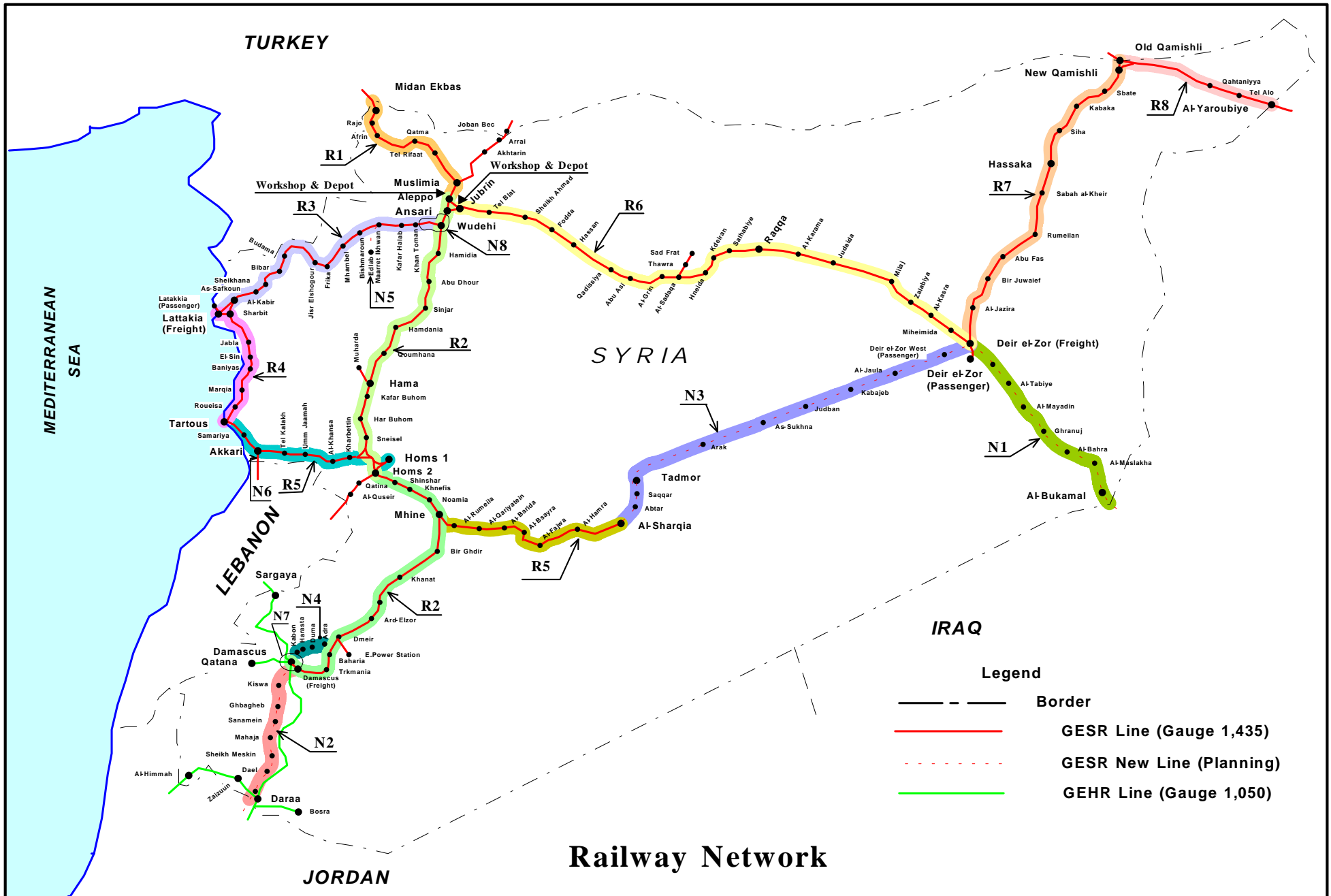
Yours faithfully,



Sadaaki KURODA, Dr. Eng.

