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Review of Railway Rehabilitation in Central Asia

for Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan

Module B - Feasibility Study of the rehabilitation measures for the Kungrad - Kazakh Border railway section (Uzbekistan)

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ABBREVIATIONS

ABLS	Automatic Block Line System
ADB	Asian Development Bank
ALC	Automatic Level Crossing
BC	Border crossing
CAR	Central Asian Republic
COTIF	Convention concerning the International Transport of Goods by Rail
CIS	Commonwealth of Independent States
CTC	Central Traffic Control
CWR	Continuous Welded Rail
EAEC	Euro Asian Economic Community
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ECE	UN Economic Commission for Europe
ECO	Economic Cooperation Organisation
ECMT	European Council of Ministers of Transport
EDD	Unified Transit Tariff
EIRR	Economic Internal Rate of Return
ERII	Electric Relay Interlocking Installation
EU	European Union
FSU	Former Soviet Union
GDP	Gross Domestic Product
IGC	Intergovermental Commission TRACECA
IMF	International Monetary Fund
IRU	International Road Transport Union
IsDB	Islamic Development Bank
JBIC	Japanese Bank for International Cooperation
KAZ	Kazakhstan
KGZ	Kyrgyz Republic
KTZ	Kazakhstan Temir Zholy (Kazakhstan national railways)
MLA	Multilateral Agreement on International Transport for Development of TRACECA
KZT	Kazakhstan Tenge
LC	Level Crossing
MKDII	Mechanic Key dependent Interlocking Installation
MOTC	Ministry of Transport and Communications
MTT	International Railway Tariff
OECD	Organisation of Economic Co-operation and Development
OSJD	Organisation for the Cooperation in Railways (based in Varshaw)
PRC	People's Republic of China
PW	Permanent Way (rails, sleepers, fastenings, ballast)
SIS	Static Interlocking System
SMGS	Agreement on International Railway Freight Transport
SPECA	Special Programme for the Economies in Central Asia
TA	Technical Assistance
TACIS	Technical Assistance for the Commonwealth of Independent States
TAJ	Tajikistan
TAR	Trans-Asian Railway
TEU	Twenty Foot Equivalent Unit
TIR	Transport International Routier
TOR	Terms of Reference
TRACECA	Transport Corridor Europe Caucasus Asia

UIC	Union International des Chemins of Fer (based in Paris)
UN	United Nations
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
USAID	United States Agency for International Development
USD	United States Dollar
UTY	Uzbek Temir Yullari (Uzbekistan national railways)
UZB	Uzbekistan
WTO	World Trade Organisation

TABLE OF CONTENTS

ANNEXES

Executive summary

The executive summary presents herein the contents of the Feasibility Study of the rehabilitation measures for the Kungrad - Kazakh Border railway section (in Uzbekistan), which is part of the Module B of the Project.

In fact one of the output of Module B is the "technical and economic feasibility study of the railway line sections previously identified in Kazakhstan, Kyrgyzstan and Uzbekistan".

Module B is composed by the following main activities for Kazakhstan, Kyrgyzstan and Uzbekistan:

B.1 - Traffic Analysis

B.2 - Technical Feasibility

B.3 - Environmental Impact

B.4 - Economic Viability

B.5 - Detailed Design

B.6 - Rehabilitation/construction implementation schedule

B.7 - Draft tender documents preparation

The Feasibility Study fully accomplished the first four activities listed above (B.1 to B.4).

The Feasibility Study is intended for supporting the creation of a financial mechanism for the implementation of measures needed for the revitalisation of the line. Consequently, the Uzbek Railways Company should use such tool for requesting support (i.e. internal funds, guarantees) to the government and for promoting the project vis-à-vis financial institutions.

In the following stage the Consultant will be, in accordance with the contract with the European Commission, developing a detailed design and tender documents for the most advantageous option generated by the present feasibility study.

Historically the section under study belongs to the line Kungrad - Beyneu (407 km) as it is shown in the following Fig. A.

Fig A- The Kungrad – Beyneu railway line

After the collapse of the former Soviet Union, the line has been split into two sections because of the introduction of the national border between Uzbekistan and Kazakhstan: the Kungrad – Border (327 km) and the Beyneu – Border (80 km).

Besides this fact, improvements along the main line have to be financed and managed by two different Railway Administrations. Consequently the study has to consider two different Feasibility Studies for rehabilitation measures concerning sections of the same line.

The importance of this line for Uzbekistan is without questions: the line is to be contributing significantly to the national economy giving access to important trade markets other than neighbouring countries.

As a matter of facts Uzbekistan is a double-land locked country and the infrastructural heritage from the former Soviet Union economy was inward oriented with relation with Russia more then with other countries. Actually this is reflected in the organisation of Uzbek railway network which has no connection with east and south and that can reach the most important trade markets only from three borders: Alat (mainly for reaching Europe and Middle East), Keles (most probably for China and Russia) and of course Karakalpakia (for Europe and Russia), the last-one passing through the Kungrad – Kazakh Border railway line.

The contents of each Chapter of the present report is shortly described hereafter to facilitate the reading of the entire document.

<u>Chapter 0</u> is the project synopsis while <u>Chapter 1</u> is the introduction to the Feasibility Study Report.

In <u>Chapter 2</u> the socio-economic background of the country is provided with specific focus on the low – Amu Darya Region, hinterland of the Kungrad – Karakalpakia railway section. Chapter 2 also deals with the general features of the transport sector in Uzbekistan and with the traffic modal distribution. Some considerations on the main aspects of the railway sub-sector are also included (institutional structure, infrastructure, rolling stock, development plans).

Traffic forecast is tackled in Chapter 3. Recent trends in railway traffic and present traffic along the TRACECA Corridor and along the Kungrad-Beyneu line are reported. Traffic forecasts have been evaluated both for passenger and for freight and two kinds of traffic have been distinguished:

- International traffic crossing the Uzbekistan – Kazakhstan border
- Domestic traffic within Uzbekistan.

In the following table the total freight traffic forecasts are summarized:

	All	Conservative			Optimistic		
	2003	2010	2015	2025	2010	2015	2025
North Bound							
TOTAL (million ton)	1.17	1,38	1,20	1,46	1,94	1,79	2,33
No Trains per day (*)	1.88	2,22	1,93	2,36	3,13	2,88	3,75
South Bound							
TOTAL (million ton)	1.96	3,03	2,87	3,16	4,04	4,30	5,58
No Trains per day (*)	3.16	4,88	4,62	5,09	6,51	6,93	9,00
Both direction							
TOTAL (million ton)	3.13	4,40	4,06	4,62	5,98	6,08	7,91
No Trains per day (*)	5.04	7,10	6,55	7,44	9,64	9,81	12,75

In the following table total passenger traffic forecasts are summarized:

Train Type	All	Conservative			Optimistic		
	2003	2010	2015	2025	2010	2015	2025
International Traffic	1.00	1.43	2.00	2.43	2.00	2.43	3.00
Local Trains	1.00	1.00	1.00	1.00	2.00	2.00	2.00

Also the possible diversion of traffic form other routes has been examined.

In Chapter 4 the description of the present situation of the line and the results of the analysis of its technical characteristics are provided. The following components have been duly investigated:

- Infrastructure (permanent way, structures, drainages, stations, level crossings, etc)
- Safety devices
- Telecommunication system
- Power supply system
- Operation.

Chapter 5 describes the measures and works which have been envisaged for the rehabilitation of the railway section. Three different rehabilitation options have been studied and for each option a description of the works to be performed and of the related improvements in terms of performances of the line are presented.

Option 1 represents the proposed low cost option, mainly consisting in the rehabilitation of the existing railway line between Kungrad and Kazakh border, excluding the rehabilitation of the stations (permanent way, buildings and passenger services) and including the power supply for 10 kV. It also includes works for the telecommunication system installation all over the line and it does not include any work for the safety devices.

Option 2 is the medium cost option, mainly consisting in the rehabilitation of the existing railway line between Kungrad and the border (as Option 1), including the rehabilitation of the stations. In the stations works include rehabilitation of the main track (running track), of the turnouts of the main track and of some platforms and buildings. Option 2 also includes, as Option 1, the power supply 10 kV and the telecommunication system construction. Finally Option 2 also envisages works for safety devices rehabilitation with two variants: only for the section from Jaslyk to the border (first priority) or all along the line.

Option 3 is the high cost option, mainly consisting in the rehabilitation of the existing railway line between Kungrad and the border, including the rehabilitation of the stations (as Option 2), with the additional works related to line doubling and line electrification. Option 3, has been developed by this Consultant only in order to comply with the Terms of Reference of the Study. Anyway, it is firmly underlined that this Option is not applicable to the current situation of the line under study. The cost analysis has been detailed in order to reach a reliable figure of investment, but the economic and financial study of this Option has not been carried out because investment cost, line capacity that would be reached, and electrification are not corresponding to the targets of this line and to the forecasted traffic flow.

The rehabilitation works have been aggregated in three main components:

- Infrastructure and power supply
- Telecommunications
- Safety devices

For each option and for each of these main components, the rehabilitation costs have been estimated (Chapter 6).

Chapter 7 tackles the issue of the Environmental Impact of the rehabilitation project. After an examination of the legislative Uzbek frame and of the natural environment along the line, the environmental impacts and effects during the rehabilitation period and during the operation period have been forecasted. Recommendations and mitigation measures, as well as a monitoring program, have also been proposed.

A preliminary implementation schedule of the rehabilitation options is included in Chapter 8.

The results of the assessment of the benefits following the project implementation are presented in Chapter 9. In accordance with the costs estimates, benefits have been associated to each work component (infrastructure, telecommunications and safety devices).

The economic and financial evaluations of the investments for the rehabilitation options are included in Chapter 10. Following the standard practice, the economic and financial justification of the project has been mapped by way of comparison of the discounted cost and benefit streams associated with the "base case" (without project) scenario and the "project case" (with project) scenario.

The results of the economic assessment of the considered project options are summarized in the following table, where Internal Rate of Return, Net Present Value (at a discount rate of 12%) and Benefit/Cost Ratio for Option 1 and Option 2 are compared.

	Option 1	*Option 2*
IRR	16.4	13,4
NPV (12% - ml US$)	26.4	10.4
BCR	1.42	1.13

Option 1 results to be the most advantageous one in economic and financial terms and so it is recommended for the implementation. Nevertheless also economic/financial indicators for Option 2 are suitable and since this can be seen as a further improvement of the Option 1, Option 2 could be implemented in the future in accordance with the traffic growth.

0. Project synopsis

Project Title:	Review of Railway Rehabilitation in Central Asia
Project Number:	65290 – EuropeAid/116151/C/SV/Multi
Country:	Kazakhstan, Kyrgyz Republic, Tajikistan, Uzbekistan

Wider project objectives: The development of viable, secure, safe and competitive transport routes linking the countries of Central Asia with Europe and other neighbouring countries. Strengthened border management capacity facilitating economic development, the movement of people and goods and the prevention of organised crime.

The object of the project is to carry out:

Module A / Analysis of the relevant national railway transport plans and any regional railway transport planning provisions.

Module B / Preparation of Technical and Economic Justifications to support and to attract the investments for the rehabilitation of railway lines in the Kyrgyz Republic, Kazakhstan and Uzbekistan for the purpose of increasing transportation capacities of these areas. Preparation of Feasibility study of measures for the maintenance, rehabilitation and renewal of the freight wagon fleet of the Tajik Railways.

Specific project objectives:

The project will carry out:

Module A /

- Overview of relevant traffic flows and forecasts, with special attention on freight transport from Central Asia towards Europe especially through TRACECA corridor;
- Identification of weaknesses and bottlenecks;
- Investigation on the cross-border elements, including co-operation in exchange of data and in customs (also with Afghanistan);
- Evaluation of multi-modal dimensions and possibilities for inter-operability;
- Harmonisation of standards and of operating procedures, with particular attention to compatibility with EU standards, in particular with regard to safety and security standards for the transportation of dangerous goods and oil products.

Module B /

Technical and Economic Feasibility Studies for the rehabilitation and construction of new railways lines. Pursuant to the Technical and Economic Justification data there will be prepared the loan applications to the lending banks for the allocation of investments to implement the projects.

Feasibility Study of measures for the maintenance, rehabilitation and renewal of the freight wagon fleet of the Tajik Railways.

Planned outputs:

Module A /

- Recommendations concerning multimodal transport
- Recommendations on harmonisation of standards and operating procedures and interoperability.
- Recommendations on improvements of border-crossing procedures.
- Traffic forecasts.
- Tentative prioritisation of recommended actions.

Module B /

- Technical and economic feasibility study of the railway line sections previously identified in Kazakhstan, Kyrgyzstan and Uzbekistan.
- Draft tender document for the same sections.
- Definition of a policy for the maintenance, rehabilitation and renewal of wagons in Tajikistan.
- Feasibility study and preparation of tender documents for rehabilitation and renewal of the existing workshops and maintenance plants in Tajikistan.

Project activities:

Module A /

A.1 – Collection and review of transport and economic studies. Data collection

A.2 – Overview of traffic flows

A.3 – Identification and review of physical, geopolitical, social and environmental issues

A.4 – Analysis of national railway transport plans and regional railway transport planning provisions.

A.5 – Traffic forecasts – Identification of capacity bottlenecks

A.6 – Investigation of border-crossing issues – Recommendations for improvement at borders

A.7 –Review of multimodal transport – Identification of development bottlenecks – Recommendations for improved services

A.8 – Harmonisation of standards and of operating procedures – Recommendations on standards adaptation and improved inter-operability

A.9 – Selection of railway section to be submitted to feasibility study under Module B

A.10 – Discussion with the Project Partners representatives

A.11 – Refining output of Module A

Module B /

Activities to be developed in Kazakhstan, Kyrgyzstan and Uzbekistan:

B.1 - Traffic Analysis

B.2 - Technical Feasibility

B.3 - Environmental Impact

B.4 - Economic Viability

B.5 - Detailed Design

B.6 - Rehabilitation/construction implementation schedule

B.7 - Draft tender documents preparation

Activities to be carried out in Tajikistan:

B.8 - Feasibility Study of measures for maintenance, rehabilitation and renewal of the freight wagon fleet of the Tajik Railways

Project starting date: 1 March 2004

Project duration: 18 months

1. Introduction

The present document is to report the conclusions of the feasibility study of the rehabilitation measures for the Kungrad – Kazakh border railway section in Uzbekistan.

Historically the section under study belongs to the line Kungrad - Beyneu (407 km) as it is shown in the following Fig. 1 – 1.

Fig 1 – 1- The Kungrad – Beyneu railway line

After the collapse of the former Soviet Union, the line has been split into two sections because of the introduction of the national border between Uzbekistan and Kazakhstan: the Kungrad – Border (327 km) and the Beyneu – Border (80 km).

The administrative change could not change so much the situation since the two sections are still working in conjunction. This is why the report is making continuous reference to the whole line.

Besides this fact, improvements along the main line have to be financed and managed by two different Railway Administrations. Consequently the study has to consider two different Feasibility Studies for rehabilitation measures concerning sections of the same line.

The importance of this line for Uzbekistan is without questions: the line is to be contributing significantly to the national economy giving access to important trade markets other than neighbouring countries.

As a matter of facts Uzbekistan is a double-land locked country and the infrastructural heritage from the former Soviet Union economy was inward oriented with relation with Russia more then with other countries. Actually this is reflected in the organisation of Uzbek railway network which has no connection with east and south and that can reach the most important trade markets only from three borders: Alat (mainly for reaching Europe and Middle East), Keles (most probably for China and Russia) and of course Karakalpakia (for Europe and Russia), the last-one passing through the Kungrad – Kazakh Border railway line.

2. Socio-economic background

2.1 General Features

Uzbekistan is located in the center of Central Asia. It is crossed or bordered by the two largest rivers in the region the Syr-Darya and the Amu-Darya that join in the Aral Sea. With an area of 447,400 sq.km including 22,000 under water it is the second largest republic in Central Asia. It has borders with Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Afghanistan. Outside river valleys the terrain is mostly of flat-to-rolling sandy desert with dunes but there are mountains at the south-east border. The climate is continental with long hot and dry summers.

The various khanats covering what is now Uzbekistan passed under Russian domination in the 19th century. After the Red Army got the upper hand an Uzbek Soviet Republic was created in 1924. Uzbekistan gained independence in 1991 at about the same time as other soviet republics of Central Asia. Since then its policy were to loosen its relations with Russia and with the CIS countries to strengthen them with countries of the region particularly China, Iran, Pakistan and more recently Afghanistan.

With an estimated population of over 26.4 million growing at an annual rate of 1.65 % per year it is the most populated of the five formerly soviet Central Asian republics. One third of the population is under 14 years old. 80% of the population is Uzbek with significant minorities of Russians, Tajiks, Kazakhs and Tatars.

2.2 Economic Profile

2.2.1 Economy

Uzbekistan is a dry, landlocked country of which 11% consists of intensely cultivated, irrigated river valleys. More than 60% of its population lives in densely populated rural communities. Uzbekistan is now the world's second-largest cotton exporter, a large producer of gold and oil, and a regionally significant producer of chemicals and machinery.

The main productions were as follows between 1986 and 2003 according to ADB calculations:

(in thousand tons)	1986	1991	1995	1999	2000	2001	2002	2003
Agriculture, *crop year*								
1. Seed cotton	4989	4646	3934	3600	3002	3265	3122	2823
2. Wheat	241	610	2347	3602	3532	3690	4967	5437
3. Rice	399	515	328	421	160	83	175	334
4. Barley	132	324	321	112	86	134	221	155
5. Corn	389	431	186	168	131	141	147	146
6. Potatoes	309	351	440	658	731	744	777	834
7. Vegetables	2491	3348	2725	2680	2645	2778	2936	3257
Mining								
1. Coal	5983	5948	3054	2956	2501	2711	2737	1910
2. Raw oil	2178	2831	7587	8145	7536	7256	7241	7134
3. Natural gas, *Bn cu. m.*	39	42	49	56	56	57	58	58

Manufacturing								
1. Cement	5425	6191	3419	3331	3284	3722	3927	4063
2. Steel	976	860	367	356	415	453	463	486
3. Rolled steel	835	761	322	325	372	402	420	447
Production Indexes								
Agriculture, *1989-91 = 100*	...	...	102	95	99	100	102	100
Mining, *1990 = 100*	99	96	103	98	102	103	103	...
Manufacturing, *1990 = 100*	89	102	100	107	107	109	110	...

Source: ADB Key Indicators 2004

According to the same source the share of agriculture in the GDP had remained nearly stable at about one fourth between the late soviet period and the most recent years. The share of industry dropped from 37 % in 1986 to 23 % in 2003. During the same period the share of the services rose from 38 % to 44 %.

According to World Bank calculations the annual growth in GDP was steady at about 4% between 1999 and 2003. During the same period the Gross National Income per capita calculated according to the Atlas method was falling from US$ 650 to US$ 420 while it was increasing significantly in other Central Asian countries.

2.2.2 Foreign Trade

The main export commodities in Uzbekistan are cotton (41.5% in 1998), gold (9.6%), energy products (9.6%), mineral fertilizers, ferrous metals, textiles, food products and automobiles. The main imports are machinery and equipment (49.8%), foodstuffs (16.4%), chemicals and metals

In 2003 the main destinations of exports was Russia (21.4%), Tajikistan (7.2%), Korea (5.3%), Turkey (4.9%), Kazakhstan (4.5%), Japan, Kyrgyzstan, Italy, Germany and Ukraine. The main sources of imports were Russia (21.7%), United States (11.4%), Germany (10.2%), Korea (9.5%), China (6.5%), Turkey, Kazakhstan, Tajikistan, Ukraine and France.

2.3 Low-Amu Darya Region, Hinterland of the Kungrad – Karakalpakia Railway Line

The Kungrad – Karakalpakia line section crosses in the Autonomous Republic of Karakalpakstan that is part of the Lower Amu-Darya Region. It is predominantly agricultural. Industry represents only about 7% of the regional gross product. In 2003 the Republic of Karakalpakstan had a population of 6.1 million and the Khoresm Region 5.5 million.

At that date the Republic of Karakalpakstan counted for only 2.3% of the national GDP, 2.6% of the agricultural output and 1.1% of the industrial output. The income per capita was about one fourth of that of Tashkent and of the Navoi Oblast that have the highest ones in the republic.

It should be noted that the traffic on the line section under consideration is largely independent of the economy of the region that is crossed as it is mostly made of through traffic.

2.4 The Transport Sector

2.4.1 General Features.

In 2003 the transport and communication sector represented just under 10% of the GDP. It employed about 250 thousand people that are 5% of the working population.

There are over 84 thousand kilometers of public roads 87% of which being paved. The pipeline network is of 13200 kilometers. Among the 3,950 km of railway lines 3,058 km are of main line 620 km being electrified.

2.4.2 Traffic Modal Distribution

The distribution of traffic volume between at the break-up of the Soviet Union and in 2003 was as follows.

Table 2.4.2 – 1 - Distribution of freight traffic by mode (million ton)

Mode	1991		2003	
	M.ton	%	M.ton	%
Railway	83.3	8.5%	45.1	6.4%
Road	855.8	87.5%	596.3	84.3%
Pipeline	37.6	3.8%	66.3	9.4%
Others	1.5	0.2%	0.1	0.0%
Total	978.3	100.0%	707.7	100.0%

Table 2.4.2 – 2 - Distribution of freight traffic by mode (billion ton-km)

Mode	1991		2003	
	B.ton-km	%	B.ton-km	%
Railway	73.7	61.4%	18.9	30.0%
Road	20.0	16.7%	9.6	15.2%
Pipeline	26.3	21.9%	34.5	54.7%
Others	0.1	0.1%	0.1	0.2%
Total	120.2	100.0%	63.1	100.0%

The share of the freight volume carried by the railways was only of 6.4 % in 2003 that is less than by pipeline. In term of ton-km the share was of 30% that is less than half what it was at the time of independence.

In 2003 the railways transported only 15.3 million passengers out of a total of 1472.6 million that is a share of 1 %. However in terms of passenger-km the share of railway transport was of 14%.

2.4.3 The Railway Sub-sector

Institutional Structure

The State Joint Stock Railway Company "Uzbekistan Temir Yullari" (UTY) was created in 1994 on the basis of the former soviet Central Asian Railways but with responsibility restricted to the national territory. UTY undertook restructuring in parallel with a thrust to rehabilitate main lines with outside financial assistance from ADB. Major changes already took place. In 1997 passenger services were detached and put under a separate company. In 2000 a marketing department was created.

A major step was made in March 2001 with a Government decree on demonopolisation and corporatisation of railway transport. It included the following measures:

- The management of UTY reports to a supervisory board including representatives of the Government as well as of users of its services;
- UTY activities are separated into:
  - Natural monopoly elements (infrastructure, traction, dispatching, power supply, signalling and communications) which remain in UTY under 100% state ownership
  - Potentially competitive elements (freight services, passenger services, container and refrigerated services, locomotives and wagons maintenance and repair workshops), scheduled for partial or total privatisation
  - Social services for railway employees remaining after most of them have been transferred to local government authorities;
- A state agency is created to regulate safety in rail transport;
- Tariff setting remains the responsibility of the Anti-Monopoly Committee.

In 2002 part of UTY activities were spun-off as joint-sock companies "Uzzheldorpass", "Uzzheldorcontainer", "Uzremwagon", "Dorreftrans" and the Tashkent facility for repair of passenger coaches are 51% owned by the state with 10% of the actions belonging to the personnel and the remaining 39% earmarked for sale to foreign investors. Substantial improvements were made in passenger transport with an increase in the train speed. For instance the 360 km between Tashkent and Samarkand are now covered in 3 hours 50 minutes.

Infrastructure

The goal of linking the various lines in the western part of the country without passing by Turkmen territory has already been achieved in the north with the construction of 341 km of new line linking Uchkuduk with Urgench and further with the Republic of Karakalpakstan. The last stretch constructed crosses the Amu-Darya River through a new 679 meter bridge.

In the south the connection of Samarkand and Karshi with Termez across national territory by constructing a new line Tashguzar – Boisun – Kumkurgan is progressing apace. A section of 56.7 km has already been open to traffic. 28 km of another section of 56.3 km have already been laid out. For the construction of the new line Uzbekistan obtained a loan of USD 150.5 million from the Japanese Bank for International Cooperation, one fifth of it being already disbursed.

Two loans have also been obtained from ADB and a third one is under way. The first loan – already completed - of an amount of USD 70 m is part of a USD 126 m project for the rehabilitation of the trunk line between the Kazakh border at Keles and Samarkand. The second loan also of USD 70 m is used for the rehabilitation of the line between Samarkand and Bukhara along with a loan of USD 5 m from the OPEC Fund and a national contribution of USD 80 m. The third loan will be used for the Marakand – Karshi line.

Rolling Stock

A workshop for the repair of passenger coaches was built in cooperation with Japan. It has a capacity of 450 wagons per year. EBRD provided a loan of USD 40 m for the procurement of 12 electrical locomotives from a Chinese supplier. It finances the overhaul of diesel locomotives and the modernisation of workshops at "Uzzheldorremmash". It also gives overall support to UTY restructuring. UTY has bilateral cooperation with a number of countries including Germany, USA and France.

Development Plans

The UTY priorities consists of the reinforcement of telecommunications by the utilisation of fibre optical cables, the procurement of new rolling stocks (electrical locomotives and wagons) as well as the modernisation of the existing one, the construction of new lines and the creation of an unified national network, the electrification of lines, the overhaul of tracks and the production of elements of line super-structure and spare parts.

The national network is made as less dependent from other countries as possible. The northern leg of this policy has been already completed with the construction of the line linking Uchkuduk with the far-north. Now maximal use is made of this new line to reduce the transit fees paid to Kazakhstan.

The southern leg is well under way. The construction of the new Tashguzar – Kumkurgan line mentioned above will provide direct access to Afghanistan where large groups of ethnic Uzbeks live. A new railway line linking Termez and Mazar-i-Sharif in Afghanistan is now under serious consideration with American financing. It can be seen as a segment of a railway route between Uzbekistan and the Persian Gulf that could be an alternative to the route crossing Turkmenistan.

The next large project could be the construction of a direct link between Tashkent and the Ferghana crossing a pass at an altitude of 2000 m. The project is more controversial because it has an essentially national character. If the construction of a new rail line across the Tien-Shan range makes it possible to connect China within the Ferghana Valley the resulting Trans-Asian Railway linking East Asia with Europe would logically follow the existing line along the Syr-Darya River across Tajikistan not the new line.

Those construction projects are costly and reduce the resources available to other tasks such as modernisation or rehabilitation.

3. Traffic Forecasts

3.1 Recent Trends in Railway Traffic

After the break-up of the Soviet Union there was a sharp fall in traffic as shown in the following table.

Traffic Type	1991	1995	1998	1999	2000	2001	2002	2003
Freight Traffic								
Volume (million ton)	83.3	46.9	41.8	41.8	42.3	41.5	44.0	45.1
Turnover (billion ton-km)	73.7	16.8	15.6	13.9	15.0	15.7	18.4	19.1
Passenger Traffic								
Volume (million pax)	15.6	15.8	15.2	13.4	14.6	15.0	14.9	15.3
Turnover (billion pax-km)	5.20	2.50	2.19	1.90	2.16	2.17	2.02	2.07

In the late nineties freight traffic volumes were only half of what they were in 1991 in terms of tons and even at only 20 % in terms of ton-km. For passenger the decline was less pronounced but the turnover at the lowest point was no more than one third of previous levels.

A recovery is taking place since 1999. It is more pronounced for freight than for passenger transport because it is later late the competition of road transport is more intense.

3.2 Traffic Distribution by Commodity

In 2003 the freight carried by the Uzbek Railways were distributed by commodity as follows:

Commodity	Volume (ton)	Share (%)
TOTAL	**51,192**	*100%*
Coal + Coke	2,368	*5%*
Ore	4,113	*8%*
Oil products	14,520	*28%*
Grain and cereals	2,355	*5%*
Chemical	3,439	*7%*
Construction materials	10,690	*21%*
Metal	1,657	*3%*
Wood products	728	*1%*
Others	11,324	*22%*

Oil products represented more than a fourth of the tonnage carried. The proportion was even higher in terms of ton-km.

3.3 Traffic along the TRACECA Corridor

The line under consideration is on one the TRACECA routes, the one linking Uzbekistan with Caucasus and further Europe through the port of Aktau. The traffic on that line is therefore partly linked with the prospects of the TRACECA corridor.

In recent years only a fraction of the railway traffic originating or ending in Uzbekistan was taking the TRACECA corridor. One reason is that trade relations with countries beyond the Caspian remain fairly small.

Table 3.3-1 – Trade of Uzbekistan with TRACECA countries in 2003

TRACECA Countries	**Total Trade**		**Export**		**Import**	
	Million USD	**Share (%)**	**Million USD**	**Share (%)**	**Million USD**	**Share (%)**
Total Uzbekistan	6689,2	100	3725,0	100	2964,2	100
TRACECA Countries	**1192,97**	**17,8**	**638,73**	**17,1**	**554,24**	**18,7**
Armenia	2,59	0,0	1,82	0,05	0.77	0,0
Azerbaijan	9,51	0,1	5,65	0,2	3,86	0,1
Bulgaria	3,76	0,1	0,79	0,02	2,97	0,1
Georgia	9,95	0,1	6,84	0,2	3,11	0,1
Kazakhstan	295,26	4,4	99,14	2,7	196,12	6,6
Kyrgyzstan	76,44	1,1	50,11	1,3	26,33	0,9
Moldavia	5,02	0,1	1,52	0,04	3,50	0,1
Mongolia	0,18	0,0	0,10	0,003	0,08	0,003
Romania	4,03	0,1	3,03	0,1	1,0	0,03
Tajikistan	145,8	2,2	121,51	3,3	24,29	0,8
Turkey	270,83	4,0	128,99	3,5	141,84	4,8
Turkmenistan	89,56	1,3	75,58	2,0	13,98	0,5
Ukraine	280,04	4,2	143,65	3,9	136,39	4,6

It should be noted that the countries bordering Uzbekistan represented a share of 9% that is almost half of the TRACECA total versus only 4.4 % for the countries on the TRACECA corridor beyond the Caspian Sea i.e. Azerbaijan, Georgia, Armenia, Turkey, Bulgaria and Romania. Energy represented 42% of exports to TRACECA countries, services 16%, metal 14% and cotton 4%. For the share was of 25% for machines and equipment, 16% for metals, 12% for energy and 11% for manufactured goods.

In addition there is a share of the Uzbek trade with Europe that takes the TRACECA corridor. The main flow is of cotton. After the TRACECA corridor was launched there was hope that Poti port could displaced Riga as the main trading center and export point for Uzbek cotton. But this did not materialize for several reasons including the lack of a trading environment in Poti and the presence of competitive route other then TRACECA. As a matter of facts Riga lost its preminent role but it was for the profit of the Iranian port of Bandar-Abas. The traffic of cotton transiting through that port went from 34,000 ton in 1996 to about 400,000 ton in 2003 representing two thirds of Uzbek cotton exports. That year only 30% went through Russian territory and 5% through TRACECA corridor. Most of the latter crossed the Caspian Sea from Aktau port rather than from Turmenbashi as was earlier the case. This means that it used the Kungrad-Beineu railway section.

3.4 Traffic on the Kungrad-Beineu Line

A processing of UTY statistics performed as part of the Module A of the present project provide 2003 traffic data by commodity group for the whole Naimankul – Akjigit section that includes the section under consideration. It is given in the table below that also show a breakdown of the line in three sections in 2000 as given by the TRACECA project " Traffic Forecasts and Feasibility Studies".

Table 3.4-1 Traffic volume on the Kungrad – Beineu Railway Line in 2000 and 2003 (thousand ton)

Commodity Group	Year 2000 (1)									Year 2003 (2)		
	Naimankul – Kungrad			Kungrad – Jaslyk			Jaslyk – Beineu			Naimankul - Akjigit		
	North - Bound	South - Bound	Both Directions	North - Bound	South - Bound	Both Directions	North - Bound	South - Bound	Both Directions	North - Bound	South - Bound	Both Directions
Coal						0			0	1	2	3
Coke		109	109		109	109		109	109	0	36	36
Ores		98	98		98	98		98	98	0	191	191
Oil products	179	73	252	122	60	182	122	61	183	138	138	276
Grain	2	62	64		35	35		35	35	2	4	7
Chemicals	49	3	52	31	43	74	31	43	74	15	95	110
From which Fertilizer	*9*		9		*21*	*21*		*21*	*21*	*4*	*18*	*22*
Construction mat.	314	24	338	56	26	82	1	16	17	673	22	694
From which Cement		*2*	2				*0*	*0*	*0*	*2*	*8*	*10*
Metal	7	96	103	2	95	97	0	95	95	168	225	393
From which Scrap		*2*	2		*2*	*2*		*2*	*2*	*0*	*3*	*3*
Wooden goods	2	25	27		35	35		37	37	1	31	32
From which timber		*13*	13		*18*	*18*		*19*	*19*	*0*	*0*	*0*
Other	611	554	1,165	956	555	1,511	1,013	545	1,558	439	784	1,223
From which Cotton	*344*		344	*349*		*349*	*353*	*0*	*353*	*255*	*0*	*255*
										0	0	
TOTAL	**1,164**	**1,044**	**2,208**	**1,167**	**1,056**	**2,223**	**1,167**	**1,039**	**2,206**	**1,436**	**1,528**	**2,964**

(1) Data collected by the TRACECA Project "Traffic Forecasts and Feasibility Studies"

(2) Data obtained by processing of UTY statistics

The above table shows that traffic volumes were in 2000 at similar levels all along the Naimankul – Beineu line although there was some difference in the distribution between commodities. The comparison of the 2000 and 2003 figures shows a substantial increase of one third between those two dates. The difference is mostly attributable to construction materials that appear to be used for the construction of a highway between Uzbekistan and Kazakhstan running nearly parallel to the railway line.

Another set of data made available by the processing carried out during the Module A is the matrix of flows between crossing points at foreign borders and either Uzbekistan regions or other crossing points. The table below shows the distribution by commodity of the flows crossing the Uzbekistan – Kazakhstan border.

Table 3.4-2 – Border Crossing Flows at Akjigit (Oasis) according to Uzbek sources (thousand ton)

Commodity Group	Border Crossing Uzbekistan – Kazakhstan at Akjigit								
	Kazakhstan - bound				Uzbekistan - bound				Total
	Uzbekistan Export	Transit from		Total	Uzbekistan Import	Transit to		Total	
		Turkmenistan	Tajikistan			Turkmenistan	Tajikistan		
Coal							2.0	2.0	2.0
Coke					3.1		32.4	35.5	35.5
Ores					0.1		190.6	190.7	190.7
Oil products	5.5	120.7		126.2	2.9		129.9	132.8	259.0
Grain	0.6			0.6	6.1		38.0	44.1	44.7
Chemicals					0.9	17.2		18.1	18.1
Construction mat.	1.8		1.1	2.9	4.3	16.3		20.6	23.5
Metal	0.2		167.3	167.5	79.8	128.3		208.1	375.6
Wooden goods			0.1	0.1	3.7	27.4		31.1	31.2
Other	254.5		156.5	411.0	395.2		297.6	692.8	1103.8
TOTAL	**262.6**	**120.7**	**325.0**	**708.3**	**496.1**	**189.2**	**690.5**	**1375.8**	**2084.1**

The above table is very valuable to analyze and forecast flows because it gives not only the volumes crossing the border but also their origin and destination either among the Uzbek regions or among the neighboring countries essentially Tajikistan and Turkmenistan. It is remarkable that Uzbek exports accounted for only just over one third of the goods leaving Uzbekistan. In the same way Uzbek imports accounted for only just over one third of the goods crossing the border at Akjigit. Almost two third of the freight leaving or entering Uzbekistan was transit cargo coming from or going to Tajikistan (49%) or Turkmenistan (15%).

Flow matrices relating border crossing points to regions or other border crossing points were also prepared under Module A for Kazakhstan for year 2003. The same format was already available for 2001 and 2000. The figures for the border crossing at Oasis / Akjigit are shown for imports into Kazakhstan and export from Kazakhstan and for transit related to three groups of borders i.e. Aktau port, Aksaraiskaya/Astrakhan and other crossing points with the Russian Federation.

Table 3.4-3 – Border Crossing Flows at Oasis (Akjigit) according to Kazakh sources (thousand ton)

Commodity Group	Border Crossing Uzbekistan - Kazakhstan at Oasis										
	Kazakhstan – bound					Uzbekistan – bound					Total
	Kazakh Import	Transit to			Total	Kazakh Export	Transit from			Total	
		Aktau	Astrakhan	Other Rus			Aktau	Astrakhan	Other Rus		
Year 2000											
Coal & Coke					0.00					0.00	0.00
Ores					0.00			0.10		0.10	0.10
Oil products					0.00			0.10		0.10	0.10
Grain					0.00					0.00	0.00
Chemicals					0.00				0.10	0.10	0.10
Construction mat.					0.00					0.00	0.00
Metal					0.00			0.20		0.20	0.20
Wooden goods					0.00					0.00	0.00
Other			0.60		0.60			0.50		0.50	1.10
TOTAL	**0.00**	**0.00**	**0.60**	**0.00**	**0.60**	**0.00**	**0.00**	**0.90**	**0.10**	**1.00**	**1.60**
Year 2001											
Coal & Coke			0.04		0.04					0.00	0.00
Ores			0.15		0.15					0.00	0.00
Oil products			0.06	0.01	0.07	0.04		0.02		0.06	0.13
Grain		0.09	0.09		0.18					0.00	0.18
Chemicals				0.08	0.08					0.00	0.08
Construction mat.			0.02	0.01	0.03	0.01				0.01	0.04
Metal			0.18	0.01	0.19					0.00	0.19
Wooden goods				0.01	0.01					0.00	0.01
Other	0.01	0.01	0.29	0.01	0.32	0.01		0.59	0.01	0.61	0.93
TOTAL	**0.01**	**0.10**	**0.83**	**0.13**	**1.07**	**0.06**	**0.00**	**0.61**	**0.01**	**0.68**	**1.75**
Year 2003											
Coal & Coke	0.00	0.00	0.00	0.00				0.03		0.03	0.03
Ores	0.00	0.00	0.00	0.00				0.20		0.20	0.20
Oil products			0.13		0.13	0.04		0.10		0.14	0.27
Grain					0.00			0.04		0.04	0.04
Chemicals									0.01	0.01	0.01
Construction mat.					0.00			0.03	0.01	0.04	0.04
Metal	0.00	0.00	0.00	0.00	0.00	0.02		0.04	0.01	0.07	0.07
Wooden goods					0.00			0.02	0.02	0.04	0.04
Other		0.01	0.09	0.17	0.27	0.01	0.02	0.32	1.53	1.88	2.15
TOTAL	**0.00**	**0.01**	**0.22**	**0.17**	**0.40**	**0.07**	**0.02**	**0.78**	**1.58**	**2.45**	**2.85**

What the above figures first show is that there were huge fluctuations in the traffic crossing the Uzbek – Kazakh border at Akjigit – Oasis border. In 2000 as in 2003 there was more traffic from Kazakhstan to Uzbekistan than in the opposite direction. On the contrary in 2001 the dominant traffic was from south to north. On the other hand there was a significant increase from under 2 million tons for the total traffic to 2,85 million tons, a rise of 43%. This is easy to explain by the fact that it was in 2001 that the new Navoi – Uchkuduk – Nukus by-passing Turkmenistan was fully open to traffic. It is the UTY policy to channel as much as possible of the north – south traffic through that route and there is some evidence that the full potential is not yet realized.

The comparison between Uzbek and Kazakh figures show that there is a remarkable consistency for all commodity groups except metal and "others". For metal the north bound traffic indicated by Uzbek statistics that corresponds to an export Tajikistan is remarkably consistent with the production by that country of huge quantities of aluminum that reached over 300,000 ton in 2002 more than half of it being sent to Europe.

For the "others" group the 0,7 million ton of south-bound traffic recorded by the UTY statistics represents only one third of the Kazakh figure. This may be due to the fact that the figures published in Uzbekistan do not include some kinds of traffic of a not strictly commercial type. This traffic will be treated separately for forecast purpose.

In addition to border crossing traffic the railway line is used for movements of a local nature. The main one is of construction materials that amounted to nearly 700,000 tons in 2003. This is considerably more than traffic recorded in 2000. There is evidence that that huge volume is linked with the construction of a highway that will link southern Karakalpakstan with Kazakhstan.

3.5 Role of the Kungrad – Beineu railway line section.

In Soviet times Uzbekistan could be seen as at the heart of Central Asia. It acted as a link not only between the various countries of the region but also between various parts of countries such as Kyrgyzstan and Tajikistan. Since the break-up of the Soviet Union interdependence between the formerly soviet countries has been steadily decreasing. It was at first as the result of the civil war in Tajikistan. As the relations between Uzbekistan and Turkmenistan changed what was the main east-west transport corridor in soviet times - that is between Fergana Valley and the port of Krasnovodsk that became Turkmenbashi – took less importance. The opening of a new link with Iran was looked at positively by Uzbekistan at first but now the pressure is mounting to by-pass it through Afghanistan.

The new policy could be seen as symbolized by the construction of the Transnational Highway linking the Ferghana valley in the east to the Karakalpakstan Republic in the north-west through Tashkent and the major cities of Samarkand, Bukhara and Nukus. The construction of an all-Uzbek railway link with the same goal is also under way. A major step was the opening of a new line connecting the trunk network with the Khoresm Vilayat and Karakalpakstan Republic through Uchkuduk. It will see its completion with the direct connection of Tashkent with the Ferghana Valley by the construction of a new Angren – Pap railway link cutting through mountainous areas.

With a normalization of the situation in Afghanistan this country has now given a new orientation to the development of the railway network. The new Guzar – Boisun – Kumkurgan railway line presently under construction with connect the center of the country with the northern region of Afghanistan with an important Uzbek minority and beyond it possibly with Iranian and Pakistanis ports.

The final railway network resulting of the implementation of the present plans will look like a five-pronged fork with a common trunk between Tashkent and Samarkand / Marokand.

- Two lines looking north in direction of Kazakhstan and Russia i.e. the line north of Tashkent and the one north of Kungrad that is the object of the feasibility study.

- In the east that is the one presently linking with Kyrgyzstan with an extension to China that could be expected in a not too distant future.
- In the west the line linking with Turkmenistan that may lose much of its importance if relations with Turkmenistan do not warm up.
- In the south the new connection with Afghanistan the role of which may depend on the evolution of the link with Turkmenistan.

It should be noted that the described pattern does not fit well with the development of a China – Europe corridor. In the highly competitive environment in which it must develop minimizing transport cost will be imperative. This gives a clear advantage to a link between the Ferghana Valley and central Uzbekistan through northern Tajikistan along the Syrdarya River.

In all cases the Kungrad – Beineu link will remain a strategically important one for Uzbekistan.

- For linking the country with Russia and through it with Europe it presents the advantage on the line north of Tashkent of having a much longer distance on Uzbek territory and of providing revenues to UTY, economic activity along the areas it crosses and savings of foreign currency that is still scarce.
- For using the TRACECA corridor passing by Aktau port instead of Turkmenbashi that may otherwise abuse of its monopoly situation.

It is worth noting that the Kungrad – Beineu railway line is also a vital one for Turkmenistan at least for now. It links this country to Kazakhstan and the Russian Federation. For the time being the alternatives are to use either un-sealed road links with Kazakhstan or ferry links with Makhachkala, Astrakhan or Baku. The on-going construction of a direct railway line between Ashgabat and Dashoguz not passing by Urgench should not involve much change in traffic level for the Kungrad – Beineu link. However in the very long term it maybe that Turkmens will implement their plans of building a new line between Turkmenbashi and Kazakhstan east of the Caspian Sea. If the project will go head the Turkmen traffic (which today is of around 15% only of the global freight traffic) along the Kungrad – Beyneu could be diverted to another line. This will of course not have any impact on the role of that line for Uzbekistan and certainly a marginal traffic on the Tajik and Kyrgyz traffic. Afghanistan may as well try to take advantage of the existence of competing routes.

3.6 Traffic Forecasts for the Railway Line Kungrad – Kazakh Border

3.6.1 Freight Traffic

For traffic forecasting two kinds of traffic are distinguished:

- International traffic crossing the Uzbekistan – Kazakhstan border
- Domestic traffic within Uzbekistan.

For international traffic the discrepancies between Uzbek and Kazakh statistics had to be taken into consideration. Traffic volumes are better explained by linking them to economic activities in separate countries such as Uzbekistan, Tajikistan and Turkmenistan. Since Uzbek statistics allow to identify origin and destination in those countries the Uzbek data was used as primary basis for the forecasts. However the traffic component apparently missing in Uzbek statistics was dealt with separately.

Forecast based on Uzbek Statistics

Forecasting is done according to the following approach:

- Base data as provided for 2003 by Uzbek statistics.
- Four target years as 2010, 2015, 2020 and 2025.
- Two scenarios: "conservative" and "optimistic"
- Ten commodities as defined in the traffic statistics

Change in traffic from a target year to the next one depends on four parameters. Two of them are not dependent on the commodity group.

- GDP change rate for each of the three countries under consideration.
- Percentage of the flows taking the considered railway line.

The two other have different values for each commodity group.

- Elasticity trade change / GDP change
- Indicator of trade orientation to a geographical area.

GDP growth rates start from slightly higher values than those recently recorded 5% in Uzbekistan, 9% in Tajikistan and 10% in Turkmenistan. They get lower with time with higher values in the high scenario and lower for the low scenario.

The percentage of flows taking the line is made dependent on the opening or improvement of lines. When a new north – south link opens in Turkmenistan the share of the Turkmen traffic routed through Kungrad will obviously decreases up to possibly reaching very low levels particularly in the low scenario.

The indicator of trade orientation is intended to take into consideration the fact that the relative importance of markets is changing with time as it has been for instance clearly the case for cotton. It is likely that the dominance of Russia in the trade of Central Asian countries will progressively be reduced. This will tend to lower the traffic on the Kungrad-Beineu line. This change is of course felt more strongly in the low scenario.

The following table displays the result of the calculation by commodity type for the two scenarios.

Table 3.6-1 – 1 Traffic forecasts based on Uzbek statistics (thousand ton)

Commodity Group	All	Conservative			Optimistic		
	2003	2010	2015	2025	2010	2015	2025
North Bound							
Coal	0	0	0	0	0	0	0
Coke	0	0	0	0	0	0	0
Ores	0	0	0	0	0	0	0
Oil products	126	267	149	11	330	254	34
Grain	1	1	1	1	1	1	1
Chemicals	0	0	0	0	0	0	0
Construction mat.	3	3	4	5	5	6	8
Metal	168	225	274	382	318	441	650
Wooden goods	0	0	0	0	0	0	0
Other	411	500	568	711	653	833	1096
TOTAL	***708***	***996***	***995***	***1110***	***1307***	***1536***	***1790***

South Bound							
Coal	2	3	3	2	3	4	4
Coke	36	53	65	60	60	79	121
Ores	191	286	356	319	327	437	673
Oil products	133	241	312	300	292	412	684
Grain	44	62	77	67	70	92	129
Chemicals	18	30	17	4	35	27	4
Construction mat.	21	36	23	10	42	36	11
Metal	208	344	249	162	404	353	195
Wooden goods	31	53	32	11	62	50	13
Other	693	977	1178	1184	1112	1431	1895
TOTAL	***1376***	***2085***	***2314***	***2120***	***2407***	***2922***	***3728***

There is a large difference between traffic volumes for the various scenarios. This is not surprising since there is significant uncertainty for the factors determining the growth in traffic such as GDP growth rate in the various countries, interrelation between GDP variations and change in foreign trade patterns, redistribution of trade flows between geographical areas, construction of new lines notably in Turkmenistan that may lead to route diversion.

To the above considered traffic should be added:

- The traffic shown in Kazak statistics and not reflected in Uzbek figures. The resulting adjustment assumes that this traffic is temporary.
- The potential traffic that could be attracted from other routes. An obvious possibility corresponds to the freight presently moving between the Tashkent area and either Aktau or Aksaraiskaya/Astrakhan.
- The local traffic presently consisting mostly of construction materials.

Table 3.6-1 – 2 Traffic forecasts for the Kungrad – Kazakh border railway line (million ton)

Commodity Group	All	Conservative			Optimistic		
	2003	2010	2015	2025	2010	2015	2025
North Bound							
International Traffic							
Uzbek data based	0.41	1,00	1,00	1,11	1,31	1,54	1,79
Local Traffic							
Construction Mat.	0.70	0,31	0,09	0,13	0,55	0,11	0,20
Others	0.06	0,08	0,11	0,22	0,09	0,14	0,33
TOTAL (million ton)	1.17	1,38	1,20	1,46	1,94	1,79	2,33
No Trains per day (*)	1.88	2,22	1,93	2,36	3,13	2,88	3,75

South Bound							
International Traffic							
Uzbek data based	0.69	2,09	2,31	2,12	2,41	2,92	3,73
Adjustment	1.07	0,54	0,00	0,00	1,07	0,54	0,00
Attracted traffic	0.00	0,15	0,19	0,31	0,27	0,38	0,75
Local Traffic							
All commodities	0.19	0,25	0,37	0,73	0,29	0,46	1,11
TOTAL (million ton)	1.96	3,03	2,87	3,16	4,04	4,30	5,58
No Trains per day (*)	3.16	4,88	4,62	5,09	6,51	6,93	9,00
Both direction							
TOTAL (million ton)	3.13	4,40	4,06	4,62	5,98	6,08	7,91
No Trains per day (*)	5.04	7,10	6,55	7,44	9,64	9,81	12,75
(*) On the basis of trains carrying 1,700 tons							

The above figures don't take into consideration freight flows that may appear in the future such as those linked with the construction of a direct railway link between Uzbekistan and Afghanistan.

The "conservative" scenario shows remarkably the influence of the rerouting of the Turkmen portion of the traffic. In this scenario it has been assumed conservatively that in 2015 a new possible corridor along the Caspian Sea coast can be in place. The new alignment has been already planned and agreed among concerned parties, it is intended to be reaching Aktau without touching Uzbekistan and so it will be in close competition with the line under study.

For the purposes of the economic analysis the average traffic between the "conservative" and "optimistic" scenarios has been considered.

3.6.2 Passenger Traffic.

There is presently a local daily train in each direction between Kungrad and Beineu. There are also seven international through trains per week in each direction, six of them being Tajik and the other Uzbek.

Table 3.6-2 – 1 Traffic forecasts for passenger trains (number of pairs of trains)

Train Type	All	Conservative			Optimistic		
	2003	2010	2015	2025	2010	2015	2025
International Traffic	1.00	1.43	2.00	2.43	2.00	2.43	3.00
Local Trains	1.00	1.00	1.00	1.00	2.00	2.00	2.00

For the purposes of the economic analysis the average traffic between the "conservative" and "optimistic" scenarios has been considered.

3.6.3 Potential diverted traffic

According to the statistics available from both Uzbek and Kazakh side, part of the traffic leaving Uzbekistan is adopting the route passing thought Keles for reaching Aktau or Astrakhan from where it reaches the final destination.

This is not the shortest trip in terms of kilometers while the shortest trip is to be using Akjigit and so the corridor under the study.

Since rehabilitation will make the whole corridor more palatable, a more natural re-routing could be certainly expected as a consequence of the intervention.

The assumptions made are that 50 % of the traffic actually going to Aktau and 20% actually going to Astrakhan both through Keles can be diverted to the existing line. All those considerations were reflected in Table 3.6.1-2.

4. Characteristics of existing lines and stations

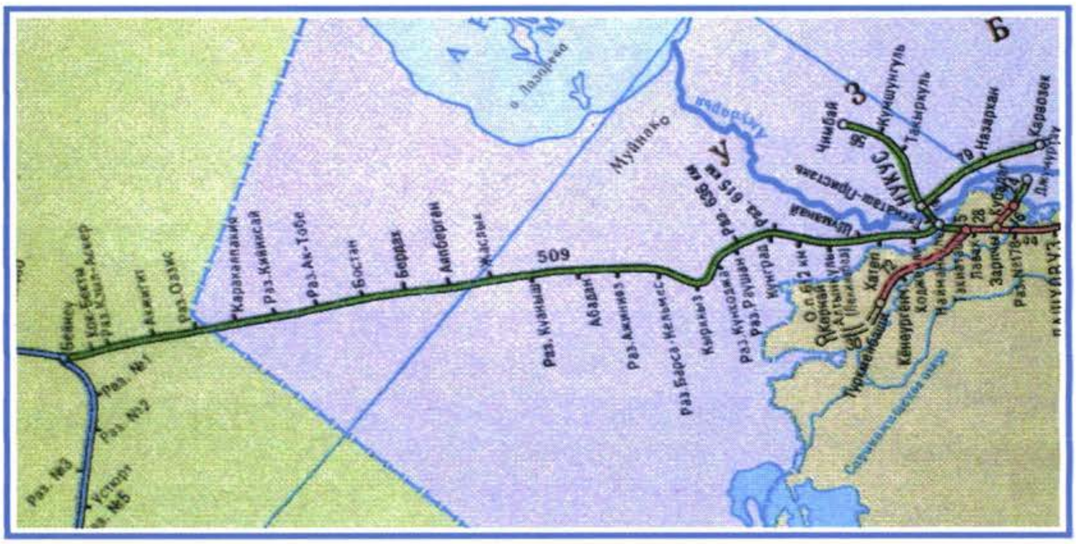
The line under study is the Kungrad – Kazakh border railway line section (327 km), belonging to the line Kungrad-Beyneu (407 km) which is located between Uzbekistan and Kazakhstan.

The following Fig. 4-1 shows the area interested by the line.

Fig 4 – 1- The Kungrad – Beyneu railway line

Details of the line are shown in the next Fig. 4-2.

Fig 4 – 2 Details of Kungrad-Beyneu railway line



In the following part of the document description is made of the main technical aspects of the line:

- Infrastructure (including PW, earthworks and structures, stations and LC),
- Safety devices,
- Telecommunications,
- Power supply.