Leader

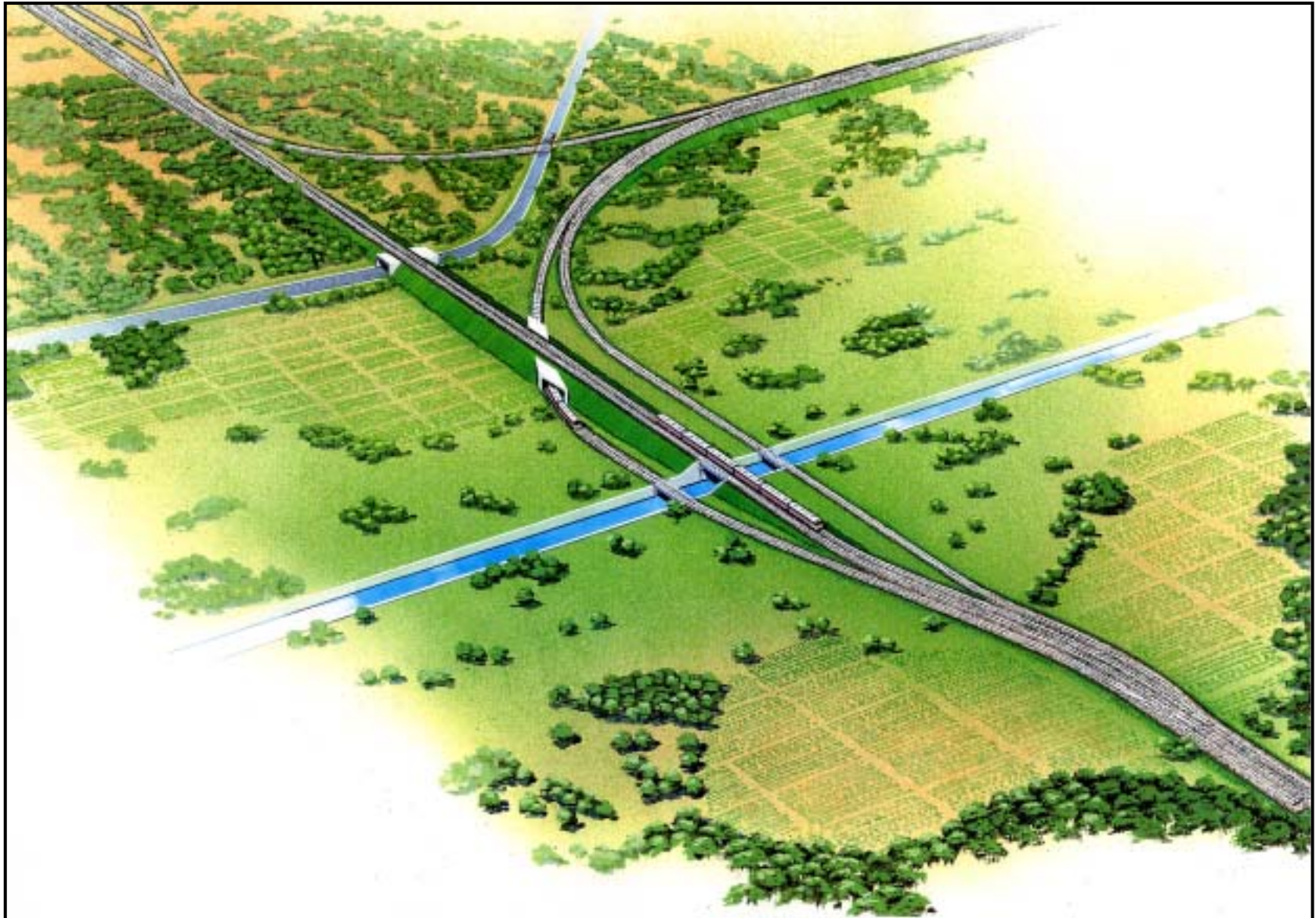
The Study Team for the Master Plan Study on the Development
of Syrian Railways in the Syrian Arab Republic



Railway Network



Route of the Project



Near by 5km

The Master Plan Study on the Development of Syrian Railways
in the Syrian Arab Republic
Volume

The Feasibility Study on the Rehabilitation/Modernization of Tartous,
Homs, and Al Sharqia Section
【Executive Summary】

Study Period : April 2000 ~ August 2001
Accepting Organization : Ministry of
Transport(MOT)
General Establishment of
Syrian Railways (GESR)

1. Objective of the Study

In this study, railway rehabilitation and modernization plans (improvement plans) are drawn up, in order to ensure safe and stable railway transport between Tartous, Homs, and Al Sharqia. Then, comprehensive evaluation is made concerning the feasibility of these improvement plans from technical, environmental, economic, and financial aspects.

At the same time, technology transfer to Syrian-side counterparts is carried out, through the implementation of the study.

2. Methods of the Study

(1) Process of the Study

At first, a master plan for the rehabilitation and modernization of GESR was drawn up. In the master plan, 13 projects for the rehabilitation and modernization of existing facilities were set up together with 9 projects for new line construction, as projects of GESR.

Then, respective projects were evaluated and given priorities, and phased improvement plans were drawn up based on priorities in consultation with the Syrian side.

Based on the results of the evaluation of respective projects and the consultations with the Syrian side, the railway rehabilitation and modernization project between Tartous, Homs, and Al Sharqia was selected as a short-term urgent project, together with the locomotive workshop modernization project. Then, it was decided to implement feasibility studies on each of these projects.

(2) Methods of the Study

In this study, the basic policies of the master plan formation were followed. At first, collection of supplementary materials and information was carried out in Syria together with a supplementary field reconnaissance.

Based on the collected materials and information and the results of the field reconnaissance, various data were analyzed and arranged. Thereafter, railway rehabilitation and improvement plans between Tartous, Homs, and Al Sharqia were drawn up. Then, comprehensive evaluation was made concerning the feasibility of the improvement plans through economic and financial analysis, and the report was compiled based on the study results.

3. Outline of the Project

3.1 Project Outline and Optimum Plan Selection

This project covers the route of about 270km running from Tartous (an important port for import and export) to Al Sharqia (with phosphate ore mines) via Homs and Mhine. For this route, the project aims at the rehabilitation and modernization of the existing track facilities, electric facilities and so forth; as well as the new construction of signal stations and double tracking for the smooth operation of trains which will be increased to cope with the growth of demand.

The section of about 40km between Akkari and Al Khansa has a steep gradient of 20‰ and is becoming bottleneck in transport. For double tracking of this section, two alternative plans (Alternative A and Alternative B) shown in Table 1 were set up and compared.

Table 1 Alternatives for Additional Track Construction between Akkari and Al Khansa

Alternative	Route	Max Gradient	Min Radius	Locomotive	Traction Force
A	Second track in parallel with the existing track	20‰	300m	2 LDE 3200	1800 t
B	Second track separate from the existing track	12‰	600m	1 LDE 3200	1800 t

The comparative study results concerning the two alternatives from various aspects are as shown in Table 2. Alternative A was finally selected as the superior plan.

Table 2 Evaluation of Alternatives by Various Aspects

Aspect	Transport and rolling stock aspects	Ground facilities aspect (track facilities, electric facilities)	Environmental aspect	Economic and financial aspects	Comprehensive evaluation
Alternative A					
Alternative B					

3.2 Main Data of the Project

(1) Estimated Traffic Volume

Table 3 Estimated Traffic Volume between Tartous, Homs, and Al Sharqia(per day per two ways)

Year	1999	2005	2010	2015	2020
No. of passengers	390	1,660	3,200	5,578	6,768
Passenger-km	40,393	157,888	364,512	583,139	733,923
Tons	8,139	15,142	26,500	44,250	71,212
Ton-km	1,665,845	2,751,711	4,921,746	7,337,964	10,957,060

(2) Train Operation and Rolling Stock

1) Maximum speed :

Diesel Car Passenger train : 130km/h (100km/h for passenger coach train by DEL traction)

Freight train : 100km/h

2) Operation safety system : Automatic block system

3) Number of Trains

Passenger train (Project adopting Alternative A)

Table 4 Number of Passenger Trains Per day per two way
unit : trains

Year	2005	2010	2015	2020
Tartous ~ Homs I	8	8	10	12
Homs I ~ Mhine	12	12	20	24
Mhine ~ Al Sharqia	0	4	6	6

Note : The numbers in Alternative B are the same as those in Alternative A.

Freight train (Project adopting Alternative A)

Table 5 Number of Freight Trains Per day per two way
unit : trains

Year	2005	2010	2015	2020	Remarks
<u>Tartous ~ Homs II</u>					
• Tartous ~ Akkari	30	48	68	98	
• Akkari ~ Al Khansa	40	66	94	138	Including deadhead trains
• Al Khansa ~ Homs II	30	48	68	98	
Homs II ~ Mhine	26	42	68	104	
<u>Mhine ~ Al Sharqia</u>					
• Mhine ~ Al Fajwa	14	24	32	62	
• Al Fajwa ~ Al Sharqia	12	22	30	60	

Note : In Alternative B, deadhead trains between Akkari and Al Khansa are unnecessary .
Excluding the section between Akkari and Al Khansa, the numbers of freight trains for Alternative B is the same as those for Alternative A.

4) Number of Necessary Rolling Stock (Project adopting Alternative A)

Table 6 Number of Necessary Rolling Stock unit : cars

Year	2005	2010	2015	2020	Remarks
Diesel locomotive	26	42	58	89	Including auxiliary locomotives
Diesel railcar	8	15	35	40	
Passenger coach	25	30	25	25	

Note : In Alternative B, auxiliary locomotives between Akkari and Al Khansa are unnecessary, accordingly, the number of necessary diesel locomotives is 23 cars for the year 2005; 37 cars for 2010; 51 cars for 2015; and 78 cars for 2020. The numbers of diesel car and passenger coach for Alternative B are the same as those for Alternative A.

(3) Amount of Investment

1) Amount of Investment

Project adopting Alternative A : 28.2 billion SP

Project adopting Alternative B : 31.6 billion SP

Breakdown by item :

Table 7 Amount of Investment unit : billion SP

Item	Track and structures	Signal and telecommunication	Rolling stock depot	Rolling stock	Total
Project adopting Alternative A	8.9	2.1	1.2	16.0	28.2
Project adopting Alternative B	13.2	2.2	1.2	15.0	31.6

2) Investment Schedule

Table 8 Investment Schedule

Railway Section	Item	2001 ~ 2005	2006 ~ 2010	2011 ~ 2015	2016 ~ 2020	Remarks	
Tartous - Homs	Structure and Track	=====	=====		-----		
	Signal and Telecom		=====	-----	-----		
	Loco & DC Depot		=====				
Homs - Mhine	Structure and Track	=====	=====				
	Signal and Telecom		=====	-----	-----		
	Loco & DC Depot	=====	=====				
Mhine - Al-Sharqia	Structure and Track	=====	=====				
	Signal and Telecom		=====	-----			
Rolling Stock	Locomotive	=====	=====	=====	=====		
	Diesel Car	=====	=====	=====	=====		
	Passenger Car	=====	=====	=====	=====		
	Freight Car	=====	=====	=====	=====		
Improvement Cost (million SP)	Alternative					Total	
	A		3,358	8,941	7,111	7,189	26,599
	B		3,358	12,271	6,925	6,822	29,376

Note :
 ===== Rehabilitation
 ===== Modernization
 ----- To cope with the increase of the traffic

“Improvement Cost” means the construction cost excluding engineering fee and contingency fee.

(4) Administration and Operation Cost

Table 9 Administration and Operation Cost unit : million SP

Year	2005	2010	2015	2020
Project adopting Alternative A	192	647	1,164	1,818
Project adopting Alternative B	191	701	1,202	1,836

(5) Economic and Financial Evaluation

Table 10 Economic and Financial Internal Rates of Return

Item	Economic Internal Rate of Return (EIRR)	Financial Internal Rate of Return (FIRR)
Project adopting Alternative A	20.5 %	7.3 %
Project adopting Alternative B	18.2 %	6.1 %

4. Comprehensive Evaluation of the Project (Conclusion)

- (1) This project aims at the rehabilitation and modernization of ground facilities (track, structures, signal and telecommunication facilities, rolling stock depot, etc.) as well as the reinforcement of transport capacity (by signal station construction or second track construction in parallel with the existing track.) and so forth. This project with these targets is technically feasible, and does not inflict large influence on the environment.
- (2) The EIRR of the project is 20.5 %. In view of this, and also taking into account other indirect benefits, the project is considered to be feasible from the national economic standpoint.
- (3) The FIRR of the project is 7.3%, and can be judged as financially viable from the enterprise view of GESR in case reasonable interest loan is applied to investment.
- (4) From the comprehensive standpoint, the project is considered to be very adequate one to rehabilitate and modernize an important route of GESR and is feasible from technical, environmental, economic, and financial aspects.
- (5) The execution of the project will enable stable railway transport between Tartous, Homs, and Al Sharqia, and will contribute to the promotion of sound socioeconomic activities in Syria.
- (6) For the effective implementation of the project, recommendations are made concerning smooth promotion of construction works; consideration for environmental

preservation; effective investment in facilities, rolling stock and so forth; and improvement of facilities maintenance and administration.