4.1 Infrastructure

4.1.1 Permanent Way and earthworks

The description of the existing Kungrad - Kazak border section has to be referred to Kungrad – Beyneu line and has to be done in the frame of the definitions established for lines by the order 70"H" dated 09.11.95, concerning types and elements of permanent way, track works, maintenance and periodicity of their execution.

From the following tables 4.1.1 – 1 and 4.1.1 - 2 the line classification in **categories**, by their technical characteristics, and in **groups,** by density of freight traffic, is possible.

Table 4.1.1 – 1 - Track classification (decree 70"H" of 09.11.95)

Track group	Density of freight traffic, mln. tkm gross weight km/per year	Track category						
		1	2	3	4	5	6	7
		Speed: passenger trains is numerator; freight trains is denominator, km/h						Station, branch and other tracks
		121-140	101-120	81-100	61-80	41-60	40 and less	
		> 80	> 70	> 60	> 50	> 40	main reception/departure tracks	
		Main tracks						
A	> 80	1	1	1	2	2	3	
B	50-80	1	1	2	2	3	3	
C	25-50	1	2	2	3	3	4	5 class
D	10-25	1	2	3	3	4	4	
E	10 and less	2	2	3	3	4	4	

Considering that the section under study had in the last years a freight traffic of 1,5÷2,0*10^6 gross tons/year, and that, on almost all the section, the speed is for the time being 50-60 km/h and that old wooden sleepers and worn out P50 rails are installed on the major part of the section, it is possible to conclude that this line is currently classified as an **E5 line**.

We will come back on this classification in the next Chapters and paragraphs.

Table 4.1.1 - 2 Technical terms and conditions for track laying and maintenance according to its class (decree 70"H" of 09.11.1995)

<table>
<tr><th colspan="5">Track class</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr>
<tr><td colspan="5">1. Superstructure constructions

Continuous welded rail (CWR) tracks on reinforced concrete sleepers or link track on timber sleepers</td></tr>
<tr><td colspan="5">2. Types and characteristics of superstructure</td></tr>
<tr><td colspan="2">New temperature –resistant R65 rails, 1 group, 1 class; new fastenings; new sleepers (impregnated timber, 1 group). Sleepers profile: on direct lines and curves R>1200 m - 1840 pcs/km; on curves with R<1200 m and less - 2000 pcs/km. Ballast: gravel or asbestos with the layer depth of 35 cm under timber sleepers; 40 cm – under reinforced concrete sleepers;</td><td>New R65 rails or used ones in accordance with the Table 2.3.

New or repaired used fastenings and sleepers – in accordance with Technical Conditions for the usage of used superstructure materials. Profile and the group of rails are the same as on the 1st and 2nd class tracks.

Gravel or asbestos ballast, with layer depth of 25 cm under timber rails and 30 cm under reinforced concrete sleepers.</td><td>Used R65 rails – in accordance with the Technical Conditions for the usage of used superstructure rails. Used fastenings and sleepers, as a rule repaired ones.

Sleeper profile is the same as on the 1 - 3 class rails. The laying of new sleepers of 2nd group is allowed.

Ballast: gravel, asbestos, gravel and sand with layer depth of 20 cm under timber sleepers and 25 cm under reinforced concrete ones.</td><td>Rails, fastenings and sleepers are all used ones of all types, including the ones unusable in track laying of the 3rd and 4th class but not lighter than R 43.

Interlacing of used reinforced concrete sleepers with timber ones is allowed.

Sleepers profile: 1440 pcs/km on direct lines; 1600 pcs/km on curves with R< 650 m.

Ballast depth underneath the sleeper not less than 15 cm.</td></tr>
</table>

Alignment

The section length is 327 km, mostly on straight, being the total curves length only 20,5 km. Every circular curve is provided with parabolic transition curves at the beginning and at the end.

The maximum allowed load is 23 t/axle.

Line formation

Along the Kungrad – Kazak border section the track formation is represented mainly by embankments 1÷2 m high with the exception of the line stretch from the Amu-Darya floodplain to Ustyurt plateau (chainages from km 745 to km 747), where the embankment height reaches up to 7.0 m.

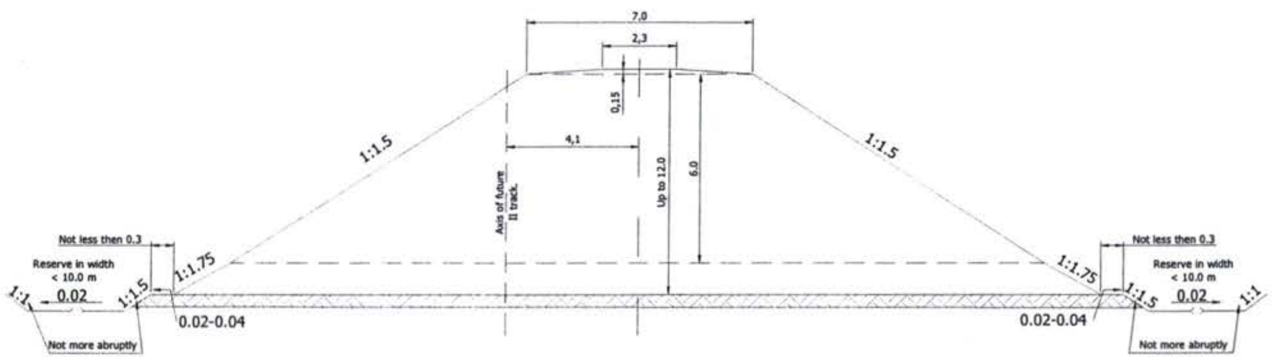
The top surface of the embankment width varies from 6,0 m to 7,1 m.

The embankment is built with local soil represented by clayey and sandy materials.

On this track section no problem related to geology, instability of soil, seismology has been detected.

The typical cross section of embankments is shown in fig. 4.1.1 – 1; it can be observed the slope of about 6% towards both sides, starting from a central strip 2,3 m wide.

Fig. 4.1.1 – 1



Typical cross structure of embankment in height up to 12 m from clay soils, fine and powdery sand and it is easy weathered rock.
The note: At erection of embankments from dry sand with a corner of a natural slope less than 340 their slopes are arranged more gentle slope .

Superstructure

The typical superstructure cross-sections on straight track and on curve are shown in fig.4.1.1 – 2. On the top surface of the embankment is laid down a sandy gravel layer 0,2÷0,3 m thick, and a ballast layer 0,20÷0,35 m thick under sleepers.

Along the main line of the track section the study is taking into consideration,

- the sandy gravel layer and the ballast layer are, respectively, 0,2 and 0,3 m thick,

- both wooden and concrete sleepers are installed (see fig. 4.1.1 – 3 and 4.1.1 – 4); they are laid down at a distance of 0,55 m / 0,50 m between their axels on straight / on curves of radius less than 1200 m (1840 / 2000 sleepers per km),
- P50 and P65 type of rails are laid down (see fig. 4.1.1 – 5),
- fastenings rail-wooden sleepers and rail-reinforced concrete sleepers are shown in fig. 4.1.1 – 6.

Fig. 4.1.1 – 2 Types of superstructure on straight track sections at a formation width 7,0 m

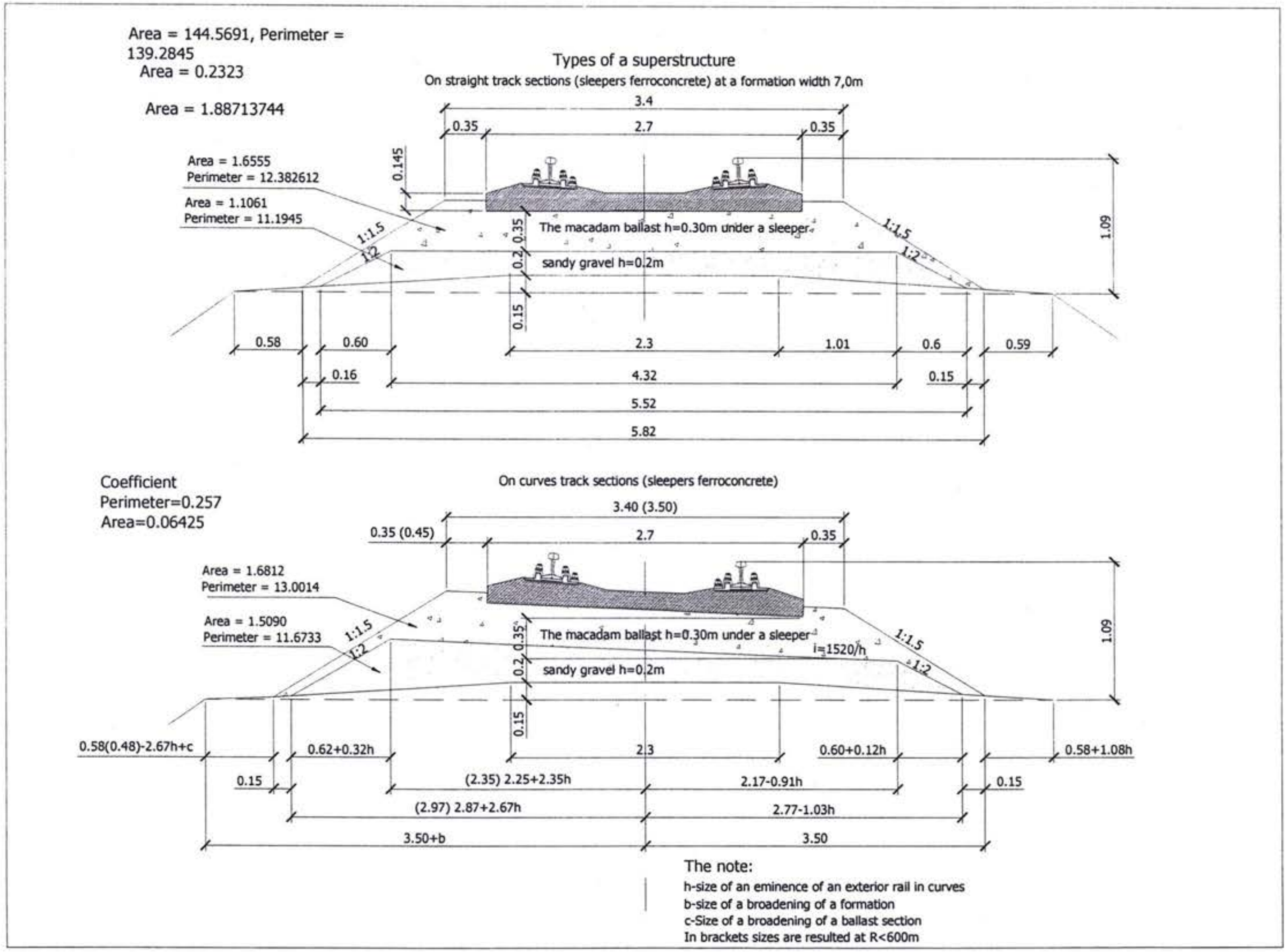
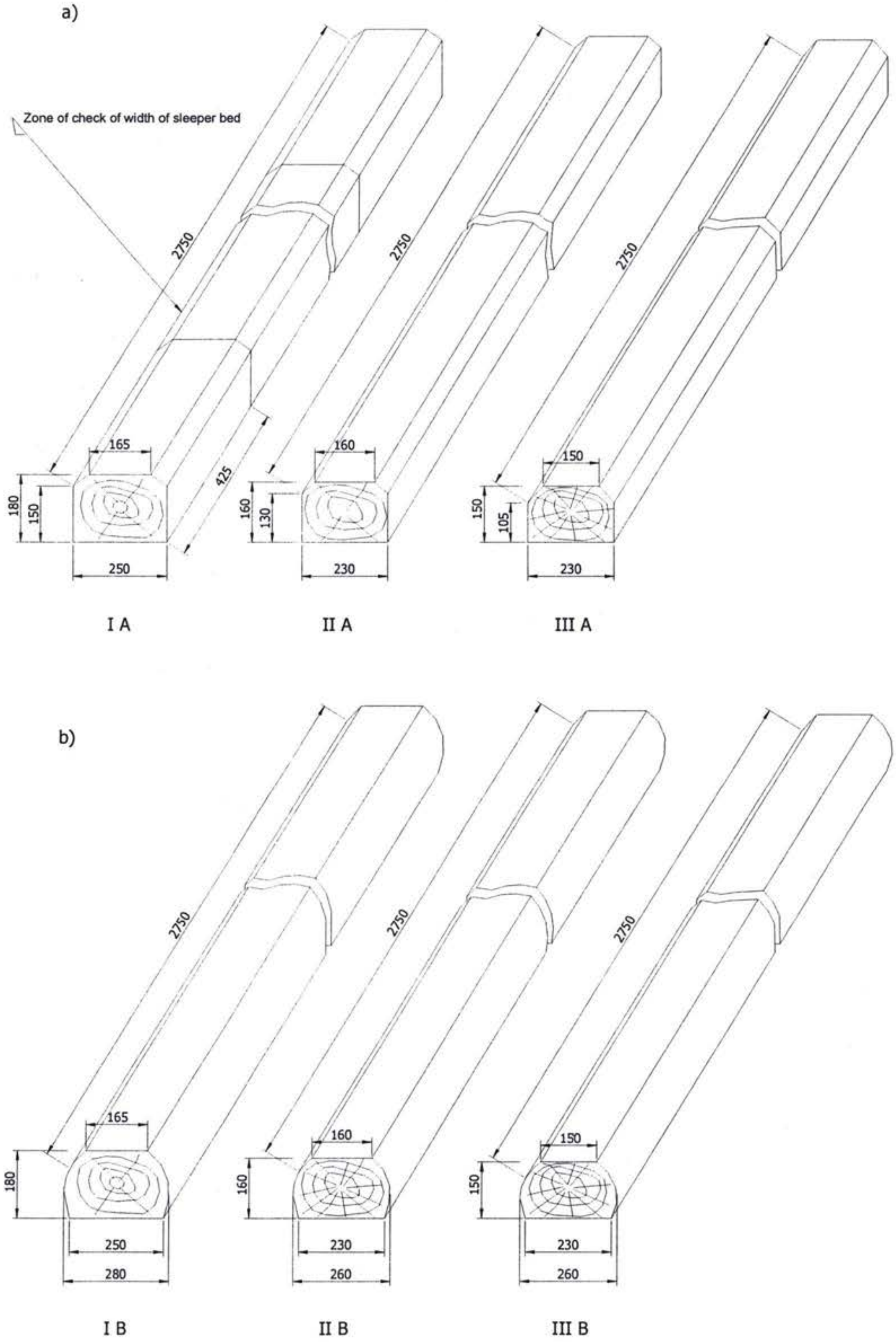
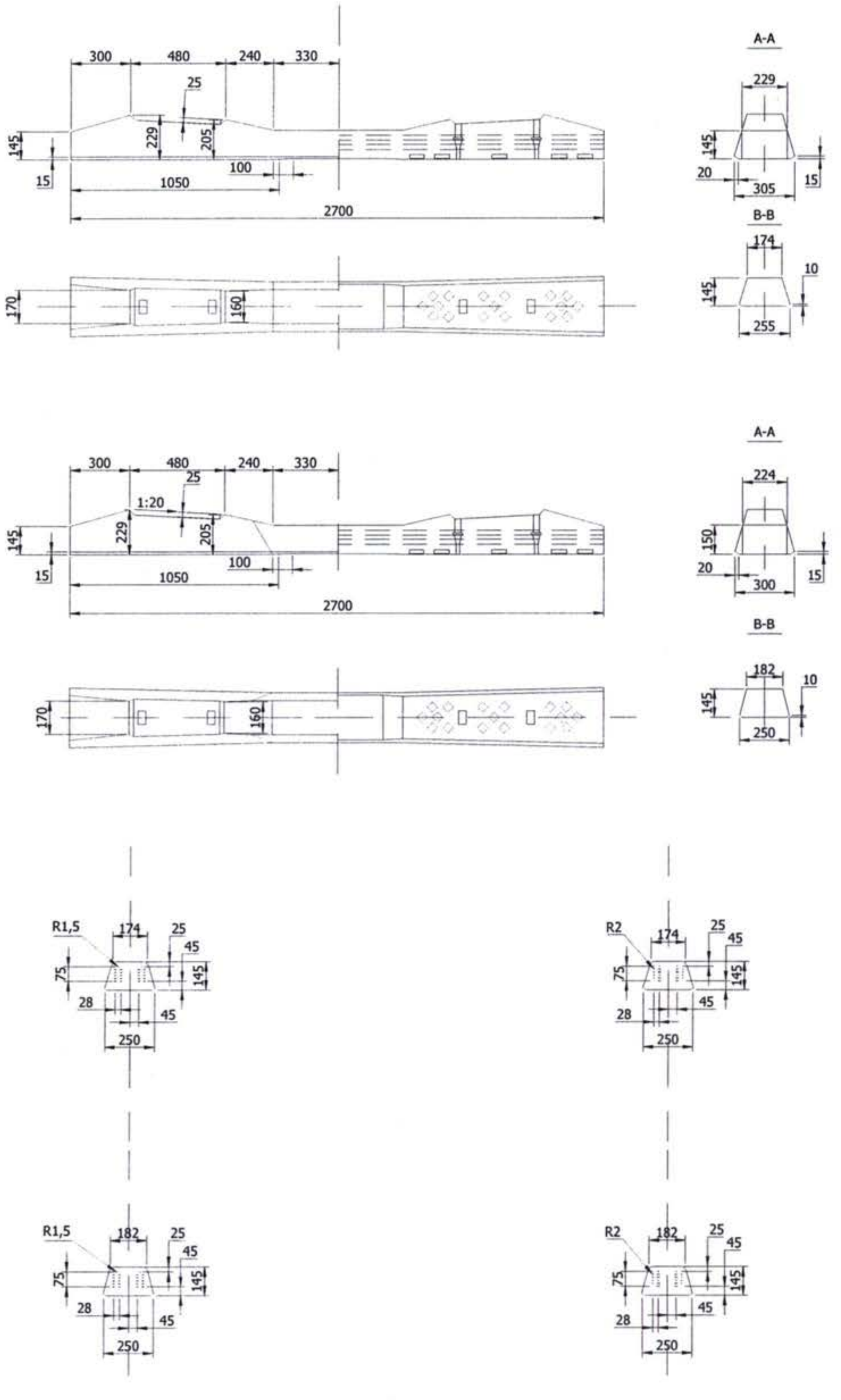


Fig. 4.1.1 – 3 Types of timber sleepers (mm)



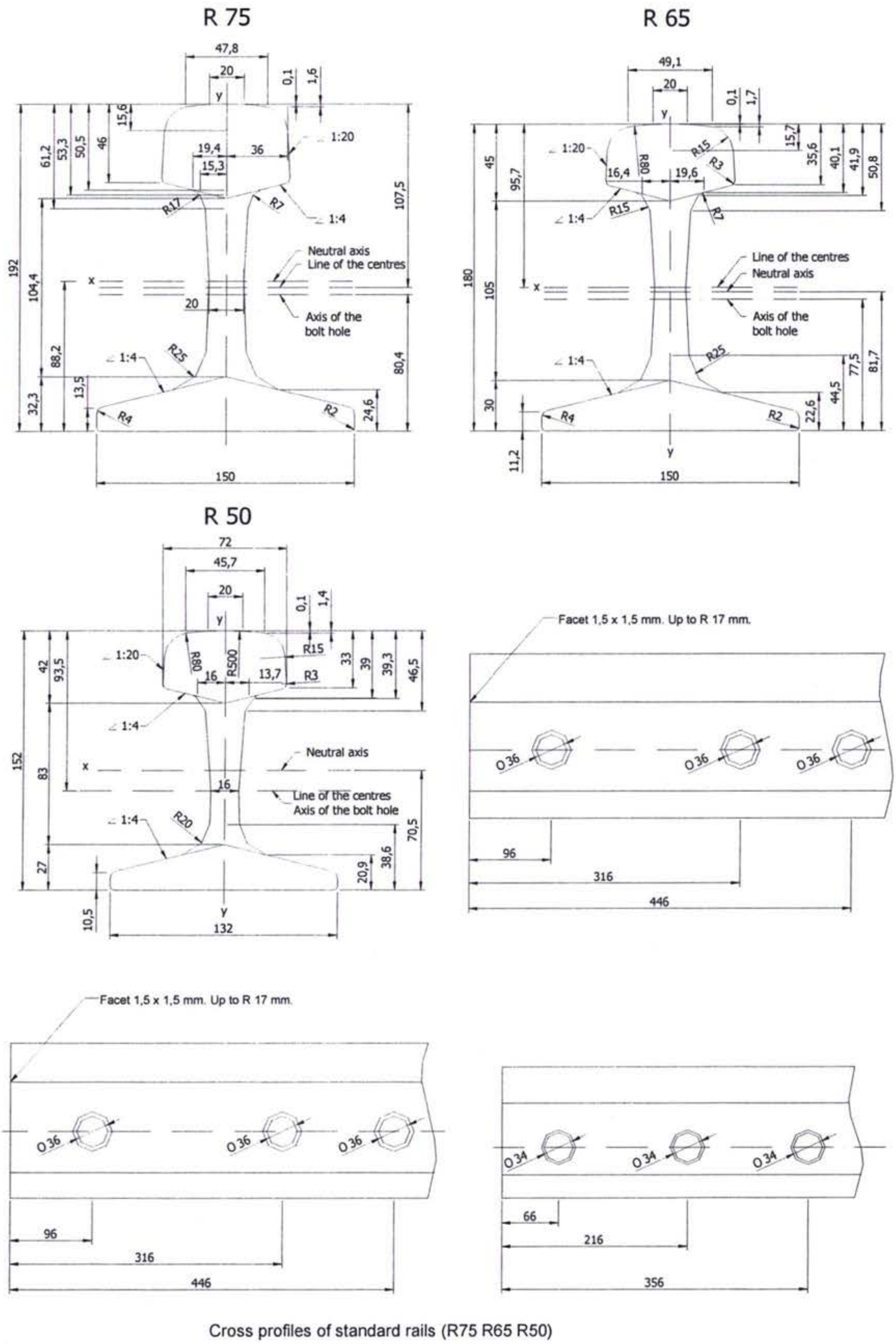
Types of timber sleepers:
A) edging; B) not edging.

Fig. 4.1.1 – 4 Design of ferroconcrete sleepers (mm)



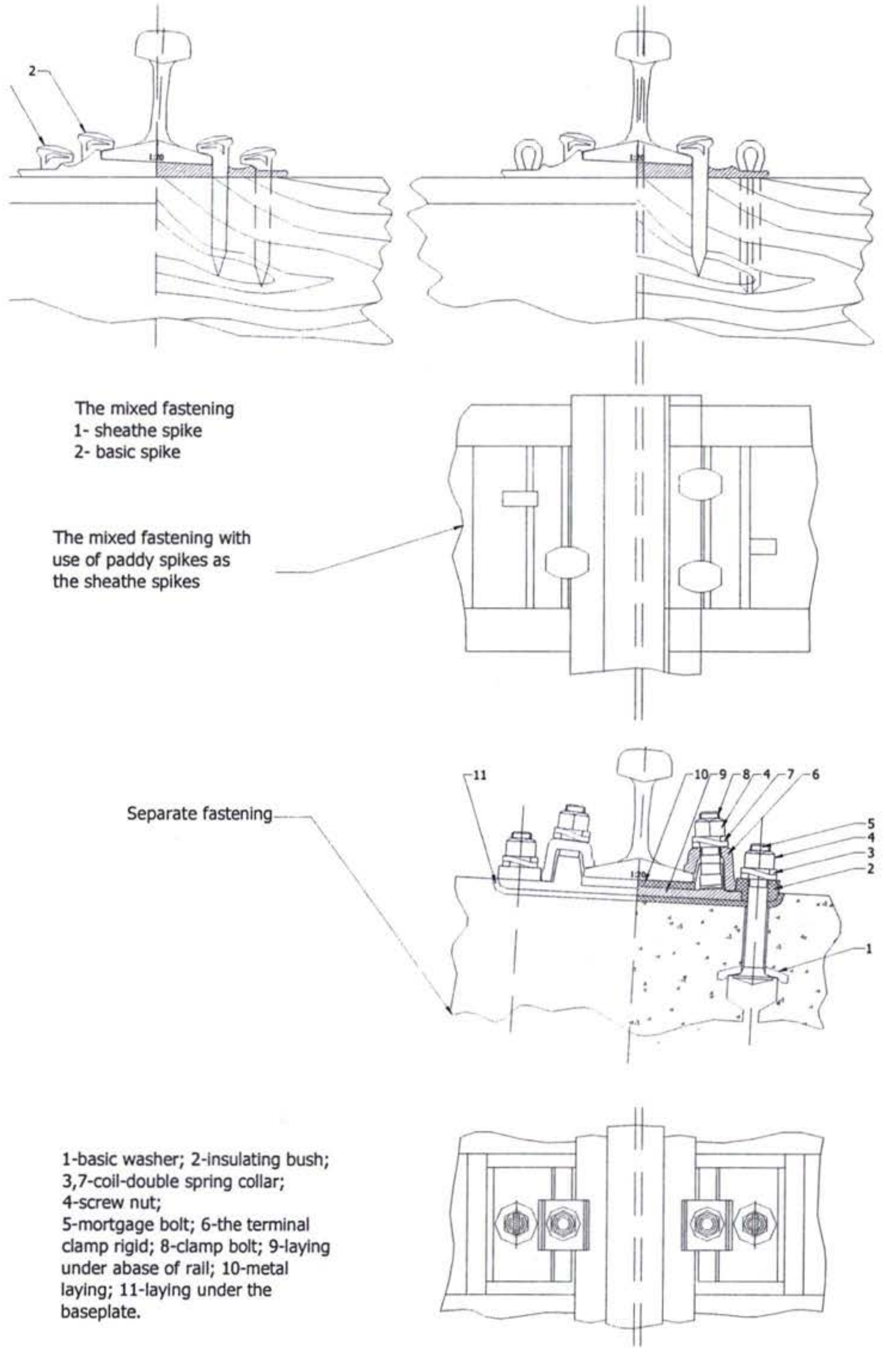
Design of ferroconcrete sleepers
a - such as C-73-1; b - such as C-73-2; c - cross sections and reinforcing of sleepers C-73-1; d - cross sections and reinforcing of sleepers such as C-73-2.

Fig. 4.1.1 – 5 Cross profiles of standard rails (R 75, R 65, R 50)



Cross profiles of standard rails (R75 R65 R50)

Fig. 4.1.1 – 6 Types of fastenings



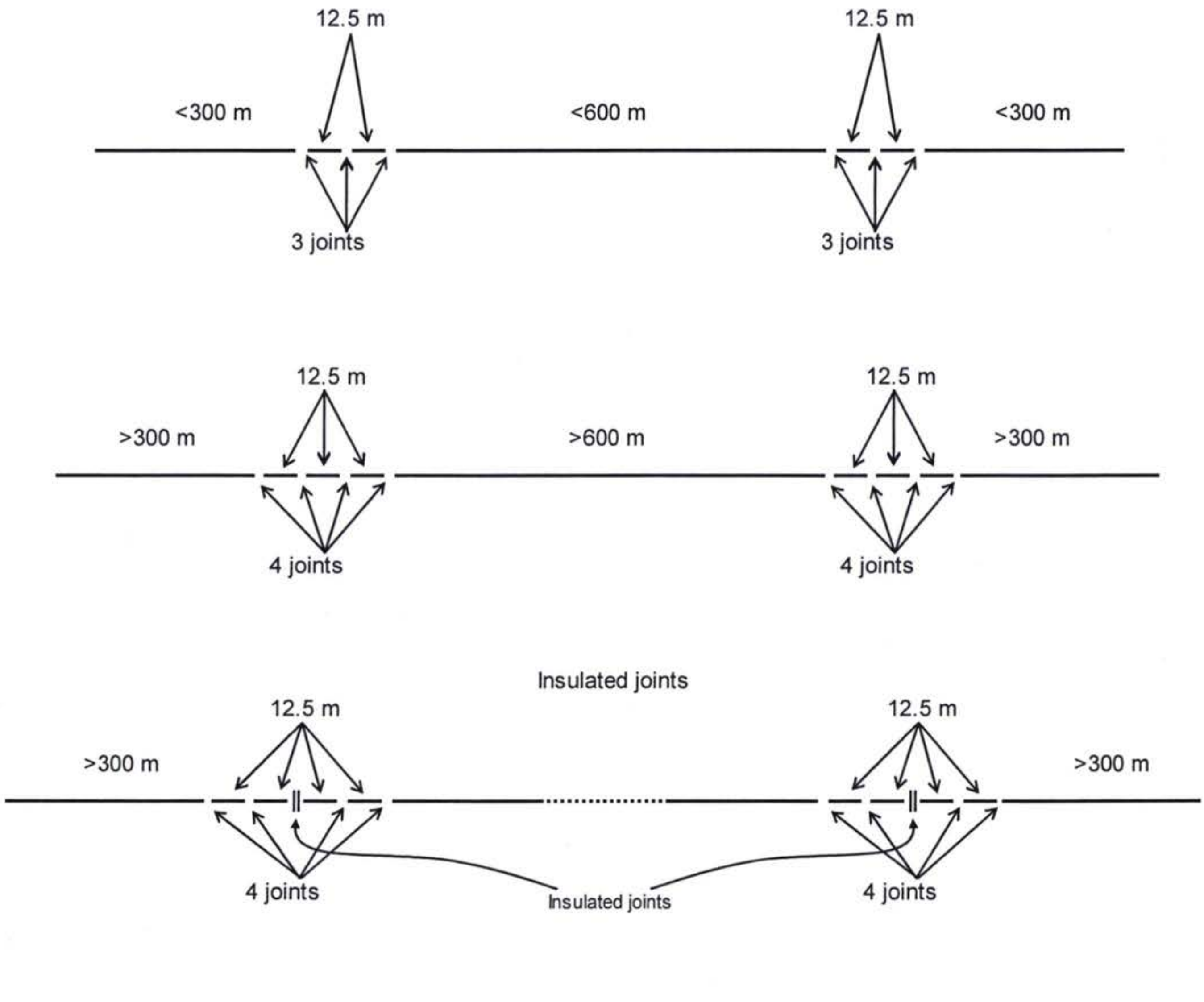
Normally the rails are provided in 25 m bars; so, when they are laid down, a joint has to be done every 25 m. To reduce the hammering at the passage of trains, the joints on one rail are displaced 3 cm from the relevant ones on the other rail along the track

On lines equipped with concrete sleepers, a great reduction of hammering effect can be obtained by welding rails in long bars (continuous welded rails, cwr).

The great advantages of this technique, which will be described in the next paragraphs, are the increase in comfort for passengers and considerable reductions in noise, in wearing out of rails and rolling stocks, in costs of maintenance.

According to Russian standards the maximum length of welded rail bars in Central Asia countries is 900÷1000 m. At the beginning and at the end of the long welded bars a sequence of joints and short bars 12,5 m long has to be laid down to allow a limited "expansion" of the long bar at the highest levels of temperature. The schemes to be implemented are reported on fig. 4.1.1 – 7:

Fig. 4.1.1. - 7
(measures in m)



The situation of the existing permanent way on line and into stations on the studied section, can be summarized as it follows (see table 4.1.1 – 3)

Table 4.1.1 – 3 Existing permanent way on line and stations

Rehabilitation of the Kungrad-Beyneu railway line - Permanent way type on the Kungrad - Border section												
Station		**Chainage**		**Type of rails**		**Type of sleepers**		**Traffic**	**Stations**			
	Name							**by 01.05**	**Siding 1**	**Turnouts**		
		start km	**end km**	**P-65**	**P-50**	**Wood**	**Concr.**	**(mln gross tn)**	**PW Type 1**	**Tot**	**P50**	**P65**
		Between turnouts		*km*	*km*	*km*	*km*					
1	*Kungrad*	*626.000*	*628.269*		*1.868*	*1.868*			*W+P50*	*12*	12	0
		628.269	645.254		16.985	16.985						
2	*Raushan*	*645.254*	*647.583*	*2.229*			*2.229*		*C+P65*	3	3	0
		647.583	657.200	*9.617*			*9.617*					
		657.200	659.200		*2.000*	*2.000*						
		659.200	670.249	*11.049*			*11.049*					
3	*Kunkhodja*	*670.249*	*672.660*	*1.057*	*1.254*	*1.254*	*1.057*		*C+P65*	3	3	0
		672.660	*686.615*	*10.000*	*4.000*	*4.100*	*9.900*	*325.800*				
4	*Kyrk-Kyz*	*686.615*	*688.715*		*1.966*	*1.966*			*W+P50*	*4*	4	0
		688.715	711.182	*6.000*	*16.500*	*22.500*	-	800.200				
5	*B.-Kelmes*	*711.182*	*713.540*		*2.258*	*2.258*			*C+P65*	*3*	3	0
		713.540	732.799	*2.400*	*19.600*	*19.600*	*2.400*	800.200				
6	*Ajiniyaz*	*732.799*	*735.140*		*2.241*	*2.241*			*W+P50*	*3*	3	0
		735.140	756.506	-	*21.400*	*21.400*	-	800.200				
7	*Abadan*	*756.506*	*757.845*		*1.205*	*1.205*			*W+P50*	*4*	4	0
		757.845	777.348		*19.503*	*19.503*		800.200				
8	*Kuanysh*	*777.348*	*779.701*		*2.253*	*2.253*			*C+P65*	3	3	0
		779.701	796.146		*16.445*	*16.445*		800.200				
9	*Jaslyk*	*796.146*	*797.890*		*1.577*	*1.577*			*W+P50*	*5*	5	0
		797.890	820.770		*22.880*	*22.880*		789.300				
10	*Ayapb.*	*820.770*	*823.136*		*2.266*	*2.266*			*C+P65*	*3*	3	0
		823.136	*845.185*	*22.049*			*22.049*	*359.000*				
11	*Berdakh*	*845.185*	*847.532*		*2.247*	*2.247*		*789.300*	*W+P50*	*3*	3	0

			847.532	870.220	22.688			22.688					
	12	Bostan	870.220	871.579	1.192			1.192		W+P50	5	1	4
			871.579	891.477	19.898			19.898	188.700				
	13	Ak-Tobe	891.477	893.800		2.223	2.223			W+P50	3	3	0
			893.800	912.309		18.509	18.509		789.300				
	14	Kiyiksay	912.309	914.651		2.242	2.242			C+P65	3	3	0
			914.651	927.900		13.249	13.249		789.300				
			927.900	932.741	4.841			4.841	441.500				
	15	Karak.	932.741	934.186		1.245	1.245			W+P50	6	5	1
			934.186	953.000	18.814			18.814	230.600				
		BORDER	953.000								**63**	**58**	**5**

In Table 4.1.1-3, also the age of the permanent way is indicated for the most part of the considered section. The age is indicated in terms of million gross tonnes passed on the railway after the last Capital Maintenance. This data will be extremely useful for the prosecution of the Feasibility Study for its influence on the running speeds of trains.

Moreover, the same table also describes the situation of the PW in the first siding of each station and the situation of the turnouts (number and PW per each station).

Some sections of the line are also equipped with continuous welded rails (CWR), as described by the following table.

Table 4.1.1 – 4 Sections equipped with CWR

Rehabilitation of the Kungrad-Beyneu railway line – PW with CWR on the Kungrad – Border section			
Chainages	**Rail type**	**Type of sleeper**	**Notes**
km 647 – km 658	P65	reinforced concrete	Continuous welded rails
km 658 – km 660	P65	wooden	Continuous welded rails
km 660 – km 677	P65	r. concrete	Continuous welded rails

The following tables resume the PW characteristics along the Kungrad-Border line.

Table 4.1.1 – 5 PW characteristics along the Kungrad-Border line

PW type Uzbekistan (327 km) (turnouts excluded)		
	Km of line	**Km in stations main tracks**
W+P50	177.071	22.976
C+P65	121.356	4.478

Turnouts on main line into stations have been excluded from the distances shown in the table 4.1.1-5. (each turnout type 1:11 has a total length of about 33.5m).

Visit of the line

The line was visited by Italferr experts from 9th to 14th of November 2004. Experts of each technical field were allowed to investigate in detail each technical matter and to take pictures on almost all the line. Photographic report of the visit is annexed.

PW defects of the line

For PW elements and details see Annex III "Infrastructure photo collection"

According to the data collected on filed and to the meetings held with UTY Representatives in Tashkent and on the line, and as reported by the annexed photographic report of the line, the following defects can be summarised:

- PW is old and worn out in many sections, rails type P50 and wooden sleepers are at their life limit, and their use leads to current heavy speed restrictions and to the sensitive risk of derailment for heavy trains (where the dynamic factor on the permanent way is higher);
- fastening devices, in particular those equipped on wooden sleepers, are old, and their fastening force is almost absent. Bolts and their parts are often worn out. A part of them is not properly working because of the conditions of the sleepers; old wooden sleepers are damaged and their retaining force on bolts and screw is low, *(fig. 8 of Annex II)I;*
- rail junctions (every 25m for the sections not interested by the C.W.R.) are old and worn out, many bolts are missing for vibration and hammering, *(fig. 5 of Annex III);*
- in correspondence with rail junction, hammering on the rails leaded to a rail consumption over the limits, in particular for those junction where the opening is larger than the maximum admitted, *(fig. 8-9 of Annex III);*
- general conditions of the alignment geometry have been lost and their preservation is very difficult because of the deformation of the track panels and the bearing capacity of the formation level;
- in parts of the line the lateral paths of 0,59 cm on both sides of the top embankment surface disappeared for the action of raining waters and blowing wind; moreover, further ballast tampings and line re-levellings by using big quantities of ballast, lead to an oversized shape of ballast in the current cross section, consequently quantities of ballast fell down and were wasted;
- in many cases the shoulders of ballast on the sides of sleepers, that in normal conditions are 0,35÷0,45 m wide, are non-existent and sleepers are not lateral contained by the ballast prism, this leading to a risk of alignment loosing, in particular in curve sections, where the centrifuge force is high, *(fig. 2 of Annex III);*
- most of the ballast is extremely polluted with clayey soil and sand, *(fig. 12 of Annex III);*
- big quantities of wooden sleepers are cracked, deformed and therefore to be replaced;
- drainage ditches are generally not existing or highly polluted, the same can be observed for drainage devices (culverts, hydraulic bridges, etc.);
- service roads on the side of formation need interventions to be safely used by railway maintenance cars;
- the double three phase overhead 10 kV line on wooden posts is in very bad condition.

PW maintenance

Constant operability of tracks, long service of its elements, uninterrupted and safe train transportation with established speeds are ensured by the system of planned-preventive maintenance which includes supervision over permanent way, track formation, its drainage and strengthening devices, structures, their maintenance and different types of repairs.

Technical specifications and norms for constructions, types and elements of permanent way, track-works, periodicities of their execution according to the order 70 "H" dated 09.11.95 are reflected in the following table 4.1.1-6.

<u>It has to be pointed out that the line in current status is in category E5 of track, corresponding to the track class 4, while after renewal of permanent way it will be in category E2 of track, corresponding to the track class 3.</u>

Table 4.1.1 – 6 Norms of intervals in renovation and major repair works of the track for establishing the necessity of track works in perspective planning
(in brackets – for junction points)
(decree 70"H" of 09.11.1995)

Track class	**Combination of group and category of the track**	**Intervals in track renovation and major repair works, ml tkm/km per year**		**Diagram of track works in the period between renovations (major repair works) of the track**	
		continuous welded rail track with reinforced concrete sleepers	**Linked train with timber rails**	**continuous welded rail track with reinforced concrete sleepers**	**Linked train with timber rails**
1	**2**	**3**	**4**	**5**	**6**
1 and 2	A1; A2; A3	1400	1200	OBПB (PC)BПBO {OBPB(PC)BPBO}	OBПB (PC)BПBO {OBPB(PC)BPBO}
	A4	1500	1300	same	same
	A5	1600	1400	same	same
	B1; B2; B3	1400	600	OBCB (PC)BCBO {OBPB(PC)BPBO}	OBCO {OB(PC)PBO}
	B4	1500	650	same	same
	B5	1600[1])	700	same	same
	C1; C2; C3	1400[1])	600[2])	OBCB (PC)BCBO {OBPB(PC)BPBO}	OBBCBBO {OB(PC)PBO}
	D1; D2; E1	Once in 25 years	Once in 15 years	OBBCBBO {OBB(PC)PBBO}	OBCBO same
3	A6	1200	1000	KBLB (PC)BLBK {OBPB(PC)BPBO}	KBLB (PC)BLBK {OBPB(PC)BPBO}
	B5; B6	1200	500		
	C4; C5	700[3])	500[2])	KBB (PC)BLK {OBPB(PC)BPBO}	KBCLK {OB(PC)BO}
	D3; D4; **E2**; E4	**Once in 25 years**	Once in 15 years	**KBBCBLK** {OBPB(PC)BPBO}	KBCLK {OB(PC)BO}
4 including reception and departure	C6	1200[3])	Once in 15 years	KBLB (PC)BLBK {OBPB(PC)BPBO}	KBCLK {OB(PC)BO}
	D5; D6; **E5;** E6	Once in 25 years	**Once in 15 years**	**KBBCBLK** {KBB(PC)BLK}	KBCLK {KBCLK}
5	A7; B7; C7; D7;E7	Once in 30 years		KBBCBLK {KLPLK}	KLCLK {KLPLK}

Note:

O – superstructure renovation; (PC) – complete rail replacement (metal elements of junction points): in the period between track renovations – with new ones; in the period between major repair works – with used *ones), accompanied by medium track repairs (on sections with asbestos ballast instead of medium may be carried out a lifting repair work or systematic warning track level adjustment); K – major track repair works; C – medium track repair; L – lifting track repair; B - systematic warning track level adjustment using the set of machines; medium repair in accordance with the project documentation may be replaced with the reconstruction of ballast prism, which is, as well as medium repair, can be carried out as a separate work.*

It is therefore possible to define normative necessity by class of tracks, types and volume of track-works, the amount of new and used materials of permanent way, machines, labour and other resources.

Operations on technical maintenance of track and switches are subdivided into the following maintenance cycles:

1. renewal of a track ("*Capital Maintenance*");
2. thorough repair of a track;
3. reconstruction of a ballast section;
4. mid-life repair of a track ("*Medium Maintenance*");
5. complete replacement of rails and metal parts of switches for new of used ones;
6. lifting track maintenance ("*Lifting Maintenance*");
7. grinding of rails;
8. planned- preventive track alignment with the use of a complex of machines.

<u>Renewal of a track</u>. It is intended for periodic full renewal of rail-sleeper panels.

Renewal of a track and switches should be accompanied by rehabilitation of a ballast section or its purification according to Technical specifications for indicated works, or accompanied by substitution of low-purity ballast of other types.

At the renewal of a track conducted with rehabilitation of a ballast section, it is necessary to carry out packing of railbed slope with liquidation or hardening of ballast stub lines and providing of a steepness of slopes 1:1.5 in conformity with standard typical cross profiles of a track formation.

At renewal of a track the following works are performed: substitution of rail-sleeper grid, repair of drainages, liquidation of heaving places in track formation and increase of bearing capacity of its main platform in places of deformation, adjustment and wadding of track with its placement on a design reference mark in the profile, adjustment of curves in the layout with restoring of design radiuses, standardization of the length of spiral curves and direct insertion curves between curves in conformity with the top speeds of movement established in the section, planning of ballast section, reduction (ct) of edge of track formation planning and purification of ditches, repair of level crossings, cleaning of river-beds and planning of cones of small structures and other works stipulated by the project.

<u>Thorough repair of tracks</u>. It is intended for substitution of permanent way on tracks of class 3-5 (switches –class 4, 5) for more powerful or less worn out ones which is mounted form either completely old materials or from combination of old with new materials including laying of old rails on tracks of class 3at speeds of t passenger trains traffic up to 100 km/h.

Thorough repair of a track is executed in a complex - with full substitution of a track skeleton, and in a separate way - with substitution of rails and fastenings, metal parts of switches, sleepers, skids with clearing or reconstruction of a ballast section.

At thorough repair of a track the same operations are to be performed as at renewal of a track.

Reconstruction of a ballast section. The reconstruction is carried out on the sections where the ballast section exceeded admissible sizes due to over-track raising of a track, and does not ensure availability of roadsides (edges) of width not less than 40 sm, or if further track raising is restricted by limited dimensional distances to structures as well as if change of ballast is necessary due to its insufficient carrying capacity or a heightening of stability of the main basic platform of track formation.

At reconstruction of ballast section clearing of detritus is made into such depth that will enable to mark the profile of the track to the designed one and restore normal sized of a section (prism). The broken stone ballast of weak rock is substituted to the ballast of hard rock. Works can be conducted together with restoration of sand cushion and laying of special coatings on the main platform of track formation. Flattening of slopes of embankment to steepness of 1:1.5, liquidation or hardening of ballast stub lines on them are carried out as well.

Other ancillary works executed under reconstruction of ballast section include: substitution of unsuitable sleepers, bars and fastenings, removal of heavy cards (at timber sleepers), alignment of circular and transition curves in the profile and payout according to the design, repair of level crossings, drainage and supporting structures, clearing of river-bed and medium structures and other ancillary works. If necessary, grinding and welding of rails, entire substitution of metal parts of switches can be carried out.

Medium repair of a track. Improvement of a ballast section by means of entire clearing broken stone ballast on the depth specified or by renewal of a low-purity ballast of other type on sections where it is not required to downgrade the mark of a track.

At medium repair of a track the same ancillary work are carried out as at reconstruction of ballast section.

Lifting track maintenance. It intended to decrease the extent of unbalance of permanent way and non-equal elasticity of under-sleeper basis by substituting worn out elements of permanent way, and partial restoration of draining properties of ballast, entire alignment and wadding of a track.

At lifting track maintenance the following works are carried out: substitution of a low-purity ballast, regulation of clearances in junctions, removal of heavy cards or adjusting shims, substitution of unsuitable sleepers, transferable bars, fastenings, anticreepers, entire lubrication and fixing of bolts, clearing of drainage structures and other works the necessity in which imply from the actual condition of a track.

Grinding of rails. Two types of grinding of rails are carried out: profile at which the head of a rail is grinded along all perimeter; and grinding intended for elimination of a undulating wear and short irregularities of other types on the surface of rails rolling with the purpose of decrease of vibration effects of a rolling stock on a track.

The abrasion is executed by rail grinding trains.

The primary grinding is carried out after laying of new and used rails. The grinding of rails is executed according to technical specifications authorized by the State Joint Stock Company UTY.

Besides the listed works, other works on track repair, structures as well as repair of industrial plants related with track operation are performed at the expense of repair fund of the railways.

The following works are referred to such operations: complete substitution of bars on switching points; fixing of switches on broken stone ballast or asbestos ballast; welding of rails, scissors crossings, other elements of switches; repair of rails, fastenings, sleepers, transferable and bridge bars; the device of a protection of track and switches, repair of fixed fences erected along the track for the warning of cattle; thorough repair of level crossings and the equipping them with automation; thorough repair of track formation and its drainage and strengthening devices; structures, structure of industrial bases which carry out mechanization and preparatory works for renewal and thorough repair of a track; erection of temporary structures related to repair of track, track formation and structures; operations on winter warehousing of detritus and other materials; redeployment of tracks machine stations, re-equipment of coaches for inhabited and cultural-welfare during their thorough repair; the device of soil roads along the track formation transfer of equipment from one to other place of operations.

Inspections for determining the present condition of a track. Includes inspection over the condition of a track and it is carried out continuously during the year including the sections where repair works are being conducted.

Operations are divided into urgent and primary, related with the elimination of dangerous inaccuracies of the track in places of their detection, and planned-preventive works, carried out with application of a complex of machines and mechanisms with the purpose of prevention of the emersion of faultinesses in a track..

According to the collected information, the following table 4.1.1-7 resumes the average quantities of replaced p.w. materials per each maintenance cycle.

Table 4.1.1 – 7 Maintenance cycles materials

Rehabilitation works for Kungrad - Beyneu Line (Kungrad-Border section)			
	Type of Maintenance		
	Lifting	Medium	Capital
Ballast	30%	60%	100%
Sleepers and fastenings	20%	40%	100%
Rails	10%	30%	100%
Per km of line			
Ballast (m3)	**540**	**1,080**	**1,800**
Sleepers and fastenings (n)	368	736	1,840
Rails (t)	13	39	130

Table 4.1.1-8 resumes the average cost for 1 km maintenance of the railway line infrastructure including permanent way, turnouts, civil works, earth-works, drainages, structures, tamping, aligning, levelling. These costs have been calculated taking into account local railway manpower, materials and machines.

For the detailed table of maintenance costs, refer to Annex VII to this study.

Table 4.1.1 – 8 Average cost for 1 km maintenance of the railway line

Rehabilitation works for Kungrad - Beyneu Line (Kungrad-Border section)			
	Cost per km of type of maintenance		
	Lifting	Medium	Capital
$/km	58,989.87	153,181.58	364,883.83

4.1.2 Stations

For stations, reference is made to Annex I "Station Photo Collection".

General

The line Kungrad-Border is provided with 15 stations with an average distance of 20 km. Their main functions are:

- operation (train crossings and overcomings);
- train parking;
- rolling stock (for service, for shunting or for maintenance) parking;
- passenger service;
- link for branches.

The following table 4.1.2-1 resumes the stations position and distances on the Kungrad-Beyneu line.

Table 4.1.2 – 1 Stations position and distances on the Kungrad-Beyneu line

Stations of the Kungrad-Beyneu line					
Station name	Chainage km	Distance km	Station name	Chainage km	Distance km
Kungrad	626.917		Berdakh	846.503	
		19.651			24.497
Raushan	646.568		Bostan	871.000	
		25.034			21.788
Kunkhodja	671.602		Ak-Tobe	892.788	
		16.582			20.797
Kyrk-Kyz	688.184		Kiyiksay	913.585	
		24.298			19.583
Barsa-Kelmes	712.482		Karakalpakia	933.168	
		21.610			20.332
Ajiniyaz	734.092		BORDER	953.500	
		23.050			1.470
Abadan	757.142		Oasis	954.970	
		21.540			21.551
Kuanysh	778.682		Akjigit	976.521	
		18.698			27.117
Jaslyk	797.380		Kzyl-Asker	1003.638	
		24.700			19.523
Ayapbergen	822.080		Kok-Bekty	1023.161	
		24.423			10.418
			Beyneu	1033.579	

The following table resumes the station typologies and their number on the entire line.

Table 4.1.2 – 2 Station typologies and their number on the entire line

Stations type	Uzbekistan	Kazakhstan	Tot
Terminal	1	1	2
Small crossing stations	9	3	12
Medium crossing stations	3	1	4
Large stations	2	0	2,0
	15	*5*	*20*

As shown in the previous table 4.1.2-2, stations along the line are of different type, according to their specific function:

1. Terminal stations of the section are Kungrad and Beyneu, whose schematic lay-out is represented in the following figures 4.1.2-1 and 4.1.2-2. These stations have the functions of regulating traffic flow on the line, parking freight trains, small maintenance for rolling stock and departing and arriving trains check, forming trains, passenger trains service.
2. Small crossing stations are typical operation stations, for allowing trains crossing and overcoming. Generally composed by two parallel tracks (one main track and one siding) and generally shaped with "8" lay-out for having 4 independent receiving and departure tracks. When passenger service is operated by the station, the main track is generally provided with one platform. The siding track is provided by a dead end safety track, for operation safety and shunting loco recovery. Finally, this station typology is generally provided with a level crossing at one end of the track set. Its scheme is represented in the following figure 4.1.2-3.
3. Medium crossing stations are the typical operation stations, for allowing trains crossing and overcoming. Generally composed by three shorter parallel tracks (one main track and two sidings) they have 3 independent receiving and departure tracks. When passenger service is operated by the station, the first siding is generally provided with one platform. The mostly used siding (where the platform is located) is provided with two dead end safety tracks on one or both station ends, for operation safety and shunting loco recovery. Finally, this station typology is generally provided with a level crossing at one end of the track set. Its scheme is represented in the following figure 4.1.2-4.
4. Large stations are of different types, generally linked to a branch.