- (7) A detailed study on new line (separate route) construction plan between Akkari and Al Khansa is separately in progress at present in GESR. As described before, each project adopting either alternative for the section between Akkari and Al Khansa has been found feasible from economic and financial standpoints. Therefore, if GESR further promotes the detailed study on the above separate-route plan, including environmental assessment, and detailed construction cost, it may be meaningful that GESR may compare again a project adopting Alternative A and another adopting Alternative B.

Contents

Chapter 1 Introduction

- 1.1 Background of Project ----- 1 - 1
- 1.2 Urgency and Importance of the Project ----- 1 - 1

Chapter 2 Route Planning

- 2.1 Alignment of the Tartous–Homs–Mhine–and Al Sharqia Section ---- 2 - 1
- 2.2 Route Alternative between Akkari and Al-Khansa ----- 2 - 5

Chapter 3 Setting Up of Alternative Plans ----- 3 - 1

Chapter 4 Traffic Demand Forecast ----- 4 - 1

Chapter 5 Transportation Plan

- 5.1 Fundamental premises for setting up transportation plan ----- 5 - 1
- 5.2 Selection of hauling system by Alternative A ----- 5 - 2
- 5.3 Train operation plan of Alternative A ----- 5 - 4
- 5.4 Train operation plan of Alternative B ----- 5 - 6
- 5.5 Comparison of Alternative A and B ----- 5 - 9

Chapter 6 Plan of Rolling stock and Depot

- 6.1 Basic plan of rolling stock ----- 6 - 1
- 6.2 Basic plan of depots ----- 6 - 1
- 6.3 Places of periodical inspection of rolling stock ----- 6 - 2
- 6.4 Staged improvement plan and cost ----- 6 - 2
- 6.5 Education ----- 6 - 2

Chapter 7 Track Facilities Improvement

- 7.1 Concept of Track Facilities Improvement Plan ----- 7 - 1
- 7.2 Track Capacity Strengthening Plan ----- 7 - 2
- 7.3 Preliminary Design ----- 7 - 13
- 7.4 Work Execution Plan ----- 7 - 16
- 7.5 Outline of Construction Cost ----- 7 - 19

Chapter 8 Signal and Telecommunication Systems

- 8.1 Installation Scheme of Signal and Telecommunication ----- 8 - 1
- 8.2 Plan of Signal Equipment and Devices ----- 8 - 2
- 8.3 Plan of Telecommunication Equipment and Devices ----- 8 - 4
- 8.4 Maintenance Organization ----- 8 - 5

8.5	Phased investment plan for signal and telecommunication equipment -----	8 - 5
Chapter 9 Investment Planning in Staged Development Plan		
9.1	Precondition for Calculating the Amount of Investment -----	9 - 1
9.2	Investment Planning in the Staged Development Plan -----	9 - 3
9.3	Schedule of Investment -----	9 - 6
9.4	Organization for Staged Development Plan -----	9 - 7
Chapter 10 Administration and Operation Plan and Business Improvement Plan		
10.1	Administration and Operation Plan -----	10 - 1
10.2	Business Improvements Plan -----	10 - 4
Chapter 11 Economic and Financial Analysis		
11.1	Economic Analysis -----	11 - 1
11.2	Financial Analysis -----	11 - 8
Chapter 12 Environmental Impact Assessment		
12.1	Assessment Process -----	12 - 1
12.2	Environmental Setting -----	12 - 1
12.3	Impacts of Proposed Project -----	12 - 3
12.4	Evaluation -----	12 - 5
Chapter 13 Conclusion and Recommendation		
13.1	Conclusion -----	13 - 1
13.2	Recommendation -----	13 - 6

Abbreviation and Glossary

ADT	Average Daily Traffic
AOC	Administration and Operation Cost
ATP	Automatic Train Protection
ATS	Automatic Train Stop
B/C	Benefit Cost Ratio
BOD	Biochemical Oxygen Demand
CCITT (ITU-T)	International Telecommunication Union
CIF	Cost, Insurance and Freight
COD	Chemical Oxygen Demand
CONOCO	Continental Oil Company
CT	Closed Track Circuit
CTC	Centralized Traffic Control
DC	Diesel Car
DEL (LDE)	Diesel Electric Locomotive
DGMO	Director Generals of Middle East Railways
DHL	Diesel Hydraulic Locomotive
DL	Diesel Locomotive
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
FC	Freight Wagon
FIRR	Financial Internal Rate of Return
FS (F/S)	Feasibility Study
GCEA	General Council for Environmental Affairs
GDP	Gross Domestic Products
GEHR	General Establishment of Hidjaz Railways
GESR	General Establishment of Syrian Railways
GORS	General Organization of Remote Sensing
GRDP	Gross Regional Domestic Products
HID	High Intensity Discharge
HMIS	Highway Maintenance and Inspection System
HVAC	Heating, Ventilation and Air Conditioning
IEC	International Electro Technical Commission
IRI	International Roughness Index
ISO	International Standard Organization
JICA	Japan International Cooperation Agency
JR	Japan Railway

LED	Light Emitting Diode
MOF	Ministry of Finance
MOT	Ministry of Transport
MP (M/P)	Master Plan
MRT	Mass Rapid Transport
NDP	Net Domestic Products
NEAP	National Environmental Action Plan
NEEDS	Nikkei Economic Evaluation Data System
NPV	Net Present Value
OD	Origin-Destination
OJT	On the Job Training
OLTC	On Load Tap Changer
OT	Open Ticket Circuit
PABX	Private Automatic Branch Exchange
PC	Passenger Coach
PC sleeper	Prestressed concrete sleeper
ROC	Rail Operating Cost
ROI	Return on Investment
ROE	Return on Equity
ROUC	Rail Operating Unit Cost
ROW	Right of Way
SDH	Synchronous Digital Hierarchy
SL	Steam Locomotive
SS	Suspended Solides
TQC	Total Quality Control
TTC	Travel Time Cost
TTUC	Travel Time Unit Cost
TTUC	Travel Time Unit Value
UIC	International Railway Union
UN	United Nations
UNDP	United Nations Development Programme
VOC	Vehicle Operating Cost
VOUC	Vehicle Operating Unit Cost

Chapter 1 Introduction

1.1 Background of Project

The Rehabilitation/Modernization of Tartous, Homs and Al Sharqia Section has been rated as one of the top priority projects in the Master Plan through the comprehensive evaluation, and is scheduled to be started in the first stage. The implementation of a Feasibility Study of the Rehabilitation/Modernization of this section was proposed in the Interim Report. Thereafter, as a result of consultations with the Syrian side, this project was agreed upon between Syria and Japan on December 11, 2000 as one of the Short-term Urgent Projects for feasibility study.

1.2 Urgency and Importance of the Project

This project is important because its object route connects Tartous (a major port for import and export), Homs (the third largest city in Syria characterized by industry and high consumption), and Al Sharqia (with phosphate ore mines), constituting an essential freight transport line which has traffic volume of 30 to 40 % of the entire traffic of GESR. The main items carried are phosphate ore, oil, cement, foodstuff, cereals, and so forth.

In this important route, among the sections between Tartous and Homs, the track alignment is especially inferior between Akkari and Al Khansa, causing the bottlenecks of transport. Furthermore, the track capacity to meet the future demand is insufficient even on other sections, requiring double tracking or construction of new signal stations. In addition, it is necessary to take such measures as improvement of track, signal and telecommunication facilities. Therefore, it can be concluded that the implementation of the Rehabilitation/Modernization of this route is extremely urgent and important for Syria.

By the completion of the Rehabilitation/Modernization of Tartous, Homs and Al Sharqia Section, the bottlenecks of transport between Akkari and Al Khansa will be eliminated, and the transport capacity of other sections along the project route will be increased to meet the future traffic demand. Due to the improvement and modernization of railway facilities including track, signal and telecommunication facilities, and rolling stock depots, efficient,

safe, speedy and reliable passenger and freight transport will be ensured, contributing to sound social and economic development of Syria.

Chapter 2 Route Planning

The location of the route of the Project is as shown in Fig. 2. 1

2.1 Alignment of the Tartous – Homs – Mhine – and Al Sharqia Section

In Syria, located at the east end of the Mediterranean Sea, there is the Nusayriyah mountain range along the coast line, and along the boundary with Lebanon in the south the Lebanon mountain range exists. At the north side of the coast there is the Lattakia port, and Tartous port in the south of the coast. The railway line from the Lattakia port to Aleppo runs around the north end of the Nusayriyah mountain range and on the other hand, from the Tartous port, there is a railway line to Homs and Damascus going through between the Nusayriyah mountain range and the Lebanon mountain range.

For the route between Tartous – Homs, the line from Homs to Tripoli of Lebanon was constructed by the technology of France and agricultural products were transported from Syria towards Lebanon, however, in the latter part of 19th century, the volume of transported products reduced because of the change of situation. From the Tartous port to Homs, the railway line was constructed (Tartous – Akkari) and improved (Akkari – Homs) by the technical assistance of Russia, and in 1968, the line between Tartous and Akkari was opened for operation.

The section from Akkari to Homs was opened for traffic in 1979 upon improving the route constructed by France.

The route between Tartous – Samariyan to Akkari (app. 37km) runs on the flat plain from the coast to Akkari (alt. 59m) around the foot of the Nusayriyah range, although there are small ups and downs of 12‰ grade, having radius of curvature of R=1,200m or more, and there is no specific problem for the alignment.

From Akkari – Tel Kalakh – Umm Jaamah to Al-khansaa (app. 39km), the route goes into the mountain section with the grade of 20‰ and the radius of curvature of R=300 – 400m, crawling up the continuous ravine area.

On the way, train can pass by each other at Tel Kalakh (Alt. 240m). Once again the railway line goes up the ravine and crosses the pass at altitude of 302m and goes down to the basin at Umm Jaamah (Alt.270m). From Umm Jaamah basin, the railway line climbs up once again to the west end of the plateau (so called the Syrian desert) and reaches to Al Khansa. Along the route, the train climbing up will be split into two trains at Akkari and rejoin at Al-Khansa for going to Homs.

For sections of Al-Khansa –Kharbettin to Homs (app. 25km), trains will be arriving at Homs (alt. 505m) after going through gentle ups and downs over the plateau. In between this section, the steepest grade is 12‰ and the radius of curve is more than $R=600m$. Before reaching Homs, at so called “5km point”, the line will be merged by the trains coming from Aleppo. The line will be separated into two direction at about 2km point to Homs-1 (passenger station) in the north direction and to Homs-2 (freight station) in the south direction to Damascus.

The section between Homs and Mhine is about 64km length, which goes around the foot of the Sharqi mountain range lying at the boundary of Lebanon.

Station Mhine (alt. 890m) is situated on the mid-way of the trunk line between Aleppo and Damascus after crossing to the south over the pass of Altitude 935m of the Nasrani mountain chain which extends to the north east of the Sharqi mountain range. In this section, the route climbs up the grade of 10 – 12‰ and on the way at the nearby flat area, stations of Shinshar, Khnnefis and Naomia are located and used for passing-by of trains. Radius of curvature is almost $R=1,000m$ and more and these curves are connected with 2 - 8km straight line. As a conclusion, alignment of the section is favorable.

In the section between Mhine and Al-Sharqia of about 111 km, the route goes towards the center of the Syrian desert along the north side of the Nasrani mountain range and goes down to Al-Qariyatein at the altitude of about 710m. At the end of the Nasrani mountain range the line goes around in between Al-Barida (alt. 766m) – Al-Bsaya (alt. 767m) and then after going through the south side of Khunayzir mountain range, goes up to Al-Fajiwa where phosphate mine is situated.