Figure 4.1.2 – 1 Kungrad station main tracks lay-out

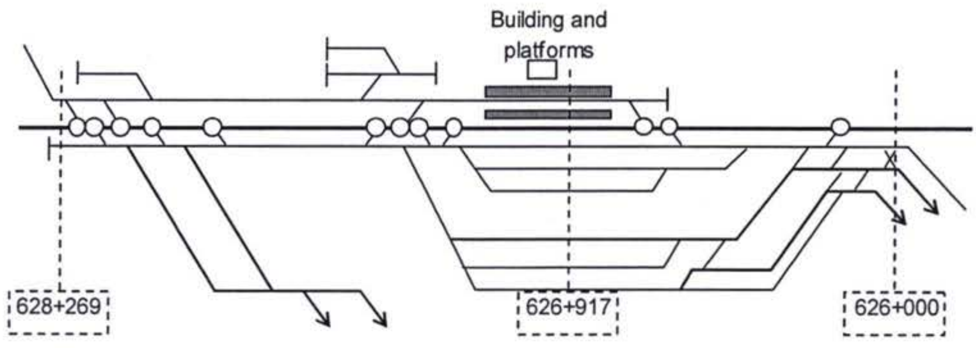


Figure 4.1.2 – 2 Beyneu station main tracks lay-out

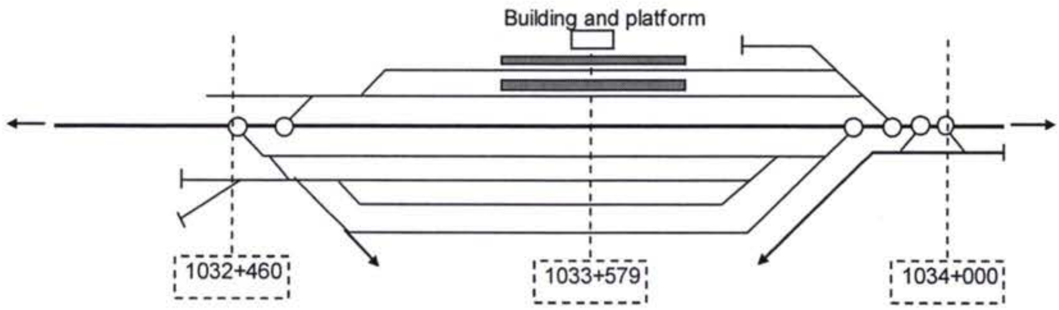


Figure 4.1.2 – 3 Typical small crossing station

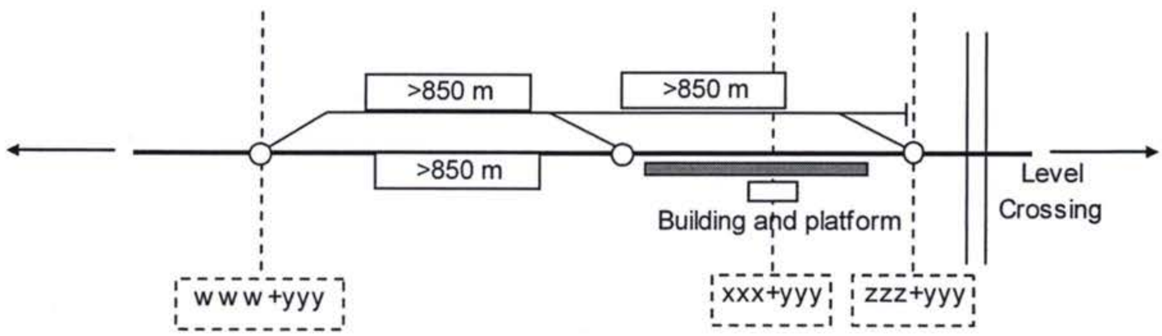
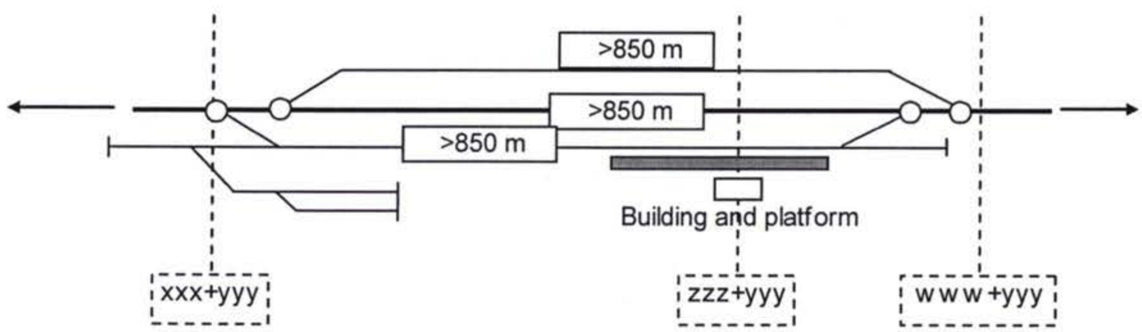


Figure 4.1.2 – 4 Typical medium crossing station



Permanent Way in stations

As shown on Table 4.1.1-3, station main lines are generally provided with P50 rails, with the exception of Raushan, Kunkhodja, Bostan. The existing turnouts are generally P50 tg 1/11 type, however 4 P65 tg 1/11 type turnouts in Bostan and one in Karakalpakia were installed.

General conditions of stations PW is not good *(Annex I "Station photo collection")*, due not only to the old PW type there installed, but also to the absence of ballast (the existing ballast is very dirty and polluted) and to the absence of water collection devices. However Consultant's experts were mainly interested in collecting data and information about the main tracks into stations, being those where major traffic will be operated and being those serving the passing trains (no stop trains). For these trains, it is therefore important to improve the characteristics of PW of the main tracks, in order to avoid highly affecting speed restrictions in the future, when general line speed will be increased at an acceptable level.

Also the conditions of existing turnouts on main line have been found not good, in particular for the high consumption of blades (moving parts of the turnouts) and cross. Turnouts engines and safety electric controls are generally in good conditions. *(Annex III fig.18).*

The annexed photo collection for permanent way elements and for stations helps to understand the current situation of the mentioned elements.

Stations buildings and platforms

Station buildings can be divided in:

- passenger buildings;
- personnel building;
- technological buildings.

The Consultant's main interest was focused on the station buildings related to passenger and technological installation in the frame of passenger welcoming capacity increase and technological installation replacement.

The state of maintenance of the buildings is acceptable, apart from some cases, indicated in the Options of the work. Nevertheless they would require a general restructuring, because of the age and of the adverse meteorological conditions of the zone. Particularly the finishes of the buildings, the coverage and the frames (doors and windows) should be replaced, while for some station buildings (those interested by greater passenger traffic) a deeper restructuring would be requested.

The worse situation concerns toilettes for the public, that – where existing – should be upgraded to be suitable to the current hygienic norms, at least for the larger stations.

In particular, it is necessary to adjust the passenger buildings as the waiting rooms, and to equip them with proper heating and ventilation systems.

Electric, water distribution and sanitary plants must be set to norm.

As it regards the external areas for passengers, as the platforms, these are generally in bad conditions and their dimensions are not matching with passenger trains average size.

Generally, every station is provided with only one platform on the proximity to the passenger building, and the platform itself has a length that doesn't overcome 30 m, absolutely undersized for the average length of passenger trains. Besides, the state of maintenance of the platforms is absolutely low, putting in some cases to risk passenger safety while waiting and boarding the train. In the frame of line speeding and therefore trains speeding also into stations (no stop trains), it seems absolutely necessary to restyle or rebuild the platforms, according to the current norms.

For stations building and platform status, see the Annex I "Stations Photo Collection".

For station building and platforms upgrading, see Option 2 works.

The following table 4.1.2-3 resumes the platforms to be extended or restyled.

Table 4.1.2 – 3 Platforms to be extended or restyled

	Station platforms	
	Uzbekistan	**Kazakhstan**
to be extended	9	4
to be restyled	5	1

4.1.3 Level Crossings

For photo report of L.C. see Annex III fig. from 19 to 23.

Along the Kungrad-Oasis railway section a total of 15 level crossings is present.

All the level crossings are situated in proximity of the stations, in a range of 100 – 1000 m of distance from the limit of the stations, with the only exception of the level crossing that is located at chainage Km 634+105. The other 14 level crossings of the line are near the following stations:

- Kungrad;
- Kunkhodja;
- Kyrk-Kyz;
- Barsa-Kelmes;
- Ajiniyaz;
- Abadan;
- Kuanysh;
- Jaslyk;
- Ayapbergen;
- Berdakh;
- Bostan;
- Ak-Tobe;
- Kiyiksay;
- Karakalpakia.

The level crossing protection system is only assured by crossing warning signals (traffic lights and Saint Andrew crosses) without barriers.

The warning signalling system is automatic: track circuits detect trains and activate warning indications at level crossings.

Usually in correspondence of the level crossings there are unpaved tracks and not proper roads. The pavement of the level crossing area is typically made of concrete blocks or rarely of wooden beams.

From general experience, the level of safety afforded by these devices on their own is insufficient. In the specific case of the Kungrad - Kazakh Border railway line this protection system could be justified by the low intensity of rail traffic and by the trifling volume of road traffic.

4.1.4 Structures and Drainages

For photo report of structures and drainages see Annex III fig. from 24 to 29.

The line object of this study is mainly running in a flat territory, mostly dry and without particular interferences with human settlements or natural constraints.

The area is mainly dry for most part of the year and this influences the nature of the river courses, almost absent. The few water courses are generally not permanent and therefore dry for the most part of the year. But this doesn't mean that the drainage system of the railway strip is not necessary; there are in fact some periods of the year in which the rainfalls are consistent and the natural depressions becomes rivers with a valuable water flow.

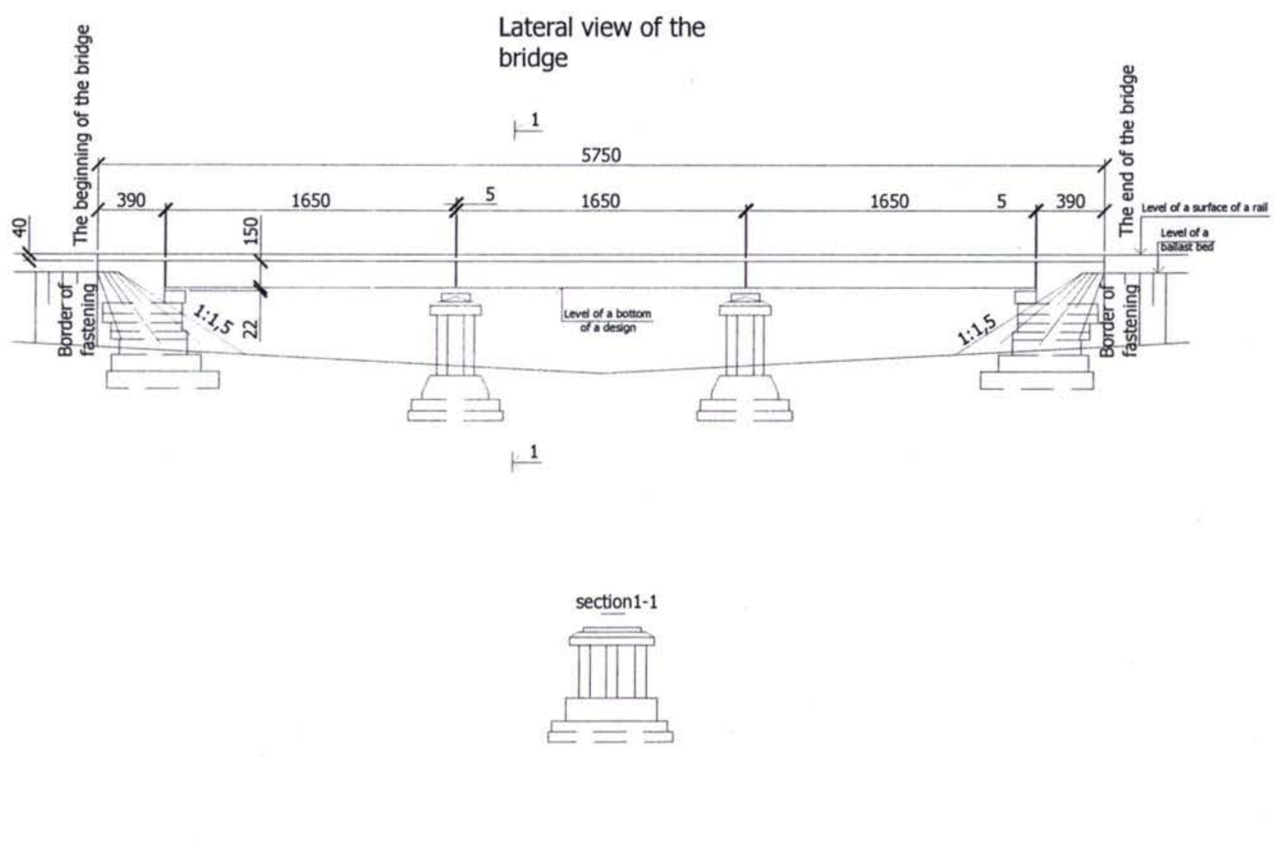
With the aim of collecting and taking away these sudden waters, the line has been designed with many pipe culverts and small bridges, mainly composed by single or double span 6m long simply leaned structures.

Drainage main structures

Along the section Kungrad – Kazak border 46 bridges were built to overtake depressions, channels and little rivers. Their length does not exceed 25 m, with the exception of one bridge 115,3 m long at chainage km 605+205. Most of the time they are waterless, but during a short period of the year a considerable quantity of rain water is canalised towards depressions and dried river beds. The bridges avoid water static pressure against the formation (dam effect), water overflowing tracks severely damaging layers of ballast and sub-ballast, erosion of the base of the slope.

They are formed by door pillars and piers supporting reinforced concrete beams, generally of standard length. On fig. 4.1.4 – 1 is shown a typical view of a railway bridge.

Fig. 4.1.4 – 1 Typical view of a railway bridge



The list of the existing bridges is reported in the Table 4.1.4 - 1

Table 4.1.4 – 1 Kungrad – border (km 953+500) section

Name of station to station block	№	Piquet value (ПК+)	Type of structure	Scheme of structure	Total length of bridge, m	Number of bars to span, unit	Condition of span		Condition of piers (bearings)	
							Satisfactory	Nonsatisf.	Satisfactory	Nonsatisf.
1	2	3	4	5	6	7	8	9	10	11
Kungrad st. – Raushan siding 1.	1	6286+88	Concrete	3x6,0	21,94	6		Renewal of span, cracks		Repair of piles
	2	6288+18	Concrete	3x5,5	22,07	6		Renewal of span		Nonsatisf.
	3	6292+69, 6	Concrete	3x6,0	21,94	6		Capital repair	Satisf.	
	4	6292+30	Concrete	3x6,0	22,07	6		Capital repair	-//-	
	5	6298+18	Concrete	3x6,0	22,07	6		Capital repair	-//-	
	6	6304+47	Concrete	2x6,0	16,02	4		Renewal of span		-//-
	7	6311+98	Concrete	2x6,0	15,9	4		Renewal of span		-//-
	8	6318+88	Concrete	2x6,0	15,88	4		Renewal of span		-//-
	9	6330+71	Concrete	2x6,0	15,9	4		Renewal of span		-//-
	10	6337+91	Concrete	2x6,0	15,98	4		Renewal of span		-//-
	11	6369+43	Concrete	3x6,0	21,95	6		Renewal of span		-//-
	12	6400+87	Concrete	1x6,0	9,9	2		Renewal of span	Satisf.	
	13	6415+06	Concrete	1x6,0	9,9	2		Renewal of span	-//-	
	14	6438+45	Concrete	1x6,0	9,98	2		Renewal of span	-//-	
	15	6452+05	Concrete	6+6x16,5+6	11530	16	Satisf.			Repair of bearing (post)
Raushan siding – Kunkhoja station 2	16	6541+41	Concrete	3x6,0	21,95	6		Renewal of span		Nonsatisf.
	17	6580+43	Concrete	2x6,0	15,98	4		Renewal of span		-//-
	18	6609+42	Concrete	2x6,0	15,91	4		Renewal of span		-//-
	19	6651+97	Concrete	3x6,0	21,91	6		Renewal of span		-//-
Kunkhoja station- Kyrk-Kyz station 3	20	6801+55	Concrete	2x6,0	15,86	4		Renewal of span		-//-
	21	6801+55	Concrete	2x6,0	15,86	4		Renewal of span		-//-
	22	6831+86	Concrete	1x6,0	9,87	2		Renewal of span	Satisf.	
	23	6849+83	Concrete	3x6,0	22,04	6		Renewal of span	Satisf.	-//-

Kyrk-Kyz station –Barsa Kelmes siding 4	24	6896+83,5	Concrete	1x6,0	9,88	2		Renewal of span	Satisf.	
	25	7014+85	Concrete	1x6,0	9,90	2		Renewal of span	Satisf.	
	26	7037+83	Concrete	1x6,0	9,90	2		Renewal of span	Satisf.	
	27	7053+87	Concrete	2x6,0	15,94	4		Renewal of span	Satisf.	Nonsatisf.
Barsa-Kelmes siding–Ajiniyaz siding 5	28	7192+39	Concrete	1x6,0	9,90	2		Renewal of span	Satisf.	
	29	7209+86	Concrete	1x6,0	9,90	2		Renewal of span	Satisf.	
	30	7238+85	Concrete	1x6,0	9,94	2		Renewal of span	Satisf.	
	31	7326+12	Concrete	1x6,0	9,93	2		Renewal of span	Satisf.	
Ajiniyaz siding – Abadan station 6	32	7356+88	Concrete	1x6,0	9,89	2		Renewal of span	Satisf.	
	33	7390+87	Concrete	2x6,0	15,94	4		Renewal of span		Nonsatisf.
	34	7429+80	Concrete	3x6,0	22,04	6		Renewal of span		-//-
Kuanysh siding –Jaslyk station 8	35	7836+56	Concrete	2x6,0	16,00	4		Renewal of span		Nonsatisf.
Lyapbergen siding –Berdakh siding 10	36	8235+10	Concrete	2x6,0	15,96	4		Renewal of span		Nonsatisf.
	37	8296+31	Concrete	1x6,0	9,83	2		Renewal of span	Satisf.	
	38	8406+09	Concrete	2x6,0	15,91	4		Renewal of span		Nonsatisf.
	39	8455+07	Concrete	2x6,0	15,93	4		Renewal of span		Nonsatisf.
Berdakh siding-Bostan station 11	40	8525+00	Concrete	3x6,0	22,00	6		Renewal of span		Nonsatisf.
	41	8563+05	Concrete	2x6,0	15,92	4		Renewal of span		Nonsatisf.
	42	8598+70	Concrete	3x6,0	22,00	6		Renewal of span		Nonsatisf.
	43	8641+05	Concrete	2x6,0	15,97	4		Renewal of span		Nonsatisf.
	44	8655+07	Concrete	3x6,0	22,00	6		Renewal of span		Nonsatisf.
	45	8670+00	Concrete	2x6,0	16,00	4		Renewal of span		Nonsatisf.
	46	8707+51	Concrete	2x6,0	15,90	4		Renewal of span		Nonsatisf.

Maintenance status

Current status and characteristics of the typical two span bridge along the line are shown in the Annex III – Photo Collection, from fig. 25 to fig. 29, while the typical pipe culvert is in fig. 24 of the same annex.

The main defects presented by reinforced concrete structures are:

- cracks in concrete;
- corrosion of armature;
- lixiviation of concrete;
- protective layer breaking off;
- waterproofing collars damages.

Their maintenance is classified by Uzbekistan railways as it follows:

operating maintenance

- clearing the structure from dust, dirt, traces of lixiviation, peeling of concrete,
- rehabilitation of original layers,
- embedding of cracks of up to 0.15 mm in width,
- injection of cracks of more than 0.15 in width with epoxide resin.

thorough repair

- as before,
- removing detachments and defected concrete parts, cleaning the armature from corrosion and protecting it with antirust paint, replacing with mortar the removed material.

reinforcement

- as before,
- implementing constructive solutions to increase the carrying capacity.

Nevertheless, when these structures have been in operation for a long time, they generally present corrosion of the armature and lixiviation of concrete. In case of capital maintenance of the line their replacement is the more rational solution.

Maintenance interventions for piers are similar. Furthermore foundations and back walls and protections have to be inspected and repaired mainly with masonry works, rebuilding or lengthening walls, installing gabions.

Drainage small structures

Besides the above mentioned bridges, the Kungrad – Kazak border section is provided with concrete/metal pipe culverts and prefabricated concrete elements (box) culverts.

A typical section is shown in fig. 4.1.4 -2.

Maintenance

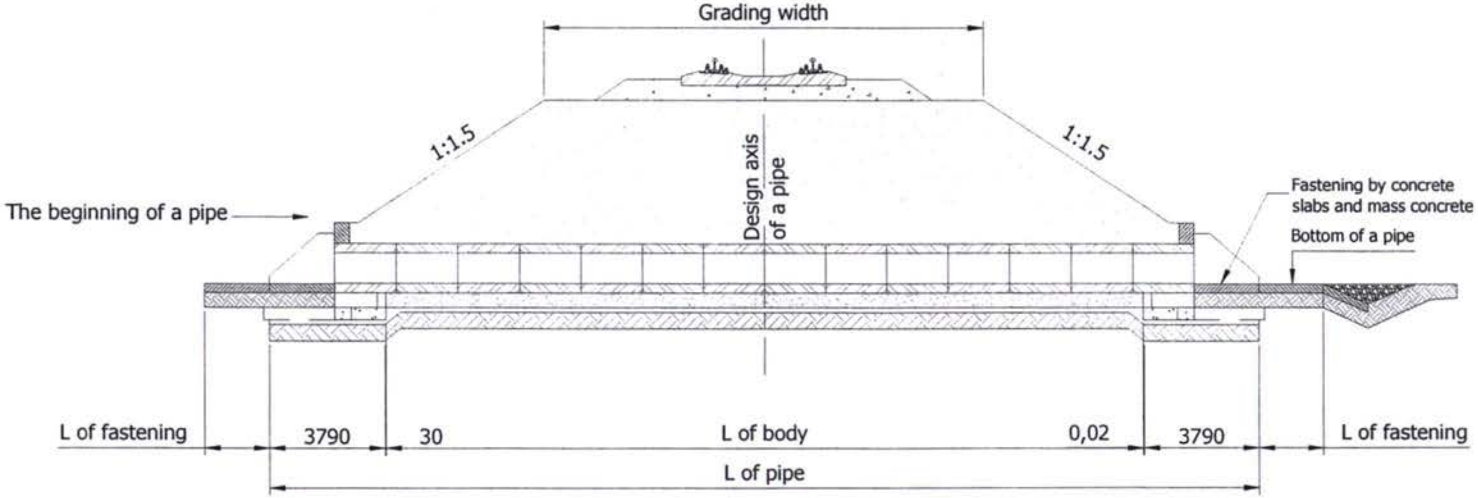
According to the condition of the structure, the activities to be implemented are

- cleaning the bottom of pipes from dust to restore the original section,
- fixing the eroded joints,
- repairing with metal grid and mortar the broken surfaces,
- charging mortar into fundaments when holes are detected,
- repairing the inlet and outlet wind walls,
- replacing the pipes and rebuilding the culvert if necessary.

The Table 4.1.4 - 2 shows the different types of culverts existing along the section and the Table 4.1.4 – 3 their location and their condition.

Fig. 4.1.4 - 2

The scheme of a laying of concrete pipes 1x1.5 and 1,5x1.5



Facade of a culvert head

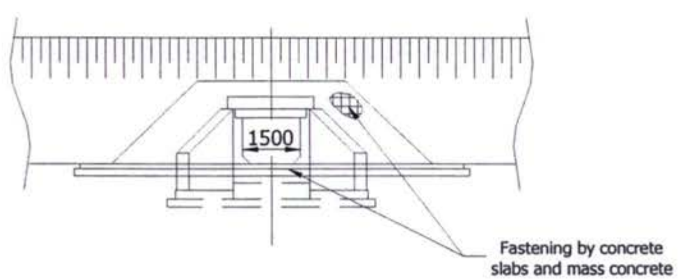


Table 4.1.4 – 2 Small drainage structure types and number (pipes and box culvert)

N°	***Type of structure***	***Kungrad – km (953+500)***
1	Metal pipe Φ 1.0 m	1
2	Reinforced concrete pipes Φ 1.0 m	15
3	Reinforced concrete pipes 2 x Φ 1.0 m	3
6	Reinforced concrete pipes Φ 1.25 m	13
7	Reinforced concrete pipes 2 x Φ 1.25 m	6
8	Reinforced concrete pipes Φ 1.5 m	8
9	Reinforced concrete pipes 2 x Φ 1.5 m	9
10	Reinforced concrete pipes Φ 2.0 m	3
11	Reinforced concrete pipes 2 x Φ 2.0 m	3
12	Prefabricated concrete elements: section 1,0 m X 1,5 m	2
13	Prefabricated concrete elements: section 1.5 m X 2.0 m	2
14	Prefabricated concrete elements: section 2.0 m X 2.0 m	2
Total		***67***

Tab. 4.1.4 – 3 List of small drainage structures existing on Kungrad-Kazakh border section. (pipe or box culverts)

Name of station to station ~~block~~	№	Chainage	Condition of bed stream	Type of structure	Pipe Φ or section dimension (m)	Length of pipe, (m)	Distance from the embankment top surface to the pipe top	Conditions	
								Non satisf.	Satisf.
1	2	3	4	5	6	7	8	9	10
Kungrad - km 953+500 section									
Kungrad station – Raushan siding	1	6381+95,6	dry	Met. pipe	1,00				
Rausha siding-Kunkhoja station	2	6664+45	dry	Reinforced concrete pipe	1,25	17,58	1,68	-	satisf.
	3	6673+34	dry	Box culvert	1,5x2,0	21,43	1,25	-	satisf.
	4	6685+00	dry	r.c.p.	1,5+1,25	18,27	1,84\2,09	-	satisf.
	5	6697+20	dry	r.c.p.	1,25	20,25	1,25	-	satisf.
	6	6711+02	dry	r.c.p.	1,5	30,4	3,18	-	satisf.
Kunkhodja station-Kyrk-Kyz station	7	6720+20	dry	Box culvert	1,5x2,0	25,20	1,13	-	satisf.
	8	6726+28	dry	r.c.p.	1,5	17,0	0,58	-	satisf.
	9	6740+26	dry	r.c.p.	1,5	19,5	3,83	-	satisf.
	10	6746+17	dry	r.c.p.	1,0	20,8	3,04	-	satisf.
	11	6750+87	dry	r.c.p.	1,25	18,65	1,91	-	satisf.
	12	6762+34	dry	r.c.p.	2,0	9,6	1,95	-	satisf.
	13	6769+45	dry	r.c.p.	1,0	18,0	2,64	-	satisf.
	14	6779+66	dry	r.c.p.	2,0	9,9	1,34	-	satisf.
	15	6783+96	dry	Box culvert	1,0x1,5	11,95	0,18	-	satisf.
	16	6792+53	dry	Box culvert	1,0x1,5	17,7	0,84	-	satisf.
	17	6837+85	dry	r.c.p.	2x1,0	16,42	1,74	-	satisf.
	18	6843+85	dry	r.c.p.	1,0	13,83	1,31	-	satisf.
Kyrk-Kyz station-Barsa Kelmes siding	19	7095+13	dry	r.c.p.	1,25	17,24	2,68	-	satisf.
	20	7102+08	dry	r.c.p.	2x1,5	16,3	1,51	-	satisf.
Barsa Kelmes siding-Ajiniyaz station	21	7135+86	dry	r.c.p.	2x1,25	12,87	1,24	-	satisf.
	22	7154+46	dry	r.c.p.	1,5	15,5	1,85	-	satisf.
	23	7172+22	dry	Box culvert	2,0x2,0	16,72	1,92	-	satisf.
	24	7295+76	dry	Box culvert	2,0x2,0	17,24	1,72	-	satisf.
Ajiniyaz siding-Abadan station	25	7408+09	dry	r.c.p.	1,25	20,4	4,81	-	satisf.
	26	7411+89	dry	r.c.p.	1,25	23,5	5,81	-	satisf.
	27	7457+85	dry	r.c.p.	2x2,0	16,3	1,72	-	satisf.
	28	7474+82	dry	r.c.p.	2x2,0	31,75	5,5	-	satisf.
	29	7537+18	dry	r.c.p.	2,0	15,46	1,55	-	satisf.
	30	7600+52	dry	r.c.p.	2x1,25	13,51	1,21	-	satisf.

Abadan station-Kuanysh siding	30	7600+52	dry	r.c.p.	2x1,25	13,51	1,21	-	satisf.
	31	7670+89	dry	r.c.p.	2x2,0	17,33	1,66	-	satisf.
	32	7683+60	dry	r.c.p.	2x1,5	14,19	1,43	-	satisf.
	33	7728+87	dry	r.c.p.	1,5	15,12	1,6	-	satisf.
	34	7746+97	dry	r.c.p.	1,25	17,33	2,41	-	satisf.
	35	7770+23	dry	r.c.p.	1,25	13,27	1,55	-	satisf.
Kuanysh siding-Jaslyk station	36	7809+10	dry	r.c.p.	1,5	15,83	1,78	-	satisf.
	37	7895+78	dry	r.c.p.	1,5	12,16	1,27	-	satisf.
	38	7936+78	dry	r.c.p.	1,0	14,22	1,66	-	satisf.
	39	7885+78	dry	r.c.p.	1,0	12,16	1,27	-	satisf.
	40	7926+78	dry	r.c.p.	1,0	14,22	1,66	-	satisf.
Jaslyk station-Ayapber gen siding	41	7985+77	dry	r.c.p.	1,0	12,08	1,79	-	satisf.
	42	8009+00	dry	r.c.p.	1,25	13,60	2,05	-	satisf.
	43	8038+78	dry	r.c.p.	1,0	13,21	1,78	-	satisf.
	44	8078+00	dry	r.c.p.	1,25	13,75	1,75	-	satisf.
	45	8151+90	dry	r.c.p.	2x1,5	15,87	1,47	-	satisf.
	46	8198+65	dry	r.c.p.	1,0	12,00	1,38	-	satisf.
Ayapberg en siding-Berdakh siding	47	8346+05	dry	r.c.p.	2x1,0	12,80	1,43	-	satisf.
Berdakh siding-Bostan station	48	8605+05	dry	r.c.p.	1,0	12,22	1,32	-	satisf.
Bostan station - Aktobe siding	49	8720+00	dry	r.c.p.	2x1,25	12,82	1,19	-	satisf.
	50	8748+98	dry	r.c.p.	1,25	13,02	1,45	-	satisf.
	51	8760+00	dry	r.c.p.	2x1,5	14,02	1,61	-	satisf.
	52	8792+88	dry	r.c.p.	2x1,5	14,01	2,28	-	satisf.
	53	8815+98	dry	r.c.p.	2x1,5	13,78	1,61	-	satisf.
	54	8853+97	dry	r.c.p.	2x1,5	20,30	1,67	-	satisf.
Aktobe siding-Kiyiksay siding	55	8907+92	dry	r.c.p.	1,25	12,99	1,34	-	satisf.
	56	9019+91	dry	r.c.p.	2x1,25	13,01	1,02	-	satisf.
	57	9037+92	dry	r.c.p.	2x1,0	12,55	1,45	-	satisf.
	58	9050+00	dry	r.c.p.	2x1,25	8,00	1,23	-	satisf.
Karakal-pakiya station-Oasis siding	59	9394+71	dry	r.c.p.	2x1,5	15,41	1,42	-	satisf.
	60	9404+71	dry	r.c.p.	1,25	12,93	1,09	-	satisf.
	61	9427+50	dry	r.c.p.	1,0	12,88	1,18	-	satisf.
	62	9455+25	dry	r.c.p.	1,0	14,61	1,92	-	satisf.
	63	9472+20	dry	r.c.p.	1,0	13,00	1,51	-	satisf.
	64	9485+20	dry	r.c.p.	1,0	14,17	1,65	-	satisf.
	65	9498+00	dry	r.c.p.	1,0	13,09	1,27	-	satisf.
	66	9527+25	dry	r.c.p.	2x1,5	13,87	1,20	-	satisf.

Ditches

According to the theoretical section of the embankment (see fig. 4.1.1 – 1), ditches have to collect raining waters all along the line. From the photographic report (*Annex II "Line photo report"*) we can see that they appear to be present only in some places. Anyway the rare atmospheric precipitation on the Karakalpakian desert justifies plainly the poor attention to this aspect of maintenance.

In the stations, on the contrary, ditches are totally missing and the damages due to the raining water stagnation and the "pumping effect" at the passage of trains that lifts fine materials from underneath, was evident in the pictures of the Kungrad, Kunkhodja, Kyrk-Kyz stations.

4.1.5 Geological and Geotechnical analysis

General geological – geomorphological and hydrogeological setting

The Kungrad – Kelmes portion of the Kungrad – Beyneu railway line, crosses the western margin of Quaternary alluvial (deltaic) plains formed by the depositional activity of the Amu-Darya river. The plains surface is generally very flat with only slight unevennesses no more than one to few meters high.

The alluvial deposits forming the plains are prevailingly composed of sand, clay and loam layers.

Beyond Kelmes the line, from the above alluvial plains, enters, through a smooth transition, into the Ustyurt plateau and runs on the flat to gently undulated plateau surfaces up to Beyneu, in Kazakhstan.

These flat surfaces are sometime bordered by sharp cliffs few ten meters high, where the bedrock of the plateau is well exposed.

As a whole the bedrock of the plateau is composed of layered Tertiary rocks including limestones, marls, sandstones and claystones, all of them being more or less rich of gypsum and other soluble salts.

The overburden that almost continuously covers the bedrock is generally composed of fine soil with inclusions of rock debris and alluvial gravels. The rock debris increase approaching the above mentioned cliffs and often form the talus of their rocky slopes.

Abundant gypsum and other salts accumulations are generally found between the overburden and the bedrock.

On the deltaic plains the ground water regime is correlated to the regime of the Amu-Darya river, expecially in the vicinities of the water course. In distant areas only seasonal fluctuations of the ground water, of limited amplitude, are recorded. During winter time the river is fed basically by the ground water.

The hydrogeology of the plateau is characterised by localised groundwater basins , locally fed. The ground water is generally found at the depth of 30 – 60 meter.

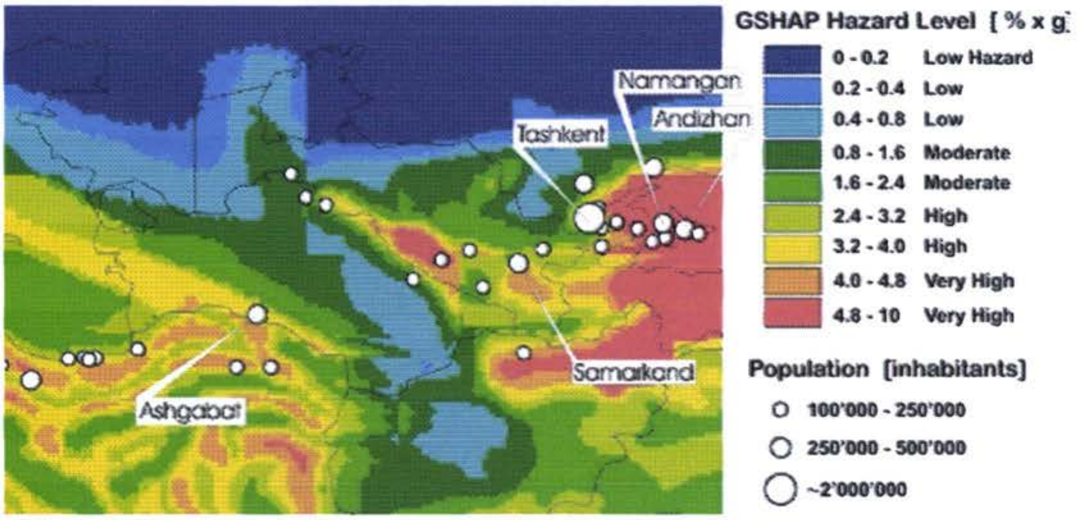
General seismology

The northern boundary of the Turan tectonic plate, characterised by the occurrence of large scale earthquakes, coincides with the latitude of Buchara – Gazli towns.

The Gazli erthquake sequence of April and May 1976 had magnitude M = 7.0 and M = 7.3. Tashkent also was badly hit in 1968 by an erthquake of M = 6.6.

On the contrary no significant seismic events are recorded in the area of the project. According to the seismic hazard map of "Global Seismic Hazard Programme" 1999, (see fig.1) this area is almost completely characterised by low seismic hazard (moderate hazard only for a limited southern portion of the project).

Fig. 4.5.2 – 1 Peak ground acceleration with a 10% chance of exceedance in 50 years



(Derived from the Map of the Global Seismic Hazard Programme - Giardini et al., 1999)

Engineering geological and geotechnical conditions of the line

The railway develops on flat, stable areas where no evidences of geological, geomorphological, hydrological conditions possibly critical for the stability and safety of the line are apparent. The stream beds that cross the railway are almost permanently dry.

Due to the above and to the typology of the proposed rehabilitation works, limited to the refurbishment and upgrading of the existing line, no specific geotechnical investigations, as may be required for the study of any new railway route, have been considered in this phase of the project.

However the aspects of the proposed rehabilitation works having engineering geological and geotechnical significance are mainly related to the selection, during the detailed design phase of the project, of the source areas and possible quarries of the materials (ballast and sub-ballast) required for the restoration of the embankment cross section.

Further geotechnical investigations

Based on the above considerations concerning the engineering geological and geotechnical conditions of the line, it is suggested that further investigations, to be performed within the scope of the project detailed design, may include the following activities:

- detailed visual survey of the area for a final assessment of the engineering geological situation of the line, with regard also to the potential scouring conditions of the foundations of the major bridges;
- testing of any existing sources of ballast and sub ballast materials, to verify their technical properties and to confirm the availability of the required quantities;
- locating, exploring and testing of new potential source areas of said materials, if necessary.

4.2 Safety devices (signaling, block devices, and CTC)

For Safety Devices reference is made to Annex IV "Safety Devices photo collection".

In terms of safety and signaling devices, the line includes the following types and a brief description of which we repeat below:

- Stations with electric relay devices
- Sections with Automatic Block Line Systems
- Automatic Level Crossings without half-barriers
- Centralised dispatching control system

Electric Relay Interlocking Installations(ERII)

These installations establish the entrance and exit routes by selecting and locking the points in the corresponding position for the required route, locking the route, permanent checking through the track circuits if the insulated sections of the route are free or occupied and by giving the free signal for the route.

These systems allow station personnel to operate points and signals via electrical devices from a single central post that contains a command and control desk and where the movement inspector operates.

Basically, the equipment is controlled from this control desk, made of mosaics representing individual outdoor elements, such as signals, points, shunting signals, track circuits etc.

These devices can be also remotely controlled and supervised from a central place (CTC) and can be unmanned.

The train route is set by simultaneously pressing the signal button and the destination button which is usually located on the track to which an entry route, for instance, is to be set.

The device automatically checks the condition of track circuits and throws points to appropriate positions by electrical points mechanisms (fig 01 and 02) which work with 220Vdc,250 W motors.

It also ensures flank protection, i.e. prevents crossing from the side and a protective route in the length of 100 m behind the exit signal in case the engine driver cannot stop the train at the prescribed distance.

At the end of this process the train route is "blocked" and the respective signal is set to clear.

All signals display two or more meaningful signal aspects which means that the signal indicates the aspect of the next signal.

The occupancy control of tracks and points, as mentioned, is carried out by track circuits.

The bridging of rails by a wagon or a locomotive is indicated as the occupancy of the section or point respectively.

The equipment operates according to following principles. The device first finds the train route defined by pressing the start and destination buttons. Then it closes this route, checks the condition of track circuits and sets the points in appropriate positions.

In the next phase it ensures flank protection: for this train runs and protects crossing routes. When checks and points setting are completed, the train route is blocked which means that other settings that could endanger the train route, are prevented.

Following this, the states of the signals are checked and the signal set to clear. The signal aspect is determined with respect to the position of points and the program foreseen.

Since signals display two or more meaning aspects, the signal aspect can be changed either by setting the next signal to clear (exit route from station) or by the situation in automatic block sections.

From the point of view of functional and constructive characteristics, all the interlocking installations are designed and used with components installed in the relay room (fig 03) (relay racks and boxes, control panel, cables distributor) and outdoor (signals, point machines, track circuits etc.) and are connected with automatic line block installations existing on the open line.

Special suppliers ensure uninterrupted power utilizing two network and storages batteries (fig 04).

In the main stations are as well present diesel generator sets of different sizes (fig 05).

Automatic Block Line Systems (ABLS) and Cab signaling

ABLS divides the line in block sections which are controlled by track circuits and protected by side light signals (fig 06), displaying the reading code for speed to the driver.

By means of permissible indications displayed, the train is authorized to advance and occupy the block section protected by respective signal.

This system permits the between stations-spacing of several trains traveling in the same direction.

From the point of view of functional and constructive characteristics, ABLS is conceived with components (signals, track circuits, cabinet for equipment, cables, etc) distributed along the line and interconnected with ERII of the neighbouring stations and with ALC and LSC

Automatic blocking is supplied with continuous type devices of automatic signaling cab whose signals start to be sent in the track circuit before the light signal at the train approaching.

When code automatic blocking is applied on the electrified sites, its track circuits are fed by alternating current.

The line is not electrified and track circuits are fed by a current with frequency of 25Hz.

The current is sent into track circuits as a combination of pulses which contain the information about signal light aspects that the driver is going to see.

The automatic cab signaling can be integrated by a self- braking device with an equipment for checking the vigilance of the driver and for controlling the train speed. The checking of the driver's vigilance is made at the approaching of the train to the closed light signal; the automatic vigilance starts from the instant the engineman's indicator changes from green to yellow signal to the instant the driver gives the confirmation by pressing an acknowledging contact.

Furthermore, in the case of running with yellow signal (in excess of a fixed speed), and also with yellow/red signal or red signal on the engineman's indicator, periodic check of vigilance each 30-40 sec comes into effect.

In all cases if the acknowledging contact will not be pressed in the due time, the train automatically stops by means of a self- braking device before reaching the next closed light signal.

The train automatically stops in the following signaling aspects:

- When approaching a red signal at a speed exceeding 20km/h
- When approaching a yellow/red signal at a speed exceeding 60-70km/h.

Automatic Level Crossings (ALC) without barriers

These installations achieve the interdiction of the road traffic at the approaching of the train with a suitable time before the train arrives at the level crossing.

After the train passes, the interdicting signalization is automatically cancelled and the level crossing is again opened for road traffic.

The track circuits of the relay interlocking system (ERI I) and ABLS installations achieve the control of the train approaching to the level crossing depending on the level crossing position.

ALC installation are operated depending on ERI I installations which restrict the railway traffic in case the first installations are out of order or are not available.

ALC installations could be operated without any local agent; their operating conditions can be remotely signaled on the train dispatcher command and control panel of the ERI I in station.

On Kungrad- Kazakh border line the main protection systems for level crossing are Saint Andrew crosses only by road side and ALC without barriers.

In the case the level crossing is located along the line the automated system is fully independent of station signals. Road side, crossing is protected by traffic lights (fig 07). The station only receives alarm signals from the system

If any level crossing is located within stations the protection system may be activated by the local interlocking through the control of an itinerary and is automatically deactivated once the train has passed and the relevant track circuit is cleared. The operation of the system is connected with station signals. Both home and departure signals indicate clear if the system efficient, meaning the road signals are on and the control system is normally operating.

A summary of the actual level crossing location is given in Table 0 of Annex VIII.

Local operators referred to this Consultant that level crossing protected with Saint Andrew cross present irrelevant road traffic

Centralised dispatching control system.

The line is equipped with a centralised dispatching control system "Neva" type.

The central place for Uzbek section is located in Tashkent and is a Dialogue system; the central place of the Kazakh section is, instead located in Atyrau. The stations of Kungrad, Jaslyk, Karakalpakia and Beyneu are managed locally that means the local movement operator has the responsibility of all it happens between home signals; the central dispatcher send it only an electric signal of agreement in order to let him to clear departure signals. Central dispatcher can see from the central place the state of occupancy of the stabling track circuits and the signals aspects of the station but he can't operate on them.

The other stations of the line can be managed locally or by remote command and control: local (that means central dispatcher excluded from operations) or fully controlled from the Center (local operator excluded from operations): the change from one method to the other is determined by turning a key on the local panel.

4.2.1 Safety and signaling systems ages

The signalling and safety systems for the Section Kungrad-Kazakh border (from km 626+917 to km 953+500) were installed or transformed as follow:

Year 1967: interlockings systems of:

- Kungrad;
- Raushan;
- Kunkhodja;
- Barsa-Kelmes;
- Ajiniyaz;
- Abadan;
- Kuanysh.

Year 1968: interlockings systems of:

- Ayapbergen;
- Berdakh;
- Bostan;
- Ak-Tobe;
- Kiyiksay.

Year 1980: interlockings system of:

- Kyrk-Kyz.

Year 1983: interlockings system of:

- Karakalpakia.

Year 1984: interlockings system of:

- Jaslyk.

4.2.2 Overview of the stations and the sidings

The section from Kungrad (Km 626+917) to Kazakh border (km 953+500) is characterized by the presence of:

- all relay interlocking systems in the stations,
- automatic block system in line,
- Centralised Traffic control from Tashkent.

The stations and the relevant distances are the following:

Kungrad (km 626+917)

This is an intermediate station of the Naymankul-Beyneu line which is the northern section of the Navoi-Uchkuduck-Beyneu Traceca line.

It is equipped with an Electric Relay Interlocking which covers all main lines, secondary lines and points with related signals for trains and shunting.

The station has 14 centralised tracks. The distance between the home signals is 3573 metres. The switch points electrically operated are 75.

The system interfaces, north side, the Kungrad-Raushan ABLS section which has, Beyneu direction 12 lock sections.

The interlocking is fed by uninterruptible power system with diesel generator (power 48 Kva).

The control panel with signals lights and tracks-diagram is shown on fig 08 of Annex IV.

Raushan (km 646+568)

The station has 4 centralised tracks.

It is equipped with an Electric Relay Interlocking which control 5 points.

The distance between the home signal is 2902 metres.

The system interfaces with Raushan-Kunkhodja ABLS section which has 15 block sections in Beyneu direction.

The interlocking is fed by uninterruptible power system without diesel generator.

The control panel with signals lights and tracks-diagram is shown on fig 9 of Annex IV.

Kunkhodja (km 671+602)

The station has 4 centralised tracks.

It is equipped with an Electric Relay Interlocking which control 6 points.

The distance between the home signal is 2440 metres.

The system interfaces with Kunkhodja- Kyrk-Kyz ABLS section which has 10 block sections in Beyneu direction.

The interlocking is fed by an uninterruptible power system without diesel generator.

The control panel with signals lights and tracks-diagram is shown on fig 11 of Annex IV.

Kyrk-Kyz (km 688+184)

The station has 5 centralised tracks.

It is equipped with an Electric Relay Interlocking which control 13 points.

The distance between the home signal is 2784 metres.

The system interfaces with Kyrk-Kyz- Barsa-Kelmes ABLS section which has 13 block sections in Beyneu direction.

The interlocking is fed by an uninterruptible power system without diesel generator.

The control panel with signals lights and tracks-diagram is shown on fig 12a of Annex IV.

Barsa-Kelmes (km 712+482)

The station has 4 centralised tracks.

It is equipped with an Electric Relay Interlocking which control 5 points.

The distance between the home signal is 2457metres.

The system interfaces with Barsa-Kelmes - Ajiniyaz ABLS section which has 11 block sections in Beyneu direction.

The interlocking is fed by an uninterruptible power system without diesel generator.

The control panel with signals lights and tracks diagram is shown on fig 13 of Annex IV.

Ajiniyaz (km734+092)

The station has 4 centralised tracks.

It is equipped with an Electric Relay Interlocking which control 5 points.

The distance between the home signal is 2437 metres.

The system interfaces with Ajiniyaz- Abadan ABLS section which has 13 block sections in Beyneu direction.

The interlocking is fed by an uninterruptible power system without diesel generator.

The control panel with signals lights and tracks-diagram is shown on fig 14 of Annex IV.

Abadan (km757+142)

The station has 3 centralised tracks.

It is equipped with an Electric Relay Interlocking which control 8 points.

The distance between the home signal is 1646 metres.

The system interfaces with Abadan- Kuanysh ABLS section which has 12 block sections in Beyneu direction.

The interlocking is fed by an uninterruptible power system without diesel generator.

The control panel with signals lights and tracks-diagram is shown on fig 15 of Annex IV.

Kuanysh (km778+682)

The station has 4 centralised tracks.

It is equipped with an Electric Relay Interlocking which control 5 points.

The distance between the home signal is 2471metres.

The system interfaces with Kuanysh- Jaslyk ABLS section which has 12 block sections in Beyneu direction.

The interlocking is fed by an uninterruptible power system without diesel generator.

The control panel with signals lights and tracks-diagram is shown on fig 16 of Annex IV.

Jaslyk (km797+380)

The station has 6 centralised tracks.

It is equipped with an Electric Relay Interlocking which control 31 points.

The distance between the home signal is 2407 metres.

The system interfaces with Jaslyk- Ayapbergen ABLS section which has 14 block sections in Beyneu direction.

The interlocking is fed by an uninterruptible power system without diesel generator.

The control panel with signals lights and tracks-diagram is shown on fig 17 of Annex IV.

Ayapbergen (km 822+080)

The station has 4 centralised tracks.

It is equipped with an Electric Relay Interlocking which control 5 points.

The distance between the home signal is 2,552 metres.

The system interfaces with Ayapbergen- Berdakh ABLS section which has 12 block sections in Beyneu direction.

The interlocking is fed by an uninterruptible power system without diesel generator.

The control panel with signals lights and tracks-diagram is shown on fig 18 of Annex IV.

Berdakh (km 846+503)

The station has 4 centralised tracks.

It is equipped with an Electric Relay Interlocking which control 5 points.

The distance between the home signal is about 2460 metres.

The system interfaces with Berdakh- Bostan ABLS section which has 13 block sections in Beyneu direction.

The interlocking is fed by an uninterruptible power system without diesel generator

The control panel with signals lights and tracks-diagram is shown on fig 19 of Annex IV.

Bostan (km 871+000)

The station has 3 centralised tracks.

It is equipped with an Electric Relay Interlocking which control 8 points.

The distance between the home signal is about 1600 metres.

The system interfaces with Bostan- Ak-Tobe ABLS section which has 11 block sections in Beyneu direction.

The interlocking is fed by an uninterruptible power system without diesel generator

The control panel with signals lights and tracks-diagram is shown on fig 20 of Annex IV.

Ak-Tobe (km 892+788)

The station has 2 centralised tracks.

It is equipped with an Electric Relay Interlocking which control 3 points.

The system interfaces with Ak-Tobe- Kiyiksay ABLS section which has 11 block sections in Beyneu direction.

The interlocking is fed by an uninterruptible power system without diesel generator

The control panel with signals lights and tracks-diagram is shown on fig 21 of Annex IV.

Kiyiksay (km 913+585)

The station has 4 centralised tracks.

It is equipped with an Electric Relay Interlocking which control 5 points.

The distance between the home signal is about 2500 metres.

The system interfaces with Kiyiksay- Karakalpakia ABLS section which has 11 block sections in Beyneu direction.

The interlocking is fed by an uninterruptible power system without diesel generator

The control panel with signals lights and tracks-diagram is shown on fig 22 of Annex IV.

Karakalpakia (km 933+168)

This is the border station which has 6 centralised tracks.

It is equipped with an Electric Relay Interlocking which control 24 points.

The distance between the home signal is about 1560 metres.

The system interfaces with Karakalpakia- Oasis ABLS section which has 13 block sections in Beyneu direction.

The interlocking is fed by a uninterruptible power system continuity power group with a 48kva diesel generator

The control panel with signals lights and tracks-diagram is shown on fig 23 of Annex IV.

Finally the present main characteristics of the signalling and safety devices are summarised in Table A of Annex VIII referred to stations and in Table B concerning line systems.

4.3 Telecommunications

4.3.1 Description of the present telecommunication situation of the line

In the following a synthetic description of the telecommunications equipment of the line Kungrad – Kazakh border is provided. A graphic description of the present telecommunication situation of the line is presented in Figure 4.3.1-1

4.3.1.1 Description of Line Telecommunication Equipment

The analogue transmission system along the railway line use both buried copper cable and aerial links.

The copper cable is installed only on the section Kungrad-Jaslyk and it has the following technical specification:

3KP 1x4x1,2 1x4 - High frequency quad copper wire, diameter 1,05mm, polyethylene insulation, quad twisted 2 copper tape shield pitch filler, polyethylene sheath.

The steel/bimetal aerial link is present on the entire section Kungrad-Beyneu and it is of the following technical type: V-12-3 and V-3-3.

4.3.1.2 Description of Station Telecommunication Equipment

All the stations are equipped with manual commutator of stations and line sections telephone service, for operation and maintenance activities. The following types of commutatores are installed: KASS – 6 and KASS – DU.

Telecom switches (analogue PABX) are installed on the following stations:

- Kungrad – ESK-400E - 300 Internal lines; ESK-400E - 400 Internal lines

- Jaslyk – ESK-400E - 400 Internal lines
- Karakalpakia – ESK-400E - 400 Internal lines

The following equipment for loud speaking communication is present: TU – 50, TU – 100, TU – 600, RUS.

The equipment for train to station radio communication presently installed is IZ RTS, 71 RTS.

Most of the equipment is very old, aged about 30 years, since it dates from the first years of 70s when the line was built.

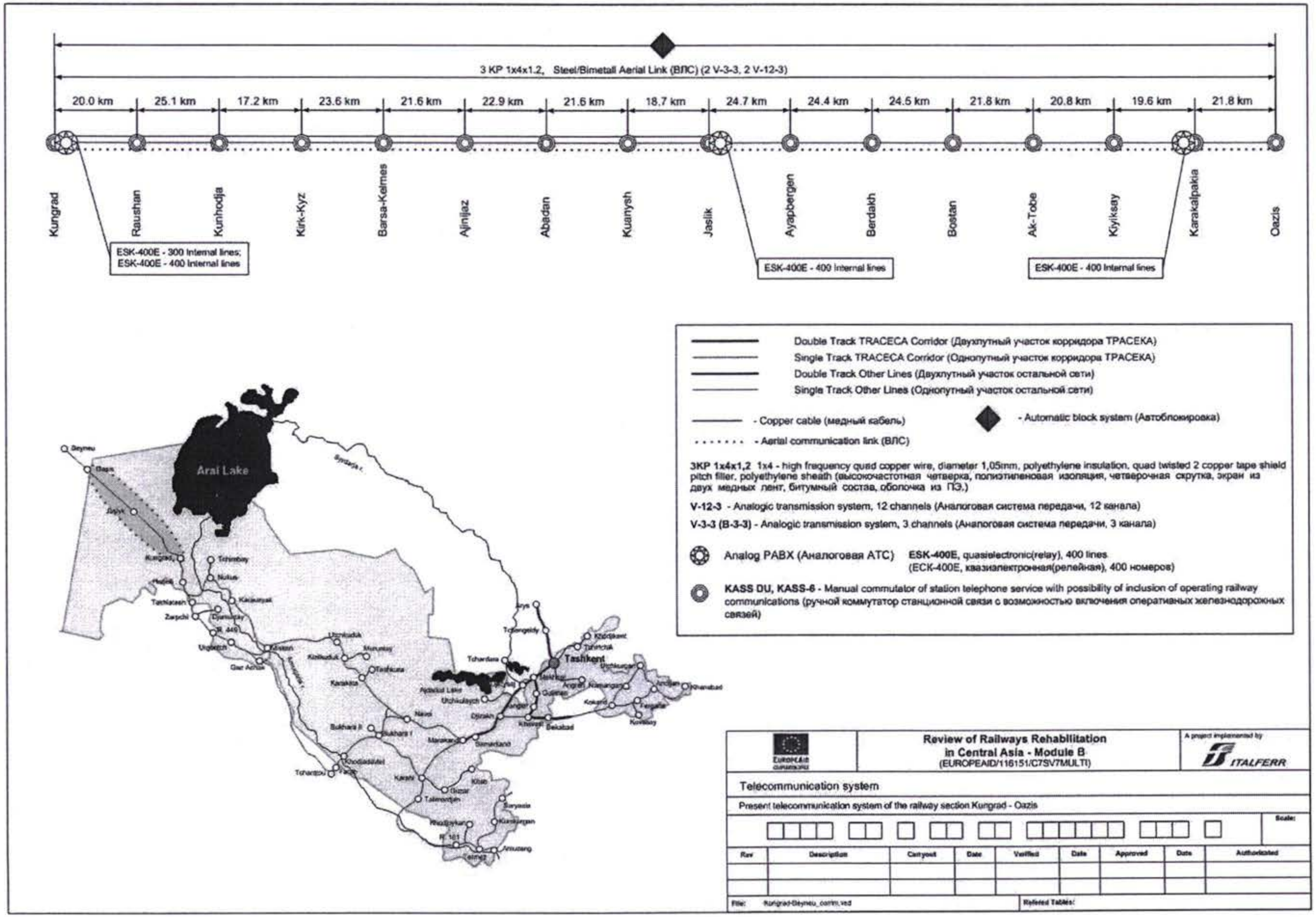


Figure 4.3.1-1 - Present telecommunication system of the railway section Kungrad - Oasis

4.4 Power supply system

4.4.1 Description

The electric power supply system of Kungrad – Kazakh border section is basically carried out by means of three medium voltage lines:

1. two three phase overhead lines installed on the same wooden posts from Kungrad to the Kazakh border; the first one operates at 6 kV and feeds exclusively the Automatic Block boxes along the section, the second one operates at 10 kV and feeds all the station facilities and plants (safety plants, lighting, pumps etc.); presently the last is de-energized from Kungrad to Jaslyk
2. one three phase overhead line installed on prefabricated reinforced concrete posts of circular section, from Kungrad to Karakalpakia, operating at 10 kV and at 6 kV from Bostan to Karakalpakia.