Afterwards, the railway line goes down towards Al-Sharqia (Alt. 614m) where the largest phosphate mine of Syria is located.

The alignment is fairly excellent, having continuous ups and downs of grade of 11–12‰ with the radius of curvature of more than R=600m.

Alignment of each section is as shown in Table 2.1 and Table 2.2.

Table 2.1 Table of Gradient Between Tartous and Al-Sharqia

Gradient (‰)	Homs 1 - Tartous			Homs 1 - Mhine			Mhine - Al-Sharqia		
	Length (m)	(%)	No.	Length (m)	(%)	No.	Length (m)	(%)	No.
0 G < 1	23,069	22.6	48	8,490	12.5	16	13,762	12.4	27
1 G < 2	2,131	2.1	6	6,210	9.2	11	5,252	4.7	9
2 G < 3	6,249	6.1	12	6,250	9.2	14	5,965	5.4	13
3 G < 4	2,469	2.4	5	1,680	2.5	5	5,590	5.0	15
4 G < 5	2,258	2.2	6	3,440	5.1	9	8,857	8.0	20
5 G < 6	2,474	2.4	8	1,300	1.9	4	3,400	3.1	8
6 G < 7	3,160	3.1	9	2,787	4.1	8	5,310	4.8	13
7 G < 8	755	0.7	2	900	1.3	3	2,450	2.2	4
8 G < 9	2,186	2.1	5	2,280	3.4	7	5,350	4.8	13
9 G < 10	4,549	4.5	9	650	1.0	2	1,836	1.7	5
10 G < 11	7,289	7.1	13	2,590	3.8	5	6,050	5.5	9
11 G < 12	6,781	6.6	13	8,660	12.8	17	23,475	21.2	39
12 G < 13	14,241	13.9	28	22,556	33.3	19	23,475	21.2	31
13 G < 14	869	0.9	3						
14 G < 15	641	0.6	3						
15 G < 16	624	0.6	2						
16 G < 17	323	0.3	1						
17 G < 18	639	0.6	2						
18 G < 19	2,250	2.2	2						
19 G < 20	200	0.2	1						
20 G < 21	19,059	18.6	11						
Total	102,216	100.0	189	67,793	100.0	120	110,772	100.0	206

Table 2.2 Table of Curve Between Tartous and Al-Sharqia

Curve R (m)	Homs 1 - Tartous			Homs 1 - Mhine			Mhine - Al-Sharqia		
	Length (m)	(%)	No.	Length (m)	(%)	No.	Length (m)	(%)	No.
300 R < 400	15,542	15.2	42				350	0.3	1
400 R < 500	5,353	5.2	18	280	0.4	1			
500 R < 600	1,997	2.0	5				570	0.5	1
600 R < 700	7,498	7.3	13	3,306	4.9	5	17,840	16.1	27
700 R < 800									
800 R < 900				2,105	3.1	3	2,910	2.6	6
900 R < 1000	276	0.3	1						
1000 R < 1100	364	0.4	1	522	0.8	1	2,630	2.4	3
1100 R < 1200									
1200 R < 1300	4,367	4.3	9	2,045	3.0	3	11,150	10.1	21
1300 R < 1400									
1400 R < 1500									
1500 R < 1600	2,722	2.7	5	1,506	2.2	2			
1600 R < 1700									
1700 R < 1800									
1800 R < 1900	210	0.2	1						
1900 R < 2000									
2000 R < 3000	4,264	4.2	4	1,628	2.4	3	1,880	1.7	7
3000 R < 4000				2,211	3.3	4	280	0.3	1
Curve Total	42,593	41.7	99	13,603	20.1	22	37,610	34.0	67
Straight	59,623	58.3		54,190	79.9		73,162	66.0	
Total	102,216	100.0		67,793	100.0		110,772	100.0	

2.2 Route Alternative between Akkari and Al-Khansa

In the 39.4km section between Akkari and Al-Khansa, the section of 23.9 km (60%) is occupied by the consecutive steep grade and the many sharp curves. The gradient is more than 12‰ with the steepest grade of 20‰ and the most longest section of 20‰ extends for 7.4 km and the radius of curvature is mostly R=300m – 400m.

This will certainly impede the train operation for future increasing traffic and therefore it is planned to alternate the route with less than 12‰ of grade and more than R=600 m radius of curvature.

Alternating route which will be used as Alternative B route in the next chapter is shown in Fig.2. 2 and the alignments of the present route are shown in Table 2.3.

Table 2.3 Existing Alignment between Akkari and Al-Khansa

Gradient (‰)	Al-Khansa - Akkari			Curve R (m)	Al-Khansa - Akkari		
	Length (m)	(%)	No.		Length (m)	(%)	No.
0 G < 1	4,321	10.9	9	300 R < 400	15,542	39.1	42
2 G < 3	1,261	3.2	2	400 R < 500	5,114	12.9	17
3 G < 4	770	1.9	1	500 R < 600	1,337	3.4	3
4 G < 5	240	0.6	1	600 R < 700	459	1.2	3
5 G < 6	790	2.0	2	1000 R < 1100	364	0.9	1
6 G < 7	625	1.6	2	1200 R < 1300	372	0.9	2
8 G < 9	426	1.1	1	1500 R < 1600	571	1.4	1
9 G < 10	405	1.0	1	2000 R < 3000	1,143	2.9	1
10 G < 11	3,457	8.7	5	Curve Total	24,902	62.7	70
11 G < 12	591	1.5	1	Straight	14,820	37.3	
12 G < 13	2,231	5.6	5	Total	39,722	100.0	
13 G < 14	869	2.2	3				
14 G < 15	641	1.6	3				
15 G < 16	624	1.6	2				
16 G < 17	323	0.8	1				
17 G < 18	639	1.6	2				
18 G < 19	2,250	5.7	2				
19 G < 20	200	0.5	1				
20 G < 21	19,059	48.0	11				
Total	39,722	100.0	55				