Lines 1 are old and obsolete. Typical post are drawn in Fig. 4.4.1 – 1.

Line 2 is new and in very good condition. Typical posts are drawn in Fig. 4.4.1 – 2.

Fig. 4.4.1 – 1 Typical posts

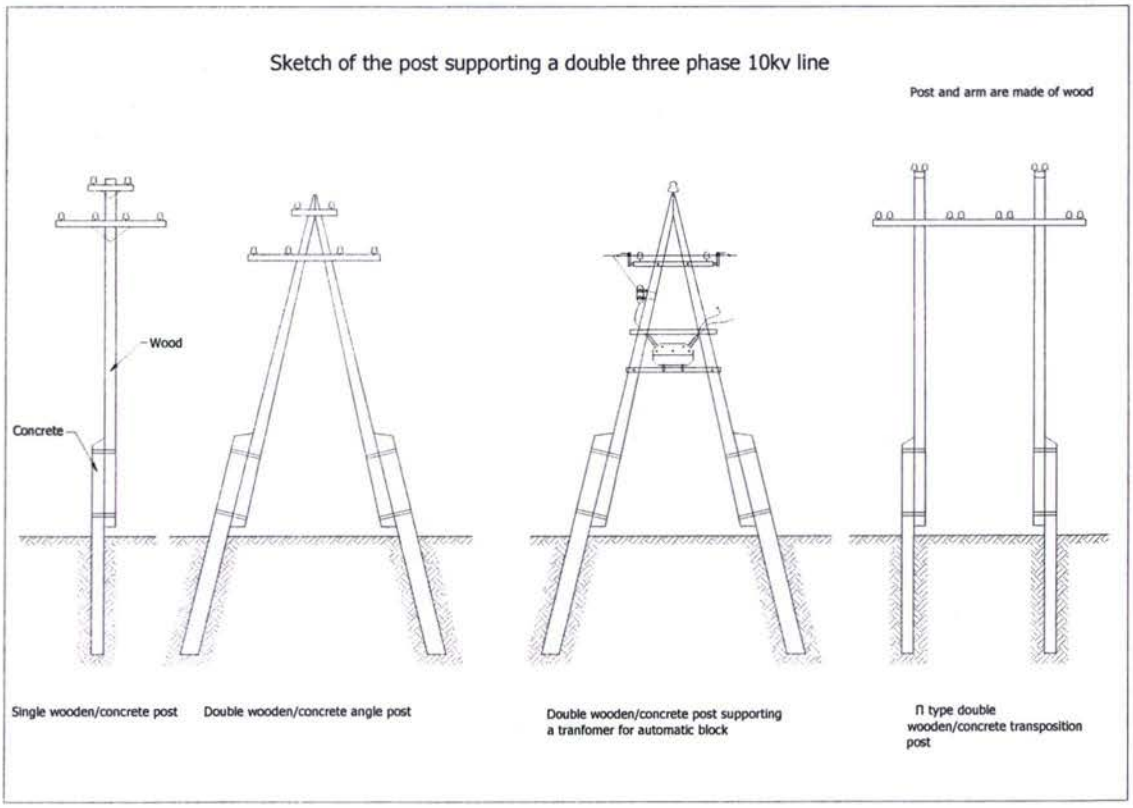
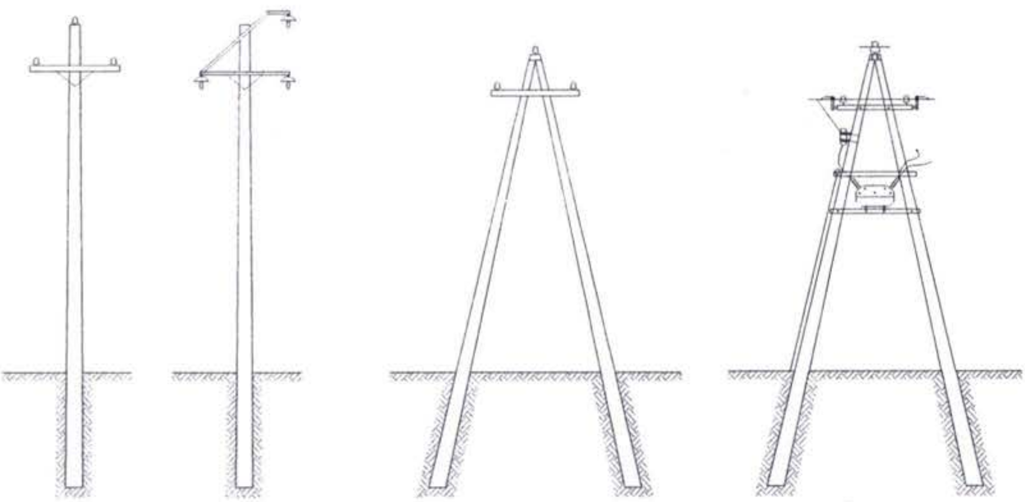


Fig. 4.4.1 – 2 Sketch of the post supporting a single three phase 10kv line

Sketch of the post supporting a single three phase 10kv line



The described 10 kV / 6kV system is connected to the high voltage 110 kV / 35 kV national system through single three phase overhead lines at a voltage of 10 kV to the cabins of "Kungrad" and "Akchalak", at a voltage of 6 kV to the cabins of "Tuley"and "Karakalpakia". Moreover the lines are sectioned and de-energized in the Abadan and Bostan cabins. The protection is implemented with VMG 50 circuit breakers, controlled by PP 67 relays.

The scheme of connections is indicated in Fig. 4.4.1 – 3 and Fig. 4.4.1 – 4.

The total load supplied to users by the system is about 300 kW for A.B., 350 kW for the lighting of stations, 3300 kW for buildings and houses, residential areas; the total is then 3950 kW.

In Kungrad there is one diesel generator for reserving an electric power supply of 48 kW.

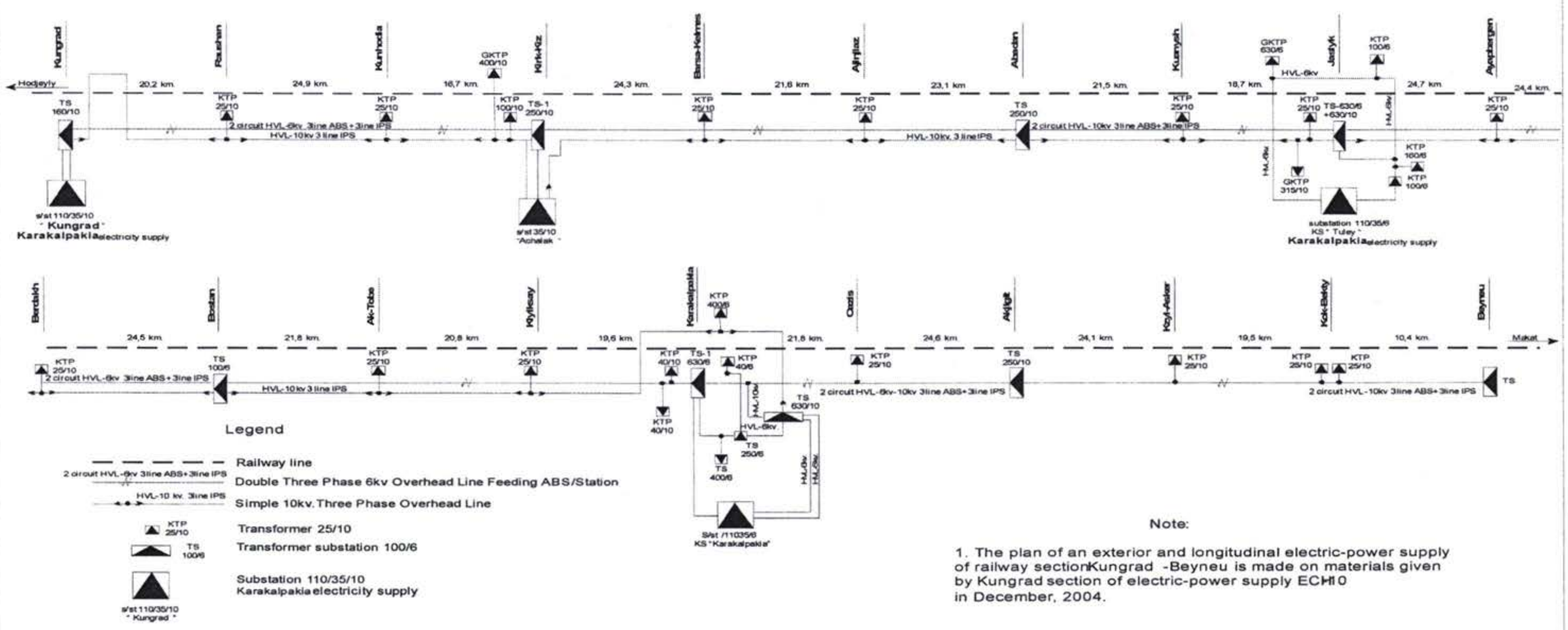
4.4.2 Defects

As above said, lines 1 are obsolete. The area is windy and the soil polluted with salt.

Both cause frequent short circuits and interruption of the power supply continuity.

The operational voltage of the three phase line feeding the A.B. was lowered to 6 kV as provisional measure to reduce the failures, but the coexistence of 10 kV and 6 kV systems does not seem to be the best solution. Presently works of partial reconstruction of the double lines 1 are going on implementing the replacement of wooden cross arms for metal ones.

Fig. 4.4.1 - 3 Kungrad – Karakalpakia (Uzbekistan) line. Power Supply Scheme – 10kv/6kv System



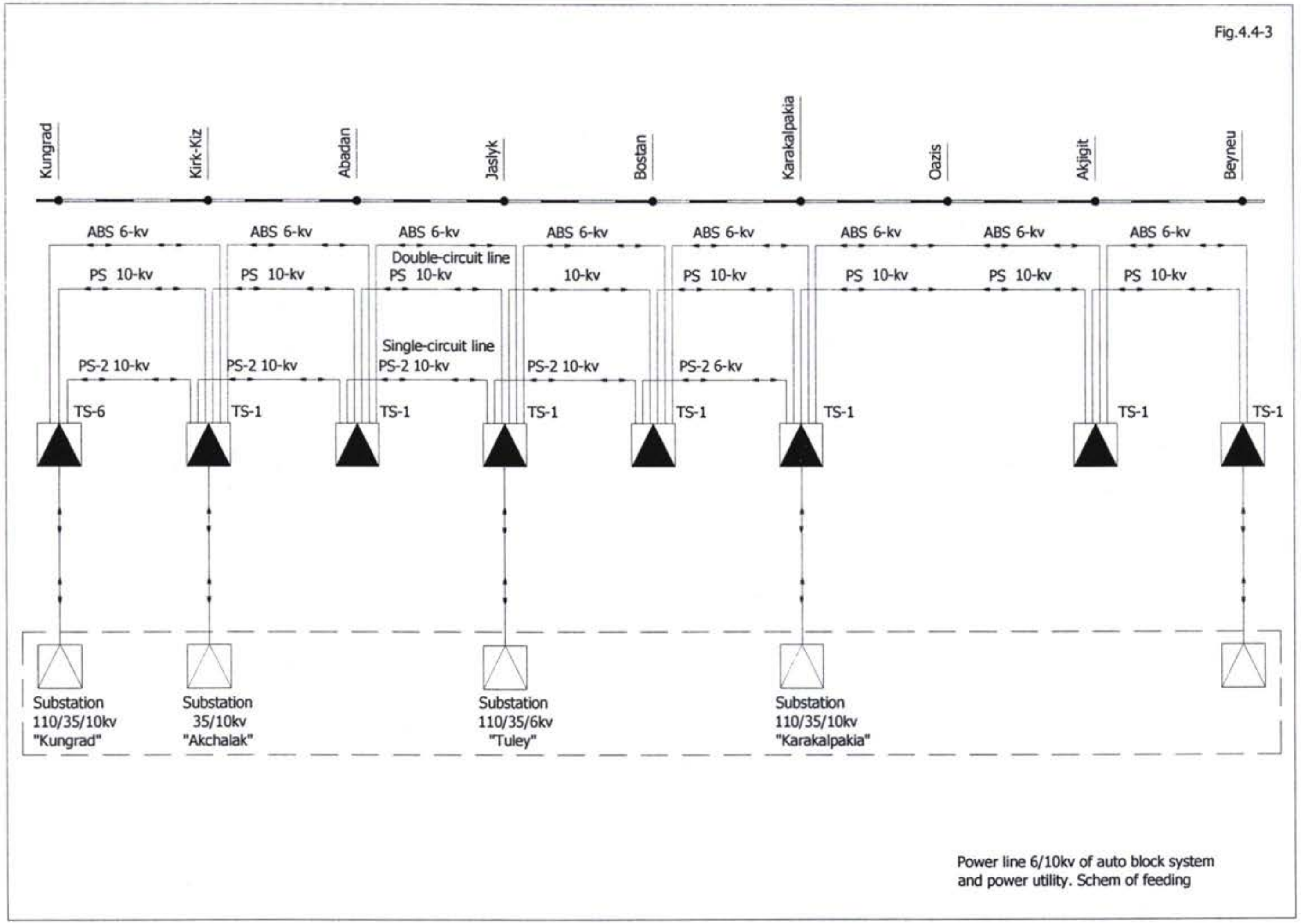
Summary of installed equipment (transformers of model OM) On the section Beyneu - border (Oazis)					
HVL-6kv.ABS	HVL-10kv.IPS	HVL-6kv.ABS	HVL-10kv.IPS	HVL-6kv.ABS	HVL-10kv.IPS
OM-0,66	OM-0,66	OM-1,25	OM-1,25	KTPO-4/6	KTPO-4/10
137	150	83	124	6	11
Section border (Oazis)-Beyneu					
41	3	11	3		5

Note:

1. The plan of an exterior and longitudinal electric-power supply of railway sectionKungrad -Beyneu is made on materials given by Kungrad section of electric-power supply ECHI0 in December, 2004.

Kungrad - Karakalpakia (Uzbekistan) Line
Power Supply Scheme - 10kv/6kv System

Fig. 4.4.1 – 4 Power line 6/10 kv of auto block system and power utility. Scheme of feeding



4.5 Operation, speeds and running times

The line is currently operated both with freight and passenger trains.

Current number of trains on the line is largely inferior to line capacity, because of the mentioned situation about traffic (see traffic chapter).

Line capacity

Line capacity in terms of number of trains per day has been estimated in the current infrastructure conditions by this Consultant, by applying the international formula of Fiche UIC 405.

According to this formula, line capacity is strictly depending on the following factors:

- Number of tracks (in this case one);
- Longest section length (longest section in terms of running time, generally the worst mix of length and acclivity); in this case the existing section between the stations of Jaslyk and Ayapbergen being 24,7 km long;
- Trains speed on this section (in this case 50 km/h as maximum speed);
- Distance between two following main signals (such as, for example, the distance between the starting signal and the home signal of the following station in case the section of line is composed only by a single block section) [D]; in this case this distance has been assumed as 1,7 km;
- Train length [te], in this case 700 m;
- headway between two trains (both for crossing trains and following trains, including the time for setting the routes within the station) [tm]; the headway must be assumed as the necessary lost time between two consecutive trains operated in the same station (for example, the minimum time between the departure of one train and the arrival of a second train in case of crossing trains). Headway is mainly depending on the signalling and communication system used in the station and along the line for train distance, in this calculation analysis 1min has been assumed, according to the modern system of signalisation adopted by the rail line;
- distance between distant and main signal [d]; in this case 1,7 km (three aspects signals);
- visibility distance of the distant signal [l].

Line capacity has been calculated with the following formula:

$$\boxed{P=\frac{T}{t_{fm}+t_r+t_{zu}}}$$

Where:

- "T" is the total operating time per day (20 hours for this line),
- "tr" is 0.67 * tfm,
- "tzu" is 0.25 * number of sections,
- "tfm" is calculated with the following formula,

$$\boxed{t_{fm} = \frac{D}{V} + \frac{l+d+te}{V} + t_m}$$

Where:

- "D" is the distance between two following main signals;
- "V" is the average speed of the section calculated according to the running simulations of the typical freight;
- "l" is the visibility distance of the signal;
- "d" is the distance between distant and main signal;
- "te" is the train length;
- "tm" is the lost operating time between two consecutive trains into the same station.

Results of the mentioned calculation show that current capacity of the line is very high in case of traffic homogeneous direction, being the line equipped with short bi-directional block sections, while the line capacity heavily decreases for traffic made by all crossing trains (one train upward, one downward):

C (100% crossing trains)= 22 trains/day

C (80% crossing trains)=90 trains/day.

Line speed restrictions

Conditions of permanent way elements cause the necessity to reduce the maximum allowed speed on the lines. Generally this measure is taken when:

- the head of rails is worn out up to the admissible values;
- the ballast layer is highly polluted;
- the sleepers are no more in reliable condition for mechanical wear, decay and cracking;
- turnouts are obsolete and their elements worn out (in particular blades and crossings);
- existing embankment section is greatly reduced by wind or rain water erosion;
- profile and alignment are far from the original designed ones, thus implying high vibrations increasing with the speed;
- bridges and culverts needs interventions.

But first of all, speed restrictions have been imposed according to the PW age on the line, in terms of gross million tons operated on the line sections after the last Capital Remonta (maintenance).

Consultant's permanent way experts correlated, during a previous study in Uzbekistan (1999 – Rehabilitation of the line Samarkan-Bukhara-Kodjadavlet), the data concerning the rail age per section, with the speed restrictions imposed by UTY on these sections.

The results of this correlation is reported in the following table and shows that, on average, when the rail age is around 700-800 million gross tons, every further 50-60 million gross tons, the line is interested by a further speed restriction of 10 km/h.

Table 4.5 – 1 Speed restriction and rail age correlation

Speed restrictions correlation with rail age		
Rail Age ('000 gross tonnes)	Speed Restriction Class (kph, passengers-freight)	Remarks
466.607	10-0	interpolated
660.870	10-20	"
774.470	30-20	"
855.070	40-30	"
917.590	50-40	"
968.670	60-50	"
1.011.860	70-60	extrapolated
1.049.270	80-70	"

Sources: Consultant's estimates.

In the case of the Kungrad-Border line section, reductions of maximum speeds were imposed along all its length with the result that today the line is operated at much less than hits possibilities in terms of line operations, speeds and transportation capacity (trains by day).

From the original 100-120 km/h speed for passenger trains and 80 km/h speed for freight trains, the maximum allowed speeds are, for the time being, the following (see Table 4.5 – 2):

Table 4.5 – 2 Line current speed restrictions

Current speed restriction on the Kungrad-Border line		
Stretches between stations	**Length** (km)	**Maximum speed allowed** (km/h)
Kungrad – Raushan	21	50
Raushan – Kyrkis	41.6	70
Kyrk -Kyz – Berdakh	158.4	50
Berdakh – Aktobe	46.3	80
Aktobe – Kaiksay	20.8	50
Kaiksay – Kazak border	39.9	60

Existing and future line speed profile is shown in Annex V "Options schemes"

Current running times

These speeds restrictions lead to the following running times on the line from Kungrad to the Border:

- *Passenger train with few stops: 6h 30'*
- *Freight trains with few stops: 8h 15'*

Time savings due to rehabilitation works will be calculated in the following chapters.

5. Rehabilitation options

5.1 General

The existing situation of the considered section has to be examined in the frame of a general crisis that involves the railway system. The railway national traffic decreased of two third in twelve years, as it was widely commented in the Module A Final Report. The reasons can be found in the economical situation as well as in the competition of other modalities of transport.

The lines that are object of this study are to be considered in this frame, and they are as well as the other ones involved in the perverse cycle that links strictly reduction of traffic, reduction of revenues, reduction of expenses, reduction of maintenance, degrade of the system.

In this context this Consultant has focused the considerations on the infrastructural problems, starting from the information available to the Consultant.

One of the most evident consequence of the existence of this problems is the reduction of the maximum allowed speed along all the section. From the original 80- 100 km/h a reduction to 50-60 km/h has actually to be faced. The reasons can be found mainly in the conditions of rails, of the sleepers, of the polluted ballast, on the bridges, on the modification of the original profile and alignment.

The effectiveness and the strict necessity of upgrading the infrastructural system is out of doubt.

The objective of the interventions considered in Option 1 and 2 is not only to improve the original characteristics, but also to obtain higher levels of safety, speed and reliability of the infrastructure, that must be considered as a present and future transportation axis for all the area.

The options envisaged for the rehabilitation of the Kungrad-Beyneu line have been studied and selected with the specific technical aims of:

- increasing traffic speed both for passenger and freight trains;
- increasing traffic safety in terms of accident (or their probability) reduction;
- increasing general service level (S.L.) offered by the infrastructure to the running trains, in terms of travel quality, speed, vibration and noise;
- reducing environmental impact of the railway system, consequent to emissions reduction, and noise and vibration reduction;
- increasing line capacity in terms of trains per day (depending on the traffic flow directions, on signalling and telecommunication devices, on stations maximum distance).

In terms of costs, the proposed options have been focused on the following targets:

- reducing maintenance costs (for rolling stock and infrastructure);
- reducing operation costs (rolling stock and operation personnel) consequent to travel time reduction;
- reducing accidents costs;
- recycling residual material of the replaced permanent way, by using them on secondary lines of the network or on sidings and branches with low traffic.

Construction cost for each option have been estimated and for each option different rates of maintenance cost reduction have been estimated (in particular due to the adoption of the long welded rails).

Main envisaged works concern the rehabilitation and replacement of the Permanent Way elements (rails, fastenings, sleepers and ballast), and increasing the bearing capacity of the existing formation and upper part of embankments.

Complete replacement of the electric power supply for stations and signalling system has also been considered together with the construction of a new telecom net.

Other minor works have been envisaged concerning the drainage system of the railway body, some replacements of major structures (beams of 6 m span bridges) and minor structures (culverts) and restyling of some station buildings and passenger facilities into stations (platforms and sheds where necessary).

Concerning safety devices, based on the results of the investigations of the technical installations and on several interviews of officials and technicians of Uzbek Railways, this Consultant verified no need of works to carry out in any case in order to restore operations safety at levels which cannot be renounced **(Alternative 1).**

Meanwhile two rehabilitation alternatives have been identified in the frame of safety devices:

- The first alternative (**Alternative 2**) concern **Jaslyk (km797+303)- Karakalpakia (km 933+151)** section.
- The second alternative (**Alternative 3**) involves the section of Alternative 2 and in addition **Kungrad (km 626+917)- Jaslyk (km797+303)** section.

Both above alternatives envisage the following works:

- the renewal of the Relay Interlocking Installations by the activation of other devices relay operated but more moderns;
- the activation of renewed Automatic Block Line Systems (ABLS) and Cab signalling;
- the insertion of the section into existing Central Posts (P.C.) situated in Tashkent.

In general, the proposed options have been developed with the aim of producing the best effects with the minor investment on the infrastructure.

The general proposed works can be seen as speed up capital maintenance, carried out on those parts of the line currently suffering for long and continuous lack of adequate maintenance.

5.2 Objectives of the rehabilitation

The Investment Component involves performing what is essentially a speeded-up capital repair of the entire Kungrad-Beyneu line, split into two sections:

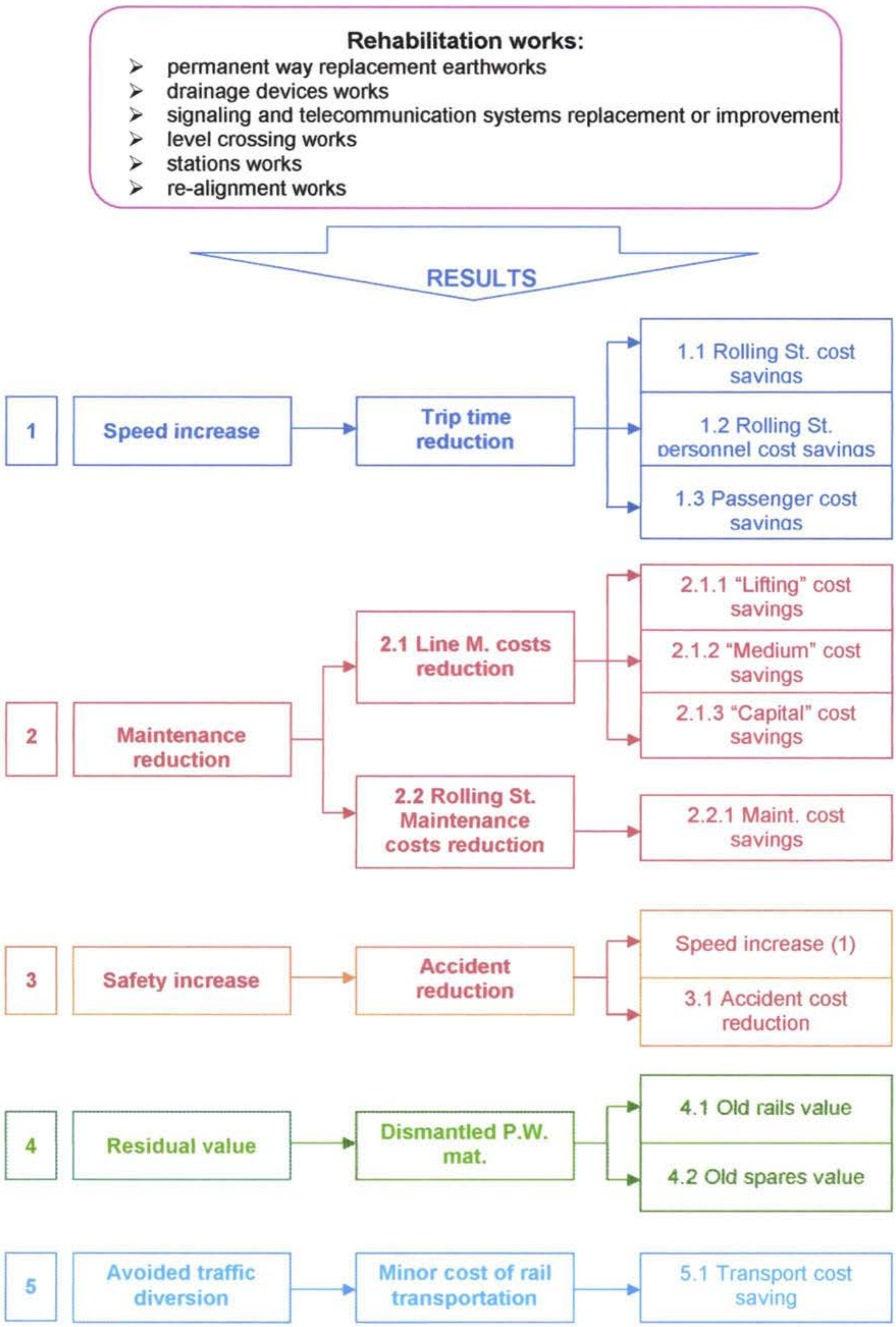
- Kungrad-border (in Uzbekistan) – 326,6 km long and 15 stations.
- border-Beyneu (in Kazakhstan) – 81,0 km long and 5 stations.

The whole line has been studied as a unique transport corridor and with homogeneous technical parameters, as it is correct under an interoperable point of view, that is one of the major tasks of this study. Anyway, for the line belongs to two different Countries and railway Authorities, in order to assess costs and benefits for the two different sections, two separated studies have been carried out.

The main objectives of the proposed rehabilitation works, common to both the line sections and two both Countries, can be resumed as follows:

- Increasing train speed both for freight and for passenger trains. Higher speed along the entire line or some sections will reflect in total travel time reductions (time savings), reflecting in travel cost savings in terms of rolling stock cost and in terms of operation and personnel cost. In fact, not only the time saving will reflect in passenger time cost reduction (extremely low in this area), but it will reflect in rolling stock cost saving, due to the possibility of reducing the train cycle along the whole network to which this line belongs. Hourly costs for the typical passenger and freight trains are calculated, their value is multiplied by the total amount of time saving per travel, by the total number of trains per year, and this will allow to estimate the total yearly cost saving due to travel time reduction. It is clear that, in order to take advantage of the benefits so created, the line operation must be modified in order to take into consideration the major speeds and therefore line timetable will be modified after the completion of the proposed rehabilitation works.
- Reducing infrastructure maintenance needs along the rehabilitated sections of the line, for "lifting", "medium" and "capital" maintenance. In particular, due to the rules currently applied by UTY on Uzbek network, "capital" maintenance will result highly reduced, this sensitively allowing to reduce maintenance costs. For each Option, infrastructure maintenance cost savings have been estimated, taking into consideration "materials", "machines" and "man-work" costs.
- Reducing rolling stock maintenance cost consequent to the better geometric and maintenance conditions of the line. In fact, in most of the proposed options, not only re-alignment and permanent way replacement is envisaged, but also rail welding is considered, this further reducing wheels and suspension devices fatigue in the long term scenarios. Vibration reduction along the line is needed therefore not only for allowing speed increase, that will give the major benefits, but also for increasing passenger service level and rolling stock and infrastructure maintenance in correspondence of the existing rail joints. Anyway, because of data lack about rolling stock maintenance costs, this item has not been taken into consideration analytically.
- Increasing travel safety along the line and into the stations, in terms of accident (or their probability) reduction. Anyway, this item is almost insensitive because implicitly hidden into the first mentioned benefit (travel speed increase). In fact, it is possible to say that since safety is the most important aspect for each railway administration (railway transport "is" safe), this parameter is practically constant, slightly depending on the maintenance status of the railway infrastructure. In fact, maintenance lacks are generally reflecting into speed restrictions, imposed by the administration for keeping a constant and acceptable safety status on the line. For this reason, when rehabilitation works occur, speed restrictions are cancelled, and operation speed of the line increases.
- Residual value of the replaced dismantled permanent way. Old permanent way, generally of P50 type, will be dismantled and possibly re-used or directly sold, at the residual value which is depending on the average age and preservation status of this material. In particular rails, iron parts as bolts, fastening devices, will be taken into consideration, while for sleepers, only those made of concrete can be considered for their residual value. Residual value of ballast, sub-ballast where existing and earths will not be considered because their re-use has been already taken into consideration within the works to be carried out on the considered sections.
- Avoided traffic diversion. In this case, for the short term period, traffic diversion on the road is impossible, because the road is currently not existing. In the future, when the road is completed, traffic diversion from the railway will be a sure effect. Dimensions of this effect will depend on the current status of the road and of the railway, on their service level and on transportation cost. It is possible to assume that rehabilitation works on the railway will help to reduce traffic diversion in the near future when the road construction is completed. Comparison will be made between the two scenarios "with project" and "without project".

Resuming the positive effects of the rehabilitation (benefits):



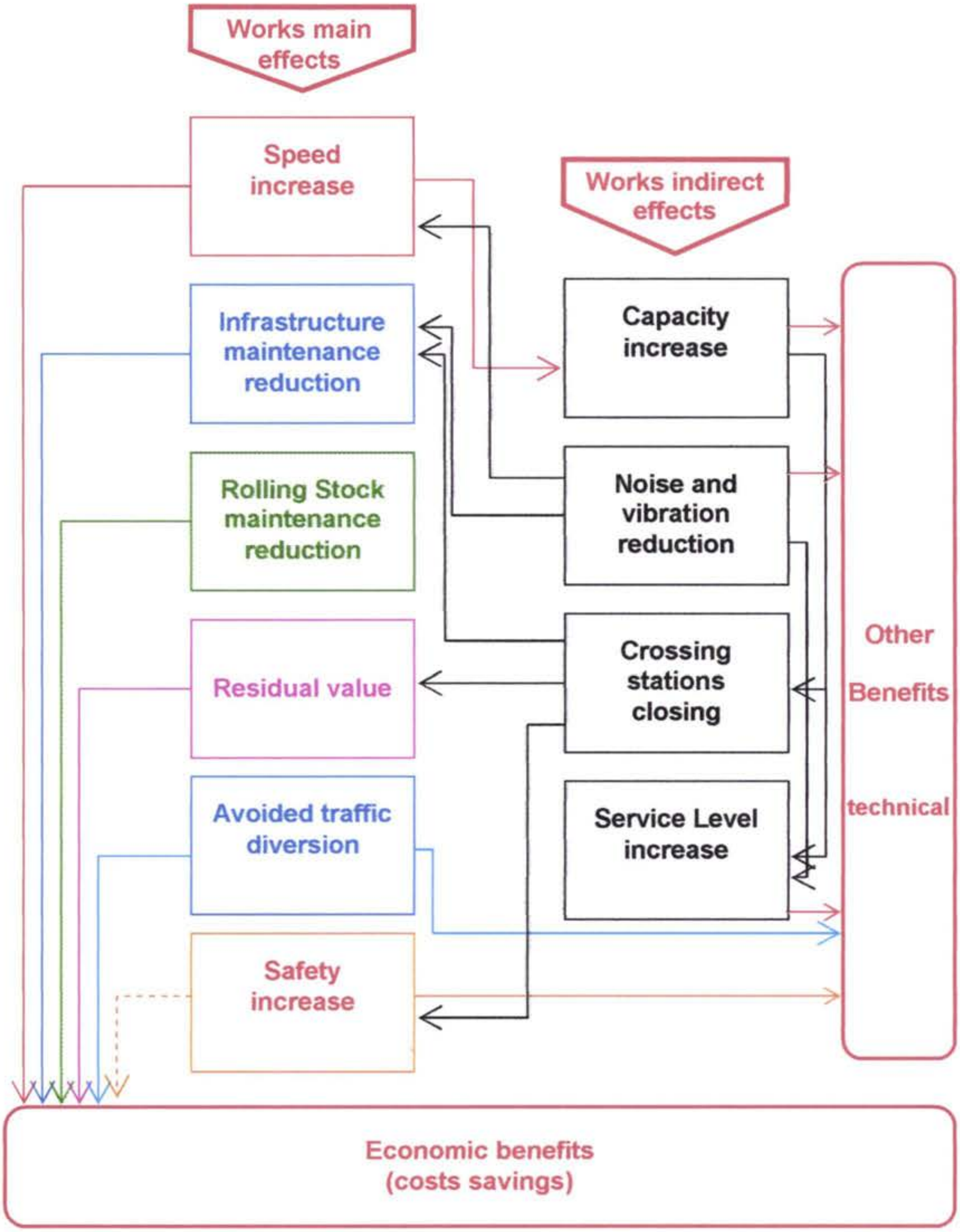
Moreover, in addition to the before mentioned aspects, there are some other potential results to be taken into consideration in this analysis. In fact, following the rehabilitation works, the line will offer an increased Service Level (S.L.), both to the users and to the surrounding areas:

- Line capacity increase. Line capacity is intended as the maximum number of trains per day served by the line and it can vary from about 30 to 90 trains per day per single track, according to different conditions of the sensitive parameters (line speed, traffic flow homogeneity, percentage of fast trains, signalling systems, distance between stations, etc.). In this case of line rehabilitation, depending the capacity on the occupation time of the block sections by the trains, capacity itself will be positively influenced by the speed increase generated by the envisaged works. A further contribution to line capacity increase will be also given by the adoption of new updated signalling system for both line and stations. The detailed analysis of line capacity will be carried out in the next chapter (5.4.3 "Performance improvements").

- Station number reduction. Present and forecast traffic on this line does not seem to require a huge line capacity increase, therefore it is possible to assume that capacity increase can be compensated by the closure of non necessary crossing stations, by keeping the line capacity at constant value. In order to clarify this item, it is obvious to show that the same capacity can be offered by a single track line section with D=15,0 km ("D" is the distance between two consecutive stations) and a single track line section with double D (30 km), corresponding to the closure of the intermediate station, if the line speed is increased from 45 km/h to 80 km/h. In the case of the line under study, the presence of more block sections between two stations (on average 1,7 km long) allows to increase line capacity only in case of homogeneous traffic direction in different periods of the day. Moreover, the presence of more block sections, further increases the effects of the speed increase, in terms of capacity. In fact, with 70% of homogeneous direction traffic, with the presence of 1,7 km long block sections, the line capacity increases to 62 trains/day (for average speed 45 km/h and D=15km). The same capacity value, can be offered with the closure of the intermediate station (D=30km/h) in case of V= 75 km/h.

  Pointless to say that in case of station number reduction, positive effects would reflect on operation and maintenance cost. Moreover, rehabilitation works will be less costly, for the elimination of sidings, station technologies and switches.

- Traffic noise and vibration reduction. The rehabilitation works envisage the elimination of the most part of rail junctions currently present along the track (every 25m), by means of the adoption of continuous welded rail (C.W.R.). Moreover the proposed works include the re-alignment of plan and vertical geometric conditions of the line, by contributing to reduce noise and vibration during train operation. If these factors can be considered as non sensitive factors in a mainly desert area for their impact on surrounding environment, their impact on S.L. for passenger service will be considerable. Anyway, large part of the benefits of these improved infrastructure conditions will be exploited in terms of increased train speed.


Works main effects
Speed increase
Works indirect effects
Infrastructure maintenance reduction
Capacity increase
Rolling Stock maintenance reduction
Noise and vibration reduction
Residual value
Crossing stations closing
Other Benefits technical
Avoided traffic diversion
Service Level increase
Safety increase
Economic benefits (costs savings)

For the solutions proposed for the signalling system, the Options aimed at improving equipment availability and reducing the cost of traffic control and maintenance of the safety devices.

The choice of these measures is based on following evaluations:

- the utilisation of computer aided interlockings in the peripherals places is avoided because of the presence of extreme environmental condition (simultaneous presence of very high temperature excursions, presence of salt, sand, high difficulty to reach the equipments etc) and the current lack of a deep knowledge of the behaviour of these equipment in such conditions;
- the utilisation of other types of automatic block systems is not recommended by this Consultant even if they have been taken into consideration and evaluated.

In fact a different type of automatic block, like axels counter automatic block, is cheaper and suitable for present and middle term traffic but its adoption would mean a worsening:

- in the safety (without supplementary systems no cab signal and no self-braking),
- in the capacity of the lines (from a station to the corresponding could run only one/two train at a time),
- possibly rail disconnections would not be detected and
- probably also RAM conditions (reliability, availability and maintenance) of the whole spacing system will suffer a worsening.

On the contrary the coded circuits automatic block system has been widely checked as regards reliability, availability and maintenance also in the extreme environmental conditions present in these lines.

Furthermore several block sections, if coupled with a planned circulation in a single direction for certain period of the day, will allow to ensure present line capacity for future needs;

- the adoption of the envisaged measures and the consequent increase of the RAM conditions of the interlockings and the block system will allow the unmanning of the smaller stations (that have no need of shuntings).

5.3 Works Typologies

The envisaged works for line and station rehabilitation have been thought in order to answer to the mentioned targets in a progressive way and with increasing investment costs.

In particular the categories in which the whole rehabilitation works can be divided are:

1. Infrastructure:
    a. Civil works concerning earthworks and drainages;
    b. Permanent way replacing works (for line and stations, there including replacement of turnouts and replacement of blades and crosses for those to be re-used on siding tracks);
    c. Existing permanent way rail welding and tension regulation;
    d. Re-alignment, leveling and ballast cleaning on the existing sections;
    e. Civil works concerning structures (replacement of bridge beams or replacement of pipe culverts);
    f. Civil works concerning station buildings and station platforms;
    g. Civil works concerning re-pavement of some level crossings (L.C.). In terms of level crossings no elimination has been envisaged for the low traffic both on the railway line and on the interfered roads (mainly unpaved roads).

2. Power supply systems: new double three-phase overhead 10kV line for supporting electrical needs of signaling and ancillary services of stations and line.
3. Safety devices:
   a. Renewal of station interlocking systems;
   b. Renewal of line traffic control and train spacing systems (signaling, block devices, etc.);
   c. Remote commanding and controlling of the line and stations (CTC).
4. Telecommunications.

5.3.1 Infrastructure and power supply system

In details the following Table 5.3.1-1 contains the description of the works to be carried out for points 1. and 2. Infrastructure and Power Supply system, as they have been considered in the Bill of Quantities for each option.

Table 5.3.1 – 1 Description of works to be carried out for infrastructure and power supply systems

INFRASTRUCTURE AND POWER SUPPLY WORKS FOR LINE AND STATIONS REHABILITATION		
	A. WORKS	DESCRIPTION
1A	Topographic survey of the line and corrections of the existing alignment and profile.	Topographic survey to be carried out along the line, for a strip of 50+50m around the existing railway axis, production of the current status cartografy, and detailed correction of the alignment and profile of the line. New plan profile in scale 1:1,000 and current cross sections of the line in scale 1:200-1:100 step 50 m will be produced, indicating the existing and future geometrical parameters of the line.
2A	Demolition of line.	It consists in dismantling the existing worn out permanent way (rails, junctions, sleepers and fastenings), transportation of the materials to the deposit sites, dividing them into old and re-usable materials (residual value). This operation will be presumably carried out according to the methodology developed in this area: after having manually eliminated the fish-plated junctions of the rails, the dismantling train will pass over the free track panels, and its tail equipped with a dismantling crane will dismantle the track panels and automatically transport them into the front platform wagons.
3A	Excavation.	After having dismantled the permanent way, escavation of about 50-60 cm of topping material of the embankment by means of machine (buldozer with front showel). Generally, during this process, old polluted ballast and old polluted sub-ballast (sandy gravel) are discharged on embankment side for their future re-use. In case this work takes place into stations, the removed top material will be transported to dump. This item also include the further compaction of the top layer of the embankment for increasing hits bearing capacity and for re-shaping the embankment roof.

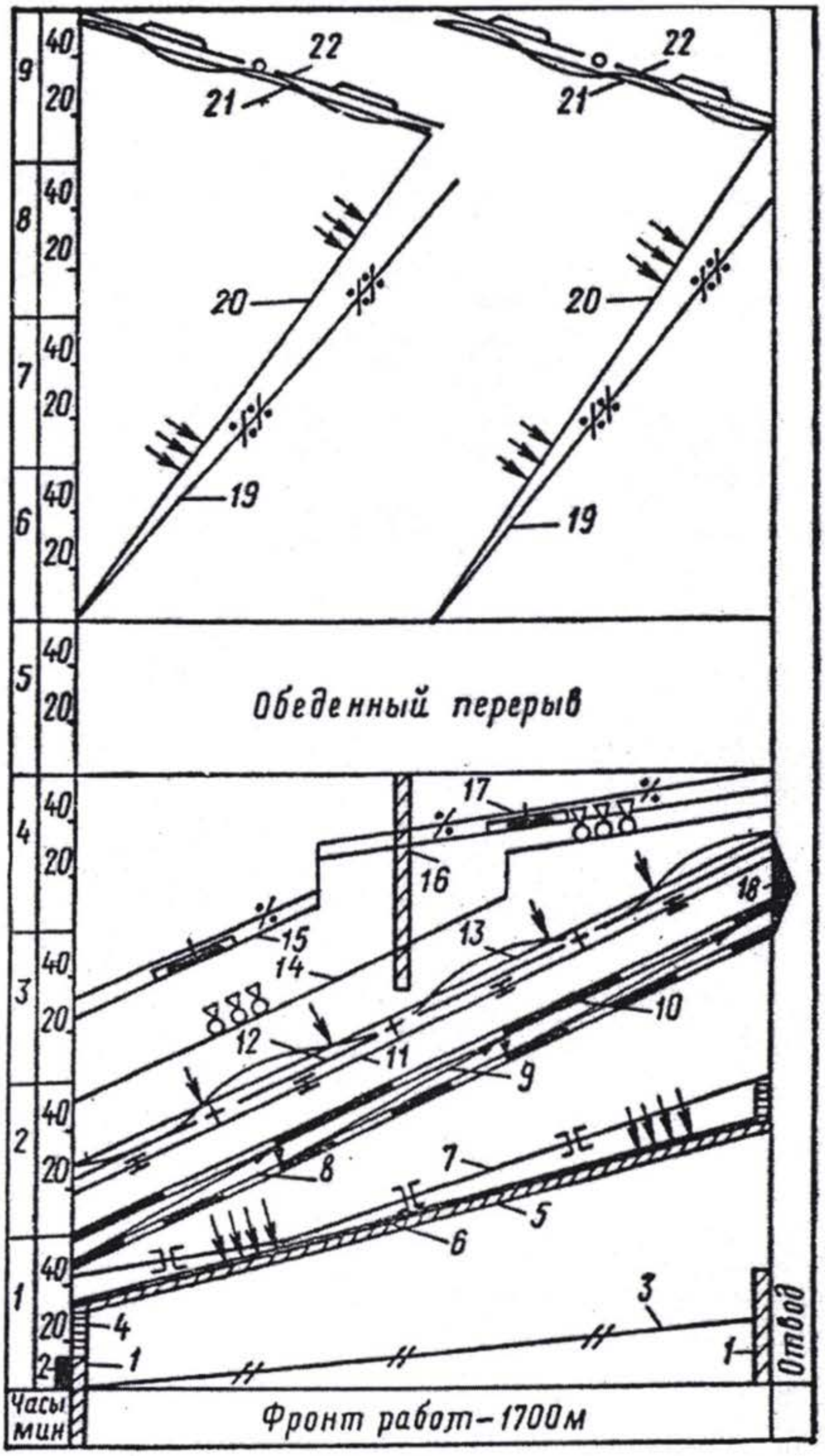
4A	Partial lateral rebuilding embankment section, placing and compacting the removed top material for widening the top surface of about 1,0 m.	This item will be applied only on those sections where the existing embankment is found to be eroded and not copliant with the typical cross section. In many cases in fact, ballast is falling on the embankment side for the embankment is reduced in transversal dimensions due to the water and wind erosion of hits slopes, not protected by means of grassing. For this item, material will be taken from the side material demolished in Item 3A for those sections where 3A took place, while for the other sections material will be transported or taken from the surrounding environment after tests. In order to widen the embankment side, the existing eroded side will be shaped in steps, and the additional earth will be added in layers of max 20-30cm in order to compact it by means of manual vibro-compacting machine.
5A	Implementation of a layer of sandy gravel material, 0,2 m thick under sleepers (sub-ballast).	After the item 4A, on the compacted top layer of the embankment the new layer of sandy gravel (sub-ballast) will be laid and compacted in the correct shape, according to typical cross section.
6A	Construction of line.	After the item 5A, the new track will be built (sleepers, fastenings and rails), by laying it on the sub-ballast layer. This procedure will be presumably carried out with the system used in this area, described in detail in the Figure on the next page. This system is based on the use of construction train, similar to the dismantling train, with opposed operations. Tail locomotive of this train will push the front laying crane against the section to be built, and the crane will lay track panels, casted outside of the field, on the sub-ballast layer. Provisional junctions will be installed and the construction train will run on the just installed panels. Construction of the line can also be carried out with other methods, as for example that envisaging the use of long welded rail to be laid on the two sides of the existing permanent way and the transportation of the sleepers only on the construction train. This second method allows to avoid the big number of weldings to be done on field and allows to transport on field sleepers and long rails separately. The first train transporting long rails would also run during line operation, laying the new rails on the two sides, the second train would dismantle the existing permanent way, cleaning and re-laying the sub-ballast, laying the sleepers (tranported by hits wagons) at the correct distance and it would finally install the lateral new rails on the sleepers, with fastenings. In the next pages the two envisaged construction methodologies will be described with schematic drawings. The item 6A also includes first layers ballast spreading, tamping and lifting of rails up to 3 cm to final level.
7A	Flash-butt or thermic weld of P65 rail.	Welding of the panels by means of flash-butt or thermic system. Welding of the rails will have to be done according to strict technical specifications, that will be detailed in the next phase of the study.
8A	Regulation of mechanical tension of long welded rails (l.w.r.).	After the rail welding, mechanical tensions will be regulated, according to strict technical specifications, that will be detailed in the next phase of the study.
9A	Final tamping and leveling of new line.	The permanent way, so welded and regulated, will be in this phase taken to hits final level and alignment by means of final tamping and leveling.
10A	Ballast cleaning on the other existing sections.	On some of the sections where existing permanent way is preserved, ballast cleaning will be carried out. Ballast cleaning concerns the existing section ballast cleaning and re-shaping, with some addition of new ballast where necessary. It can be carried out by means of automatic machines or by handwork.

11A	Tamping, leveling and aligning the other existing sections with l.w.r.	All over the sections where existing permanent way is preserved, tamping, leveling and aligning will be carried out for reaching the final alignment.
12A	Substitution of culverts concrete pipes.	For some culverts, the worn out pipes will be dismantled and repalced with new ones. The operation needs line interruption, permanent way dismantling, embankment cutting, structural works and embankment and permanent way reconstruction. On average, each culvert is 12m long (embankment between 1 and 2m high).
13A	Excavation of ditches.	Hydraulic drainages must be cleaned and embankment side ditches must be excavated when absent, in order to protect the embankment side from water infiltration and foot erosion. In general, no concrete cover is requested for the ditches. Trapezoid ditch 0.5-0.5-0.5 has a volume of 0,5m3/m.
14A	Pavement of level crossings.	This item concerns the reconstruction of the pavement of the level crossings for the area of railway crossing only. It has been estimated that each level crossing envisages an area of about 50m by 10m.
15A	Passenger stations: platforms new.	Dismantling and reconstruction of passenger platforms into stations. During the reconstruction of the platform, also drainage works for the running track will be carried out.
16A	Passenger stations: platforms restyling.	Existing platforms restyling.
17A	Passenger stations: building restyling.	Station building restyling.
18A	Replacing switch crossings.	For the preserved turnouts or for the turnouts to be re-used on siding tracks, where the existing conditions of crossings are not acceptable (consumed), the crossings will be replaced with new ones.
19A	Replacing switch blades.	For the preserved turnouts or for the turnouts to be re-used on siding tracks, where the existing conditions of blades are not acceptable (consumed), the blades will be replaced with new ones.
20A	Replacing (or installation) of switch small tg(complete).	It includes dismantling of existing old turnouts and construction of new turnouts.
21A	Construction of new double threephase overhead 10kV line.	It includes foundation works for the new reinforced concrete posts (50m distance), posts installation, posts equipments, cables laying and their tensioning. Finally it includes electrical connections to the sources and clients.

Points 2A, 6A and 9A correspond to general Capital Maintenance carried out by the Railway Administration. They in fact include dismantling of the P.W., compacting the sub-layers, laying the new P.W. panels, and adding the necessary quantity of ballast for tamping and leveling till the final requested level.

These actions and working times are strictly connected with the methodology adopted by the Railway Administration and are well described by the following time scheme.

Fig 5.3.1 – 1 Main work schedule in the major repair works on track



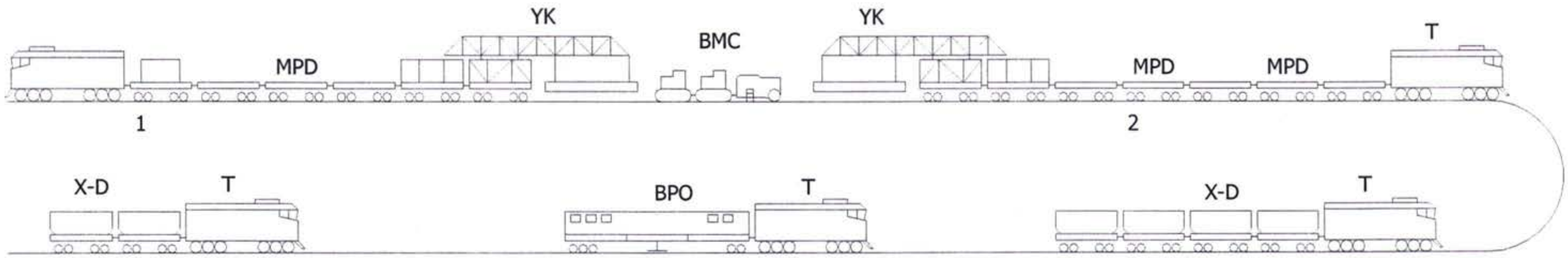
1 – preparing for charging and discharging of gravel-cleaning machine; 2 – securing the closure of the route section; 3 – preparing for dismantling; 4 - preparing for charging and discharging of gravel-cleaning machine; 5 – gravel cleaning; 6 – track rectification; 7 – unbolting the rail joints; 8 - dismantling of the track; 9 – gravel ploughing; 10 – track laying; 11 - bolting the rail joints; 12 – installing inventory stop brakes; 13 – setting the track on axle; 14 – gravel unloading; 15 – track rectification with VPO-3000 machine; 16 – equipping electrically-failed joints; 17 and 19 – exit of stop brakes; 18 – exhaust unit; 20 - track rectification; 21 - lining of the track; 22 – prism alignment.

Finally, the following table contains detailed timing of each phase of the works.

Table 5.3.1 – 2 Operational main work schedule in "possession"

N.	Operation name	Planned time	
		Duration (min)	End of operation, Hours and minutes
	The passing of the last scheduled train on station		10.40
	The work of the dismantling train		
1	Arrival to the place of work	15	10.50
2	Positioning in running order	8	10.58
3	Dismantling of first packet (gravel-cleaning machine's work start)	12	11.10
4	Dismantling of second packet	12	11.22
5	Same, third etc	12	11.34
22	Dismantling of twentieth packet	12	14.58
23	Positioning in transport order	12	15.10
24	Departure of dismantling train	5	15.15
	Gravel-cleaning machine's work		
1	Arrival on track	5	11.15
2	Gravel cleaning on the first section extending over 50 m (beginning of track laying)	5	11.20
3	Finishing gravel cleaning	225	15.00
4	Derailment	5	15.05
	Laying train work starts		
1	Following to the place of work	20	11.10
2	Positioning in running order (start of laying)	10	11.20
3	First packet laying	12	11.32
4	Same, second etc	12	11.44
22	Twentieth packet laying	12	15.20
23	Exhaust unit positioning of crane in transport order	10	15.30
24	Departure for station	3	15.33
	Hoppers-dozers work		
1	Following to the place of work of welded structure from 40 hoppers-dozers (start unloading)	15	13.00
2	Ballast unloading during track laying		15.20
3	Unloading after track laying		15.35
4	Departure of welded structure from 40 hoppers-dozers for station		15.40
	The work of VPO-3000 machine		
1	Following to the place of work	15	13.35
2	Charging	5	13.40
3	Machine's work during gravel unloading		15.40
4	The finishing of the measured shovel-packing		15.55
5	Machine discharging and leaving for station	5	16.00
	Hoppers-dozers work		
1	Following to the place of work	15	14.00
2	Ballast unloading		16.15
3	Departure of welded structure from 40 hoppers-dozers for station		16.20
4	Time route section is closed	from 10. 40 until 16.40	

Fig. 5.3.1 – 2 Current Permanent Way replacement cycle



1 - dismantling (distributor) train; 2 - packing (laying) train; T - disel locomotive; MPD - motor platform; YK - laying crane; BMC - balast dearer; XD - hopper-batcher; BPO - liner-tamper supfaser.

It must be underlined that, while the first two categories of works (Infrastructure and Power Supply) have been treated strictly together for homogeneous results of the works, Safety Devices and Telecommunications have been analyzed as separated items for their being completely independent from the other items in terms of effects on the line operation and on benefits deriving from their application.

5.3.2 Telecommunications

The Consultant has recently developed for the European Commission the TACIS/TRACECA project Central Asia Railways Telecommunications (2002-2003). Outputs of that project were the Central Asia Railways Telecommunications and Signalling Master Plan and 8 Feasibility Studies for the modernisation of railways telecommunication systems. The present telecommunication project is consequently in accordance with the indications and recommendations of the mentioned Master Plan and the adopted methodology and the proposed technical solutions are derived by the Central Asia Railways Telecommunications Project.

Services to be guarantee

The telecommunication services to be guaranteed in the strictly railway context can be grouped into the following categories:

Signalling telecommunications (train spacing and protection). The role of this type of telecommunications is to transmit information regarding the status of the signalling field elements such as: signal condition, track circuit clear, points setting, etc. This information serves to space and protect trains in circulation; therefore they must be securely transmitted. In and around stations, the flow of information from track to signal boxes and vice versa utilises a local cable network. For full line section information can travel from track to station as well as from station to station.

Operating telecommunications (traffic and energy command and control). The term "Railway operating telecommunications" covers all telecommunications directly connected with train circulation other than signalling information, like for example: railway operations and electric line control; control over various line elements (for example, level crossings); dedicated station to station lines; lines dedicated to maintenance; shunting radio; ground to train radio; etc.

Applications telecommunications (management information system, invoicing, ticketing, etc.). In terms of global development of computer applications, the railway sector has also experienced a significant increase of requirements for high-speed data transmission systems, and an equally significant increase in the demand for high quality and secure connections. The network to design must therefore respond to these needs by guaranteeing adequate transmission capacity.

The role of these services affects the choice of the type of telecommunications system to adopt, with particular reference to the type of cabling.

Naturally, other functions have to be considered as well, such as: short and long distance automatic telephone services; data transmission; radio communications; public services.

Definition of needs of the telecommunication system

The increase in the demand for ever higher volumes of information and transmission speed has been such an incentive for technological development as to lead, especially in the case of telecommunications, to the replacement of perfectly functioning systems with others of the latest generation with lower investment and maintenance costs. This type of replacement intervention had never been before part of the railway logic. Now it has, however, become a standard of new trends in the sector. Multi-service networks, for services companies, are coming to the fore as a strategic medium: all the various types of communication (data, voice and video) being channelled along the same transmission medium.

The multi-service networks that have to meet these requirements have, also, to respond to the following major criteria:

- use of a multi-hierarchical level architecture, based on the most recent technology adopted in Western Europe;
- secure transmission;
- open and flexible structure to facilitate extension and upgrading;
- management systems compatible with local and long distance operability;
- the capacity to interface with all types of terminals;
- an adequate number of spare channels to implement advanced level services, considering also the future expansion of the demand in communications;
- and the possibility of marketing residual capacity.

To meet these basic requisites it is essential to consider the adoption of digital technology as an inevitable fact, because it permits cost reductions for both constructors and users, as well as increased performance.

Among the many existing transmission technologies, the most respondent ones to the explained needs could be based on the utilisation of copper cable or optic fibre cable.

For the same transmission capacity the sheer dimensions of copper cables compared to optic fibre is a point in favour of fibre optics cable, because it allows smaller ducting as well as junctions and terminals. Also, the adoption of optic fibre cable, together with PCM (Pulse Code Modulation) technology transmission systems, allows a great number of channels with high quality transmission characteristics, because the system, using optic fibre transported light impulses, is practically immune to the electromagnetic interference normally induced in copper cables and even more so in aerial lines. Moreover, optic fibre is a dielectric component and therefore not subject to breakdown due to lightning strikes or other sources of overload by contact with overhead traction power lines (if present). There are no drawbacks in using fibre optics for railway operating and telecommunications applications. Local copper cable networks are only necessary for certain signalling telecommunication services and for short distance and limited bandwidth communications.

The technical/economic comparison between aerial and buried cable leads to the conclusion that the recommended solution for railway applications should be that of a cable buried in a High Density Polyethylene (HDPE) conduit for the high degree of protection this offers, coupled with advantages in terms of functional reliability, operational costs, ease of maintenance and cable life span.

Network availability and flexibility

Availability is one of the indicators that measures quality of service and refers to the probability that a certain system, operating in a given environment, is available at a certain time.

Redundancy is used to increase network availability. Fundamentally, redundancy for SDH networks can be obtained with a ring-shaped structure achieved by connecting the extremities of the transmission system together, which permits access to the apparatus from two different directions.

The flexibility of the network refers to its attitude toward low cost modification to respond to the requirements of changing demand.

For this purpose, modular structure is required, especially for transmission equipment, and, if necessary, for increased transmission capacity simply by adding other modules.

Importance of standard protocol

It has to be stressed the importance of using systems based on standard protocols. Although a solution based on proprietary protocol can be valid from the technical point of view and can be competitive from the financial side, it will have strong implications for the future steps too.

Telecommunications works as a system; which means that to talk about railways telecommunications generally doesn't mean to talk about a single railway line you are considering, but of the telecommunications system needed for the operation of that line. Consequently during the technical evaluation of the possible solution also the following aspects have to be considered in discarding "proprietary protocols based-solutions":

- there will be no fair competition in the tenders once a proprietary protocol will be starting colonising the area;
- additional costs will be born for allowing different part of the network (with different protocols) to talk each other, providing that this is possible;
- maintenance and future provisions of spare parts can't take the advantage of economy scale (with different systems in place) but mainly will be in the hands of the protocol owner with uncontrollable consequences on the costs.

Description of the proposed system

The Consultant has developed a parallel Feasibility Study for the railway section Oasis – Beyneu in Kazakhstan for the rehabilitation the entire line Kungrad – Beyneu. The technical solution studied for the Kungrad – Oasis section is therefore the very same solution designed for the section in Kazakhstan and they can be seen as two parts of the same project.

The following telecommunication system, suitable for low traffic lines, is proposed and has been evaluated for the Kungrad - Oasis line:

- STM1 (155 Mbps) + E1 (2 Mbps) - using a SDH (Synchronous Digital Hierarchy) based system for the primary backbone complemented by PDH (Plesyocronous Digital Hierarchy) based system for the secondary backbone.

The system is based on two level network solution, with a first level of backbone assured by SDH 155.52 Mbps technology and a secondary provided by PDH technology with multiplexer of 2 Mbps capacity.

The highest backbone of the system is a ring structure using STM1 (155 Mbps) for the transport between the Add/Drop Multiplexers (ADM1) at the higher order stations (Kungrad, Jaslyk, Karakalpakia) which are equipped also with PABX.

The secondary backbone uses PDH technology, adopts E1 (2Mbps) for transport and uses PRMs (Primary Rate Multiplexer) for the transmission and for interfacing with higher level.

A scheme of the system proposed for the line Kungrad – Oasis is represented in Figure 5.4.2-1.

The system uses:

- 2 fibres of the optic cable for the functionality of the primary connection
- 2 fibres of the optic cable for the functionality of the secondary connection
- 2 fibres of the optic cable for redundancy reason (closure of the line).

Fibres for the primary and secondary connections are normally in the same cable while fibres for redundancy should be physically located in another cable and in another place.

Since the second cable is needed to ensure the redundancy of the system in case of problems with the first one (a cut of the cable, a card out of order or not functioning properly and consequent need of substitution), this measure allows for safety conditions of trains running along the line. In order to do that, it is "necessary" to maintain the two cables physically separated so to prevent the simultaneous cut of both.

Every cable is supposed to be of the current international standard: 32 fibres. Thus the cable's capacity is redundant in respect to the real use for the railways purpose (4 fibres in one cable and 2 fibres in the other one). Because of that and to reduce costs, the two-cable solutions are adopted only when there are no other possibilities, so to reduce costs.

Therefore for the Kungrad – Oasis line, as far as the redundancy is concerned, it has been considered the following two possibilities:

- implement a second cable for the redundancy, or
- renting of channels or a fibre pair from third party.

A preliminary screening of the just mentioned possibilities has excluded the first-one, namely the adoption of a second cable, for costs reasons: major cost vis-à-vis an oversized system composed by two optical fibres cables (the "two-cable solution" is - in so far the total cost of the solution - at least 40 percent to 60 percent more expensive than the alternatives with the "one-cable solution").

Therefore, as a transitory measure, the closure of the ring will be by external link and the suggestion is to use the existing facilities of public Telecom along the railway line. For the closure of the ring 5 links at 2 Mbps are needed. In the near future, an optic cable will be also laid by the Ministry of Communications and it has been agreed that Railways will be use this cable for redundancy and in the same way the cable of the Railways will be used for the redundancy of the public telecom system.

It has to be remarked that the use of a link external to the railway network could be seen as a transitory measure in the time being up to when long distance transmission will be in operating on the primary railway network (in this case, involving also the Kazakh network, Kandagach – Makat – Beyneu – Miskent – Samarkand – Tashkent – Arys – Kandagach) and consequently the closure of the ring can be actuated directly by the railways.

Taking into consideration optical signals attenuation and distances between higher order stations, additional regenerators of optical signals have been introduced in correspondence of stations every time distances appears to be critical for the efficiency of the transmission.

The suggested solution covers also copper cable transmission for service telephones (those in open line in correspondence to the signals for neighbouring track circuits, additional future needs like remote signals control, interlocking station systems, central control of power supply for the line contact, remote level crossing control).

The adopted standards will simplify the technical arrangement necessary to operate trans-border train services in the border stations of Karakalpakia and Oasis with Kazakh Railways.

As already explained, the whole architecture would require 6 fibres. The cable to be implemented (a 32 optic fibre cable) will be supplying 4 fibres while the other links will be taken externally as explained previously.

Both the primary backbone and the secondary backbone are protected by a ring configuration, thus the system is able to guarantee the proper functioning in consequence of a single failure and allows point-to-point link.

Point-to-multipoint links, the use bandwidth on demand and the automatic re-routing are not allowed by this system, but some of these just mentioned weak points can be later exceeded because the system has the capability of growing with a minimum of changes (adding other devices, such as IP Router in the main station).

The old telecom exchanges will be replaced with latest generation automatic electronic exchanges (PABX) of adequate potential, that will include the interfaces with the digital junction lines (conforming to ITU-T standard G.703) in output and a fully automatic system for calls, with the adoption of a new national numbering plan that makes calls between different exchanges possible by forming certain telephone number prefixes.

For each connected number it will be possible to allow or deny national and international calls and automatic connection to the public network. It will also be possible to provide each customer, with adequate apparatus, DTMF or digital telephones and all the services of a modern public telephone system (call notice during a conversation, call back in case of number engaged, call transfer, etc.).

The new exchanges will also allow for easy expansion of capacity, foreseeing spaces in the cabinets for inserting user cards without having to add or replace control and switching gear, which must already be adequate at maximum capacity of the exchange model and redundant for greater reliability.

This transmission system is highly suited to replace the service currently provided by telex, now rarely used and with high maintenance costs, especially for the dedicated telegraph exchanges and telex machines themselves.

All stations are also equipped with UPS and every PABX is provided with special electric power supply station, sized on the effective needs of the system, and able to be further expanded by incorporating modules. A storage battery will assure the proper functionality of the PABX for at least 8 hours – in case of blackout of power supply. The battery will also assure the functionality of accessory devices (i.e. service terminals) in the case the system is not equipped with devices for memorising failure signals during blackout.

A system for management, supervision, and maintenance of all PCM equipment of the country has to be implemented. Generally, for a country network railways configuration, such a system is organised on two levels: the first level is formed by Element Manager (EM) spread along the lines supervised by the system, while the second one by a Network Manager (NM), consisting of one only equipment. By this system, the possible alarm will be recorded by both the competent EM and the NM. The NM will be set in Tashkent, while the EM will be set in Kungrad.

The PABX Management System is based in Kungrad; it consists in a Domain Management System that allows centralized management of all the PABX of the line by high-level user interfaces. All the functions are realised on the same HW and SW platforms and use the same database to achieve a global management system with a single access point. The system is implemented on PC and will interface with global network management systems (telecom and data), in accordance with the standard SMNP (Simple Network Management Protocol).

The Synchronisation System allows every apparatus to receive the synchronisation signal from both sides. At the ends of every section and every 30-35 apparatus, a SASE (Stand Alone Synchronisation Equipment) has to be installed. The SASE produces a high-quality clock that is used for synchronisation of all the apparatus. With this system, every apparatus will use the Ck coming from one side as prime priority signal and the Ck from the other side as signal with second level of priority. SASE will be installed in Kungrad and Karakalpakia.

Technical specifications for the equipment will be provided separately with the Detailed Design and the Tender Dossier to be presented later in the project.

The Consultant strongly recommends to continue the technical co-operation with Kazakh Railway because of the possible future synergies able to reduce costs form both sides.

Co-operation with public telecom has also to be carried out. The limited resources to be devoted to the renewing of the existing telecom infrastructure suggest a close collaboration between different possible actors in the sector aiming at optimising the resources utilisation.

Finally it has to be remarked that the proposed system uses standard protocols, as previously recommended in the Basic Criteria chapter.

5.3.3 Safety devices

For the point 3. Safety Devices, both proposed Alternatives envisage the following works typologies:

- renewal of the Relay Interlocking Installations by the activation of other devices relay operated but more moderns;
- activation of renewed Automatic Block Line Systems (ABLS) and Cab signalling;
- insertion of the section into existing Central Posts (C.P.) situated in Tashkent which is already structured such as to progressively accept the management of other sections of lines.

Therefore, despite for the completeness of the whole scenarios each proposed Option envisaged the adoption of works belonging to item 1. 2. 3. and 4., items 3. and 4. can be assessed separately from the first two.

Detailed description of each proposed work will be carried out in the second phase of Module B of this study, together with the Technical Specifications for Contractors.

5.4 OPTION 1

5.4.1 General description

Option 1 represents the proposed low cost option, mainly consisting in the rehabilitation of the existing railway line between Kungrad and Kazakh border, excluding the rehabilitation of the stations (permanent way, buildings and passenger services) and including the power supply for 10 kV. It also includes works for the telecommunication system installation all over the line and it does not include any work for the safety devices.

The line will be rehabilitated along the sections between two consecutive stations, till the station first turnout, while the stations will be left in the current conditions as for the earthworks, permanent way and turnouts, and facilities (platforms, buildings, etc.).

In particular Option 1 envisages the complete replacement of the permanent way, till the sub-ballast layer, along the sections with current P50 rails and worn out wooden sleepers, and the re-alignment and welding of the whole line, including the sections currently already replaced with P65 rails and concrete pre-stressed sleepers.

Option 1 also includes:

- worn out bridges replacement,
- construction of a new power supply line for station services and signalling system all along the line,
- new telecommunication system all along the line,
- Option 1 does not include any works related to new Station Interlocking System (S.I.S.), Line Block System (L.B.S.) and CTC control, because Italferr experts evaluated that there is no need of works for restoring operation safety at levels which cannot be renounced.

In the following description the details of the works.

A scheme of the works to be performed along the line is attached in Annex V "Options and schemes".

5.4.2 Works

Infrastructure

In the Option 1, only the upgrading of the line, excluding the stations, is considered.

The length of the stations is defined by the position of the extreme points.

With the implementation of the Option 1, every section between stations, from Kungrad to Kazak border, will be equipped with P65 rails, concrete sleepers, continuous welded rails (cwr) and embankment will be reshaped in perfect conditions.

In order to obtain these results different provisions and activities are to be considered, according with the existing situations along the line (see Table 4.1.1 – 3)

a) Stretches with P50 or P65/P50 rails on wooden sleepers

- demolition of 177 km of old track,
- excavation of a layer 0,6 m thick of material (521.600 m^3)on the top formation,
- laying down a layer of 0,2 m thick of sandy gravel material (218.000 m^3),
- laying down a layer 0,3 m thick of compressed sandy gravel material,
- substitution of the existing wooden sleepers with 326.000 concrete sleepers,
- installing new P65 rails on the main line for a total length of 177 km (22240 tons),
- installation of a layer of ballast 0.3 m thick under sleepers (317.000 m^3),
- regulation of mechanical tensions of long welded bars (243 km),
- formation of continuous welded rail, about 16,500 weldings (243 km),

- demolition of level crossing pavements,
- rebuilding of definitive level crossing pavements (15 L.C. with the replacement of 24 concrete blocks each),
- final tamping, levelling, aligning.

b) *Stretches with P65 rails on wooden sleepers*

As before; P65 rails are recovered and used in other part of the line.

c) *Stretches with P65 rails on concrete sleepers and cwr*

- Tamping, levelling, aligning, addition of ballast (and ballast cleaning) if necessary,
- The stretches rehabilitated in the last 4 years do not need any intervention.

d) *Stretches with P65 rails on concrete sleepers, without cwr*

- regulation of mechanical tensions of long welded bars,
- formation of cwr,
- as point c).

e) *Stretches with P65 rails on mixed wooden/concrete sleepers*

As point b).

Earthworks

- Partial lateral rebuilding embankment section for 100 km, placing and compacting the removed top material for widening the top surface of about 1,0 m.

Drainages and structures

- 42 bridges out of 46 need the replacement of beams, in total 176 beams 6,0 m long; 29 out of 46 need interventions to repair their piers,
- Excavation of drainage ditches on embankment foot for 100 km.

Safety devices

No works have been envisaged.

Telecommunications

In order to install the new telecom net as indicated in the previous chapter, the following table details the number of every specific equipment to be implemented and the quantity of civil works to be performed for allowing the implementation of the system.

Table 5.4.2-1 Telecommunication work items

Feasibility Study Kungrad – Kazakh Border - Bill of Quantities			
Item	**Q-ty**	**Unit**	**Note**
ADM 4 with installation	0	unit	
ADM 1 with installation	3	unit	
MUX D/I with installation	18	unit	
Regenerators	5	unit	
UPS with installation	15	unit	
PABX 500 with installation	0	unit	
PABX 800 with installation	0	unit	
PABX 1000 with installation	2	unit	
PABX 1500 with installation	0	unit	
PABX 2000 with installation	1	unit	
PABX 2500 with installation	0	unit	
Various item for equipment (frames, cards, etc.)	10%	percentage	percentage of the equipment costs
Stock	10%	percentage	percentage of the equipment costs
PCM management system	1	unit	
PABX management system	1	unit	
Syncronisation system	2	unit	
Fiber Optical Cable	361,13	km	
Other costs for OF cable (junctions, cable ends, tubes, shafts, etc.)	15%	percentage	percentage of the OF Cable costs
Laying of the OF cable	328,3	km	
Copper Cable	361,13	km	
Other costs for Copper cable (junctions, cable ends, tubes, shafts, etc.)	15%	percentage	percentage of Copper Cable costs
Laying of the Copper cable	328,3	km	
Preparation of rooms, big stations	1	unit	
Preparation of rooms, medium stations	2	unit	
Preparation of rooms, small stations	12	unit	

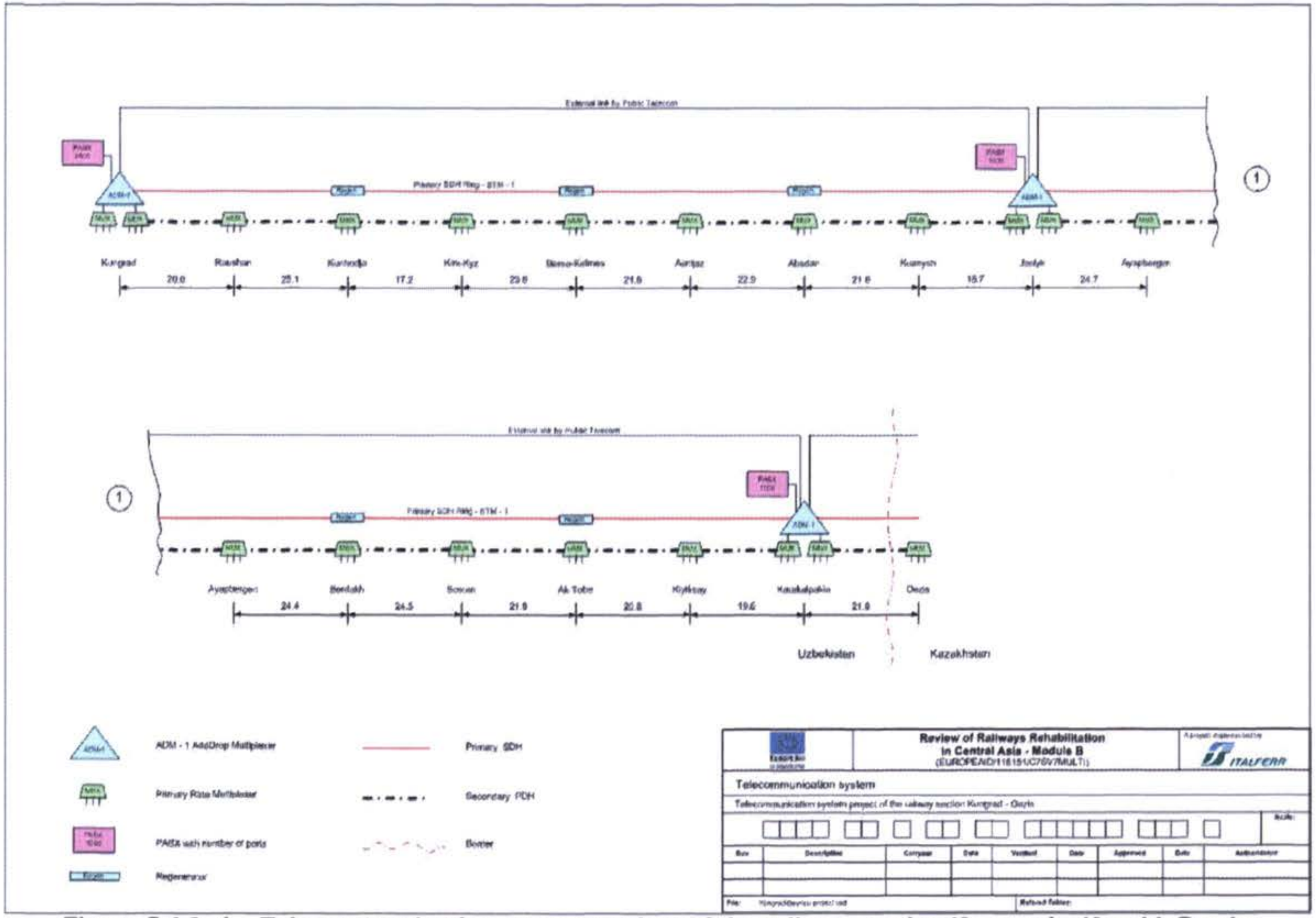


Figure 5.4.2 -1 – Telecommunication system project of the railway section Kungrad – Kazakh Border

Power supply system

As it was said in paragraph 4.4, works of partial rehabilitation of the double three phase 10 kV overhead line, consisting in the substitution of the existing wooden arm with new ones made of steel, are going on.

It is this Consultant firm opinion that the line needs a more radical intervention, that is its complete rebuilding.

5.4.3 Performances improvements

Option 1 has been thought in order to recover original line parameters and in some cases to upgrade them. For example in terms of stability of the earthworks, of protection of railway body from water and other factors erosion, of increasing bearing capacity of the line structures and for assuring long life to the elements composing the infrastructure.

Option 1 takes to the following performances improvements:

1. Traffic vibrations and dynamic forces are limited at the minimum values this reflecting on a more comfortable train travel, on a reduced impact on the environment, on a reduction of fuel consumption and on a reduction of maintenance need both for line and for rolling stock.
2. Line speed is recovered to hits original values, except from the stations where in any case most of trains will have to stop and therefore the speed is limited for operation purposes. Line speed after the works will be recovered to the following values:
    a. Max speed into stations 50 km/h.
    b. Max speed in approaching the stations 70 km/h.
    c. Max speed on line sections 110 km/h for passenger trains, 80 for freight trains.
3. Line capacity in terms of trains per day will be increased from the current minimum value of 22 trains per day, to the minimum value of **34 trains per day** (increasing with the percentage of homogeneous direction traffic).
4. Line maintenance costs will be largely reduced for the following main reasons:
    a. Capital maintenance (the most expensive) in the years following the rehabilitation will be absent (except from the stations).
    b. Medium maintenance in the years following the rehabilitation will be largely reduced.
    c. Lifting maintenance will be reduced.
    d. Number of spare parts to be used for each maintenance cycle will be reduced.
    e. The new elements composing the infrastructure will be of modern type, so to allow a sensitive reduction of failures during their lifetime.
    f. Line category, according to the current norms adopted in the Country, will be increased by the works and therefore maintenance needs will be reduced.
    g. Wooden sleepers will be replaced by concrete ones, having much longer life and assuring a better loads transfer to the ballast, there helping to reduce ballast friction and pollution.
    h. Elimination or sensitive reduction of rail joints (C.W.R. will be adopted) will contribute to reduce maintenance.

For maintenance needs and costs reduction, see chapter 8.1 "Benefits assessment".

For residual value of the replaced materials, see chapter 8.1 "Benefits assessment".

One of the main effects of the rehabilitation works will be traffic safety increase, but this parameter, as previously stated, is strictly correlated with line speed. Therefore this Consultant assumed no benefits will be assessed for traffic safety, while the majority of the benefits will be derived from time savings due to speed increase.

For the calculation of the time savings occurring with the rehabilitation works, passenger and freight typical trains have been simulated on the existing line and on the renewed line, according to the following simulation inputs:

Table 5.4.3 – 1 Speeds for passenger trains "with" and "without project"

Rehabilitation of the line Kungrad - Beyneu *Speeds for passenger trains with and without the project - Uzbek section*			
Passenger Speeds	**section**	**speed**	
Vmax line without project	all except the following	50	km/h
Vmax line without project	913.6-953.5	60	km/h
Vmax line without project	646.5-688.2	70	km/h
Vmax line without project	846.5-892.8	80	km/h
Vmax line with project	all	110	km/h
Vmax station without project	all	50	km/h
Vmax station with project Option 2	all	110	km/h
Vmax station with project Option 1	all	50	km/h

Table 5.4.3 - 2 Speeds for freight trains "with" and "without project"

Rehabilitation of the line Kungrad - Beyneu *Speeds for freigth trains with and without the project - Uzbek section*		
Freight Speeds		
Vmax line without project	50	km/h
Vmax line without project section 913.6-953.5	60	km/h
Vmax line without project section 646.5-688.2 and 846.5-892.8	70	km/h
Vmax line with project	80	km/h
Vmax station without project or with project Option 1	50	km/h
Vmax station with project Option 2	70	km/h

The results are shown on Table 5.4.3-2

Table 5.4.3 – 3 Trip time and time saving

	Rehabilitation of the line Kungrad - Beyneu *Trip time and time savings - Uzbek section*					
	Scenarios		**Passenger trains**		**Freight trains**	
			existing time (h)	option 1 time (h)	existing time (h)	option 1 time (h)
	Tot time no stop	(h)	**5.90**	**3.38**	**6.03**	**4.39**
		(min)	353.98	203.01	361.79	263.67
	Time savings without stops	(h)	**0,00**	**2.52**	**0.00**	**1.64**
		(min)	0,00	150.97	0.00	98.12
	Additional time for each stop	(min)	2.53	2.53	15.96	15.96
	Total travel time	(h)	**6.24**	**3.72**	**8.16**	**6.52**
		(min)	374.23	223.25	489.50	391.38
2007	**Time savings with stops**	**(h)**		**2.52**		**1.64**
	in Uzbekistan section	**(min)**		**151**		**98**
2017 (*)	**Time savings with stops**	**(h)**		3.17		2.30
	in Uzbekistan section	**(min)**		**190**		**138**

(*) Note: After 10 years of operation, it is estimated an additional traffic of about 40-45 million gross tons. To this corresponds an additional speed restriction of about 10 km/h along the sections where Capital Maintenance will not be carried out. These sections are estimated, according to the capital maintenance schedule for "without project" scenario, to be about 150 km, out of the 200 km currently being worn out. Therefore, after 10 years, it is calculated that on 150 km, speed will be reduced of additional 10 km/h, corresponding to the calculated additional time losses.

5.5 OPTION 2

5.5.1 General description

Option 2 is the medium cost option, mainly consisting in the rehabilitation of the existing railway line between Kungrad and the border (as Option 1), including the rehabilitation of the stations. In the stations works include rehabilitation of the main track (running track), of the turnouts of the main track and of some platforms and buildings. Option 2 also includes, as Option 1, the power supply 10 kV and the telecommunication system construction. Finally Option 2 also envisages works for safety devices rehabilitation with two variants: only for the section from Jaslyk to the border (first priority) or all along the line.

The line will be rehabilitated along the sections between two consecutive stations, and into the stations. Rehabilitation works will include earthworks, drainage systems for the railway body, permanent way and turnouts replacement were necessary (were old P50 permanent way is currently in use), and station facilities (platforms, buildings, etc.) were necessary.

Option 2 also includes:

- worn out bridges replacement,
- construction of a new power supply line for station services and signaling system all along the line,
- new telecommunication system all along the line,
- new Station Interlocking System (S.I.S.), Line Block System (L.B.S.) and CTC control for all the line or, in alternative, only on section between Jaslyk and the border,.

In the following description the details of the works.

A scheme of the works to be performed along the line is attached in Annex V "Options and schemes".

5.5.2 Works

Infrastructure

In Option 2, both stations and line are involved in the upgrading activity. Only 4 stations out of 15, for the time being, have the main lines equipped with P65 rails and concrete sleepers (in total 4,5 km, excluding turnouts length); the remaining eleven stations have a total length of 23 km of main lines (excluding the turnouts length) that is to be added to the 177 km considered in point 5.4.2 a) and have to be treated in the same way. The 4,5 km of main lines already rehabilitated have been inserted in the activities foreseen for the stretches of points 5.4.2 c) and d).

Moreover all the existing turnouts type P50 tg 1/11 operating on the main lines, are to be replaced by switches type P65 tg 1/11: in total 58 new turnouts have to be installed while for the half of them a restyling cycle has been thought for replacing their cross and blades, in order to re-use them on sidings.

In details:

a) *Stretches with P50 or P65/P50 rails on wooden sleepers*

- demolition of 200 km of old track;
- excavation of a layer 0,6 m thick of material (589,120 m^3)on the top formation;
- laying down a layer of 0,2 m thick of sandy gravel material (246,240 m^3);
- laying down a layer 0,3 m thick of compressed sandy gravel material;
- substitution of the existing wooden sleepers with 368,000 concrete sleepers;
- installing new P65 rails on the main line for a total length of 200 km (26,000 tons);
- installation of a layer of ballast 0.3 m thick under sleepers (358,000 m^3),
- regulation of mechanical tensions of long welded bars (270.5 km);
- formation of continuous welded rail, about 17,350 weldings (270.5 km);
- demolition of level crossing pavements;
- rebuilding of definitive level crossing pavements (15 L.C. with the replacement of 24 concrete blocks each);
- final tamping, levelling, aligning.

b) <u>*Stretches with P65 rails on wooden sleepers*</u>

As before; P65 rails are recovered and used in other part of the line.

c) <u>*Stretches with P65 rails on concrete sleepers and cwr*</u>

- Tamping, levelling, aligning, addition of ballast (and ballast cleaning) if necessary,
- The stretches rehabilitated in the last 4 years do not need any intervention.

d) <u>*Stretches with P65 rails on concrete sleepers, without cwr*</u>

- regulation of mechanical tensions of long welded bars;
- formation of cwr;
- as point c).

e) <u>*Stretches with P65 rails on mixed wooden/concrete sleepers*</u>

As point b).

Stations

- 9 passenger platforms demolition and reconstruction;
- 5 passenger platforms restyling;
- 5 station buildings restyling (each one for an area of 120 m2);
- 58 new small tangent turnouts P65.

Earthworks

- Partial lateral rebuilding embankment section for 100 km, placing and compacting the removed top material for widening the top surface of about 1,0 m.

Drainages and structures

- 42 bridges out of 46 need the replacement of beams, in total 176 beams 6,0 m long; 29 out of 46 need interventions to repair their piers;
- Excavation of drainage ditches on embankment and in stations for 100 km of line and 25 km in stations.

Safety devices

Both safety devices Alternatives 2 and 3 are considered in the frame of Option 2 for safety devices.

Safety devices Alternative 2:

- Renewal relay interlockings systems in:
  - a) Jaslyk;
  - b) Ayapbergen;
  - c) Berdakh;
  - d) Bostan;
  - e) Ak-Tobe;
  - f) Kiyiksay;
  - g) Karakalpakia.
- Renewal of Automatic Block Line Systems (ABLS) and Cab signalling in the following sections:
  - a) Jaslyk- Ayapbergen;
  - b) Ayapbergen- Berdakh;
  - c) Berdakh- Bostan;
  - d) Bostan- Ak-Tobe;
  - e) Ak-Tobe- Kiyiksay;
  - f) Kiyiksay- Karakalpakia.
- Insertion of the new devices into the existing Central Post of CTC located in Tashkent.

Safety devices Alternative 3:

Alternative 2 plus:

- Renewal relay interlocking systems in:
  - a) Kungrad;
  - b) Raushan;
  - c) Kunkhodja;
  - d) Kyrk-Kyz;
  - e) Barsa-Kelme;
  - f) Ajiniyaz;
  - g) Abadan;

h) Kuanysh.

- Activation of Automatic Block Line Systems (ABLS) and Cab signalling in the following sections:
    a) Kungrad- Raushan;
    b) Raushan- Kunkhodja;
    c) Kunkhodja- Kyrk-Kyz;
    d) Kyrk-Kyz- Barsa-Kelmes;
    e) Barsa-Kelmes - Ajiniyaz;
    f) Ajiniyaz- Abadan;
    g) Abadan- Kuanysh;
    h) Kuanysh- Jaslyk.
- Insertion of the new devices into the existing Central Post of CTC in Tashkent.

Alternative 2 is evaluated of higher priority as the relevant lines present higher difficulty of access and generally have the worst environmental conditions, consequently the failures that is easy to foresee in equipment thirty years aged, would have in these sections heavier consequences on the quality (safety and regularity) of the traffic.

Telecommunications

See Option 1.

Power supply system

Besides the reconstruction of the double three phase 10 kV overhead line in the Option 2 is foreseen the elimination of the 6 kV system and to provide an updated protection system (cabins, circuit breakers controlled by directional earth relays etc.) of the new 10 kV lines.

5.5.3 Performances improvements

Option 2, as Option 1, has been thought in order to recover original line parameters and in some cases to upgrade them. Option 2 moreover, by rehabilitating also the stations main lines and the turnouts, allows to take advantages of the new performances also in the stations, with sensitive time savings for non stop trains.

Together with all the performances improvements achieved with Option 1, Option 2:

5. recovers <u>line speed</u> to hits original values also in the stations. Line speed after the works will be recovered to the following values:
    a. Max speed into stations 110 km/h for passenger trains, 80 for freight trains;
    b. Max speed on line sections 110 km/h for passenger trains, 80 for freight trains.
6. <u>Line capacity</u> in terms of trains per day will be increased from the current minimum value of 22 trains per day, to the minimum value of **40 trains per day** (increasing with the percentage of homogeneous direction traffic).
7. <u>Line maintenance costs</u> will be largely reduced for the same reasons of Option 1 also for the stations.

For maintenance needs and costs reduction, see chapter 8.1 "Benefits assessment".

For residual value of the replaced materials, see chapter 8.1 "Benefits assessment".

For the calculation of the time savings occurring with the rehabilitation works, passenger and freight typical trains have been simulated on the existing line and on the renewed line, according to the same inputs shown in Tables 5.4.3-1 and 5.4.3-2.

The results are shown on Table 5.5.3-1

Table 5.5.3 – 1 Time savings

	Rehabilitation of the line Kungrad - Beyneu Trip time and time savings - Uzbek section					
	Scenarios		**Passenger trains**		**Freight trains**	
			existing time (h)	option 2 time (h)	existing time (h)	option 2 time (h)
	Tot time no stop	(h)	**5,90**	**2,98**	**6,03**	**4,15**
		(min)	353,98	178,74	361,79	249,13
	Time savings without stops	(h)	**0,00**	**2,92**	**0,00**	**1,88**
		(min)	0,00	175,25	0,00	112,66
	Additional time for each stop	(min)	2,53	3,17	15,96	16,35
	Total travel time	(h)	**6,24**	**3,40**	**8,16**	**6,33**
		(min)	374,23	204,07	489,50	379,93
2007	**Time savings with stops in Uzbekistan section**	**(h)**		**2,84**		**1,83**
		(min)		**170**		**110**
2017 (*)	**Time savings with stops in Uzbekistan section**	**(h)**		3,50		2,48
		(min)		**210**		**149**

(*) Note: After 10 years of operation, it is estimated an additional traffic of about 40-45 million gross tons. To this corresponds an additional speed restriction of about 10 km/h along the sections where Capital Maintenance will not be carried out. These sections are estimated, according to the capital maintenance schedule for "without project" scenario, to be about 150 km, out of the 200 km currently being worn out. Therefore, after 10 years, it is calculated that on 150 km, speed will be reduced of additional 10 km/h, corresponding to the calculated additional time losses.

5.6 OPTION 3

5.6.1 General description

Option 3 is the high cost option, mainly consisting in the rehabilitation of the existing railway line between Kungrad and the border, including the rehabilitation of the stations (as Option 2), with the additional works related to line doubling and line electrification.

Note:

Option 3, mainly consisting in line doubling and electrification, has been developed by this Consultant only in order to comply with the Terms of Reference of the Study, asking for further investigations about the possibility of line doubling and electrification.

Anyway, it must be firmly underlined that this Option is not applicable to the current situation of the line under study, and its analysis has been detailed only for demonstrating the non applicability of this Option and the related envisaged works.

The cost analysis has been detailed in order to reach a reliable figure of investment, but the economic and financial study of this Option has not been carried out because investment cost, line capacity that would be reached, and electrification are not corresponding to the targets of this line and to the forecasted traffic flow.

A scheme of the works to be performed along the line is attached in Annex V "Options and schemes".

5.6.2 Works

Option 3 is only composed by Infrastructure and line electrification investments.

Infrastructure

Option 3, together with all the envisaged works of Option 2, whose cost must be added, envisages all the related works for line doubling on side (railway axis distance 4,0m). These works include:

- widening of the existing embankment,
- doubling of the existing structures (bridges and culverts),
- constructing the second line permanent way,
- modifying the stations lay-outs for entering with the second running track,
- adding new passengers platforms into stations and adding at least one new siding (the existing siding will be inserted in the second running track),
- replacing the existing turnouts into stations and adding necessary new turnouts,
- closing some minor stations (in case of line doubling the number of necessary stations would decrease for capacity reasons) in order to setup the line to the new operation and in order to reduce investment, maintenance and operation costs.

To plan a reliable future line lay-out, an operation study has been carried out in order to verify the number and the location of the stations to be closed, and in order to estimate the number of new turnouts to be provided for the final configuration.

In details:

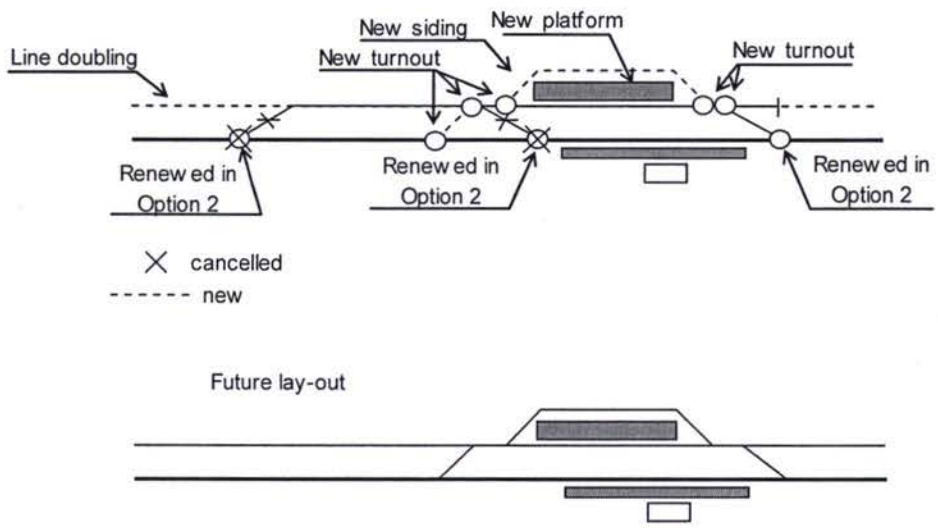
In addition to the works envisaged in Option 2:

- closing of the following stations or transformation into stops (no interlocking system, no turnouts, passenger trains only stop for passenger service):
  a) Raushan (3 turnouts saved compared with Option 2);
  b) Kyrk-Kyz (4 turnouts saved);
  c) Ajiniyaz (3 turnouts saved);
  d) Kuanysh (3 turnouts saved);
  e) Ayapbergen (3 turnouts saved);
  f) Ak-Tobe (3 turnouts saved);
  g) Kiyiksay (3 turnouts saved).

For the other preserved stations, additional 32 turnouts have been estimated necessary for station lay-outs improvement. Therefore the difference between saved and new turnouts, shows that other 10 new turnouts will have to be purchased compared to Option 2.

As example, the following Figure shows the station lay-out upgrading for line doubling of the typical crossing station of the Kungrad-Beyneu line.

Fig 5.6.2 – 1 Typical station lay-out in case of line doubling.



Other major works to be carried out for line doubling:

- laying down a layer of 0,2 m thick of sandy gravel material (444,000 m^3);
- laying down a layer 0,3 m thick of compressed sandy gravel material;
- new concrete sleepers: 620,000;
- installing new P65 rails on the main line for a total length of 327 km (43,800 tons);
- installation of a layer of ballast 0.3 m thick under sleepers (602,500 m^3);
- regulation of mechanical tensions of long welded bars (327 km);
- formation of continuous welded rail, about 22,720 weldings (327 km);
- final tamping, levelling, aligning.

Earthworks

- Widening of the existing embankment 2,4 millions m3 of earth.

Drainages and structures

- Excavating 300 km of side ditch for the new track embankment,
- doubling 46 bridges,
- doubling 66 pipe culverts (single and double, for a total of 82 pipes).

Safety devices

Not investigated.

Telecommunications

As for Option 2.

Power supply system

As for Option 2.

Line electrification for traction purposes

- Construction of the catenary including masts and wires for two tracks,
- Construction of the electric sub-stations (5 substations – one every 60 km).

5.6.3 Performances improvements

Option 3, as Option 2, shows the same advantages in terms of maintenance reduction and traffic safety.

But the main effects of Option 3 are mainly responsible of its non applicability, together with the massive investment cost. In fact Option 3 takes to a line capacity value that can be estimated between 180 and 220 trains per day, or more, depending on the capacity of its terminals, that would become the real bottlenecks of the network. Traffic on this line absolutely does not justify such an investment.

It is therefore out of doubt that this Option has no sense in this context and this Consultant analysis will not get further apart from construction costs which are investigated in the next chapter for completing the scope.

6. Rehabilitation options costs estimates

6.1 Unit costs

For the rehabilitation of the Kungrad – Beyneu line, a detailed cost analysis has been carried out by this Consultant, with the valuable support of the local Sub-Consultant.

The analysis was aimed at detailing all the cost items, including foreign and national expenditures for materials, foreign and national cost for man-power, cost of the machines and expenditures for taxes, duties and Contractor and Client general expenditures.

For the Infrastructure and Power supply, the construction cost is subdivided into the following types of work and expenditures in accordance with the structure of capital investments and the planned schedule of activities of constructing-and-mounting companies (Contractors):

- Materials;
- Construction works;
- Works on mounting of equipment (mounting works);
- Expenditures on equipment, furniture and inventory;
- Miscellaneous expenditures of a contractor;
- Miscellaneous expenditures of a customer.

A Contractor includes in the above cost both direct and concomitant expenditures (factor costs, miscellaneous expenditures, profit, and also funds for payment of taxes, duties and other obligatory payments).

Direct expenditures (including miscellaneous ones) are the expenditures of a contractor to construct a requested object that is labour and material resources, etc.

When calculating a construction cost, the following types of work and expenditures are considered:

1. Materials cost – cost of the necessary building materials, divided in national and foreign costs, according to the production Country;
2. Manpower Construction works – works on construction of buildings, different types of structures, finishing works, installation of external and internal engineering networks, installation of foundation and supporting structures for equipment, preparation a site for construction , etc.;
3. Manpower Mounting works - assembly and installation of devices at the place of their permanent operation (including inspection and individual testing of all kinds of equipment, electric installations, devices, computer engineering, connection of the equipment to engineering networks and other works);
4. Cost of equipment, furniture, inventory – the cost of manufacturing, purchasing and delivery to the warehouse of all sets of equipment, controlling equipment, instruments, punches, spare parts included in the basic funds of production capacity, cost of materials necessary for mounting of equipment, cost of equipment mounting, etc.;
5. Miscellaneous expenditures are the rest of expenditures not included in the factor costs for construction-and-mounting works, including:
   - Other industrial expenditures defined for a construction project (a contractor's expenditures);
   - For organization of construction works (overhead expenses);
   - For construction of temporary buildings;

- For performing works in winter time;
- For long service bonus;
- For additional leave of workers;
- Travelling expenses;
- For transportation of workers up to the building object;
- For relocation of construction-and-mounting organizations;
- For a mobile method of work performance;
- Insurance of construction risks;
- Obligatory payments (taxes), duties in conformity with the legislation of the Republic of Uzbekistan;
- Unforeseen costs and other expenditures for construction of objects.

Besides, the construction cost includes other expenditures of a customer during the construction:

- Allotment of a piece of land for construction of an object and external engineering structures;
- Fixing of points and signs;
- Demolition of structures;
- Bonus for timely and prescheduled commissioning of objects;
- Insurance of building risks;
- For banking services;
- Loan interests;
- Maintenance of a customer's facilities;
- Training of operational staff;
- Design and survey works;
- Survey works;
- Expertise of the design documentation;
- Profit necessary to cover the expenditures of a customer;
- Unforeseen costs.

The cost of the above mentioned expenditures is defined through calculations or through actual expenses of a customer and a contractor.

In the conditions of the market economy being developed in the Republic of Uzbekistan, the prioritized importance is attached to the method of calculating a construction cost based on the cost of resources. This method of defining a construction cost is a method of calculating expenditures in current prices or forecast prices and tariffs to be incurred during a project implementation.

A construction cost in current prices is defined on the basis of resource estimates developed through the above mentioned resource method with the use of information on actual prices for resources.

The factor cost is determined based on the allocated resources in current prices by types of expenditures:

a) wages including charges on social insurance;
b) maintenance cost of machines and mechanisms;
c) cost of building materials, items and structures including their transportation.

When calculating a construction cost, the level of current prices is taken on the basis of:

- wages – average statistical wage of construction workers as per the data of the State Committee on Forecast and Statistics;
- maintenance of machines and mechanisms – as per similar objects or special calculations;

- materials, items, structures, equipment - proceeding from the price level at the local and foreign markets, on the basis of wholesale prices of manufacturing factories, prices at stock exchanges and fairs of building materials, the catalogue of current prices for building materials published by the State Architecture and Construction Committee of the Republic of Uzbekistan (Gosarhitektstroy), data of the regional price formation centres of the State Architecture and Construction Committee of the Republic of Uzbekistan.

6.1.1 Unit costs for materials

The following table resumes the main unit costs for materials, according to detailed investigation carried out over the Uzbek market, split into "foreign" or "national production.

Table 6.1.1 – 1 Main unit costs for materials

Rehabilitation works for Kungrad - Beyneu Line "Main unit costs for materials"				
Material	Unit	Rate ($)	Variation	
Rails	tonne	580.00	+/-20 $	Foreign
Concrete sleepers	each	25.00	+/-4 $	National
Indirect fastenings	couple	25.00	+/-3 $	Foreign
Ballast	m3	5.50	+/-1 $	National
Sub-ballast	m3	2.00	+/-1 $	National
New double three-phase overhead 10kV line	km	12,000.00	+/-10 %	60% For/ 40% Nat
Bridge beams in reinforced concrete (6m span)	each	7,750.00	+/-10 %	National
Total turnout large tangent with concrete sleepers	each	43,000.00	+/-10 %	Foreign
Total turnout small tangent with concrete sleepers	each	52,000.00	+/-10 %	Foreign
Turnout crossing	each	4,000.00	+/-15 %	Foreign
Turnout blades	pair	15,600.00	+/-15 %	Foreign
Rail joint	each	25.00	+/-4 $	Foreign
Isulated joint	each	34.00	+/-4 $	Foreign

Sources: UTY, Boshtransloyiha, Italferr

6.1.2 Unit costs for machines

The following table resumes the main unit costs for machines averagely used for similar rehabilitation works for railways.

Table 6.1.2 – 1 Main unit costs for machines

Rehabilitation works for Kungrad - Beyneu Line "Main unit costs for machines"			
	Machine	*Unit*	*$*
1.	MOTORGRADERSE (MAINTAINERS) OF MEAN (AVERAGE) TYPE 99 [135] KWT [Л.С]	MACH/HOUR	8.27
2.	BULLDOZER AT WORK ON OTHER TYPES OF CONSTRUCTION: 79 [108] KWT [Л.С]	MACH/HOUR	11.63
3.	BULLDOZER AT WRK ON OTHER TYPES OF CONSRUCTION: 96 [130] KWT [Л.С]	MACH/HOUR	11.63
4.	TROLLEY OF WIDE GAUGE WITH CRANE 3,5 T	MACH/HOUR	17.69
5.	GANTRIES OVERHANGING FOR WORKS ON ASSEMBLAGE BASES, 10 T	MACH/HOUR	2.02
6.	CRANES ON RAILWAY MOTION 16 T	MACH/HOUR	8.27
7.	STACKING (LAYING) CRANES FOR RAIL UNITS 25 M ON WOODEN SLEEPERS	MACH/HOUR	67.71
8.	STACKING CRANES FOR RAIL UNITS 25 M ON CONCRETE SLEEPERS	MACH/HOUR	67.71
9.	MACHINES FOR BALLASTING OF RAILWAY TRAIL ON CONCRETE SLEEPERS	MACH/HOUR	37.24
10.	MACHINES FOR TAMPING WITH PNEUMATIC TAMPING PICK (CUTTING)	MACH/HOUR	12.16
11.	LINERS	MACH/HOUR	3.11
12.	MOTOR PLATFORMS FOR TRACKLAYER	MACH/HOUR	37.58
13.	PLATFORM OF WIDE GAUGE WITH ROLLER CONVEYER	MACH/HOUR	2.41
14.	PLATFORMS OF WIDE GAUGE 71 T	MACH/HOUR	2.41
15.	SELF-PROPELLED TRACK LIFT	MACH/HOUR	6.11
16.	DIESEL LOCOMOTIVES OF WIDE GAUGE SHUNTING 883 [1200] Kwt [Л.С]	MACH/HOUR	59.47
17.	DIESEL LOCOMOTIVES OF WIDE GAUGE 294 [400] KWT [Л.С]	MACH/HOUR	59.47
18.	SINGLE BUCKET DIESEL EXCAVATOR ON CATERPILLAR AT WORK ON OTHER TYPES OF CONSTRUCTION: 0,4 M3	MACH/HOUR	14.06

These figures are referred to Railway Administration (R.A.) owned machines. It is therefore assumed that the Contactor will make use of these machines, by renting them from the R.A. or will use hits own machines at similar current costs.

Anyway, for the work typology considered in the frame of the line rehabilitation, this Consultant estimates that the cost of machines is between 6 and 10% of the materials cost.