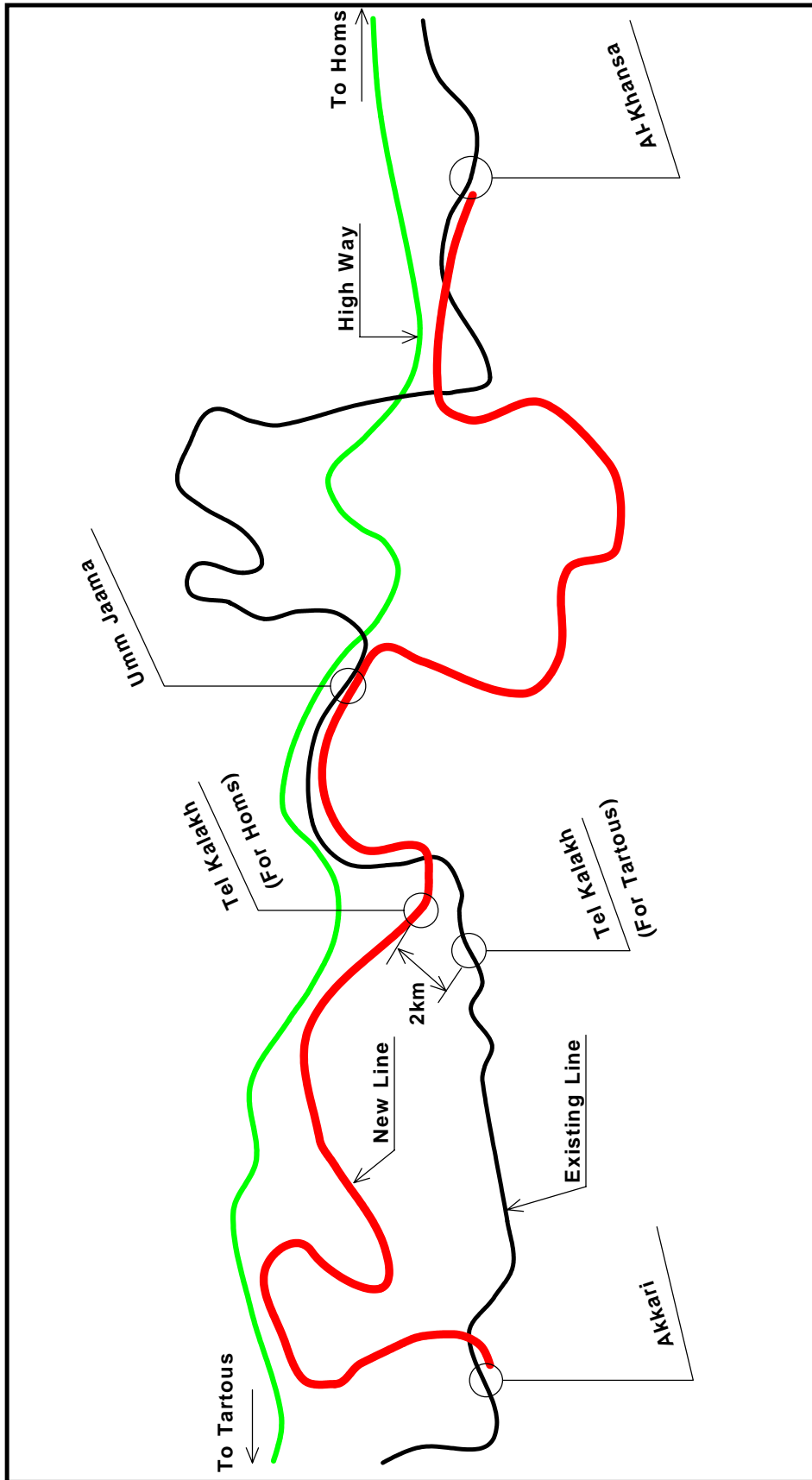


Fig.2.2 Railway Route Between Akkari and Al Khansa

Chapter 3 Setting Up of Alternative Plans

In planning the track addition (double tracking) on the section between Akkari and Al Khansa which is causing bottlenecks transport at present, the two alternatives shown in Table 3.1 are set up.

Table 3.1 Alternatives for Improvement of railway Transport
between Akkari and Al Khansa

Alternative	Case	Route	Max Gradient	Min Radius	Locomotive	Traction Force
A	A-1	Second track in parallel with the existing track	20‰	300 m	One LDE 3200	950 t
	A-2	Second track in parallel with the existing track	20‰	300 m	Two LDE 3200	1,800 t
B	-	Second track separately from the existing track	12‰	600 m	One LDE 3200	1,800 t

Chapter 4 Traffic Demand Forecast

Traffic demand of the Master Plan is applied to this Feasibility Study. Assumptions and procedures for demand forecast shall be referred to Chapter 7 of the Master Plan. Demands en route are illustrated in Figures of 4.1, 4.2 and 4.3. Also they are summarized in Table 4.1.