6.1.3 Unit costs for local manpower

It is assumed by this Consultant that the works to be carried out for the line rehabilitation will be carried out by local manpower with the exception of field engineers and works coordinators, whose costs will be considered apart.

It is estimated therefore that the Contractor will make use of local workers and the average salaries and wages have been derived from those of railway employees in the country to which the line belongs (Uzbekistan).

The following table 6.1.3-2 resumes the main unit costs for local manpower, per work item, according to the bill of quantities adopted for Options evaluation and based on average worker cost data, shown in table 6.1.3-1.

Table 6.1.3 – 1 Average worker cost data

Rehabilitation works for Kungrad - Beyneu Line *"General data for project cost estimation"*		
Average annual salary of builders in the region counting on 1 month, defined from statistical data for previous 12 months, soum/moths	48.228	$/ month
Average monthly fund of working time in hours as of data of the Ministry of Labor and Social Protection of population of the Republic of Uzbekistan	168	hour
Coefficient of account of the amount of deduction for social insurance (Kcc)	1.372	coeff.
Net local manpower cost per hour	0.2870714	$/hour
Total local manpower cost per hour	0.393862	$/hour

Table 6.1.3 – 2 Main unit cost for local manpower

Rehabilitation works for Kungrad - Beyneu Line *"Main unit costs for local manpower"*			
	Work Items	Unit	US$
2A	Demolition of line	km	243.90
3A	Excavation	m^3	0.09
4A	Partial lateral rebuilding embankment section placing and compacting the removed top material for widening the top surface of about 1,0 m	m^3	0.12
5A	Implementation of a layer of sandy gravel material, 0,2 m thick under sleepers (sub-ballast)	m^3	0.02
6A	Construction of line	m	0.54
7A	Flash-butt or thermic weld of P65 rail	each	1.00
8A	Regulation of mechanical tension of long welded rails (l.w.r.)	km	75.00
9A	Final tamping and levelling of line	km	79.10
10A	Ballast cleaning on the other existing sections	km	29.16

11A	Tamping, levelling and aligning the existing sections with c.w.r.	km	79.10
12A	Substitution of concrete pipes of 20 culverts	n	200.00
13A	Excavation of ditches	m	0.50
14A	Pavement of level crossings	each	100.00
15A	Passenger stations: platforms new	m2	6.00
16A	Passenger stations: platforms restyling	m2	4.00
17A	Passenger stations: building restyling	m2	30.00
18A	Replacing switch crossings	each	41.72
19A	Replacing switch blades	each	41.72
20A	Replacing of switch small tg (complete)	each	83.44
21A	Construction of new pipe culverts (extension of the existing) for line doubling	each	130.00
22A	Construction of new bridges for line doubling (4,3m span)	each	1,500.00

6.1.4 Cost calculation flow

The following Table 6.1.4-1 resumes the main factors for calculation of the total cost amounts.

Table 6.1.4 – 1 Main factors for calculation of total cost amounts

Rehabilitation works for Kungrad - Beyneu Line *"General data for project cost estimation"*			
Expenses for operation of machines and mechanisms (Сэм)		5-10%	of materials cost
Transport expenditures for materials		6	%
Transport expenditures for constructions		6	%
Risk coefficient		1.15	coeff.
Other expenses and cost of contractor		20	%
Other expenses and costs of the client		9	%
Expenses for insurance of construction objects		0.4	%

Other expenses and costs of the contractor include:

- profit;
- administrative costs of the company;

- fix costs for the company;
- other general expenses.

The value of 20% has been recovered among average values of similar works in Uzbekistan.

Other expenses and costs of the client include:

- tendering costs;
- administrative costs of the company;
- fix costs for the company;
- other general expenses.

The value of 9% has been recovered among average values of similar works in Uzbekistan.

The following table resumes the cost calculation flow.

Table 6.1.4 – 2 Cost calculation flow

Rehabilitation works for Kungrad - Beyneu Line "Project cost calculation flow"		
Item	**Article of expenses**	**Calculation method**
1	Expenses for construction materials (including 6% for transport)	from the construction materials list
	including: imported materials	
	produced in Uzbekistan	
2	Expenses for salary with account of social insurance charges (including 6% for movements)	from the work list with addition of social insurance
3	Expenses for operation of machines	from the operation machines cost
A	**Total net cost of construction**	**A=1+2+3**
4	Other expenses and costs of the contractor	4=20%A
5	Other expenses and cost of the client	5=9%A
B	**Total cost of construction and contractor and client expenses**	**B=A+4+5**
6	tax 25%	D=25%B
C	**Total cost of construction and contractor and client expenses with taxes**	**C=B+6**
7	Expenses for insurance of construction objects	7=0,4%C
8	Risk coefficient defined on basis of forecasted index of construction price growth for the following year	8=15%(C+7)
D	**Total cost of construction in current prices**	**D=C+7+8**

6.2 Option 1 costs

6.2.1 Infrastructure and Power supply costs

The following table 6.2.1-1 resumes the result of cost analysis for Option 1 for Infrastructure and Power supply (10kV line).

The table has been developed according to the detailed bill of quantities that is annexed to this report (Annex VI) and it includes also international manpower cost (Contractor consulting team) for works supervision and co-ordination.

25% taxes and risk coefficient are not applied to international manpower.

Table 6.2.1 – 1 Cost analysis for Option 1 for Infrastructure and Power supply (10kV line)

Rehabilitation works for Kungrad - Beyneu Line (Kungrad-Border section) "Option 1 cost for Infrastructure and Power supply"		
Item number	**Article of expenses**	**Cost ($)**
1	Expenses for construction materials (including 6% for transport)	39,383,195.83
	including: imported materials	24,465,844.10
	materials produced in Uzbekistan	14,917,351.73
2	Expenses for local workers salary with account of social insurance charges (including 6% for movements)	955,483.19
3	Expenses for machines and tools	3,544,487.63
A	**Total net cost of construction**	**43,883,166.65**
4	Other expenses and costs of the contractor	8,776,633.33
5	Other expenses and cost of the client	3,949,485.00
B	**Total cost of construction and contractor and client expenses**	**56,609,284.98**
6	tax 25%	14,152,321.25
C	**Total cost of construction and contractor and client expenses with taxes**	**70,761,606.23**
7	Expenses for insurance of construction objects	283,046.42
8	Risk coefficient defined on basis of forecasted index of construction price growth for the following year	10,656,697.90
D	**Sub-Total cost of construction in current prices**	**81,701,350.55**
E	**International consulting cost**	**3,877,875.00**
F	**Total cost of construction in current prices**	**85,579,225.55**

The estimation of investments costs for Option 1 Infrastructure and Power supply add to about ***85,579,225 $***

Accuracy of this amount is estimated +/-15%.

6.2.2 Safety devices costs

Not applicable. Option 1 does not envisage safety devices investments.

6.2.3 Telecommunications costs

The capital cost has been estimated starting from the bill of quantities of the proposed telecommunication system which details the number of every specific equipment to be implemented and the quantity of civil works to be performed for allowing the implementation of the system (see table in paragraph 5.4.2).

In the subsequent stage, these quantities have been associated to the correspondent unit rate in order to produce the final estimation of the global capital costs. The unit rates reflect market prices and conditions prevailing at the end of 2004 and also include costs for installation/set up of the equipment, hypothesis for the discount rates used during tender stage and taxation effects.

As far as costs for installation/set up of equipment are concerned, they have been estimated as percentage of the purchase costs. The percentage to be used has been carefully assessed taking into account the large experience of the Consultant in installing railways telecom equipment in Europe and abroad together with factors like difficulty and possibility to use local expert under supervision of expatriate experts. The percentage ranges from 2% to 10%.

As far as the discount rates during tender stage are concerned, the Consultant has deducted the reduction usually applied by suppliers. The reduction has been evaluated from the Consultant experience in evaluating tenders for the Italian State Railways but with a very cautious approach in order not to underestimate capital costs. Consequently, although deduction is sometime higher, the applied discount rates are ranging form 10% to 20%.

Finally, as the equipment is normally exempt form taxes and duties on imported goods especially vis-à-vis funds from IFIs, all taxes have been omitted in the study.

A provision for contingency has been introduced on the basis of the aggregate investment, as commonly happens for preliminary studies. The suggested percentage is 10%, in accordance with the Consultant experience.

Following the above mentioned assumption, estimates for the capital costs related to the renewing of the telecommunication system are summarised in the following table:

CAPITAL COSTS

Description	Amount (US$)
Equipment	854,000
Fibre optical and copper cables (with junctions, cable ends and conduits)	4,689,000
Laying of fibre optical and copper cables	1,576,000
Civil works	10,000
Contingencies (10 %)	713,000
Total	**7,842,000**

As already explained in the technical analysis, the proposed technical solution needs the closure of the ring for redundancy reason. This necessity would be turning into running costs for renting channels or fibres from third parties.

It is suggested to rent channels from public Telecom for assuring redundancy (5 links at 2 Mbps are needed for the closure of the ring). In this way the cost of renting can not be suffered because of the mutual advantage of the parts. An agreement between Railways and Ministry of Communications on mutual utilisation of future optic fibre cables has already been reached.

6.3 Option 2 costs

6.3.1 Infrastructure and Power supply costs

The following table 6.3.1-1 resumes the result of cost analysis for Option 2 for Infrastructure and Power supply (10kV line).

The table has been developed according to the detailed bill of quantities that is annexed to this report and it includes also international manpower cost (Contractor consulting team) for works supervision and co-ordination.

25% taxes and risk coefficient are not applied to international manpower.

Table 6.3.1 – 1 Cost analysis for Option 2 for Infrastructure and Power supply (1- kV line)

Rehabilitation works for Kungrad - Beyneu Line (Kungrad-Border section) "Option 2 cost for Infrastructure and Power supply "		
Item number	**Article of expenses**	**Cost ($)**
1	Expenses for construction materials (including 6% for transport)	48,584,720.26
	including: imported materials	31,723,089.58
	materials produced in Uzbekistan	16,861,630.68
2	Expenses for local workers salary with account of social insurance charges (including 6% for movements)	1,101,825.36
3	Expenses for machines and tools	4,372,624.82
A	**Total net cost of construction**	**54,059,170.44**
4	Other expenses and costs of the contractor	10,811,834.09
5	Other expenses and cost of the client	4,865,325.34
B	**Total cost of construction and contractor and client expenses**	**69,736,329.87**
6	tax 25%	17,434,082.47
C	**Total cost of construction and contractor and client expenses with taxes**	**87,170,412.33**

7	Expenses for insurance of construction objects	348,681.65
8	Risk coefficient defined on basis of forecasted index of construction price growth for the following year	13,127,864.10
D	**Sub-Total cost of construction in current prices**	**100,646,958.08**
E	**International consulting cost**	**4,655,475.00**
F	**Total cost of construction in current prices**	**105,302,433.08**

The estimation of investments costs for Option 2 Infrastructure and Power supply add to about ***105,302,433 $***

Accuracy of this amount is estimated +/-15%.

6.3.2 Safety devices costs

As mentioned before, Safety devices Alternatives 2 and 3 are both included in the general investment Option 2.

Investment values have been estimated by average and current prices of materials and labour and are especially referred to EU prices in case of innovative electronic equipment.

We have taken into account the following investments on Tables D1&D2 of Annex VIII:

- Basic investments for Alternative 2 (Table D1)
- Basic investments for Alternative 3 (Table D2)

The estimation of investments costs for Alternative 2 add to about ***6,104,000 $***

The estimation of investments costs for Alternative 3 add to about ***15,067,000 $***

Investments costs for both solutions include the following items:

- construction design;
- supply and material transportation;
- factory tests;
- site preparation(worksites setting up);
- installation;
- field tests,
- commissioning;
- quality assurance;
- warranty for first year after plants delivery to Client;
- project management and procurement;
- risks and contingencies strictly related to the scope of the work.

The sharing out of the costs adopted is shown on following table:

Table 6.3.2 - 1

Kungrad-Karakalpakia-Beyneu	supply quote %	works quote %	national quote %	foreign quote %
Signal System				
Relay Interlockings	80%	20%	20%	80%
Indoor power supplies	80%	20%	20%	80%
Level crossings	70%	30%	30%	70%
Block systems	75%	25%	20%	80%
Centralised Traffic Control				
Peripheral Places	75%	25%	10%	90%

Kungrad-Karakalpakia-Beyneu:sharing out of the costs

As a consequence (see annexed tables D1&D2 of Annex VIII)

Alternative 2:

Total cost	6,103,962$ of which:
Supply quote:	4,731,570 $ (78%)
Works quote:	1,372,392 $ (22%) with
National quote:	1,225,392 $ (20%)
Foreign quote:	4,878,570 $ (80%)

Alternative 3:

Total cost	15,067,081 $ of which:
Supply quote:	11,705,965 $ (78%)
Works quote:	3,361,116 $ (22%) with
National quote:	3,036,116 $ (20%)
Foreign quote:	12,030,965 $ (80%)

Finally, as the equipment is normally exempt form taxes and duties on imported goods especially vis-à-vis funds from IFIs, all taxes have been omitted in the study.

6.3.3 Telecommunications costs

As for Option 1: 7,842,000 $.

6.4 Option 3 costs

The following table 6.4-1 resumes the result of cost analysis for Option 3 for Infrastructure and line Electrification.

The table has been developed according to the detailed bill of quantities that is annexed to this report and it includes also international manpower cost (Contractor consulting team) for works supervision and co-ordination.

25% taxes and risk coefficient are not applied to international manpower.

Table 6.4 – 1 Cost analysis for Option 3 for Infrastructure and line Electrification

Rehabilitation works for Kungrad - Beyneu Line (Kungrad-Border section) "Option 3 cost for Infrastructure and Electrification " (*)		
Item number	**Article of expenses**	**Cost ($)**
1	Expenses for construction materials (including 6% for transport)	180,264,253.94
	including: imported materials	149,196,314.40
	materials produced in Uzbekistan	31,067,939.54
2	Expenses for local workers salary with account of social insurance charges (including 6% for movements)	7,167,812.69
3	Expenses for machines and tools	16,223,782.85
A	**Total net cost of construction**	**203,655,849.48**
4	Other expenses and costs of the contractor	40,731,169.90
5	Other expenses and cost of the client	18,329,026.45
B	**Total cost of construction and contractor and client expenses**	**262,716,045.83**
6	tax 25%	65,679,011.46
C	**Total cost of construction and contractor and client expenses with taxes**	**328,395,057.29**
7	Expenses for insurance of construction objects	1,313,580.23
8	Risk coefficient defined on basis of forecasted index of construction price growth for the following year	49,456,295.63
D	**Sub-Total cost of construction in current prices**	**379,164,933.15**
E	**International consulting cost**	**7,103,700.00**
F	**Total cost of construction in current prices**	**386,268,633.15**

(*) Option 2 costs must be added

*The estimation of investments costs for Option 3+2 Infrastructure (rehabilitation of the existing track plus line doubling), Power supply, and line Electrification add to about **491,571,066 $***

Accuracy of this amount is estimated +/-20%.

6.5 Cost summary

Option 1

- Line rehabilitation stations excluded,
- Power supply new 10 kV line,
- Telecom,
- No signalling devices.

93,421,225 $ +/- 15%

Option 2

- Line rehabilitation stations included,
- Power supply new 10 kV line,
- Telecom,
- Signalling devices from Jaslyk to the border.

119,248,433 $ +/- 15%

- Line rehabilitation stations included,
- Power supply new 10 kV line,
- Telecom,
- Signalling devices all the line.

128,211,433 $ +/- 15%

Option 3

- Line rehabilitation stations included,
- Power supply new 10 kV line,
- Telecom,
- Line doubling,
- Electrification.

491,571,066 $ +/-20%.

7. Environmental impact issues

7.1 Introduction

The focus of the Environmental Impact Issues is to:

- identify and analyse the potential impacts on affected area;
- identify and analyse the "Critical Areas" for each line under study;
- propose the mitigation measures in order to reduce the potential impacts on affected area.

7.2 Laws and regulations frame in Uzbekistan

7.2.1 Government Environmental Policy

The government of Uzbekistan has acknowledged the extent of the country's environmental problems, and it has made an oral commitment to address them. But the governmental structures to deal with these problems remain confused and ill defined._Old agencies and organizations have been expanded to address these questions, and new ones have been created, resulting in a bureaucratic web of agencies with no generally understood commitment to attack environmental problems directly. Various nongovernmental and grassroots environmental organizations also have begun to form, some closely tied to the current government and others assuming an opposition stance. For example, environmental issues were prominent points in the original platform of Birlik, the first major opposition movement to emerge in Uzbekistan (see The 1980s, this ch.). By the mid-1990s, such issues had become a key concern of all opposition groups and a cause of growing concern among the population as a whole.

In the first half of the 1990s, many plans were proposed to limit or discourage economic practices that damage the environment. Despite discussion of programs to require payments for resources (especially water) and to collect fines from heavy polluters, however, little has been accomplished. The obstacles are a lack of law enforcement in these areas, inconsistent government economic and environmental planning, corruption, and the overwhelming concentration of power in the hands of a president who shows little tolerance of grassroots activity.

International donors and Western assistance agencies have devised programs to transfer technology and know-how to address these problems. But the country's environmental problems are predominantly the result of abuse and mismanagement of natural resources promoted by political and economic priorities. Until the political will emerges to regard environmental and health problems as a threat not only to the government in power but also to the very survival of Uzbekistan, the increasingly grave environmental threat will not be addressed effectively.

National programs for environment protection

1. The national program on the termination of the use of ozone-destroying substances. The purpose of the program is the performance by the Republic of the Uzbekistan the obligations following from the Viennese Convention and the Montreal protocol on substances, destroying

ozone layer. Leading national organization is the State committee of Republic of the Uzbekistan for nature protection. Supported by the GEF, UNEP,UNDP.

2. International Conventions on "Climate change " and "Combating desertification". A GEF project to carry out a country study on climate change in Uzbekistan is ongoing with UNDP assistance and preparations to produce a national desertification action plan are underway with "UNEP/UNDP" support. These programs should ensure concrete progress for addressing critical environmental problems in the Republic. Leading state organisation is Main Organisation on Meteorology Supported by GEF/UNDP.

3. National Biodiversity Conservation Strategy and Action Plan. IN 1995 Uzbekistan became a party of the International Convention on Biodiversity. The Republic initiated a project to develop a national biodiversity strategy and action plan which received support from UNDP and the Global Environmental Facility (GEF). The purpose of the national biodiversity strategy is to provide an overall unified policy and planning framework for the management of biodiversity resources in the country. Approved by the Government of the Republic Of Uzbekistan in 1998. Project implementation was by the state Committee for Nature Protection.

4. Transboundary Biodiversity Project (Western Tien Shan Mountains). Briefly the project have directed for development of biodiversity strategy and action plan for biodiversity conservation. Supported by GEF.

5. The national plan of actions on hygiene of environment of the Republic Uzbekistan. The national plan of actions is developed to achieve long-term political purposes in the field of environment and health protection. Basic executors - State committee of Republic Uzbekistan for nature protection and Ministry of public health services with technical assistance of World organization of public health services.

6. Aral Sea Programme. The programme is intended to address the long term water and land use management problems of the region while in short/ medium term providing support to address the immediate needs of populations within the worst effected areas. In addition to the long term implications the programme has for more rational natural resource management in the region there are also three programmes with specific importance to biodiversity in Uzbekistan.

7. National Action Plan for Environment Protection in Republic of the Uzbekistan (NAPEESD) this is currently being prepared with the assistance of the World Bank. The biodiversity strategy will be incorporated into NAPEESD as one of its major components. The NAPEESD will ensure a unified approach to environmental planning and ensure components will be interrelated and supportive. It has three main tasks:

1. improvement of ecological conditions for health of people;
2. assistance to effective and steady use of natural resources;
3. protection of most vulnerable and valuable ecosystems.

Environmental legislation in Uzbekistan: List of main legal acts

1. Constitution of the Republic of Uzbekistan as of December 8,1992
2. Law of the Republic of Uzbekistan, "On property in the Republic of Uzbekistan", as of October 31, 1990
3. Law of the Republic of Uzbekistan :On public associations in the Republic of Uzbekistan", Sept.15, 1991
4. Law of the Republic of Uzbekistan "On lease" November 22, 1991

5. Law of the Republic of Uzbekistan "On state sanitary supervision", July 3, 1992

6. Law of the Republic of Uzbekistan "On the protection of nature", December 9, 1992

7. Law of the Republic of Uzbekistan "On insurance" May 6, 1993

8. Law of the Republic of Uzbekistan "On the Cabinet of Ministers of the Republic of Uzbekistan", May 6, 1993

1. Law of the Republic of Uzbekistan "On local authorities", September 2, 1993

9. Law of the Republic of Uzbekistan "On the bodies of citizens' self-management", September 2, 1993

10. Law of the Republic of Uzbekistan "On foreign investment and guarantees for activities of foreign investors", May 5, 1994

11. Code of the Republic of Uzbekistan "On administrative liability" September 22, 1994

12. Criminal code of the Republic of Uzbekistan, September 22, 1994

13. Law of the Republic of Uzbekistan "On concessions", August 30, 1995

14. Labour code of the Republic of Uzbekistan, December 21, 1995

15. Law of the Republic of Uzbekistan "On architecture and city development", December 22, 1995

16. Law of the Republic of Uzbekistan "On free economic zones", April 25, 1996

17. Civil Code of the Republic of Uzbekistan, September 29, 1996

18. The Tax Code of the Republic of Uzbekistan, April 24, 1997

19. Economic Procedural Code of the Republic of Uzbekistan, August 30, 1997

20. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On recognising amendments to the Governmental Resolutions to be inefficient due to the adoption of the Law of the Republic of Uzbekistan "On the protection of nature" 278, June 8, 1993

21. President's decree "On measures for a further deepening of economic reforms, protection of private property and development of entrepreneurship" УП-475, January 21, 1994

22. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On state support to the international foundation of ecology and Health Ecosan", 556, November 17, 1994

23. Resolution of the Oliy Majlis of the Republic of Uzbekistan "On enforcement of the regulations of the State Committee of the Republic of Uzbekistan for the protection of nature", April 26, 1996

24. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On approval of the regulations about the procedure of establishment and operation of the uniform system of State Cadasters in the Republic of Uzbekistan", 255, July 17, 1996

25. Decree of the President of the Republic of Uzbekistan "On the establishment of the Ministry of Agriculture and Water Economy of the Republic of Uzbekistan", УП-1617, November 1, 1996

26. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On arrangement of the activities of the Ministry of Agriculture and Water Economy of the Republic of Uzbekistan", November 26, 1996

27. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "Regulations of the National Commissions of the Republic of Uzbekistan on sustainable development", November 12, 1997

28. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On approval of the regulations of protected zones and on protection of geodesic posts in the Republic of Uzbekistan", February 16, 1998

Land legislation

1. Law of the Republic of Uzbekistan "on Land", June, 20, 1990

2. Resolution of the Cabinet of Ministers of the UzbekSSR "On land rehabilitation, preservation and rational use of fertile top soil during the development of mineral and peat deposits, geological prospecting, construction and other work", 352, June 22, 1976

3. Resolution of the Cabinet of Ministers of the UzbekSSR, 416 "On procedure of keeping the State Land Cadastre", June 24, 1977

4. Resolution of the Cabinet of Ministers under the President of the Republic of Uzbekistan "On approval of the regulations of water protection zones of water and other reservoirs, rivers, main channels and collectors as well as the supply sources of water for drinking and everyday use, treatment and health improvement purposes in the Republic of Uzbekistan", 174, April 7, 1992

5. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On the approval of regulations on the procedure of settlement of land disputes in the Republic of Uzbekistan", 246, May 25, 1992

6. Resolution of the Cabinet of Ministers under the President of the Republic of Uzbekistan "On approval of regulations on the procedure of preparation of materials for the Withdrawal and Provision of plots of land for non-agricultural purposes in the Republic of Uzbekistan", 248, May 27, 1992

7. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On approval of the procedure of calculation of the size of loss and compensation of loss of agricultural and forestry entities in connection with the land withdrawal for purposes not linked with agriculture and forestry", 282, June 15, 1992

8. Decree of President of the Republic of Uzbekistan "On measures for further deepening of economic reforms, provision of private property and development of entrepreneurship", УП-745, January 21, 1994

9. Decree of President of the Republic of Uzbekistan "On initiation and incentives for private entrepreneurship", УП-1030, January 5, 1995

10. Decree of President of the Republic of Uzbekistan "On additional measures for the improvement of conditions for the activities of diplomatic missions and international organisation in the Republic of Uzbekistan", УП-1287, November 14, 1995

11. Decree of President of the Republic of Uzbekistan "On the improvement of efficiency of the use of land", November 24, 1994

12. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On measures for the improvement of efficiency of the use of land", 575, November 29, 1994

13. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On procedure of selling trading and service unite into the private ownership together with plots of land on which they are located and the plots of land - into life-long inherited ownership", 126, April 11, 1995

Legislation on Subsoil

1. Law of the Republic of Uzbekistan "On the subsoil", September 22, 1994

2. Resolution of the Cabinet of Ministers of the UzbekSSR "On the use of subsoil for location of the units not linked with mining", 375, June 20, 1984

3. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan 19, January 13, 1997 "On the approval of regulatory acts in compliance with the law of the Republic of Uzbekistan "On the subsoil" which approved:
   a. regulations "On the procedure of allocation of mining sites for the purpose not related to mineral mining;
   b. regulations "On the state control and monitoring the use and protection of the subsoil, geological prospecting of the subsoil and rational use of mineral resources", approved by the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan, 19, January 13, 1997
4. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On approval of regulatory acts in compliance with the law of the Republic of Uzbekistan "On the subsoil", 20, January 13, 1997:
   c. regulations "On procedure of allocation of mining sites for development of mineral deposits"
   d. regulations "On procedure of the issue of permits for construction on the areas above mineral deposits"
   e. regulation "On procedure of writing off the subsoil user's balance the stocks of minerals extracted and lost during mining"
   f. Uniform Rules of subsoil protection during the development of deposits.
5. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On approval of model regulations of geological and mark shader service pursuant to the law "On the subsoil", 168, April 1, 1997

6. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On approval of the procedure of keeping the State cadastre of deposits , manifestations of minerals and technogenic formations in the Republic of Uzbekistan", 258, May 26, 1997

7. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On approval of regulations about the discoverers of mineral deposits", 279, June 2, 1997

Water legislation

1. Law of the Resolution of the Republic of Uzbekistan "On water and water use", May 6, 1993

2. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On measures for arrangement of the use of underground waters, enhancement of their protection from contamination and depletion", 179, April 8, 1992

3. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On a limited water use", 385, August 3, 1993

4. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On approval of regulations of the procedure of development and keeping the state water cadastre of the Republic of Uzbekistan", 11, January 7, 1998

Flora protection and use legislation

1. Law of the Republic of Uzbekistan "On protection and use of flora" December 26, 1997
2. Forestry Code of the Republic of Uzbekistan, July 26, 1978
3. Resolution of the Cabinet of Ministers of the UzbekSSR "On improvement of the protection of forests from fire, harmful insects and disease", 349, July 30, 1968
4. Resolution of the Council of Ministers of the UzbekSSR "On approval of the rules of fire safety in forests of the USSR and on measures for the enhancement of fire protection of forests", 309, July 14, 1971
5. Resolution of the Council of Ministers of the UzbekSSR "On inclusion of Republican forest in the first group and their division by categories of the level of protection", 429, June 18, 1980
6. Resolution of the Council of Ministers of the UzbekSSR "On state accounting of forests keeping the state forestry cadastre and sectorial accounting of the condition and use of the land of the state stock of forests", 59, January 26, 1982
7. Resolution of the Council of Ministers of the UzbekSSR "On the procedure of collection of wild fruits, nuts, berries, medicinal plants and technical raw materials in forests and on the land of the state forestry stock not covered with forests", 104, March 9, 1987
8. Decree of the President of the Republic of Uzbekistan "On improvement of the management of the forestry economy in the Republic of Uzbekistan", February 12, 1991
9. Resolution of the Council of Ministers of the UzbekSSR "On improvement of the management of the forestry economy in the Republic", 115, April 30, 1991
10. Resolution of the Council of Ministers of the UzbekSSR "On approval of regulations of the State Forestry Committee of the Republic of Uzbekistan", 192, July 17, 1991
11. Resolution of the Council of Ministers of the Republic of Uzbekistan "On measures for arrangement and operations of forestry entities on the territory of the forestry stock of the Republic of Uzbekistan", 469, October 12, 1992

12. Resolution of the Council of Ministers of the Republic of Uzbekistan "On enhancement of protection of valuable and disappearing species of flora and fauna and On arrangements for their use", September 3, 1993
13. Resolution of the Council of Ministers of the Republic of Uzbekistan "On
14. Resolution of the Council of Ministers of the Republic of Uzbekistan "On measures for breeding poplars for industrial purposes and making plantations of other quickly growing trees used for timber", February 8, 1994
15. Resolution of the Council of Ministers of the Republic of Uzbekistan "On approval of rates for the calculation of compensation for the damage caused to flora of the Republic of Uzbekistan", 293, July 27, 1995

Fauna protection and use legislation

1. Law of the Republic of Uzbekistan "On fauna protection and use", December 26, 1997
2. Resolution of the Council of Ministers of the UzbekSSR "On procedure of the State accounting of animals and its use and fauna cadastre", 258, May 17, 1984
3. Resolution of the Supreme Council of the Republic of Uzbekistan "On enhancement of the protection of valuable and disappearing species of flora and fauns and arrangement of their use", September 3, 1993
4. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On measures for enhancement of the protection of valuable and disappearing species of flora and fauna and arrangement of their use", 500, December 15, 1993

Legislation on specially protected territories

1. Law of the Republic of Uzbekistan "On specially protected natural territories", May 7, 1993
2. Resolution of the Council of Ministers of the UzbekSSR "On the establishment of the Ugam-Chatkal State National Park", 270, July 30, 1990
3. Resolution of the Cabinet of Ministers under the President of the UzbekSSR "On approval of regulations of the Ugam-Chatkal State Natural National Park", April 22, 1991
4. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On the Red Book of the Republic of Uzbekistan", 109, March 9, 1992
5. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On introduction of charges for over-standard emissions (discharge) of pollutants into the environment and waste disposal", 303, June 28, 1992
6. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On approval and regulations of funds for nature protection", May 24, 1993
7. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On approval of the procedure of keeping the State cadastre of specially protected natural territories of the Republic of Uzbekistan", 104, March 10, 1998

Legislation on atmospheric air protection

1. Law of the Republic of Uzbekistan "On protection of the atmospheric air". December 27, 1996

Hydrometeorology legislation

1. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On hydrometeorological service of the Republic of Uzbekistan", 110, March 9, 1992
2. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On approval of regulations of the main department of hydrometeorology under the Cabinet of Ministers of the Republic of Uzbekistan", 225, May 7, 1992
3. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On measures for the improvement of hydrometeorological service of the economy of the Republic of Uzbekistan", 70, February 27, 1995

Administrative frame: Institutes and committees

The State Committee For Nature Protection *("Goskompriroda")* is the main specially authorized overall co-ordinating organ for nature protection. Its basic tasks are follow:

- Implementing governmental control over protection of nature environment, use of and restoration of the natural resources;
- Developing and implementing unified of nature protective and resource-saving policies;
- Taking other actions toward a ecologically sustainable and healthy environment;
- Managing protected areas, and ensuring integrity of their protection regime;

The State Committee For Nature Protection includes the following departments:

- Atmosphere Conservation;
- Supervision On Land And Water Resources Conservation And Use;
- Scientific/Technical Innovations And Their Propaganda;
- Economics And Organisation of Natural Management;
- State Expertise Committee;
- Environmental Information And Forecast;
- Foreign Relations And International Programs;
- Environmental Law;
- Conservation And Use of Undersurface Resources and Waste Utilization;
- Environmental Standards, Standardization, And Certification;
- Accounting, Reporting, And Economics. Besides this, there are two specialized National Inspections within *"Goskompriroda"*;
- State Biological Control Service responsible for conservation of flora and fauna and reserves management *("Gosbiocontrol")*;
- State Inspection of Specialized Analytical Control *("Gossiak")*;

A certain role in protection of flora and fauna is played by other ministries and department, the most important of which are the State Committee of Forestry *("Goskomles")* and the concern *"Uzfish" ("Uzryba")* which in the government structure have departmental inspections on protection of biological resources. The State Committee of Forestry *("Goskomles")*. The primary responsibilities are:

- State management in the field of use, reproduction, protection of woods, support of reservations and national parks on territory of forests;
- Departmental management and supervision of the hunting facilities, enforcement of rules of hunting on territory of forests;

- Realization of a unified policy, directed at the extension and rational use of wood resources, on their reproduction and improving of the situation with forests with the purposes of increasing their ecological value;
- Registration and assessment of wood fund, flora and fauna;
- Running of reserves, state hunting facilities, provision of departmental protection for flora and fauna, regularity and timeliness of development and realization of measures on saving the environment, conditions of reproduction and paths of migration of animals;
- Observance of forest-related legislation, control in the performance of the normative and engineering specifications of forest management and hunting facilities;

There are the following departments, regulating the use of wood and biological resources, within the structure of the State Committee for Forestry:

- Administrative Board for Forestry Management, Conservation, and Protection;
- State Forestry Inspection;
- Main Administrative Boards for Hunting Facilities, Reserves, and National Parks *("Glavokhota")*, Corporation *"Uzfish" ("Uzryba")*. This organisation is responsible for management and agency-level protection of fishery resources in areas of natural and artificial reservoirs and streams.

7.3 Description of the environment

7.3.1 Geography and natural ecological environment

With an area of 447,000 square kilometres (approximately the size of France), Uzbekistan stretches 1,425 kilometres from west to east and 930 kilometres from north to south. Bordering Turkmenistan to the southwest, Kazakhstan to the north, and Tajikistan and Kyrgyzstan to the south and east, Uzbekistan is not only one of the larger Central Asian states but also the only Central Asian state to border all of the other four. Uzbekistan also shares a short border with Afghanistan to the south.

The physical environment of Uzbekistan is diverse, ranging from the flat, desert topography that comprises almost 80 percent of the country's territory to mountain peaks in the east reaching about 4,500 meters above sea level. The southeastern portion of Uzbekistan is characterized by the foothills of the Tian Shan mountains, which rise higher in neighbouring Kyrgyzstan and Tajikistan and form a natural border between Central Asia and China. The vast Qizilqum (Turkic for "red sand"--Russian spelling Kyzyl Kum) Desert, shared with southern Kazakhstan, dominates the northern lowland portion of Uzbekistan (see fig. 2). The most fertile part of Uzbekistan, the Fergana Valley, is an area of about 21,440 square kilometers directly east of the Qizilqum and surrounded by mountain ranges to the north, south, and east. The western end of the valley is defined by the course of the Syrdariya, which runs across the northeastern sector of Uzbekistan from southern Kazakhstan into the Qizilqum. Although the Fergana Valley receives just 100 to 300 millimeters of rainfall per year, only small patches of desert remain in the center and along ridges on the periphery of the valley.

Water resources, which are unevenly distributed, are in short supply in most of Uzbekistan. The vast plains that occupy two-thirds of Uzbekistan's territory have little water, and there are few lakes. The two largest rivers feeding Uzbekistan are the Amu Darya and the Syrdariya, which originate in the mountains of Tajikistan and Kyrgyzstan, respectively. These rivers form the two main river basins of Central Asia; they are used primarily for irrigation, and several artificial canals have been built to expand the supply of arable land in the Fergana Valley and elsewhere.

Another important feature of Uzbekistan's physical environment is the significant seismic activity that dominates much of the country. Indeed, much of Uzbekistan's capital city, Tashkent, was destroyed in a major earthquake in 1966, and other earthquakes have caused significant damage before and since the Tashkent disaster. The mountain areas are especially prone to earthquakes.

Uzbekistan's climate is classified as continental, with hot summers and cool winters. Summer temperatures often surpass 40°C; winter temperatures average about -23°C, but may fall as low as -40°C. Most of the country also is quite arid, with average annual rainfall amounting to between 100 and 200 millimeters and occurring mostly in winter and spring. Between July and September, little precipitation falls, essentially stopping the growth of vegetation during that period.

Despite Uzbekistan's rich and varied natural environment, decades of environmental neglect in the Soviet Union have combined with skewed economic policies in the Soviet south to make Uzbekistan one of the gravest of the CIS's many environmental crises. The heavy use of agrochemicals, diversion of huge amounts of irrigation water from the two rivers that feed the region, and the chronic lack of water treatment plants are among the factors that have caused health and environmental problems on an enormous scale.

Environmental devastation in Uzbekistan is best exemplified by the catastrophe of the Aral Sea. Because of diversion of the Amu Darya and Syrdariya for cotton cultivation and other purposes, what once was the world's fourth largest inland sea has shrunk in the past thirty years to only about one-third of its 1960 volume and less than half its 1960 geographical size. The desiccation and salinization of the lake have caused extensive storms of salt and dust from the sea's dried bottom, wreaking havoc on the region's agriculture and ecosystems and on the population's health. Desertification has led to the large-scale loss of plant and animal life, loss of arable land, changed climatic conditions, depleted yields on the cultivated land that remains, and destruction of historical and cultural monuments. Every year, many tons of salts reportedly are carried as far as 800 kilometers away. Regional experts assert that salt and dust storms from the Aral Sea have raised the level of particulate matter in the earth's atmosphere by more than 5 percent, seriously affecting global climate change.

The Aral Sea disaster is only the most visible indicator of environmental decay, however. The Soviet approach to environmental management brought decades of poor water management and lack of water or sewage treatment facilities; inordinately heavy use of pesticides, herbicides, defoliants, and fertilizers in the fields; and construction of industrial enterprises without regard to human or environmental impact. Those policies present enormous environmental challenges throughout Uzbekistan.

Large-scale use of chemicals for cotton cultivation, inefficient irrigation systems, and poor drainage systems are examples of the conditions that led to a high filtration of salinized and contaminated water back into the soil. Post-Soviet policies have become even more dangerous; in the early 1990s, the average application of chemical fertilizers and insecticides throughout the Central Asian republics was twenty to twenty-five kilograms per hectare, compared with the former average of three kilograms per hectare for the entire Soviet Union. As a result, the supply of fresh water has received further contaminants. Industrial pollutants also have damaged Uzbekistan's water. In the Amu Darya, concentrations of phenol and oil products have been measured at far above acceptable health standards. In 1989 the minister of health of the Turkmen SSR described the Amu Darya as a sewage ditch for industrial and agricultural waste substances. Experts who monitored the river in 1995 reported even further deterioration.

In the early 1990s, about 60 percent of pollution control funding went to water-related projects, but only about half of cities and about one-quarter of villages have sewers. Communal water systems do not meet health standards; much of the population lacks drinking water systems and must drink water straight from contaminated irrigation ditches, canals, or the Amu Darya itself.

According to one report, virtually all the large underground fresh-water supplies in Uzbekistan are polluted by industrial and chemical wastes. An official in Uzbekistan's Ministry of Environment estimated that about half of the country's population lives in regions where the water is severely polluted. The government estimated in 1995 that only 230 of the country's 8,000 industrial enterprises were following pollution control standards.

Poor water management and heavy use of agricultural chemicals also have polluted the air. Salt and dust storms and the spraying of pesticides and defoliants for the cotton crop have led to severe degradation of air quality in rural areas.

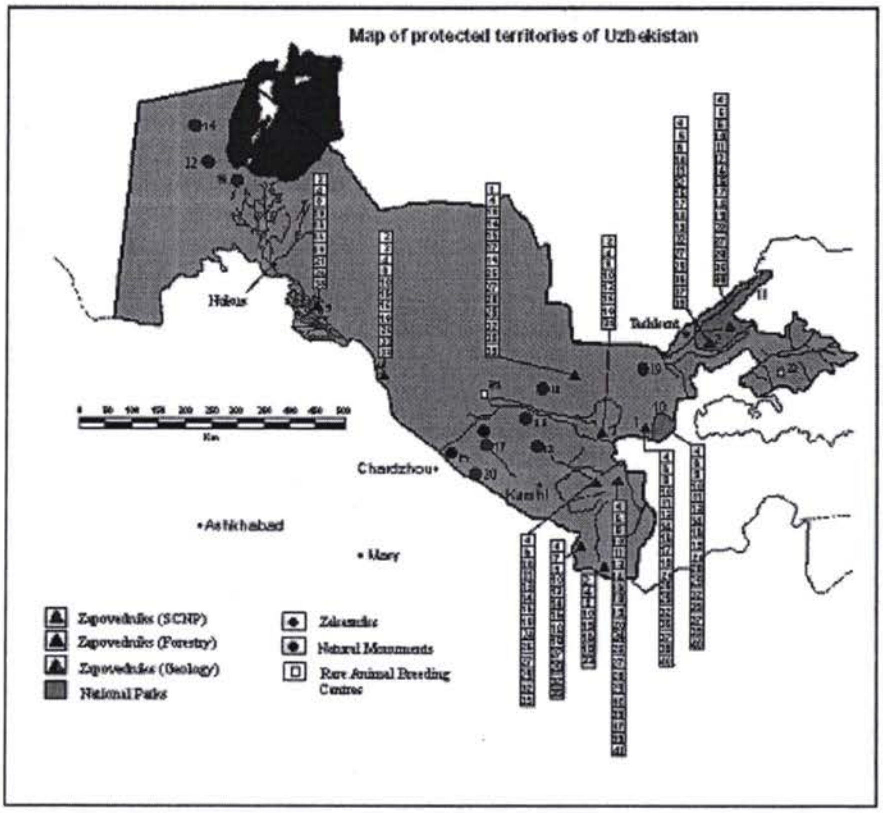
In urban areas, factories and auto emissions are a growing threat to air quality. Fewer than half of factory smokestacks in Uzbekistan are equipped with filtration devices, and none has the capacity to filter gaseous emissions. In addition, a high percentage of existing filters are defective or out of operation. Air pollution data for Tashkent, Farghona, and Olmaliq show all three cities exceeding recommended levels of nitrous dioxide and particulates. High levels of heavy metals such as lead, nickel, zinc, copper, mercury, and manganese have been found in Uzbekistan's atmosphere, mainly from the burning of fossil fuels, waste materials, and ferrous and nonferrous metallurgy. Especially high concentrations of heavy metals have been reported in Toshkent Province and in the southern part of Uzbekistan near the Olmaliq Metallurgy Combine. In the mid-1990s, Uzbekistan's industrial production, about 60 percent of the total for the Central Asian nations excluding Kazakhstan, also yielded about 60 percent of the total volume of Central Asia's emissions of harmful substances into the atmosphere. Because automobiles are relatively scarce, automotive exhaust is a problem only in Tashkent and Farghona.

Particularly protected territories

At present there are 9 reserves on the republican territory.

6 reserves of 9 are under the control of State forest committee, 2 under the control of State nature committee, 1 is under the control of State geology committee. their area accounts for 202.3 hectares.

There are 2 State National parks. Their area corers more then 600 000 hectares, 9 state natural cover area more than 1. 200 000 hectares 2 state natural monuments. Natural complexes unique in its variety and abundance of flora and fauna.



Such as juniper, flood-land, tugai forest are taken under protection. More than 350 animal species and 700 plant species habit in them. Many species are introduced in the Uzbekistan Red Book and in "The Red Book of International nature protection Union". The reserves have definite specifications: Gissar mountain - juniper reservation cowers are of 80986,1 hectares. There are 800 plant species and 140 animal species. Its specification is nature complexes and ecosystems of the Gissar mountain range.

Chatkal - mountains forest biospeheric reserve covers area of 457339 hectares. There are 1060 plant species, 32 animal species and 168 bird species. Its specification preservation of mountain ecosystems of the West Tien Shan, ecological monitoring of environmental state.

Classification

All territory of the Uzbekistan is divided into 5 physico-geographical parts, they are: deserts ecosystems, foothills semi-deserts and steppes, river and coastal ecosystems of main rivers, water-swamp ecosystems, mountain ecosystems.

The desert ecosystems.

Desert ecosystems take a big part of Turan lowland as well as Kizil-Kum desert. Desert systems are divided into following kinds: sandy deserts, saline deserts, clay and stony (gypsum) deserts. Desert ecosystems of the Uzbekistan has rich and multifarious flora and fauna. It is also the main place of inhabitancy of rare types of animals such as djeiran, honey badger, Imperial Eagle and etc.

Sandy deserts

They are formed on the deserted sandy soils and sands. They take about 27 % of total flat territory of the republic. The climate of sandy deserts is very arid and continental. The minimal and maximal temperatures are from -36 to +47 degrees centigrade. There are about 320 types of flower plants such as Ammodendron conollyi, Salsola richteri etc. The fauna of vertebrates includes about 200 types from which 16 types of reptiles, more than 150 kinds of birds and 22 mammals.

Stony (gypsum) desert

This is a main landscape of the Usturt plateau and of part of the Kizil-Kum desert. Minimal and maximal temperatures are from -32 to + 46 centigrade. Typical features are solidity of the soils and developed surface of gypsum horizon.

Flora counts more than 400 kinds of plants, fauna - 129 kinds from which 11 kinds of reptiles, 100 types of birds and 18 kinds of mammals.

Saline desert

This type of the deserts are situated on saline regions of the Usturt plateau and modern delta of the Amu-Darya river. Typical features are constant humidity of surface horizons of the soils and temporary existence of reservoirs. Flora counts more than 304 kinds of plants, fauna - 118 kinds from which 7 kinds of reptiles, 100 types of birds and 11 kinds of mammals.

Clay desert

It is situated on clay sediments in the basin of Kashkadarya river. Clay deserts are rich in surface waters. The climate is softer. Minimal and maximal temperatures are from -30 to +49 degrees centigrade.

Steppes

Mountain steppes are situated at a height of 2000 -2600 meters above the sea level. The main soils: dark sierozems. The average temperature is 11-14 degrees centigrade. Flora counts 634 kinds of plants.

River and coastal ecosystems.

These ecosystems include flat regions of the Amu-Darya and Syrdarya valleys. There are three main places of inhabitancy: reed-bed, open sandbank, and tugais.

Water-swamp ecosystems.

There is an unique combination of desert and damped territories in the Uzbekistan. The damped territories are divided into the natural (delta of Amu-Darya) and the quaternary. The main features of this ecosystem are big area of water space and big average level of moisture. There are 2 kinds of plants are highly developed in the delta of Amu-Darya river: tugai and reed plants.

Mountain ecosystems

They are divided into foothill semi-deserts, mountain deciduous forests, archa forests, alpine meadows and high mountain zone. This foothill zone till the heights of 800-1200 meters above the sea level. The soils are light sierozems. The average year temperature in the West Tien-Shan 12.6 degrees centigrade. The zone of foothill semi-deserts takes the 2/3 of the mountain territory of the republic. Flora is represented by 400 kinds of plants.

The mountain deciduous forests take not very big squares (218,2 thousand of hectares) and are situated on the heights from 800-1000 to 2500 - 2800 meters above the sea level. The main background of the landscape is tree-brushland plants. The average temperature is 10 degrees centigrade. The flora is represented by 47 kinds of trees and 96 kinds of bushes.

Alpine meadows are situated on the heights from 2700 to 3700 meters. It is characterized by moderately cold climate with average annual temperature being +8 degrees centigrade. The total area in the republic is 0.6 mill. hectares.
High Mountain zones. The zone of high mountains starts above 3500 meters above the sea level. Its total area makes 9.600.000 sq.km. All the year around average 24-hour temperature never exceeds 0 degrees centigrade. Vegetation is represented by "carpet" meadows of undersized grass. This relief consists of high mountain peaks, glacial circuses and steep rocky slopes. Flora of short grass carpet meadows of Uzbekistan totals 110 typical alpine species.

Current services and benefits of biodiversity in Uzbekistan

Uzbekistan survival is closely linked with the availability and reliability of the limited water resources. The ecological stability of the catchment areas of the Amu-Darya and Syrdarya rivers are therefore of paramount strategic and economic importance to the republic.
Soil erosion control. The existence of natural vegetation prevents or reduces all forms of erosion. In the mountain areas of Uzbekistan it is particularly important in the prevention of mudslides that can do enormous damage.
Desertification. Loss of natural forestry and vegetation, the desiccation of Aral sea resulting in the creation of a large area of saline desert have set in motion extensive desertification processes in all the Central Asian republics. Remaining areas of both natural and artificial vegetation play a crucial role in reducing the rate of desertification.

System of protected areas

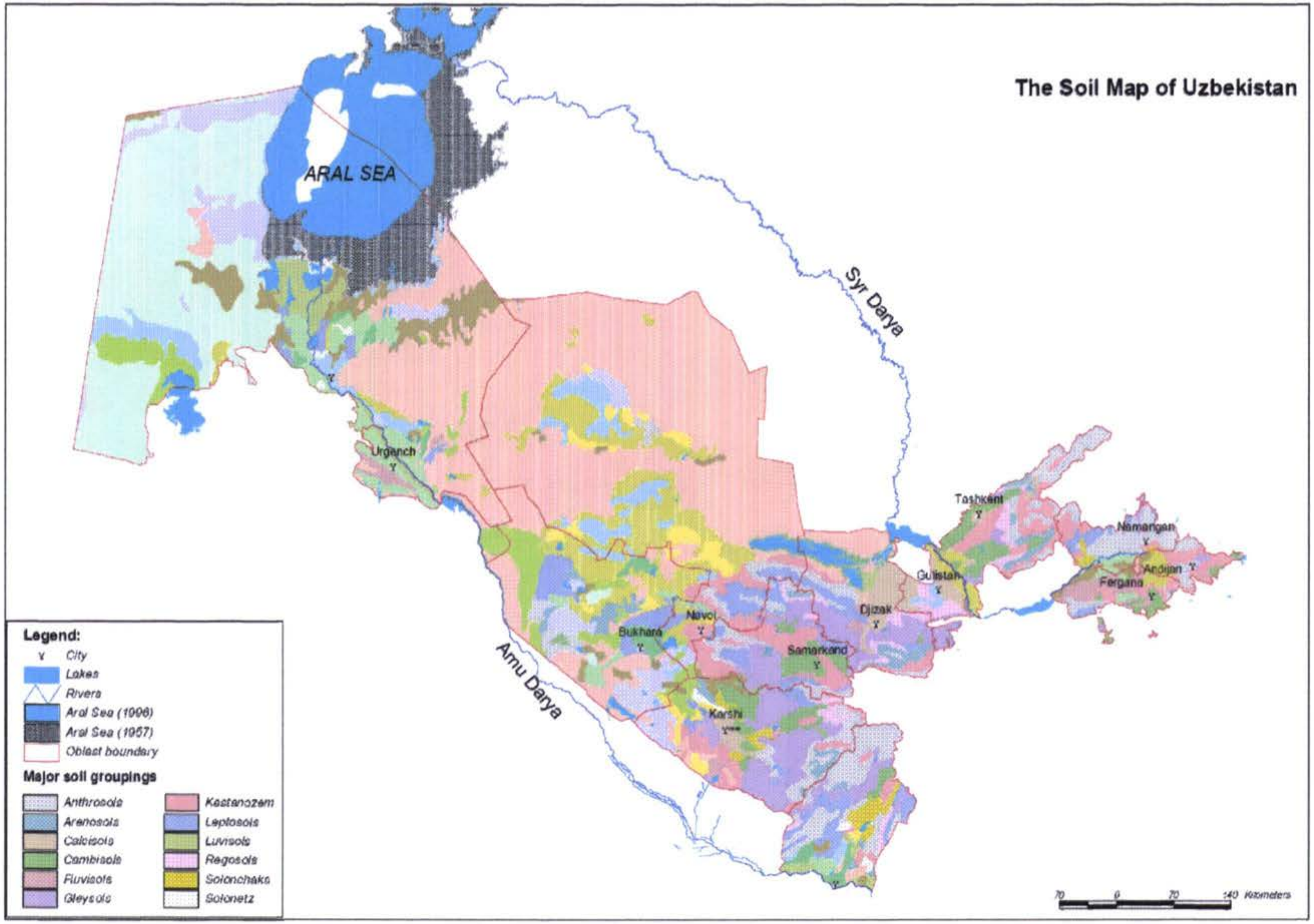
In Uzbekistan there are currently four basic categories of protected areas: *State Reserves* (these are the oldest and most strict form of protected area. They are not open to any form of utilization, with the exception of controlled scientific research), *State National Parks* (these are a relatively recent introduction to the system. The basic objective is to provide biodiversity protection in the context of some rational and strictly controlled utilization), *Special State Reserves* (these are impermanent and sometimes seasonal reserves which provide a relaxed level of protection. Though the State Committee for Nature Protection has the overall responsibility for monitoring these areas the local authority directly responsible for land use in the area has practical control and retains the right to discontinue the area as a special state reserve), and *State Natural Memorials* (these include natural monuments, a geological reserves and an ornithological reserves. State Natural Memorials are administered by State Committees for Nature Protection, Forestry and over agencies).

The following table summarizes the above mentioned.