Table 4.1 Summary of Traffic Demand en Route (Maximum Demand in Section)

Section	Passenger (unit : person / day)					Freight (unit : ton / day)				
	2000	2005	2010	2015	2020	2000	2005	2010	2015	2020
Al-Sharqia - Mhine	0	0	830	1,216	1,366	2,969	5,872	12,110	16,926	24,297
Mhine - Homs	357	1,445	2,264	4,172	5,024	5,551	11,029	19,891	32,525	51,267
Homs - Tartous	21	630	1,132	1,608	2,342	4,445	12,942	20,980	30,608	44,988

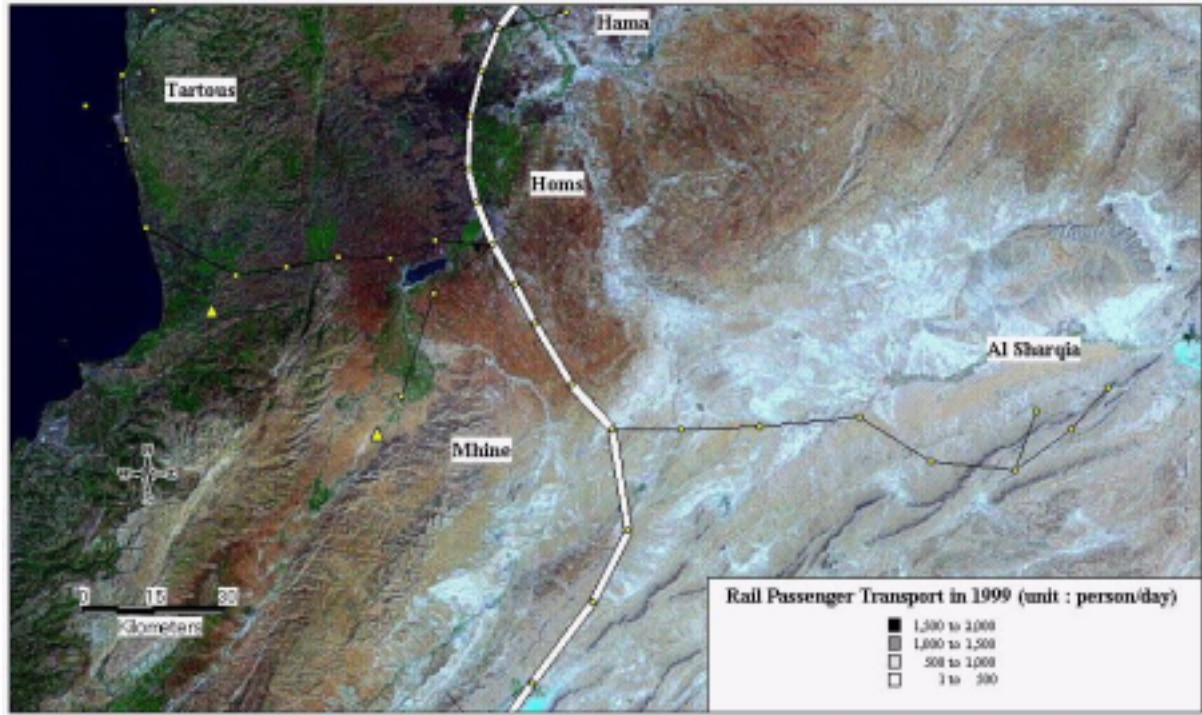


Figure 4.1(1) Traffic Demand en Route in 2000 (Passenger)

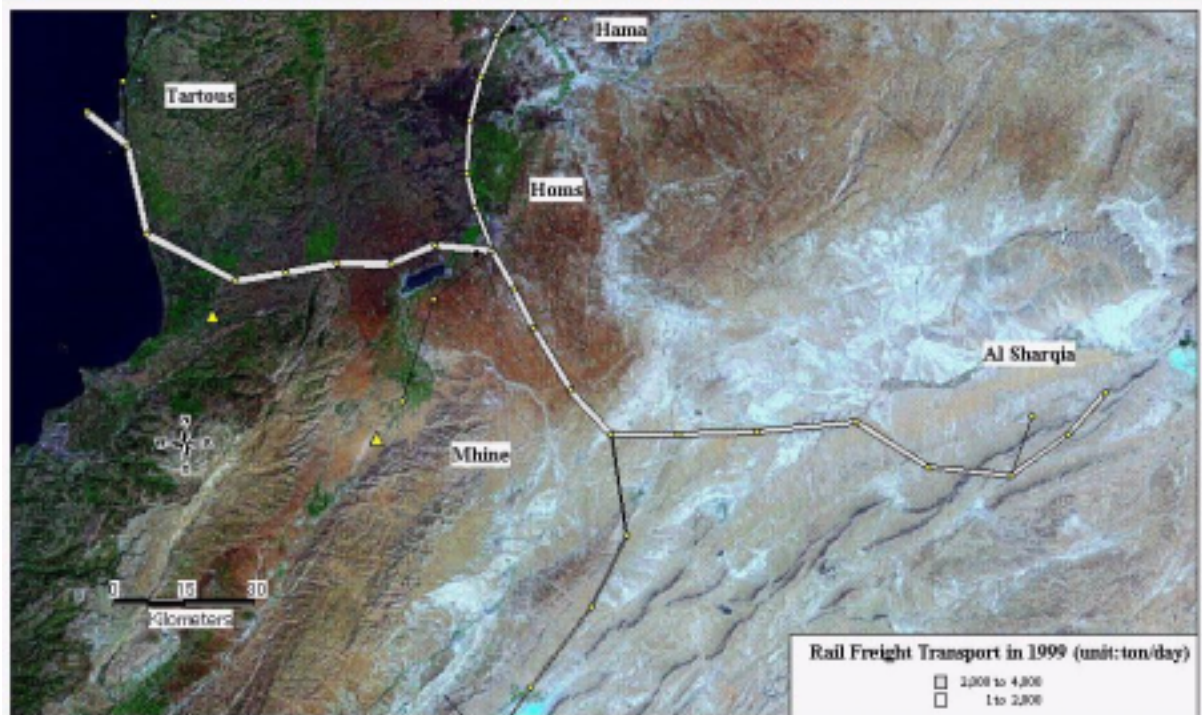


Figure 4.1(2) Traffic Demand en Route in 2000(Freight)