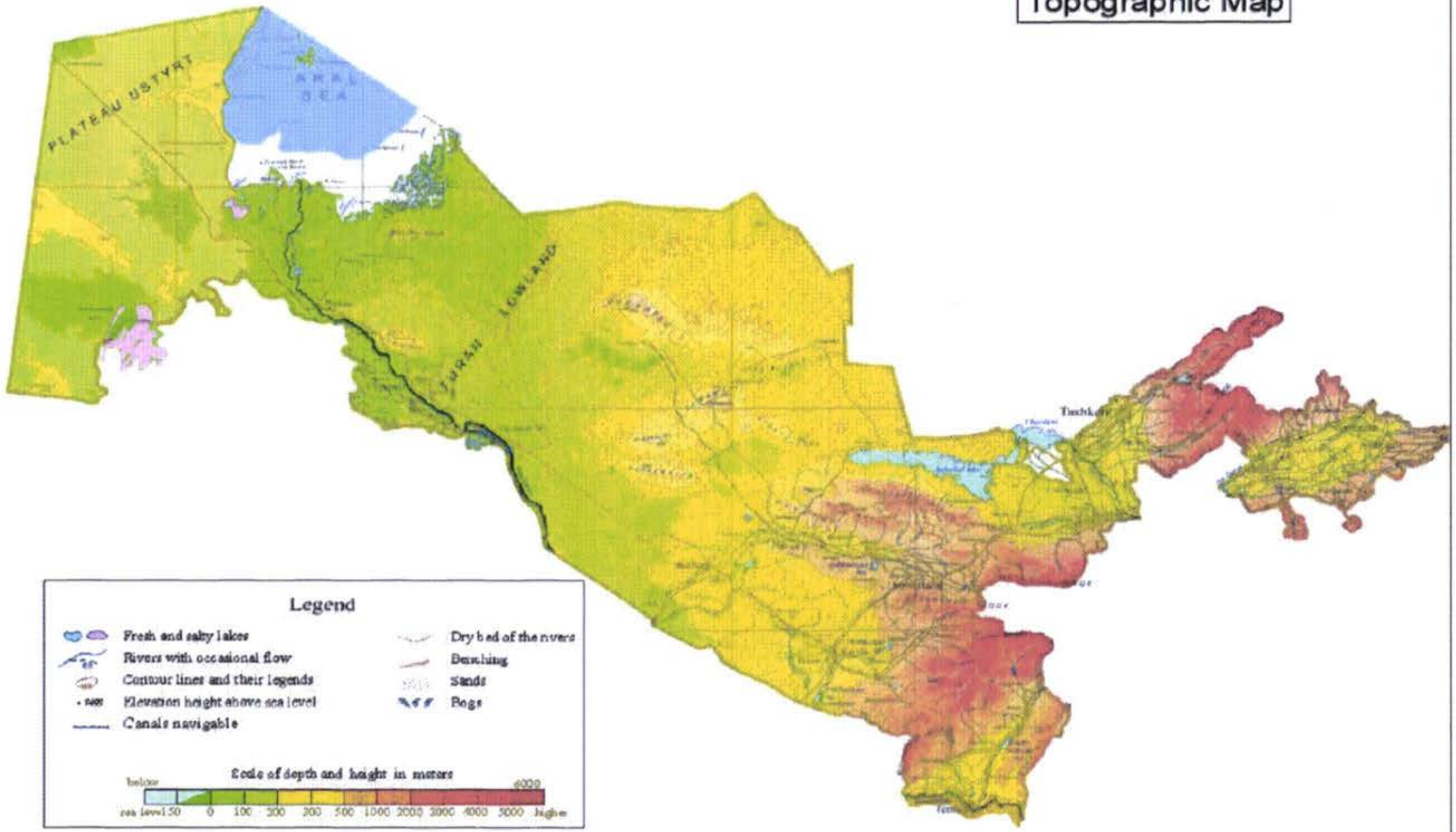
Table 7.3.1-1 Summary data of Protected Areas

No	Official name and year of foundation	Location	Area sq.km	IUCN Category	Agency
STATE STRICT RESERVES (ZAPOVEDNICS)					
1	Chatkal mountain forestry biosphere reserve 1947	Tashkent province, Parkent and Akhangaran districts	356.8	I	Goskompriroda
2	Gissar mountain archa reserve 1983	Kashkadarya province, Yakkabad and Shakrisabz districts	814.3	I	Goskompriroda
3	Zaamin mountain archa reserve 1926, 1960	Djizak province, Zaamin and Bakhmal districts	268.4	I	Goskomles
4	Badai-tugai steppe-tugai 1971	Republic of Karakalpakstan, Beruni and Kegeli districts	64.6	I	Goskomles

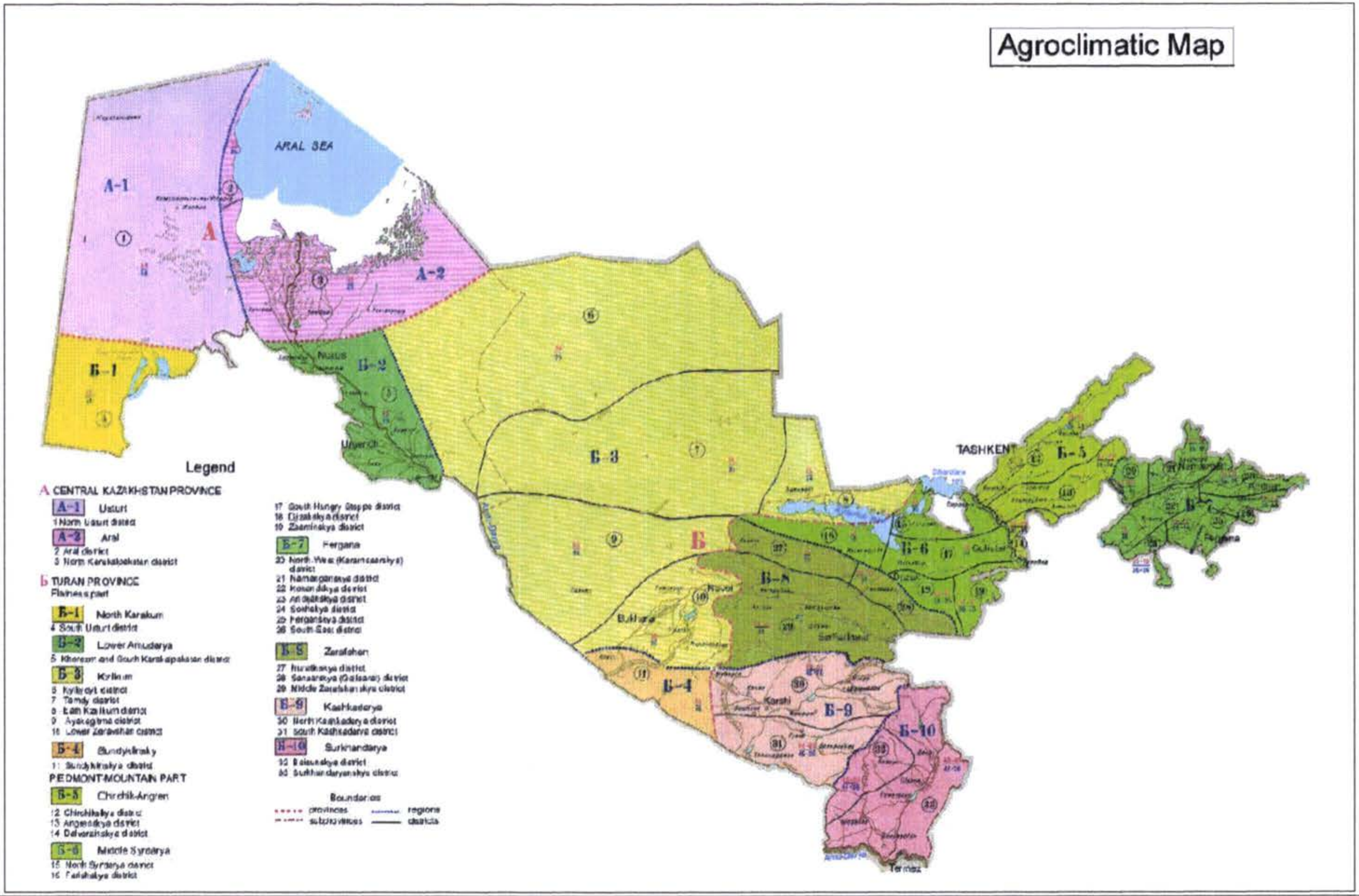
5	Kyzylkum tugai-sand reserve 1971	Bukhara province, Romitan district, Khorezm province, Druzbincki district	101.4	I	Goskomles
6	Zerafshan lowland tugai reserve 1975	Samarkand province, Bulungur and Jambay districts	23.5	I	Goskomles
7	Nuratin mountain wallnut-tree reserve 1975	Jizak province, Farish district	177.5	I	Goskomles
8	Kitab geological reserve 1979	Kashkadarya province, Kitab district	53.7	I	Goskomgeologia
9	Surkhan mountain forestry reserve, 1987	Surkhandarya region, Sherabad and Termez districts	276.7	I	Goskomles
	Total area		2136.9		
STATE NATIONAL PARKS					
1	Zaamin People's Park 1976	Djizak region, Zaamin district	241.1	II	Goskomles
2	Ugam-Chatkal Natural National Park 1990	Tashkent region, Bostanlyk, Parkent and Akhangaran reg	5745.9	II	Goskomles
	Total area		**5987.0**		
NURSERIES FOR RARE ANIMALS					
1	Ecocenter "Jeiran" 1976	Bukhara region	51.4	III	Goskompriroda
	Total area		**51.4**	III	
STATE RESERVES FOR SPECIAL PURPOSES OR WITH RELAXED PROTECTION REGIME (ZAKAZNICS)					
1	Arnasay 1983	Djizak region	633.0	IV	Uzryba
2	Karakul 1990	Bukhara region	100.0	IV	Goskompriroda
3	Saygachy 1991	Republic of Karakalpakstan	10,000.0	IV	Goskompriroda
4	Sydochy 1991	Republic of Karakalpakstan	500.0	IV	Goskompriroda
5	Sarmysh 1991	Navoi region	25.2	IV	Goskompriroda
6	Karakir 1992	Bukhara region	300.0	IV	Goskompriroda
7	Karnabchul 1992	Samarkand region	400.0	IV	Goskompriroda
8	Koshrabad 1992	Samarkand region	165.0	IV	Goskompriroda
9	Dengizkul 1992	Bukhara region	86.0	IV	Goskompriroda
	Total area		12239.2		
STATE NATURAL MEMORIALS					
1	Vardanzi (1975), 1983	Bukhara region	3.0	IV	Goskomles
2	Yazyavan 1991	Ferghana and Namangan regions	31.8	IV	Goskompriroda
	Total area		**34.8**		


The Soil Map of Uzbekistan
ARAL SEA
Syr Darya
Amu Darya
Urgench
Tashkent
Namangan
Andijan
Fergana
Gulistan
Djizak
Navoi
Bukhara
Samarkand
Karshi
Legend:
City
Lakes
Rivers
Aral Sea (1996)
Aral Sea (1957)
Oblast boundary
Major soil groupings
Anthrosols
Arenosols
Calcisols
Cambisols
Fluvisols
Gleysols
Kastanozem
Leptosols
Luvisols
Regosols
Solonchaks
Solonetz
70 0 70 140 Kilometers

Topographic Map



Topographic Map of Uzbekistan


Agroclimatic Map
ARAL SEA
A-1
A
A-2
Б-1
Nukus
Б-2
Urgench
Б-3
Б
TASHKENT
Б-5
Б-6
Б-8
Navoi
Bukhara
Samarkand
Б-4
Karshi
Б-9
Б-10
Fergana
Termez
Legend
A CENTRAL KAZAKHSTAN PROVINCE
A-1 Usturt
1 North Usturt district
A-2 Aral
2 Aral district
3 North Karakalpakstan district
Б TURAN PROVINCE
Flainess part
Б-1 North Karakum
4 South Usturt district
Б-2 Lower Amudarya
5 Khorezm and South Karakalpakstan district
Б-3 Kyzilkum
7 Tamdy district
9 Ayakagitma district
10 Lower Zeravshan district
Б-4 Bundyklinsky
PEDMONT-MOUNTAIN PART
Б-5 Chirchik-Angren
12 Chirchiksky district
13 Angrensky district
14 Dalverzinskya district
Б-6 Middle Syrdarya
15 North Syrdarya district
16 Farishskya district
17 South Hungry Steppe district
18 Dzhizakskya district
19 Zaaminskya district
Б-7 Fergana
20 North-West (Karamcaarskya) district
21 Namanganskya district
24 Sokhskya district
25 Ferganskya district
26 South East district
Б-8 Zerafshan
28 Sanzarskya (Galisarai) district
29 Middle Zerafshanskya district
Б-9 Kashkadarya
30 North Kashkadarya district
31 South Kashkadarya district
Б-10 Surkhandarya
32 Baisunskya district
33 Surkhandaryanskya district
Boundaries
provinces
subprovinces
regions
districts

7.3.2 Environmental strategies, programs and projects

Following a brief description of ecological projects executing in Kazakhstan, Kyrgyzstan and Uzbekistan is shown. Also activities of the different governmental, non-governmental and international organizations in field of the environment protection on national and regional levels are described – INTAS, COPERNICUS, USAID, UNDP, Global Environmental Facility (GEF), UNEP, WB, UNESCO, and other.

Joint projects on trans-boundary and regional environmental problems	**Kazakhstan** 	**Kyrgyzstan** 	**Uzbekistan** 
National Environmental Action Plan	yes		yes
Participation in international environmental conventions	9	3	8
Creation of regional environmental database	Yes		yes
Regional Environmental Action Plan	Yes	yes	yes
Environmental projects			
Region of the Semipalatinsk nuclear testing area	yes		
Foothills of the Tyan-Shan	Yes	yes	yes
Region of the Caspian Sea	yes		
Aral Sea Project			
Aral Sea VISION	Yes	yes	yes
International Fund for the Saving Aral Sea	Yes		yes
Aral Sea Basin Capacity Development Project	Yes		yes
National strategies and Reports			
Biodiversity			
Water			
Climate Change			
Ozone layer			
Desertification			

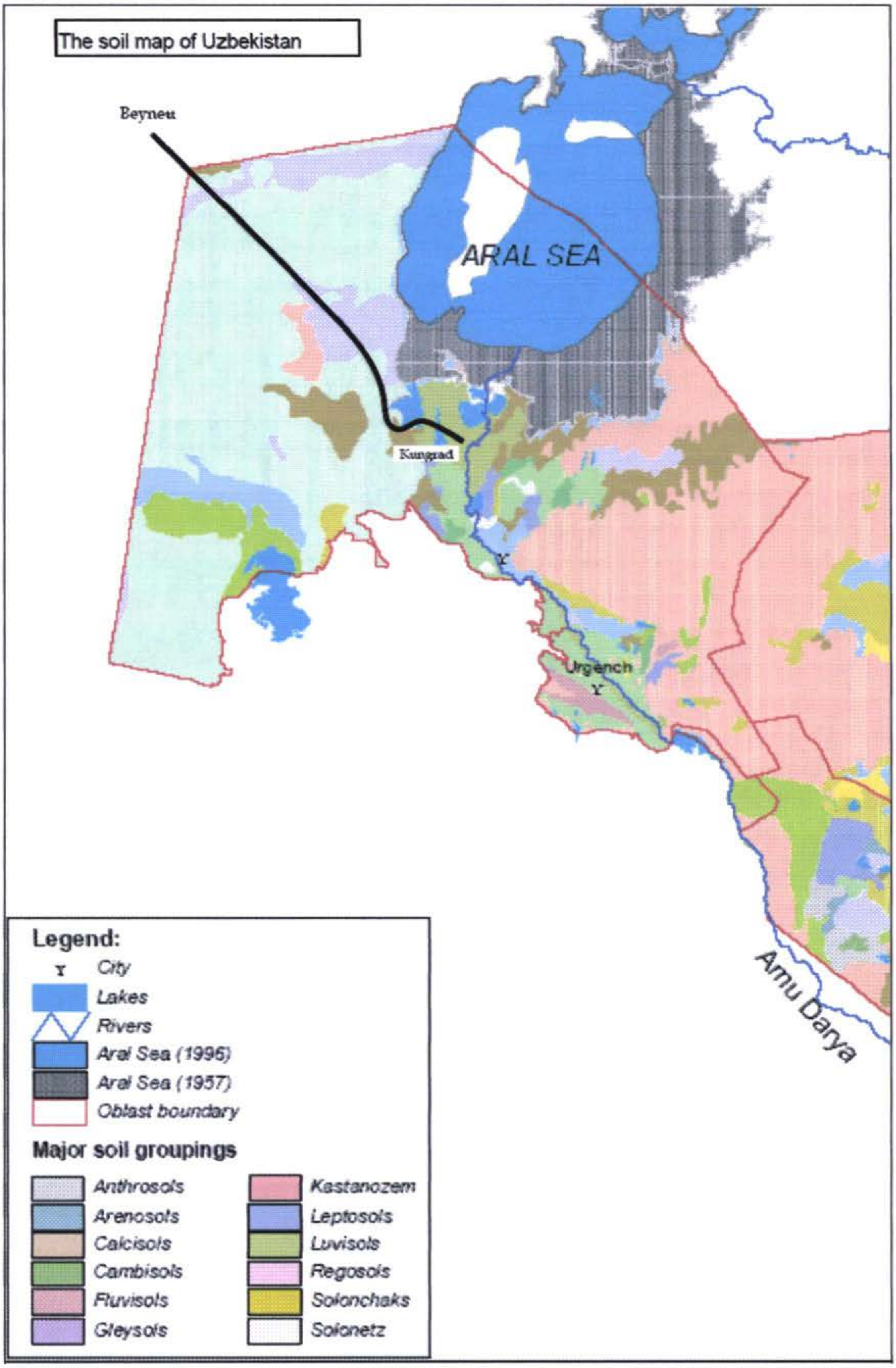
7.3.3 Analysis of environmental status along the lines (sensitive areas)

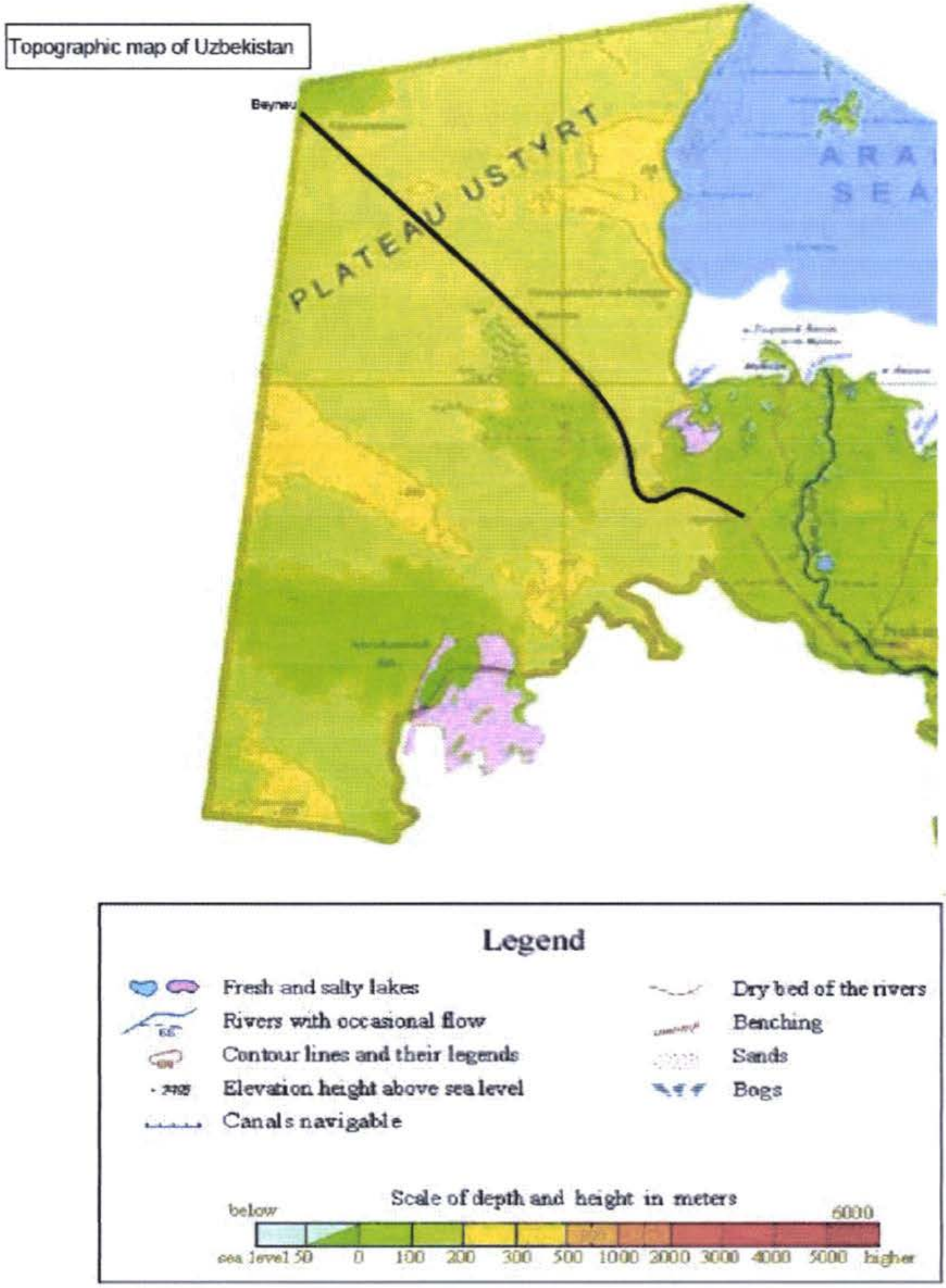
As result of the environmental investigation relatively to the territory examined, the environmental related to the territorial areas interested by the railway lines can be summarised in the following types:

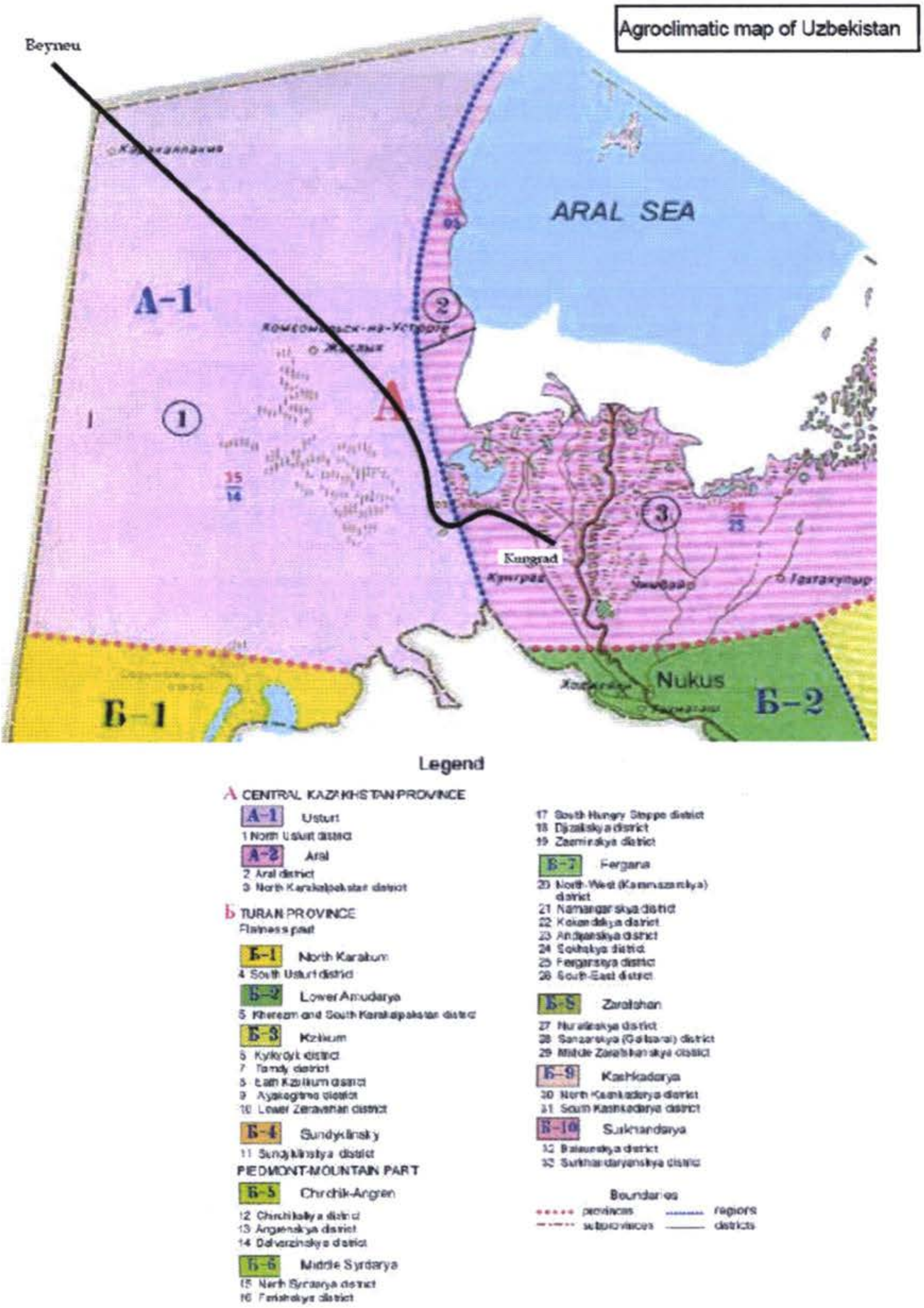
Kungrad – Beyneu line	• urban areas • areas far from borrow pits (ballast)

Critical Areas

Sections (Km)	Actual land use	Environment items	Environmental receptors
626-627	Urban area (Kungrad)	Urban ecology	Residential build-up area
645-646	Urban area (Raushan)	Urban ecology	Residential build-up area
671-672	Urban area (Kunhodja)	Urban ecology	Residential build-up area
689-690	Urban area (Kirk-Kyz)	Urban ecology	Residential build-up area
710-711	Urban area (Barsa-Kelmes)	Urban ecology	Residential build-up area
731-732	Urban area (Ajinijaz)	Urban ecology	Residential build-up area
760-761	Urban area (Abadan)	Urban ecology	Residential build-up area
779-780	Urban area (Kuanysh)	Urban ecology	Residential build-up area
796-797	Urban area (Jaslik)	Urban ecology	Residential build-up area
820-821	Urban area (Ayapbergen)	Urban ecology	Residential build-up area
845-846	Urban area (Berdakh)	Urban ecology	Residential build-up area
870-871	Urban area (Bostan)	Urban ecology	Residential build-up area
893-894	Urban area (Ak-Tobe)	Urban ecology	Residential build-up area
910-911	Urban area (Kiyiksay)	Urban ecology	Residential build-up area
933-934	Urban area (Karakalpakia)	Urban ecology	Residential build-up area


The soil map of Uzbekistan
Beyneu
ARAL SEA
Kungrad
Urgench
Amu Darya
Legend:
City
Lakes
Rivers
Aral Sea (1996)
Aral Sea (1957)
Oblast boundary
Major soil groupings
Anthrosols
Arenosols
Calcisols
Cambisols
Fluvisols
Gleysols
Kastanozem
Leptosols
Luvisols
Regosols
Solonchaks
Solonetz


Topographic map of Uzbekistan
Beyneu
PLATEAU USTYRT
Legend
Fresh and salty lakes
Rivers with occasional flow
Contour lines and their legends
Elevation height above sea level
Canals navigable
Dry bed of the rivers
Benching
Sands
Bogs
Scale of depth and height in meters
below sea level 50
0
100
200
300
500
1000
2000
3000
4000
5000
6000
higher


Agroclimatic map of Uzbekistan
Beyneu
ARAL SEA
A-1
A
Kungrad
Nukus
Б-1
Б-2
Legend
A CENTRAL KAZAKHSTAN PROVINCE
A-1 Usturt
1 North Usturt district
A-2 Aral
2 Aral district
3 North Karakalpakstan district
Б TURAN PROVINCE
Flatness part
Б-1 North Karakum
4 South Usturt district
Б-2 Lower Amudarya
Б-3 Kizilkum
7 Tamdy district
10 Lower Zeravshan district
Б-4 Sundyklinsky
PIEDMONT-MOUNTAIN PART
Б-5 Chirchik-Angren
Б-6 Middle Syrdarya
16 Farishskya district
17 South Hungry Steppe district
18 Djizakskya district
Б-7 Fergana
21 Namanganskya district
23 Andijanskya district
26 South-East district
Б-8 Zarafshan
Б-9 Kashkadarya
30 North Kashkadarya district
31 South Kashkadarya district
Б-10 Surkhandarya
Boundaries
provinces
regions
subprovinces
districts

7.4 Environment Impact Forecast

The issue described below is based on the observation by the consultant, the review of the available and relevant literature and statistics on the area and the characteristics of the infrastructure.

The impacts of the construction period will be described for defining the recommendations and measures to prevent the environmental interferences and to retain and mitigate the potential pollutions.

The foresees rehabilitation works groups are:

- railway line works (rehabilitation of the embankments, construction of the embankments, dismantling and remounting the contact wire, the rails and the sleepers; building, upgrading or capital repairing of culverts, technological rehabilitation works);
- works carried out outside the railway line (guard ditches, drainage, etc.)
- environmental protections works.

7.4.1 Environment impact/effects during rehabilitation period

Obviously the realisation of a new transport infrastructure provokes major impacts on the surrounding environment then the rehabilitation works proposed by this project, but, in general, there are some guidelines to be always followed.

The interferences and the criticisms linked to the construction period are connected with two aspects. The more general come from the analysis of the total area involved by the infrastructure implementation, in order to identify the most compatible areas to realize the rehabilitations, namely the overall vulnerability of the concerned environmental context.

The second aspect, more linked to the technical and operative management of the construction site, is connected to the proposed works peculiarities, that is the whole activities and logistics structures provided for each site, that in a different way could produce insertion problems.

The basic principles connected to construction site location are:

- the construction site should be placed close by the working area in order to reach easily the assembly place, in order to reduce as far as possible the trouble brought about means of transport traffic;
- the construction site space should have surface area wide enough to permit the planned activities carrying out, but on the same time these areas should be limited as much as possible to reduce the (temporary) occupation of land;
- fixing the construction site position should be necessary to consider the right possibility of easy connection with the present services network (electricity, piping system for white or black drain water);
- the possibility to assure a smooth approach road or a material transports on the railroad;
- it will be necessary to verify the materials supplying and waste management, that is the right conditions of the road system (small transport distances for supplied materials);

- the construction site should be realized so that to reduce at the lowest terms the insertion of the potential environmental interferences with the neighbourhood (local people life and activity).

Likewise the impacts and effects of the involved environmental components will be essentials to parameter, during the construction period, the interference's insertion brought by the construction site peculiarities, their dimensions and the characteristic of the pertinent territorial context.

With reference to the environmental components it is possible to synthesize a list of the principals potentials problems induced by the construction period:

Environmental components	Potential effects
Atmosphere	Alterations of air quality conditions Dust production
Water environment	Fluvial regime modification Alterations of water quality conditions
Land and subsoil	Morphological modifications
Vegetation, flora and fauna	Vegetation damages due to powder production Departure / Damages to the fauna
Noise – Vibration	Disturb due to means of transport traffic and work processing

It is possible to foresee that the majority of the construction materials will be brought to the work site through the existing railway. The material supply will be realized accordingly with the necessity of the project and it will be organized by a specific time/ quality schedule. The schedule must avoid the overloading of materials in the construction site, as well as the too long permanence of stocked materials in the site itself.

The traffic trucks have strong variation in time, in relationship with the nature of the terrain operations. The highest intensity of the traffic is estimated for the embankment working (ballast transportation) a medium intensity for the concrete plants and the lowest intensity for the operations of leveling and ground excavations, when the traffic takes place from the embankment to the borrow pit and back.

As mentioned above, the construction work of the project will potentially generate a series of environmental impacts on the area of the construction site and along the line. Analysis is detailed as follow.

Impacts on physical environment

Impacts on soil and water resources

a. Soil and subsoil environment

From Kungrad to approximately Kelmes the project area extends on the Quaternary deltaic plains formed by the depositional activity of the Amu-Darya river. The alluvial sediments forming the plains are mainly composed of sands, clay and loam layers.

The plains surface is generally fairly regular, presenting only slight unevennesses no more than few m high.

The ground water of these plains is generally correlated with the regime of the Amu-Darya river.

Past Kelmes the project area extends onto Ustyurt plateau up to Beyneu.

The flat to gently undulated surfaces of the plateau are sometime bordered by sharp cliffs composed of layered Tertiary rocks including limestones, marls, sandstones and claystones, more or less rich of gypsum and other soluble salts. These rock formations form the bedrock of the plateau, generally covered by overburden materials composed of fine soils with inclusions of rock debris and alluvial gravels.

Gypsum and other salts generally accumulate between the overburden and the bedrock.

The hydrogeology of the plateau is characterised by localised ground water basins generally found at the depth of 30 – 60 m .

The area of the project appears interested only by low to moderate seismic activity.

The forecasted potential impact forms on the soil environment that could be identified in:

- the removal of the vegetal soil bed and the construction of an artificial profile through the works of embankments executed on the road territory;
- the deterioration of the soil profile of parcels were there will be settled site organizations and working points for the destructions of soil profiles (by leveling);
- the apparition of erosion;
- the loss of natural characteristics of the fertile soil bed through inadequate storage in the soil dumps resulted from uncovers;
- the removal/degradation of the fertile soil bed in the areas where new technological roads or detours of the current access routes will be realized;
- the isolation of some soil surfaces from the natural ecologic circuits through their concreting;
- accidental spills of some substances/compounds (used oils, lubricants, fuel) directly on the soil;
- the uncontrolled storage of waste, construction materials or technological waste;
- potential leaks in the sewage/used water collection systems;
- quality modifications of the soil under the influence of air pollutants (qualitative and quantitative of the local geochemical circuits);
- Interruption of subsoil and overland drainage patterns.

The materials that are to be used during the construction works do not present a strong risk of pollution for the soil. The most important aspect is represented, however, by the ground mass which will be processed.

On one side, we are referring to the filling materials that will be delivered both from quarries (clay, broken stone and aggregates) and borrowing pits. This will generate a transfer of possible disturbance from the research area of the present study to the sources of materials (the accentuation of phenomena like erosion, the modification of the local levels of underwater).

On the other hand the waste materials resulted by excavation shall be, on their turn, deposited.

The soil erosion and damages generated by soil borrow and spoil regard the following two aspects:

- a large scale borrow will result in heavy damages and disturbance to the earth surface of the borrow pits and their surroundings, leading to damages and extinction of the vegetation, soil exposition, declining of mountain body stability and soil anti erosion capacity, and along the line, under the scouring of rich rainfall, the surface rocks are liable to be broken and weathering, forming soil and water erosion;

- large amount of broken rocks and various impurities are contained in the construction spoil, which is low both in stability and anti erosion capacity. If piled improperly, under strong scouring if rainfall in rain season, it is easily denuded and collapsed, forming mud – rock flow and dirty muddy water, damaging nearby soil and farm lands, and also bringing about pollution and damages to irrigation canals and ditches, rivers and pounds.

b. Impacts on water environment

Particular regard should be posed in the selection of the place for the construction site location.

First of all must subdivide the arguments in two principals group of problems, from one side there is the construction site impact and then this consequences on the water environment (impact factor) connected to vulnerability of the environment.

On the other side there are the risk on which the installation could be subject for natural reasons (natural risk factors) underestimate or not exactly evaluate.

The first group of problems is related to:

- all the waters pollution risks, either superficial or deep, due to the pollutant substances spilling on the construction site services area (oils, petrol, unloading, etc.) and along the routes of the mechanics means;

- the insertion of cloudy waters, for the presence on the water-rivers of powders and sediments coming from washing waters of concreting stations, with consequent damage to existing life around them;

- the unloading of white or black water generate from the high concentration of construction site authorized person;

Obviously the spilling of pollutants substances or unloading, even fortuitous, involves heavy problems also on the underground water. On this sense oneself advise the opportunity to provide all the construction site of suitable system to deal the water before of their insertion in the superficial water network.

To the second group of problems are then ascribed to the cases of construction site wrong location, ad as an example the alluvial or active riverside areas or terraces reaching when there are exceptional floods. The works site will be selected by a preliminary investigation of the areas subjects to periodic river flows, in order to reduce to the highest the probability of the same sites inundation.

In succession are carried over in a systematic form, the list of potential effects of construction site on the examined system:

- *Alteration of hydrographical superficial network*

The effect it is conductible to the obstructions and barriers introduction intercepting the hydrographical superficial network. The potential receptors are composed from the bigger and the smaller watercourse and from the superficial stream activity.

- *Alteration of physical/chemicals characteristics of superficial waters*

Generally speaking the effect is as consequence of the pollutant spilling substances or to mud or grounds introduction on the watercourses involved by the work fulfilment. The phenomenon is to be considered temporary to the construction site phase, and it is interesting particularly the building phase, the excavations, the impermeabilizations, the machinery utilization, etc.;

- *Alteration of physical/chemicals characteristics of underground waters*

Almost all the project actions can theoretically alter the underground waters characteristics, chemicals and physicals. This effect can rise essentially from the building phase following, as an example, the fortuitous spilling to soil of pollutant substances penetrating deeply and pollute the water bed.

The project actions that potentially can alter the quality of the underground waters are the excavations and the clearing, tests and assays, structures (as example the foundations), the processing inside the construction site, the impermeabilizations, the wastes stocks and clearances.

These actions are referring to the construction site, and therefore the coming effects are of temporary impact. The receptors of which it is possible will be involved by this effect are principally, the high and medium permeability soils, and subordinately, these identified with medium and low permeability;

- *Engaging on of erosion phenomena*

Generally this effect is caused by means of all actions of the project connected with the removal of the vegetal covering and/or the superficial part of the soil. When the soil is subject to the erosion, take place also the transport of the solid in the direction of the flowing waters, with consequent increase of the turbidity of superficial water corps (secondary effects).

The project actions that can determine the engaging of erosion phenomena are: the physical areas occupation, the evacuation, the clearing, the building, the impermeabilization, the placements and the secondary works;

- *Alteration of the water underground flow*

Generally speaking this effect can be determined by all the project actions, relatives above all to the construction phase, interesting in a certain way the subsoil. The receptors potentially involved by this effect are the water-bed and the picking up works of the same water-bed.

c. Soil and water environment impacts interaction

<u>Impacts induced by the construction site activities</u>

With reference to the soil permeability it is possible to say that during the works it is foreseen to spill into the soil and the subsoil substances generating pollution.

These substances are:

- suspended solids – are the suspended sediments that carried by the waters percolate into the subsoil polluting both the unsaturated soils sector and the water-bed below. This kind of pollutant will inevitably generate the increase of water turbidity especially in the reinforcing and piles foundation or slopes protection.

  The activities generating this pollution are:

  - excavations and spoil works in the riverbeds and in their close vicinity as in the case of bridges and culverts works;
  - surfaces washing of the construction site service areas;
  - washing of the motor vehicles wheels;
  - washing out by the rain waters of the powders and the mud placed on the road system engaged by the construction site means;
  - construction works near water-course (rivers and channels);

- oils and hydrocarbons – to these categories can add the fuels, the lubricants fluids for the hydraulic system normally used on the construction site. The reasons of he pollution brought by these fluids are principally linked to:

  - leaks from the fuel tanks valves or tubes;
  - fuel tanks corrosion;
  - damages induced by frost to the fuel tanks;
  - supplying activity of the construction site means and of the same tanks;
  - oils leaks from pomp and generator;
  - used oils abandonment;
  - accidents (accidentals leaks during the refuelling activities, mechanics breakage of hydraulic tubes, insufficient capacity of the holding basins).

- concrete and his derived products utilization - the cement and his derived products utilisation in the construction site, present contamination risks for the water environmental due to the water use for processing them. Particularly during the "on site" production of concrete are used big quantity of water especially for washing the equipment. In the case of outside purchase of concrete by means truck mixer, the pollution could rise from the washing of the same into the construction site area, necessary to reduce the impacts on the atmosphere of routing construction site-quarry-dump;

- heavy metals – The heavy metal pollution normally are referring to mercury, cadmium, lead and aluminium, they are the bigger responsible of the environmental damages. The heavy metals pollution it is strictly linked to the industrial and combustion activities that are causing the movement of them at the surrounding level. The heavy metal is polluting either the soil than the subsoil, the vegetation and the waterbeds.

- liquid sewage
- pesticides
- herbicide
- others pollutant and dangerous substances as: rubbish; solvents; detergents; paints; sealing products; adhesive; drilling fluids; others chemicals substances.

Impacts induced by the processing

About what are specifically concerning the soil and subsoil components, the construction site activities can provoke the physical impacts temporary or permanent because of:

- reduction of the functional soil qualities (either productive or protective) due to the temporary surface area covering (even if soon after reclaimed), presence of gravel, sands or waste-materials inactive, and also due to incidental organic horizon loss or to happen of long anaerobic conditions;
- soil compactness from the construction site means;
- trouble of the network lay out for irrigation and drain in the agricultural context;
- chemicals pollution coming from the heavy metal and the organic substances included on construction site means exhaust pipe, the loss of oils and hydrocarbons and the mechanics parts wear from the some machinery.

The areas where these impacts could happen are principally those destined to the main construction site, to the motor vehicles transit roads and the temporary occupations areas to stocking soil and/or materials. Heavy traffic, specific to the construction site, determines various emissions of polluting substances into the atmosphere (NOx, CO, SOx – characteristic to diesel fuel -, particles in suspension etc). There will also be particles resulted from friction and attrition (the rolling way, the tires). The atmosphere is also washed by rain, thus the pollutants present in the air are transferred to the other environmental factors (surface and ground water, soil, etc).

Excavations and soil movements

The excavations can be pollutant activities center if realized with presence of mud or substances like that, and if first of all are interfering directly with the waterbed or water-course.

The pollution of waterbed and soils could be realized on the case of soaking into the subsoil, washing away, water flow and delivery to existing pits.

Fuelling and maintenance stations

The fuelling and maintenance stations for the gear and transportation means are potential pollution sources for soil and surface and ground waters. These stations must be approved of in their project phase and must be checked periodically during their functioning period, from the environmental protection point of view. It is to be expected that the contractor does not build new stations for refuelling motor vehicles and other gear at work, the endowments of the enterprise being used for this task. Anyway, the fuel distribution toward the gear at work will be done directly at the work point. During the execution of these operations the necessary precautionary and protective measures will have to be taken in order to prevent the discharge of fuels in the open environment.

Simple means of intervention in the case of fuel spills will be made available: metal platters placed under the fuelling hoses, sand crates for the absorption of the discharged fuel, etc.

Works filling on the back

On this case the risk exist if the soil utilized for refilling is polluted from substances that, by filtration, could reach the waterbed or the water superficial body.

Finishing and maintenance works

The operations of finishing and maintenance of crossing works of culverts for the superficial waters manhole cover could create pollution for the waters firstly superficial and than underground, due to the washing away or the direct fall of small parcel of metal, paint and detergents.

As to what concerns the site organizational facilities, their place has not been established yet. But in the cases in which the works are carried out in the proximity of the intersected watercourses, all of these could produce the direct pollution of the water. Also, water coming from precipitation, which washes the surface of the site, may mobilize the sediments and thus, indirectly, these end up in the watercourses.

At the current phase in the elaboration of the project, the technologies that will be used by the builders are not yet known. They will request authorizations for the functioning of their production bases, the employed technologies, from the Regional Agencies for Environmental Protection.

It is considered that the emissions of pollutant substances (resulted from road traffic characteristic to the construction site, from manipulation to execution of materials), which might reach directly, or indirectly into the surface or ground waters are not in important quantities and they do not modify the framing in water quality categories.

The pollutant quantities that will usually reach the watercourses during the execution period will not affect the aquatic ecosystems or the water facilities. Only by accidental spilling of large amounts of fuel, oils or construction materials, the aquatic environment could be damaged.

As to what concerns the possibility of polluting the phreatic bed, it is considered that it will also be relatively reduced. The storage of fuel in hermetically sealed reservoirs will be imposed; the maintenance of the gear (washing, repairing, part and oil changes, refuelling) will be done only in specially designed places (concrete platforms, with decanters to retain the losses).

Impacts on biological environment (flora and fauna)

Flora and vegetation

In the case of the construction site areas will be placed in an natural valence context, it is necessary to underline that at the end of works this areas must be object of recovery activity to previous situation. Besides, a lot of dust caused by construction and transportation activities covers the stems and leaves of the roadside crops and vegetation, which will affect there.

During the works, where are observing alteration phenomena (affect the photosynthesis and production decrease of the agricultural products and vegetation withering) on the existing vegetal community in a strip of 1 km adjacent to the railway, it will necessary take all the expedient suitable to reduce such interferences.

One of the most important phenomenon correspond to the dust presence on leaves surfaces of the arboreal and shrub species and on the grass present alongside the edge of the lines and the areas of the works site.

It is possible to take under control this phenomenon by means recurrent forecasted bathing to carry out in order to cut down the dust production. In case of works are interfering with individual arboreal and shrub but where is not necessary to cut, could be adopt as protection net or mobile barrier.

The description of the natural environmental situation let to identify all the present receptors and to forecast the possible interferences on the potential identified receptors due to rehabilitation activities, presence and operations of considered construction site including the pertinent accessory works.

In succession are put in evidence the receptors subject to alterations and the list with description of potential impacts determined of construction site implementation.

The main identified receptors are:

- natural vegetation
- hedges and/or shrub rows and/or lonely trees (autochthonous or not native)

Potential impacts identified:

- removal of natural vegetation, including naturalistic value elements;
- removal of arboreal elements of human origin;
- alteration of vegetal populations due to pollution ;
- removal of vegetal soil.

The removal impacts of natural vegetation, including the naturalistic value elements, and those of arboreal elements of human origin, are determined by the project actions carried out during the construction phase as: excavations, clearings and works of art achievements.

The removal of vegetal soil is of diffused characteristic because this is generating by all the project actions forecasted for the construction site fulfilment.

All the vegetal formations and the lonely trees close to the construction site areas are potentially subjects of alteration because of pollution aroused by the powders lifted from the mechanical means utilized during work phase. The impacts during the construction site phase appear in any case of short significance, because this provokes temporary alterations to the physiological functionality at the involved vegetation.

The impact on the vegetation and fauna of the pollutants existing in the work perimeter are due at:

- <u>Particles ;</u>
- <u>Sulfur Dioxide ;</u>
- <u>Nitrogen oxides ;</u>
- <u>Heavy metals;</u>

Inside every kind of impact the gravity is variable in the role of involved receptor sensibility, and also by the level of involvement of it. The receptor sensibility comes from a number of parameters like: to be natural, resistant, rare and endemic, with particular geographic distribution.

The involvement degree is the measure on which the receptors are subjected to the removal both: the quantitative point (amount of individuals removed, removed area on the total) and the qualitative point (modality of receptors involvement, such as partial, marginal, etc.).

Fauna

About with fauna interference, this aspect it is not considered significant since these presence are too limited and restricted to micro fauna.

In addition it necessary to put in evidence that the construction sites setting up activities – make level and or soil surface re-shape – are not operations provoking the direct fauna destruction, because the territorial context of reference don't result to be passing road.

Nevertheless the problem of the construction site placed close to watercourses, it could involve the water variation of some physical-chemicals characteristics of these and consequently it could cause damage to fishing fauna development. This problem it is faced with the control of working areas waters insertion points.

The works of rehabilitating and modernizing the already existing railway can lead to the amplification of the stress affecting the natural ecosystems, as a result of both the direct works and the collateral effects (the increment of traffic), leading to unwanted phenomena of loosing the ecological diversity, the simplification of functional structures and shortening of trophic chains, increasing the sensitivity of the ecosystems.

This is why after the concluding of the necessary works on the infrastructures, it is necessary to apply a proper nature protecting management in these perimeters by involving all the responsible institutions.

Impacts on atmospheric environment

Pollutant emissions during railway rehabilitation and laying works relate mainly to earth movement, handling other materials and the actual building of specific facilities.

Dust emissions vary from day to day, depending on weather conditions, activities, specific operations and vehicle traffic.

Railway rehabilitation works consist of a series of different operations, each of them generating its own dust quantity for a certain period of time. In other words, the beginning and end of dust emission within a construction site may be very well defined, but they vary quite a lot depending on the different phases of the rehabilitation process. This characteristic makes dust emissions different from other uncontrolled dust sources, which either have a relatively fixed cycle or an annual cycle easy to highlight.

As with dust emissions, the condition of these pollutants depends on the different activities and specific operations, thus varying from day to day, from one process phase to the other.

The main activities that represent dust emission sources are:

- Excavations that including earth scarification; excavation and gathering earth and ballast in piles, charging the earth and the ballast in wagons and in tracks.
- Filling including material discharging from the wagons on the railway bed, compacting, layers scarifying, line tamping, slopes finishing, final levelling of the railway formation layer.
- Material transport.

- Wind erosion, it is a phenomenon the appears due to uncovered ground surfaces that are exposed to the wind action.

The main problems brought about the works realization phase, on the component atmosphere are concerning:

- the powder production;

- the gas emissions and the dust.

The powder emission, induced by the activities carrying out constitutes the main atmospheric pollution for a railway construction site. However both of the problems can be verified along the line system involved from the heavy means movement, and around the areas on which take place the works.

The rehabilitation involve a series of various operations, each having its duration and dust generating potential. In other words, when realizing the construction, the emissions have well define periods of existence (the rehabilitation time), but they can substantially vary from one construction phase to another. Exactly these particularities differentiate then from other uncontrolled sources of dust, which have stationary emissions or follow an undetectable annual cycle.

Atmosphere pollution represents one of the major elements that effect the population' life conditions in the large and small town areas. The discomfort produced by smoke and smells, the visibility reducing, the negative effect on the human health and the vegetation due to harmful powders and gasses, the damages to the buildings due to the dust and corrosive gases, all these belong to the major environment issues of the urban areas. The atmosphere is the largest pollution spreading vector, the evacuated noxious affecting as much directly as indirectly the human element and then others components of the natural and artificial (built) environment.

It is to be noticed that the spatial distribution of the concentration fields due to the emissions resulted from the activities developed along the railway line placement do present some particularities, characteristic to the line sources:

- atmospheric pollutants are distributed mostly along the railway line;

- the highest pollutant concentrations appear in the railway placement, along it;

- the pollutant concentrations are quickly diminishing with the distance on a direction perpendicular on the railway axis;

- the highest pollutant concentrations in the line proximity areas appear when the wind blows perpendicular on the railway axis.

In conclusion the significant area of impact extends along the railway line on its both sides, on strips of 80 - 100 m width at the most (transversally on the line) which led to an effective width of 40 – 50 m because the works for every track are not simultaneous.

The emission of a pollutant in the air (irrespective of time or quality) may produce a perturbation of all the environmental factors implied in the impact area of the emission. The emission effect depends both on its concentration and on its duration, on how sensitive the receptor is and on the meteorological conditions while the emission is realized. The proper effect of the emission may be observed in relation to the impact upon the environmental factors and upon the population.

In succession there are indicated some indications usually applied during works of railway intervention fulfilment.

The powders - The powder production coming from the means movement and from the works, could be controlled carrying out expedients as listed in succession.

In particular in order to contain the problem linked to the powder raising induced from the traffic of the construction site means must be carry out recurrent wettings of the construction site surfaces. This action will made with reference to the seasonal period, with an increase of wettings during the summer time. The efficacy of the powders control with water it depend essentially from the frequency on which the system is applied.

Furthermore to reduce the powder production it will be possible to provide the chemical stabilization of the construction site tracks.

With reference to the urban road systems distances (for the built-up area involved along the connections between railway and quarry sites) and the extra urban one, engaged from the transits of the construction site means entrusted with the purchasing materials transport, it is necessary to put in evidence that, to reduce the interferences of construction site means on the road system, must:

- to clean with water the tyres of the coming out vehicles from each construction site through washing systems placed near the entry;
- to cover the means boxes with sheets to reduce eventual powder dispersions during the materials transport.

Gas emissions and the dust

An other issue is concerning the problem of the nitrogen oxide, the dust and the powder from the construction site means. To face at this problem the construction site means must correspond to the emission limits in compliance with regulations. Therefore the construction site means must be equipped of dust reduction systems of which it will be necessary to plan a suitable and frequent maintenance and to verify the efficiency also through the measurement of fumes opacity.

Finally for the construction site means and the fixed installations must foresee to utilize equipment with electric engine linked to the existing network.

Wind erosion represents an additional dust source. Wind erosion occurs due to the presence of uncovered areas, which are exposed to wind action for a certain period of time. The dust produced by material handling and wind erosion usually has natural origins (soil particles, mineral dust).

Apart from these dust sources, there are also pollution emission sources specific for internal combustion engines, is the engines of the equipment used in different works on site. Another pollutant source specific for internal combustion engines is the vehicle traffic (vehicle carrying materials and products used in the construction works). The works within the site, especially the ones carried out for earthwork reinforcement, represent the pollution sources with the highest atmospheric pollution potential.

Regardless of their type, equipment and vehicles run on Diesel engines and the exhaust gases, discharged into the air, contain the entire range of pollutants specific for internal combustion engines: nitrogen oxides (NO_x), non-methane volatile organic compounds (COVnm), methane (CH_4), carbon oxides (CO, CO_2), hydrogen nitride (NH_3), heavy metal particles (Cd, CU, Cr, Ni, Se, Zn), polynuclear hydrocarbons (HAP), sulphur dioxide (SO_2).

The range of organic and inorganic pollutants discharged into the air through vehicle exhaust gases contains substances with different toxicity levels. Thus, apart from the ordinary pollutants (NOx, SO2, CO, particles), there are certain potentially dangerous substances, whose cancerous nature has been discovered through different epidemiological studies prepared under the care of the World Health Organisation. The substances are: cadmium, nickel, chromium and polynuclear aromatic hydrocarbons (HAP).

There are also nitrogen protoxide (N2O), which is known to destroy the stratosphere ozone layer, and methane, which, in combination with CO, has a global impact on the environment, since these are greenhouse effect generating gases.

Obviously, pollutant emissions decrease as the engine performance is higher; the world trend in this respect is to manufacture engines with less fuel consumption per power unit and with restrictive emission control.

Atmospheric pollutant emission sources specific for the area under review are the following: soil sources, nearby soil sources (emission heights of up to 4 m from the soil level), open sources (earth handling) and mobile sources. The source characteristics and the area geometry place the site in the linear pollutant source category.

Impacts on human environment

The exposure to the pollutant substances during this period is acute (of high intensity and for a period of 1-7 days) or sub-acute (of average intensity and for a period of 3-6 months).

The exposure to pollutants in this period of time is generated by the following sources:

- equipment provided with diesel engines (particles, irritant pollutants),
- soil processing (suspended particles);
- multiple noise sources.

Impacts generated by construction noise and vibration

The noise represents an environment factor omnipresent for which is difficult to establish the tolerance limit between the necessary level and the noxious one, depending on a multitude of physical factors (physical of the noise, personal of the receiver or other external variables).

The noise influence on the human body depends on a factor series:

- factors related to noise: intensity, frequency, action times, noise feature (continuous or intermittent);
- factors related to the human body: age, activity, physical state, individual sensitivity;
- factors related to the place of the action: space dimension, field configuration, architectural structure, etc.

Generally, the noise effects depend on the characteristics and complexity of the activity to be carried out. The simple, repetitive and monotonous activities are less affected by noise.

In order to limit the possible impact of the sound pollution on population health, there are recommended the following measures:

- equipment operating within the limits of the functional parameters;
- monitoring the noise levels in order to adopt the correction measures of the excessive sound pollution.

The construction site will generate problems linked to the noise emissions and vibrations connected either the working activities or the materials movement.

In order to accurately present the different aspects regarding the noise produced by various devices, three levels of observation are been considered:

- sources noises;
- proximity noises;
- distance noises

In the case of source noises each equipment have to be Each of the three levels of observance presents its own characteristics.

Impacts of construction solid waste on environmental

The solid waste from the construction activities and its environmental impacts can be summarized into two categories:

- living refuse by construction workers. This kind of refuse can be collected and disposed by environmental sanitation departments in urban areas, while in rural areas, it may cause harms to soil, vegetation and water environment.
- various kinds of construction refuses will be generated by rehabilitation and upgrade works.

The categories of works will produce:

Work	Wastes
Embankment works	Solid waste, pulverulent
Contact line replacement	Copper wastes, ceramics insulators and other metallic materials
Replacement of the safety systems of the stations for the power supply	Liquid waste, acid electrolytic solutions, plastic boxes/ tanks, lead electrode
Current repairs of the equipment	Used oils, worn – out tyres, metallic wastes
Site organizations	Domestic waste, paper, packing

The toxic and dangerous wastes as fuel (gasoline), lubrificants and brimstone acid, required for a good functioning of equipment. Equipment fuel supply will be done with a cistern car, when necessary. The equipment will be brought to site in good functioning, will al technical revisions carried out fuel changes. Fuel change will be done after each working season in authorized workshops, where also the hydraulic and transmission oils will be changed.

7.4.2 Environment impact/effects forecast for operation period

Impacts on water and soil environment

From Kungrad to approximately Kelmes the project area extends on the Quaternary deltaic plains formed by the depositional activity of the Amu-Darya river.

The ground water of these plains is generally correlated with the regime of the Amu-Darya river.

Past Kelmes the project area extends onto Ustyurt plateau up to Beyneu.

The hydrogeology of the plateau is characterised by localised ground water basins generally found at the depth of 30 – 60 m .

Environmental impact

Considering that the proposed railway rehabilitation works do not require any re routing of the existing line, no significant impacts on the geological environment are expected in relation with this project; the only project action of some potential impact on the soil and subsoil refers, in fact, to the possible quarrying of the materials required for the re construction of the top of the railway embankment.

An important danger of the underground water is related to the qualitative changes of the water produced through the pollution with impure substances altering the water's physical, chemical and biological qualities. The more significant contamination may appear in case of accidents or failures in the freight transport, special the liquid products transport. In fact the potential polluting substances, if not disposed of properly and evacuated directly into the watercourses, will modify their quality class.

Impacts on biological environment (flora and fauna)

The proposed railway projects are an existing railways requiring upgrading and do not involve in any fresh encroachment into previously inaccessible areas. Therefore destruction of valuable wildlife habitants and impediments to wildlife movements is not expected during the operation period.

Impacts on atmospheric environment

When the rehabilitation project is completed the discharge amount of air pollutants will be decrease considerably.

Impacts on noise and vibration environment

Quite part of the lines lies on the outskirt of the cities or countryside where there are less residents and rarely located sensitive areas; in those stretches the railway noise has a minor impact.

Impacts of solid waste during the operation period

After the project completion the passenger flow increase generating unfavourable impact to the railway and train sanitary conditions. The stations mainly handle the train refuse and domestic refuse from railway stations. All the refuse are required to have a classified treatment in for categories (including paper, wood, fruit shell and fruit foodstuffs); plastic and glass and metal with refuse box provided respectively the trains and stations.

During the operating period specific domestic waste will be resulted from the railway traffic and also waste resulting for an improper actions of the railway traffic participants such as throwing away of bags during traffic.

Matrix of identification and screening of Environmental Impacts during the construction and operation period

The following matrix summarizing:

- Type of impact (positive or negative);
- The timing (construction, operation);
- Nature of impact (direct, indirect, cumulative);
- The magnitude of impact (low, medium, high).

Impact Issue	Timing	Type of Impact	Nature	Magnitude
Soil pollution and erosion				
Erosion	Construction-operation	Negative	Direct	Medium
Alteration of overland and soil drainage	Construction-operation	Negative	Direct	Medium
Air quality	Construction	Negative	Direct	Medium
Nuisance noise	Construction	Negative	Direct	Medium
Vibration	Construction	Negative	Direct	Medium
Natural ecosystem				
Alteration or damage of wildlife habitats, biological resources or ecosystem	Construction	Negative	Direct-indirect	Low
Solid waste management	Construction-operation	Negative	Direct-indirect	Medium
Social – economic environment				
Employment opportunities related to rehabilitation works	Construction	Positive	Direct	Medium
Human health				
Water borne diseases	Construction	Negative	Indirect	Medium
Increasing water demand/waste water	Construction	Negative	Direct	Medium
Construction camp	Construction	Negative	Direct	Medium

7.5 Recommendations and Mitigations measures

7.5.1 Environmental protection measures plan during construction period

This section addresses mitigation measures to minimize the potential adverse impacts have been identified. The recommended mitigation measures, both for construction and operation period, are discussed in this chapter, following the same categories for potential impacts. Such measures consist essentially on prescriptions for the construction period or rather project solutions or technical-realizations with the purpose of foreseeing the possible rising up of impacts in the territory.

Therefore, both in the construction and operation period, it should try:

- to contain the impact on the settlement keeping the layout of the project as further as possible from the houses/residential area and, where this is not possible, adopting technical solutions.
- to reduce the interruption of the agricultural continuum restoring the accessibility conditions of the local connections network.
- to maintain the continuity of the water network

It has been underlined two categories of the project:

- the one of mitigation measures
- the one of optimisation of the project on the contents at the outline

The mitigation measures are finalized to pursue the elimination/ control of the potential interferences gathered during the environmental analysis that had taken into consideration all the elements involved.

The second category of activities carries out a double function: integrate the project infrastructure and the interventions of mitigation defined among the operation context. In the definition of these works, the landscape planning covers an extreme important role. In order to define the type of operation of environmental setting it was taken into deep consideration the components Vegetation and Landscape.

Measures of environmental prevention and protection during construction period

At this phase of the project the number and location of the construction site cannot be identified exactly.

Obviously the realisation of a new transport infrastructure provokes major impacts on the surrounding environment then the rehabilitation works proposed by this project, but, in general, there are some guidelines to be always followed.

The places where these organizations will be built must be so set as they don't bring any harm to the natural or human environment (through affecting the vegetation, by imposing land clearings, by affecting the soil structure, atmospheric emissions, by the production of accidents caused by the traffic within the site, or in manoeuvring the materials, by the accidental unloading of cars which transport materials in the surface water courses, by the production of noise etc). Also, it is recommended that they occupies terrain surfaces as reduced as possible, so they don't take out of the actual circuit too large areas of land.

To ensure that constructions camps, temporary works and lifestyle of construction workers do not negatively effect to the adjacent communities, workers should be prevent from using resources held in common by local population. Construction camps should provide services which otherwise would overburden the local public facilities/ utilities.

However, to limit or even to eliminate the impact, several special works are foreseen: installations for cleansing used waters (septic tank) coming from the site organization, decanter for the sludge from the concrete station, impermeable work platforms, etc.

For these objectives to work and for the installations, which serve them, notices and accords must be solicited and obtained by the proper authorities. Usually any measure of good management of construction works, good practice will insure, implicitly, the protection of the environment.

Water and soil environment

In the interested area, one of the most important impact is that on the water environment, strictly connected at the soil environment.

Recommendations and mitigations for prevention water and soil pollution

Concerning the prevention from the pollutions it will need to pursue the following measures. The contamination of the soil, of the under-soil and water structures, superficial and underground, could be done only inside the construction site areas and during the single artwork.

Main items for the prevention measures of the water and soil pollution inside the construction areas that have to be analysed are:

1. prevention of contamination of water structures or of soil by chemical substances used at the construction site;
2. prevention of contamination from stocking of waste produce by the temporally waste depots;
3. recommendations for activities related the delivery of fuel to the deposit and to the refuelling operations;
4. water drainage and waste water treatment devices;
5. maintenance of the construction site machineries.

Even if it is impossible at this stage of the project to localize the areas of the construction site, it is possible to describe the general organisation principles.

It is recommended that the platforms for the production bases have concrete or broken stone surfaces in order to stop or reduce infiltrations by pollutant substances; the provisioning with drains to direct eventual spills, which go over the top in impermeable slots out of which the contaminated liquids can be collected operatively.

Also, for the production bases, the gear maintenance and washing platforms must be executed with a slope so that they insure the collection of residual water (resulted from the wash), oils, fuel, and then introducing them into a decanter, that is periodically cleaned, and the deposits are transported to the nearest cleaning station.

Inside the site organizations the flow of meteoric water must be insured as it washes a large area, on which various substances from eventual losses, so that no they are not forming puddles which, in time, might infiltrate into the underground polluting the soil and the pyretic bed. Their evacuation can be done at the closes emissary or even on the surrounding terrain after they pass through a decanter basin.

The wastewaters that come from the site organization must be introduced into a septic tank, which will be periodically cleaned and evacuated at a cleaning station nearby with which a service contract has been signed previously.

For the execution period the constructor has the obligation to realize all the measures for environmental protection for the polluting or potentially polluting objectives (production bases, material storage facilities, site organizations, earth quarries).

For the foreseen activities along the line the general organisation principles are mainly related to the presence of potential receptors of the impacts, as the watercourses. This kind of activities could in fact generate an increase of the water turbidity.

If the excavation escarpment are stable enough and there is the necessary space, this material can also be used for erecting a temporary embankment around the dig, in order to avoid the flooding and also problems of water contamination that could derive from it.

In general the activity in the bed of the watercourses should take place into circumscribed areas, dry and separated from the running flow trough provisional works and performed in order to limiting problems on the existing bed and on the bank upstream and downstream in the intervention area.

Where possible all the equipments and the plants used for the works should be kept outside the overflowing area during the hours and periods in which the works have been interrupted. It is necessary to avoid the stocking of big quantities of iron close to the work areas: the oxidation of iron materials could in fact determine pollution phenomenon in the waters and soils.

The platform of the organization must be designed so that the meteoric water is also collected through a system of ditches or drains, where sedimentation can take place before the discharge, or they can be outfitted with draining holes from where the water can be introduced into the modulated cleansing station outfitted for sewage waters. For the collecting and the cleaning of the wastewaters during the constructions execution it be referred to the following basic operations:

- Installing of septic tanks at the construction site;
- Drainage of the rain water towards the sedimentation chambers (which must reduce the suspension by 90%);
- Before discharging to the emissaries, the collected rain water will be passed through oil separators (which must reduce the oil content by 90%).

Therefore the mitigations measures that shall be foreseen for prevention water and soil pollution are:

- Appropriate waste management control;
- Disposal management of unused oil, fuels and their containers;
- Ensure drainage systems do not polluted water sources through appropriate alignment or through filtration;
- Ensure other sources of pollution are not allowed to enter the waters course;

- Prevent water pollution and turbidity;
- Scheduling construction activities near waterways for seasonably dry periods, wherever possible.

Recommendations and mitigations for prevention soil erosion and slope stability

Owing to the favourable nature of the topography, no special mitigation measures for stabilizing, cut and fill slopes are considered necessary, for the most part. In case of the area, normal good engineering practice and drainage system will be adequate.

In case of areas prone to erosion soil, the proposed mitigation measures will be in addition special retain structures (gabion retaining structures) and bio – engineering medium control techniques. This kind of mitigation measures should be incorporated during major works. Bio – engineering, as well as other slope protection measures are very site specific and can be selected at engineering design stage and finally during the construction.

The mitigations measures shall be foreseen for prevention of soil erosion and slope stability are:

- scheduling construction activities near waterways for seasonably dry periods, wherever possible.;
- re – vegetation of barren earth surface such borrow pits and storage yards, where appropriate, with final treatment to involve landscaping aesthetics, as well as measures for erosion control;
- protection of drainage from flowing waters, trough bafflers in the cannels, rocks aprons at the end of the culverts and other points or rapid water flows, surface stones and/or gabions (wire baskets filled with stones) by embankments or abutments at stream crossings;
- Construct the base of the railway from porous material in order to allow water to continue draining.

Most of the part used/occupied by the construction site, once demolished, will be given back to the public service, through the realization of projects following the plans of the town Council, or to private previous use.

In particular at the end of the construction phase and in order to avoid after the closing of the construction site, impacts on the water and soil, it will be important to provide the following recovery activities:

1. Elimination of residues, of constructive works and of debris.
2. Restoring of the original morphology
3. Restoring of the superficial hydrography.
4. Restoring the current soil uses.

Recommendations for subsoil environment changes

Biological environment (flora and fauna)

In order to protect the actual vegetation and farm crops from destruction, maximum care should be taken in selection of foreseen detours and access routes to the construction sites and to the borrow pits and quarries. Design and construction of the required detours at several locations along the projects should choose that will cause minimal damage to the natural vegetation.

Land clearing with the destruction of shrubs or other vegetative cover may lead to soil erosion, modification in biodiversity, loss of indigenous vegetation.

A new right of way of permanent road alternatives or of temporary detours during construction, will result in consumption of natural space, destruction of flora and severance effects on fauna.

The stability of ecosystem, which was already altered by human interventions, is reduced and its vulnerability to new disturbance factors is significant.

The use of chemicals, herbicides, etc., to clear vegetation shall be forbidden due to the heavy pollution they cause to the soils, ground and surface water and they are toxic to humans and animals.

Then the mitigation measures foreseen for this component are:

- Prevention of neighbouring surface deterioration in order to not lose and/or affect the floristic and faunistic habitats from working and conterminous areas and detours and, in addition, access road to the construction sites and to the borrow pits and quarries
- Control of dust levels;
- Control of fuel and other volatile matters discharge near sewerage;
- Prevention of drainage systems alteration;
- Prevention of soil compaction in areas designed for materials and equipment storage;
- Restore vegetation immediately after the end of works.

Atmospheric environment

It is recommended that during the works to be used only equipment and means of transport that have Diesel engines that produce very little carbon monoxide and no Pb emissions. Construction machinery must be well maintained to minimize excessive gaseous emission.

Traffic speed should be restricted and application of water or other dust suppressants should be applied to the road at regular intervals (in the urban areas the use of bumps is recommended). The pavement of the roads has direct positive impact on people's health and decreasing risk of accidents in order to reduce dust in the urban areas, particular gravel is recommended.

Trucks carrying fine materials that are easily wind blown should be covered with appropriate covers.

To control the powders inside the construction site areas, in the presence of receptors, could be adopted in addition continuous panels of h = 2.00/2.50 m.

Noise and vibrations environment

The following recommendations may be added:

- The itinerary of the transport track must be carefully studied in order to avoid as much as possible noise and vibration disturbances and than strictly respected;

- In particular the dumpers must be operating as far as possible from the existing human settlement;
- For the working activities be developed at distances from populated areas lower than 200 m, the works should be undertaken only during the day or screened by anti – noise screens;
- The arranging of the activities in the construction site should be studied in the way that noisy activities would be protected;
- The stocking of materials in the construction site should be located in such a way to act as a noise barrier toward the settlements;
- The noise absorption system provided for the machinery should be regularly maintained.

Solid wastes

The construction period recommendations about the management of the solid wastes come from the working activities are:

- the waste stores from the rehabilitation of the embankments must be reused after a screening;
- the waste remaining will be transported in the existing landfills where fertilizing works are to be provided and reclaim such areas for production. In alternative the waste could be use as cover material in municipal urban waste stores for reduce the emissions to the atmosphere and prevent animals and human access;
- the metal waste should be reused, as possible;
- The used electrolyte solutions will be first neutralized then disposed of the closest municipal waste facilities;

7.5.2 Environmental protection measures plan during operation period

The objective of the present study is that to mitigate the foreseen impacts from the rehabilitation works for the proposal and existing alignment. At the same time the mitigations measures have the aim, in the operation phase, both for the new and for the actual stretches with the objective to the global environmental rehabilitation of the interested areas.

With reference to what before developed concerning the analysis of the interferences derived from the work during the operative phase, follows the description of the mitigation measures foreseen. The environmental components, the parameters involved and the related effects are summarized in the table below.

ENVIRONMENTAL COMPONENT	ENVIRONMENTAL PARAMETER	EFFECT
Water environment	water network	crossing of the main and secondary hydric network
	areas of overflowing	crossing of the areas influenced by periodical overflowing.
	hydrogeological vulnerability	crossing of areas with high vulnerability
Noise-Vibration Enviroment	Acoustic limits	receptors in which it is possible to see the overcoming of the acoustic limits

With reference to the potential effects noticed during the environmental analysis , below the description of the mitigation measures adopted.

Water environment

The mitigation measures required for the component will be planned in the project preparation and carried out in the construction phase.

Water network

The problems of the alteration of the continuity of the superficial and underground hydric network belong to the aspects taken into consideration during the projecting of the works. The project should guarantee the maintenance of the superficial hydric network continuity either the principal nor the secondary one through the adoption of the appropriate works.

Overflowing areas

The analysis of the work status before the rehabilitation works underlines some aspects, interested by the layout project, influenced by potential overflowing .

In these aspects the stretches in the surveys should be dimensioned without interfering with the superficial discharge characteristics. Besides the presence of the culverts that guarantees the maintenance of the superficial water network allows to avoid the effect of dams in compare to the superficial discharge.

The river discharge in the areas have a condition of extreme variability, so it is absolutely requested a detailed hidrogeological study to evaluate the highest level of the river Chou and of his main side-streams in the most raining periods of the year. It would be then requested to evaluate the return timing from the condition of the flooding and from the water levels that may change the structure of the railway line.

Actually is possible to conjecture the whole valley as an overflow area, this by simply observing the valley's morphology particularly flat, the absolute absence of obstacles to prevent the outflow of the waters and also the light incision of the fluvial basin.

Hydro-geological vulnerability

The analysis carried out for the definition of the hydrogeological vulnerability areas directly affected by the project layout underlined the problem of protection from a possible contamination connected with the infiltration of contaminated waters in the water tables under conditions of high level of vulnerability.

In fact it is emerged that in the inspected area the level of vulnerability is really high depending on the depth of the water table. In this case, such an elevate level of vulnerability imposes the necessity to avoid the dispersion of the waters in the soil and of taking away them to areas of low level. The separation will be provided using a canalisation network properly sized and their content will determine the realization of appropriate catchment's areas, waterproof at the bottom, that will allow to perform the pre-treatment of the fluids before being give back to the superficial hydric network.

Noise and vibration environment

The estimated analysis of the infrastructural railway insertion, has underlined the necessity of providing mitigation measures along the railway in order to minimize acoustic environmental impact.

The leading criteria will be:

- to maximum protection likely to be achieved by using plane dimensional anti – noise screening in high sensitive areas (school, hospital, etc.) and in the high populated residential areas;

- to take the noise level lower or equal to 70 dB(A) in all residential areas.

The acoustic protection measures suggested could be divided into two categories:

- sound absorbent barriers in which, in function with the distance and of the quality of the receptors involved nor the intervention context .

- insertion, when is possible, of arbores/shrubbery screens functioning as a filter for the acoustic contaminations; these green screens provide also a function of integration of the infrastructure in the landscape. Forestation may be made along the line in a planned way if possible, especially at the newly constructed railway and it may be set up with evergreen arbores, shrubs and lawns combining together.

Matrix of environmental recommendations and measures of mitigation

Project stage	**Project preparation**	**Construction period**	**Operation period**
1. Planning activities			
- Selection of construction camp sites and ensure availability of resources (water, fuel, etc.) for potential future settlements			
- Selection of less vulnerable sites (distant from urban areas, cultural heritage sites, protected areas)			
- Consultations with local officials before locating and building the camp			
- Consider the location of special environmental areas during route selection for detour roads			
- Traffic management: plan location of sign/ traffic management measures (bumps) to be posted/ constructed			
2. Activities during preparatory phase and construction works			
- Identification of critical areas and construction of speed bumps/ passing points			
- Post traffic sign and warnings at construction sites in advance			
3. Construction activities related to erosion and slope stability			

- Re - vegetation of barren earth surface such as borrow pits and storage			
- Avoid any under cutting of such slopes			
- Avoid using land slide susceptible slopes for the extraction of construction material			
- In unstable areas use gabion retaining structure			
- Use of bio - engineering techniques			
4. Other preventive measures			
- Reused of the waste stores from the rehabilitation, as much is possible			
- Adoption of regulation that prohibit livestock grazing on railway shoulder, embankments and row			
- Rehabilitation of detours after construction			
- Maximum care should be taken in selection of detours and access routes to borrow pits and quarries: design and construction should choose routes that will cause minimal damage to the natural vegetation			
5. Construction activities related to water and air quality and noise			
- Scheduling construction activities near waterways for seasonably dry period			
- Protection drainage from flowing waters			
- Prevent water pollution and turbidity			
- Construction waste, waste oil and other liquids must be disposed in a proper manner			
- Reduction of the traffic speed especially in the urban areas			
- Application of water on construction roads and sites pavements as appropriate to prevent high dust emissions			

- All trucks carrying fine material should be covered			
- Construction machinery must be well maintained to minimize excessive gaseous emissions			
- Areas with activities producing excessive dust or for material stock should be screened			
- Activities producing excessive noise levels should be restricted to the day time and equipment producing high levels should be suppressed or screened			
6 . Activities related to construction camps			
- Restore vegetation immediately after the end of the works			
- The storage of the hazardous materials by the construction camps and their use in construction must be appropriate			
- After the use of these materials their disposal system must be proper			
7. Activities related to borrow pits and quarries			
- Working plan giving an outline of the direction , phasing and depth of working			
- Reclamation/ restoration n plan giving details of final grading, drainage and sediment control, resoling and re - vegetation measures and design after use			
8. Operation activities related at the noise level control			
- Protection the critical surrounding areas with noise barriers			

7.6 Environmental management plan

The potential negative impacts have been identified and discussed in Chapter D and the recommended mitigation measures that should be adopted to avoid or minimise potential adverse impacts are discussed in Chapter E. Some of the measures involve good engineering practices while others are viewed from human and social angle. The table at the end of this Chapter provides a summary of mitigation plan and the organisation responsible for their implementation.

The management will cover two periods. It will cover the period during the construction phase of the project and operation phase of the railway line programme.

The following stakeholders will perform different roles in the management programme:

- interested Ministries and the Environmental protection agencies;
- extension personnel and community participation. To ensure that Environmental management measures succeed, the extension personnel in the relevant/line departments will carry out the work of community mobilisation continuously. This is a two way process in that the affected communities are involved right from the start so that mutually beneficial agreements are reached to between all the agencies;
- the Contractor is the key player during the pre-and construction phase. He is to ensure that all guidelines as agreed on in the contract documents regarding the Environment are implemented.

Environmental management and protection program

A principal project goal is environmental protection of the project. It is achieved through avoidance or mitigation of anticipated drawbacks associated with the project, and enhancement of the project benefits. Towards this goal, the Consultant recommends an environmental management and protection program.

7.6.1 Environmental Management

The environmental management program has the following objectives: protection of the environment from potentially detrimental line and related activities, and vice versa; enhancement of line attributes, especially in regard to integrated local development; governmental institutional strengthening in conducting environmental protections and monitoring. These objectives can be achieved by the following elements of the environmental program: a small environmental team, as guided by an advisory group; resources to assist the highway-related units; a diverse array of impact mitigation and enhancement measures; contractor requirements for environmental protection to be implemented during the rehabilitation of the lines.

Environmental Team

The Consultant proposes a small team of the Local Railway Companies (LRC) to operate an environmental management program for this project. This group would coordinate and administer all aspects of the program. Through training and experience with this project, this team would develop further an environmental oversight capability within LRC on future projects, and programs. Specific duties of the team for the project road will include the following: promote cooperation among government officials, contractors, engineers, construction crews; organize training workshops; facilitate environmental monitoring and evaluation of the biophysical and socio-cultural concerns pertaining to the line; help administer resources designated for assistance at the local level; conduct studies, and perform other project-related tasks.

A two-person team, a coordinator and an assistant, should be sufficient to implement the environmental management program. The team will require additional LRC support (e.g., secretarial and vehicle driving) assistance, upon occasion.

Resources

Resources for implementing the environmental management program are of two types, personnel and finances. The recommended personnel include the environmental management team, an advisory group to the project, and an array of persons from construction staff to government officials at all levels. Further recommended are bringing the latter together at workshops.

The advisory group is an organization that should issue candid advice on program, liaison, and practical matters concerning environmental aspects of the project. This group should represent the array of parties involved in activities of the road project (e.g., transport operators, local financiers), and persons with living and/or professional experience with the areas of the project. The Environmental Coordinator will ultimately decide upon the composition, size, policies, and procedures (e.g., conditions and timing of group gatherings) of the advisory group.

The workshops are of three types. One will facilitate coordination and communication among parties involved in small, local development projects. Another workshop will provide practical training for construction and LRC personnel on implementation of mitigation measures appropriate to Project. A third is a series of duplicated workshops that will focus upon arrangements its and techniques for maintenance at the local level.

Project and Local Development

Impacts of railway projects are usually viewed as potentially deleterious effects to be avoided or mitigated. Another category of effects, beneficial ones often accrue to railway projects both during and after construction is completed, and/or may be indirectly induced by changed transport.

Project benefits occur during construction or rehabilitation of lines. Employment and purchases of local supplies are not the sole potential positive benefits during construction. Others are development related, but often are unrealised where the projects address a sole aim (i.e., implementation) without consideration of other community needs.

People at the local level are relatively uniformed about the project, activities and procedures. Many communication problems can be avoided if publicity begins soon after tender documents are issued. Informing people about the projects, planned construction schedule, employment, procurement procedures and other concerns in the form of press releases, memoranda to relevant parties, and other means that will facilitate liaison.

Requirements of Contractors

Frequently, there is displeasure over barren areas, rubble pipes, scattered wastes sprawling borrow pits, damaged archaeological artefacts and other problems that are easily preventable through careful construction practices.

Adherence of construction workers to environmental requirements is a major aspect of environmental protection in road projects. This adherence is best achieved through training and contract stipulations, as outlined in tender documents. Monitoring and enforcement of the requirements are necessary aspects of the process that will be part of the duties of the environmental team.

Environmental Management Plan

Impact Issue	***Measure Required***	***Timing (start up of measures)***	***Duration of Measures***	***Responsibility***	***Monitoring***
Physical Environment					
-Erosion	Re-vegetation of barren earth surface such as borrow pits and storage	Project preparation	Operation phase	LRC-Contractor	Monitor implementation
	Special retaining structures	Project preparation and construction phase	Construction and operation phase	LRC-Contractor	Monitor implementation
-Slope stability	Avoid using land slide susceptible slopes for the extraction of construction material	Construction phase	Construction phase	LRC-Contractor	Monitor implementation
	In unstable areas use gabion retaining structures	Project preparation	Construction phase	LRC-Contractor	Monitor implementation / construction
	Bio-engineering techniques.	Project preparation and construction phase	Construction and operation phase	LRC-Contractor	Monitor implementation
Hydrological conditions and water quality					
-Water resources and water quality	Waste oil and other liquids must be disposed in a proper manner	Construction phase	Construction phase	LRC-Contractor	Monitor implementation
	Increased use of natural resources due to influx of construction workers: Ensure drainage systems do not pollute water sources through appropriate alignment or through filtration as appropriate Ensure other sources of pollution are not allowed to enter the water courses Ensure that local people's needs take precedent over construction and construction workers Ensure that access points/paths to water sources for people are not disrupted during construction and post-construction Contractors are required to make arrangements for water supply that do not affect supply to other users To ensure that access points to water	Construction phase	Construction phase	LRC-Contractor	Monitor implementation

Impact Issue	***Measure Required***	***Timing (start up of measures)***	***Duration of Measures***	***Responsibility***	***Monitoring***
	sources are not blocked during construction To provide adequate washing facilities for construction workers Prevent pollution of water courses				
Air quality	Traffic speed should be reduced (bumps) and regular application of water on road pavements may be required as appropriate to prevent high dust emission	Project preparation	Construction phase and operation	LRC-Contractor-Local authorities	Monitor implementation / construction
	All trucks carrying fine material should be covered	Construction phase	Construction phase	LRC-Contractor	Monitor implementation
	Construction machinery must be well maintained to minimise excessive gaseous emission	Construction phase	Construction phase	LRC-Contractor	Monitor implementation
	In order to reduce dust in the villages, also a particular gravel is recommended	Project preparation	Construction phase	LRC-Contractor	Monitor implementation
Nuisance noise	Activities producing excessive noise levels (work in borrow pits and quarries) should be restricted to the day time and equipment normally producing high levels should be suppressed or screened when working within a distance of 200 m. from any settlement or religious building	Construction phase	Construction phase	LRC-Contractor	Monitor implementation
Construction camp	Consultations with local officials before locating and building the camps, including discussions on appropriate sites, resources, dispute resolution procedures and rights and responsibilities of various parties	Project preparation	Construction phase	LRC-Contractor	Monitor implementation
	Restore vegetation immediately after the end of works	Construction phase	Construction phase/end of work	LRC-Contractor	Monitor implementation
	The storage of the hazardous materials by the construction camps and their use in construction (vehicles, asphalt plants etc.) must	Construction phase	Construction phase	LRC-Contractor	Monitor implementation

Impact Issue	*Measure Required*	*Timing (start up of measures)*	*Duration of Measures*	*Responsibility*	*Monitoring*
	be such as not to let chemicals to leak to the soil or water system. After the use of these materials their disposal system must be proper as not to harm environment				
Biological Environment					
Natural vegetation	Maximum care should be taken in selection of detours and access routes to borrow pits and quarries	Project preparation	Construction phase	LRC-Contractor	Monitor implementation
	Design and construction of the required detours at several locations along the project line should choose routes that will cause minimal damage to the natural vegetation	Project preparation	Construction phase	LRC-Contractor	Monitor implementation
	Minimise destruction of trees and vegetation	Construction phase	Construction phase	LRC-Contractor	Monitor implementation
	Restore vegetation immediately after the end of works	Construction phase	Construction phase	LRC-Contractor	Monitor implementation

7.7 Monitoring program

7.7.1 Monitoring in construction period

Monitoring is carried out to assess any disturbance to the environment and to protect both LRC and the affected parties from false charge. An environmental inspector could be proposed to this project by LRC. The inspector should have a number of short-term inputs from the commencement of the construction through to its completion and until cleanup has been finalised.

During construction, monitoring of the following indicators is recommended. Although LRC will retain administrative directive and management, certain part of this programme, as described below, will be performed by other agencies under contract to LRC.

Monitoring plan and implementation program

Monitoring a project or a program and its surrounding is a tool for decision-making, not an end product. The monitoring will be conducted by the environmental team and Environmental protection agencies. The monitoring will involve maximum use of information collected in existing regular channels for reasons of resources efficiency and to avoid adding to the workload of the organisation compiling data. The information will be used in three types of monitoring: construction activities; effects of the project upon the surrounding environment and vice versa; internal progress of the environmental management group.

Environmental implementation measures

Monitoring the environmental protection measures during construction mainly concern the progress of impact mitigation and enhancement and the construction activities that are required of the contractors. The latter include rehabilitation or protection of borrow pits, re-vegetation of barren areas, bush clearance with minimal ancillary damage to the landscape, proper waste management and other obligations. An aim is for the environmental team to help the contractors maintain sensitivity towards environmental concerns, meet their contractual responsibilities and have flexibility in response to environment-related issue.

The effects of the project road upon surrounding environment has both short-range and long-term dimension. The short-range effects mainly involve construction-related activities.

Monitoring these events require attention to the following:

- Appropriate data collected by government agencies;
- Suitable institutional arrangements and communications;
- Necessary staff to get tasks done;
- Adequate financial and technical resources;
- Capacities to compile, process and analyse information in a timely fashion.

The kinds of effects to be monitored:

- Population displacement;

- Resettlements and compensation;
- Construction-related pollution;
- Land and water uses;
- City infrastructure.

In addition to construction-related concerns, the environmental management team will establish systems to monitor long-range, mainly development-related effects.

It will be necessary to assess the capacities of organisations to collect the required data and perform appropriate analyses.

Environmental management team

The aim of a group that monitors its own program is to determine the adequacy of past and present tasks, so as to plan for the future. On the project road these evaluations will address the subjects of staff, finance, support, resources, progress of program activities and change to work plans.

The monitoring will include quarterly work-plans that are update as necessary and quarterly meetings or as necessary, to anticipate problems, suggest solutions and help implement the work program.

Work program

The environmental protection work program has the following goals:

- The implementation of environmental protection measures both during the construction of the project and afterwards;
- The addressing of environmental issues by appropriate organisations and officials, within the context of long-term planning and management of the project;
- The organisational strengthening of LRC.

Work activities

Work activities for environmental protection associated with the project are in four areas:

- Establishment of liaison, communications and working arrangements;
- Implementation of measures for avoiding or mitigating problems and enhancing benefits and opportunities associated with the roads project;
- Monitoring activities;
- LRC staff training.

Much of the work involves monitoring contractor activities and coordination of the impact mitigation and enhancement measures. The Environmental Coordinator will arrange specific work activities and organizations responsible for their implementation.

Schedule

Early activities of the environmental team include the following:

- Preparation of the training materials for the workshops, followed by the start of the training itself;
- Dissemination of information about the project;

Many of the activities involve coordination, encouragement, and impetus provided by the environmental staff, rather than their extensive participation.

Some tasks will begin with the construction of the line. These include the following activities:

- Establishing working relationships and monitoring arrangements with the contractors;
- Facilitation of planning for lay-byes and service centres;
- Feedback from the advisory group on organisation, initial efforts and future program priorities.

7.7.2 Monitoring Plan Physical and Biological Environment

Soil and Erosion

Monitoring during construction shall be done by LRC (Environmental Inspector) as per the mitigation measures recommended. During operation the district maintenance office should conduct the surveillance of erosion.

Terrestrial Vegetation

The purpose of this programme is to monitor effects of the project during the construction and after the completion of the project. The monitoring of components associated with terrestrial vegetation will be contracted to the interested Ministry and the Environmental protection agencies, they will determine which species stands should be planted and implement as recommended by mitigation plan and periodically report the progress to LRC.

Agricultural Land

The LRC (Env. Ins.) should ensure that topsoil stripping and separate stockpiling occur during construction on agricultural land. Topsoil shall be removed to its actual depth. After completion of the work all stored topsoil shall be returned to its original area.

Nuisance Noise and Dust

It will be the responsibility of LRC (Env. Ins.) or Site Engineer to ensure that appropriate control measures are taken.

Clean up

Following the completion of the road project, it will be necessary to cleanup and rehabilitate the construction site.

This monitoring will be maintained for only a short duration during the cleanup of the construction site to ensure that environmental precautions are implemented.

7.7.3 Monitoring Indicators

Objectively verifiable monitoring should include (It is a suggestion):

Item	Indicator (Ex.)
Soil	Hectare of land by use, tons/hectare/year of loss of terrain
Water	COD, BOD, (O2 mg/l), other (following the legislation of Kazakhstan, Uzbekistan, Kyrgyzstan)
Biota, vegetation	Hectares and type of green areas, hectares and type of critical areas, tons and type of harvest products, n° of animal-vehicle traffic accident
Safety	Accident/injury records, traffic counts, safety inventory
Atmosphere	Traffic counts, traffic projections, vehicle test records, meteorological records, emissions in atmosphere (NO, CO, SOx, PM10)
Noise pollution	Noise levels: dB(A)
Line maintenance records	Drain maintenance reports, supplies inventory records, rehabilitation

Environmental Monitoring Plan

Impact	*Measure*	*Monitoring*	*Planning / Project Preparation*	*Construction*	*Operatio n*
Physical Environment					
-Erosion	Mulch used in establishing vegetation propagated by seeds as appropriate	Monitor implementation			
	Adoption of regulations that prohibit livestock grazing on road shoulder, embankments, and right of way, as necessary.	Monitor implementation			
	Special retaining structures	Monitor implementation / construction			
-Slope stability	Re-vegetation of the land, since tree roots can hold soil together	Monitor implementation			
	Up slope cultivation in such zones should be prohibited	Monitor implementation			
	In unstable areas use gabion retaining structures	Monitor implementation / construction			
	Bio-engineering techniques	Monitor implementation / construction			
ons and water quality					
-water resources and water quality	Waste oil and other liquids must be disposed in a proper manner	Monitor implementation			
Air quality	Traffic speed should be reduced (in the villages the use of bumps is recommended) and regular application of water on road	Monitor implementation / construction			

Impact	*Measure*	*Monitoring*	*Planning / Project Preparation*	*Construction*	*Operation*
	pavements may be required as appropriate to prevent high dust emission				
	All trucks carrying fine material should be covered	Monitor implementation			
	Construction machinery must be well maintained to minimise excessive gaseous emission	Monitor implementation			
	In order to reduce dust in the villages, also a particular gravel is recommended	Monitor implementation			
Nuisance noise	Activities producing excessive noise levels (work in borrow pits and quarries) should be restricted to the day time and equipment normally producing high levels should be suppressed or screened when working within a distance of 200 m. from any settlement or religious building	Monitor implementation			
Construction camp	Consultations with local officials before locating and building the camps, including discussions on appropriate sites, resources, dispute resolution procedures and rights and responsibilities of various parties	Monitor implementation			
	Restore vegetation immediately after he end of works	Monitor implementation			
	Assess vector ecology in work areas and avoid creation of undesirable habitats (e.g. stagnant water)	Monitor implementation			
	The storage of the hazardous materials by the construction camps and their use in construction (vehicles, asphalt plants etc.) must be such as not to let chemicals to leak to the soil or water system. After the use of these materials their disposal system must be proper as not to harm environment	Monitor implementation			
	Biological Environment				

Impact	*Measure*	*Monitoring*	*Planning / Project Preparation*	*Construction*	*Operation*
Natural vegetation	Maximum care should be taken in selection of detours and access routes to borrow pits and quarries	Monitor implementation			
	Design and construction of the required detours at several locations along the project road should choose routes that will cause minimal damage to the natural vegetation	Monitor implementation			
	Minimise destruction of vegetation	Monitor implementation			
	Restore vegetation immediately after the end of works	Monitor implementation			
	Forbid project staff to kill, injure or poach wild animals	Monitor implementation			
Borrow pits and quarries	Pit or quarry location and area	Monitor implementation			
	Access arrangements	Monitor implementation			
	A working plan giving an outline of the direction, phasing and depth of working	Monitor implementation			
	A reclamation/restoration plan giving details of final grading, drainage and sediment control, resoling and re-vegetation measures and design after use	Monitor implementation			

8. Preliminary implementation schedule

The following Table 8 - 1 and Table 8 - 2 show a preliminary implementation plan for both Option 1 and Option 2.

The Option 1 considers that all the activities will be up to Contractors. Three Contracts are envisaged: the first one for executing PW and civil works (replacement of beams and repairs of piers in 46 bridges), the second one for building the new double three-phase 10 kV overhead line, the third one for providing and installing an optic fibre cable and accessories. The first contract foresees that Uzbek railways will hand over to the Contractor one tamping, one profiler and one welding machines for all the time necessary to carry out the PW works.

The scheduled activities will be completed in 34 months.

The Option 2 includes the safety plants works and the rehabilitation of the stations, installing on their running track P65 rails and P65tg1/11 turnout, if not existing, in addition to all the works envisaged in Option 1. A fourth contract is then necessary for executing the safety plants.

The scheduled activities will be completed in 41 months.

Table 8.1 Implementation programme for Option 1

	ACTIVITY/months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
1	*Approval of financing*																																			
2	*Final tender document preparation*	■	■																																	
3	*Tendering and signature of contract for PW,civil works, new 10 kV line*			■	■																															
4	*Mobilisation*					■	■																													
5	*Topographic survey, final profile*						■	■	■	■	■																									
6	*Emission of orders for material purchase*							■	■																											
7	*Production and handing over of materials*								■	■	■	■	■	■	■	■	■	■	■																	
8	*Welding P65 rails in 100m bars*																■	■	■	■	■	■														
9	*Laying down 100 m rail bars along the line*																				■	■	■	■												
10	*Starting demolition, excavation, laying down new subballast, ballast, concrete sleepers, P 65 rails (1000m/day)*																					■	■	■	■	■	■	■	■	■						
11	*First ballasting, first tamping*																					■	■	■	■	■	■	■	■	■	■					
12	*Second ballasting, second tamping*																						■	■	■	■	■	■	■	■	■					
13	*Welding rails in 1000m bars along the line*																							■	■	■	■	■	■	■	■	■				
14	*Regulation of rail mechanical tension and welding in long bars.*																								■	■	■	■	■	■	■	■	■			
15	*Final tamping, leveling, aligning*																											■	■	■	■	■	■	■		
16	*Dismantling, recovering and classificating materials*																									■	■	■	■	■	■	■	■			
17	*Tests and taking over of rehabilitated line*																																			
	CIVIL WORKS																																			
18	*Ordering materials*							■																												
19	*Production and handing over of materials*									■	■	■	■	■	■	■	■	■																		
20	*Replacement of beams of bridges and repair of piers*														■	■	■	■	■	■	■	■	■	■												
	New double three phase 10 kV overhead line																																			
21	*Ordering materials*							■																												
22	*Production and handing over of materials*									■	■	■	■	■	■	■	■	■	■																	
23	*Assembling line*																■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
24	*Tests and toking over of new 10 kV line*																																			

Table 8 - 2 Implementation programme for Option 2 (part 1/2)

	ACTIVITY/months	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	23-24	25-26	27-28	29-30	31-32	33-34	35-36	37-38	39-40	41-42	43-44	45-46	47-48	49-50
1	*Approval of financing*																									
2	*Final tender document preparation for PW and civil works*																									
3	*Tendering and signing contract for PW and civil works*																									
4	*Mobilisation*																									
5	*Topographic survey, final profile*																									
6	*Emission of orders for material purchase*																									
7	*Production and handing over of materials*																									
8	*Welding P65 rails in 100m bars*																									
9	*Laying down 100 m rail bars along the line*																									
10	*Demolition, excavation, laying down subballast, ballast, concrete sleepers, P 65 rails*																									
11	*First ballasting, first tamping*																									
12	*Second ballasting, second tamping*																									
13	*Welding rails in 1000m bars along the line*																									
14	*Regulation of rail mechanical tension and welding in long bars.*																									
15	*Replacing rails with P65 in stations*																									
16	*Replacing turnouts with P65 tg 1/11 ones on main line of stations*																									
17	*Final tamping, leveling, aligning*																									
18	*Dismanteling, recovering , classificating materials*																									
19	*Tests and taking over of rehabilitated line*																									
	Civil works (rehabilitation of bridges)																									
20	*Ordering materials (cement, aggregates, prefabricated biams)*																									
21	*Production and handing over of materials*																									
22	*Replacement of beams and repair of piers on bridges*																									

Table 8 - 2 Implementation programme for Option 2 (part 2/2)

	ACTIVITY/months	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	23-24	25-26	27-28	29-30	31-32	33-34	35-36	37-38	39-40	41-42	43-44	45-46	47-48	49-50
1	*Approval of financing*																									
2	*Final tender document preparation for PW and civil works*																									
3	*Tendering and signing contract for PW and civil works*																									
4	*Mobilisation*																									
5	*Topographic survey, final profile*																									
6	*Emission of orders for material purchase*																									
7	*Production and handing over of materials*																									
8	*Welding P65 rails in 100m bars*																									
9	*Laying down 100 m rail bars along the line*																									
10	*Demolition, excavation, laying down subballast, ballast, concrete sleepers, P 65 rails*																									
11	*First ballasting, first tamping*																									
12	*Second ballasting, second tamping*																									
13	*Welding rails in 1000m bars along the line*																									
14	*Regulation of rail mechanical tension and welding in long bars.*																									
15	*Replacing rails with P65 in stations*																									
16	*Replacing turnouts with P65 tg 1/11 ones on main line of stations*																									
17	*Final tamping, leveling, aligning*																									
18	*Dismanteling, recovering , classificating materials*																									
19	*Tests and taking over of rehabilitated line*																									
	Civil works (rehabilitation of bridges)																									
20	*Ordering materials (cement, aggregates, prefabricated biams)*																									
21	*Production and handing over of materials*																									
22	*Replacement of beams and repair of piers on bridges*																									

9. Benefits Assessment of the Project

9.1 Option 1

Option 1 benefits are divided in:

1. benefits deriving from the upgrading works related to infrastructure (included stations) and power supply,
2. benefits deriving from works for new telecom system installation.

These two groups of benefits, as the investment costs, have been treated separately.

9.1.1 Benefits from Infrastructure and power supply works

Running time savings

As calculated in chapter 5.4.3, the following time savings have been considered should Option 1 be carried out.

Time savings have been assumed in comparison with "do nothing" scenario, where "do nothing" means that the line will not be upgraded in the terms of this study, but will in any case be taken in operation with the on going maintenance cycles, according to current UTY finance flows and UTY priority schedule for the whole network.

Time savings from 2007 to 2017:

- 151 minutes for passenger trains,
- 98 minutes for freight trains.

Time savings from 2017 to the following years:

- 190 minutes for passenger trains,
- 138 minutes for freight trains.

Benefits related to time savings As a consequence of the time savings a number of benefits have been included in the calculation.

<u>Value of the time saved by passenger</u> using the railways have been calculated starting form the passenger train traffic along the line and its projection in the future.

This benefit has taken into account only the Uzbek part of passenger. As a matter of facts a relevant part of the passenger are Tajiks and in that case time savings don't accrue to the Uzebk economy. Anyway the assumption is very conservative since theoretically a further decrease of the performance could result in a decrease of the revenue for using the Uzbek railway system.

The value of the time has been calculated starting taking into account the following data/assumption:

GDP at national level (year 2002): 9688 ml US$

Total population (year 2002): 25,4 million residents

Employed people: 30%

Assuming that 220 is the average number of working day in one year and 8 hours is the normal working time per day, the hourly add value per resident employed has been estimated in 0,722 US$ per hour.

The same indicator for not-employed people has been estimated as one-third of the previous one. For the estimation of the add value (or value of time) for a generic passenger, it has been assumed that 1/3 of the trips are for business and 2/3 for other purposes. Consequently the added value of one hour of travelling is given by the related weighted figure and it has been estimated to be equal to 0.419 US$ per hour per passenger.

Value of time has been finally estimated by using savings in time and assuming 756 passenger per train.

Value of time saved by freight has been assumed to be related to the value of time impacts on the income of final user (i.e. importer, exporter and trader). This is based on the fact that the time the transaction takes place plays a key role in buying or selling a good.

In buying a material good, usually, there is a time gap between buyer's disbursement and acquiring the merchandise. This time gap is mainly due to travel time. The buyer, then, needs to finance the operation during the time between disbursement and selling again the merchandise. The trader operates with a bank, which finances the trade operation receiving an interest that in the present situation can be valued around 12% per year. Knowing the value of the merchandise traded is then possible to assign a value to travel time for freight. The freight time value of one hour can be calculated multiplying the value of the good by the interest rate and dividing by 8,760, which are the hours contained in one year.

Information available in the base year suggests the use of foreign trade which allows to establish an average unit price of the traded freights (i.e. US$ per ton).

The analysis has been carried out on figures concerning foreign trade with Europe in the year 1999 (Source OECD) but excluding, mineral fuel, crude materials and lubricants. Dividing value of import and exports by the related quantity the average unit price of total merchandise traded is 2,170. US$/ton. Consequently adopting 12% interest rate, the freight time is 0,00128 US$ per ton per hour.

Value of time has been finally estimated by using savings in time and tonnes transported. As for the passenger, the freight traffic considered in this case is the Uzbek-one only.

Locomotive and rolling savings effect are also a close consequence of the time savings along the line because of the shortest cycle of utilisation. The reduced transport time result in a reduction of the in the overall locomotive and rolling stock requirement.

Although most of the regional railways fleet is very old, and it's financial book correspondingly low, the value in economic terms of the service it provides is that of the imported resources it replaces. Train hourly costs (working and standby) have therefore been calculated analytically, on the bases of the current world price for locomotives, freight cars and passenger coaches and according to the standards train configuration.

As far as the calculation for locomotive is concerned it has been assumed the cost for a 4000 HP diesel-electric equivalent to 3000 HP locomotive widely used in term of average train's overall power.

As far as the freight train composition is concerned, the behaviour is to use double traction twinning two 3000 HP locomotive or very often to have triple traction using three 3000 HP locomotive. For the purposes of the economic analysis the conservative assumption of computing in any case 1 locomotive also for freight train has been taken.

The following Table 9.1.1-1 and Table 9.1.1-2 shows result of the calculation which have been used crossed with time savings.

Table 9.1.1-1 Locomotive hourly cost calculation

Description	Value	Unit
BASIC DATA		
Locomotive:		
Diesel Locomotive cost	2.300.000	US$
Installed Horsepower	4.000	HP
Economic Life:		
Life	18	years
Utilisation	1.820	hours/year
Total life	32.760	hours
Financial Charges:		
Interest rate	12%	
Maintenance:		
Parts & Labour Factor	120%	of depreciation
Power:		
Diesel fuel cost	0,21	US$/liter
Specific consumption	0,15	liter/HP/hour
Hourly consumption	600	liter/hour
Ownership cost:		
Depreciation	70,21	US$/hour
Interest	80,04	US$/hour
TOTAL	150,25	US$/hour
Operating cost		
Maintenance	84,25	US$/hour
Power	126,00	US$/hour
Lubricants	31,50	25% Fuel
TOTAL	241,75	US$/hour
TOTAL HOURLY OPERATING COSTS		
Working	392,0	US$/hour
Standby	80,04	US$/hour

Table 9.1.1-2 Rolling stock hourly cost calculation

Description	Freight Wagons						Passenger Coach	Unit
BASIC DATA	Boxcar	Flat car	Gondola	Tank car	Grain carrier	Cement carrier		
Wagon:								
Wagon cost	30.000	25.000	30.000	35.000	35.000	35.000	1.320.000	US$
Specifications:								
Number of axles	4	4	4	4	4	4	4	
Tare	22,88	20,90	22,00	25,30	22,00	28,50	20,00	tonnes
Payload	68,00	70,00	69,00	62,00	64,00	67,00	70,00	tonnes
Max Gross weight	90,88	90,90	91,00	87,30	86,00	95,50	90,00	tonnes
Economic life:								
Life	32	32	22	32	30	26	25	years
Utilisation	4.040	5.880	3.570	7.580	4.500	6.000	4.000	hour/year
Total life	129.280	188.160	78.540	242.560	135.000	156.000	100.000	hour
Financial charges:								
Interest rate	12%	12%	12%	12%	12%	12%	12%	
Maintenance:								
Parts & Labour Factor	100%	100%	100%	100%	100%	100%	100%	of depreciation
Ownership cost:								
Depreciation	0,23	0,13	0,38	0,14	0,26	0,22	13,20	US$/hour
Interest	0,46	0,26	0,53	0,29	0,48	0,36	20,59	US$/hour
TOTAL	0,69	0,39	0,91	0,43	0,74	0,58	33,79	US$/hour
Operating cost								
Maintenance	0,23	0,13	0,38	0,14	0,26	0,22	13,20	US$/hour
TOTAL	0,23	0,13	0,38	0,14	0,26	0,22	13,20	US$/hour
	TOTAL HOURLY OPERATING COSTS							
Working	0,92	0,53	1,29	0,58	1,00	0,81	46,99	US$/hour
Standby	0,46	0,26	0,53	0,29	0,48	0,36	20,59	US$/hour

Replaced materials residual value

Dismantled permanent way can be re-used on secondary lines or on station sidings and its residual value has been considered as a benefit of the "with project" option.

The following table 9.1.1-3 shows the Consultant's estimate of the rails residual value according to the rail age (dismantled sleepers and iron parts of the old fastenings and junctions are generally worn out and therefore their residual value is low).

Table 9.1.1 – 3 Estimate of the rail residual value according to the rail age

Track Age ('000 Gross Tonnes)	*Average Rail Age ('000 Gross Tonnes)*	*Residual Value Gross (US$/tonne)*	*Residual Value Recovered (US$/tonne)*	*Net Value (US$/km)*
<200,000	100,000	500	450	58,500
201,000 – 400,000	300,000	462	393	51,051
401,000 – 500,000	450,000	340	300	39,000
501,000 – 700,000	600,000	240	210	27,300
701,000 – 800,000	750,000	160	140	18,233
801,000 - 1,000,000	900,000	66	56	7,293
>1,000,000	1,000,000	50	43	5,525

Sources: Consultant's estimate

According to the age of the dismantled rails and their quantities, the following table 9.1.1-4 calculates the rails residual value.

Table 9.1.1 – 4 Rails residual value according to age the dismantled rails and their quantities

Rehabilitation of Kungrad-Beyneu railway line - Kungrad-Border section Rails residual value for Option 1			
	km of PW replaced	Unit value	Net value
('000 Gross Tonnes)	*(km)*	*(US$/km)*	*(US$)*
800-1000	122.4	7,293	892,663
700-800	54.6	18,233	995,495
total	**177**		**1,888,158**

Infrastructure maintenance costs savings

According to current line maintenance procedures, to line maintenance costs per km per cycle and typology (see chapter 4.1.1) and according to the evaluation of maintenance needs after the works have been completed, Consultant estimated the following maintenance costs related to Option 1.

Some maintenance has also been envisaged for the years in which option related works are being carried out, for maintaining the sections out of the option (stations tracks).

Table 9.1.1 – 5 Forecast of maintenance costs related to Option 1

Rehabilitation works for Kungrad - Beyneu Line (Kungrad-Border section) Line maintenance costs for OPTION 1							
Year	*Required Maintenance (km)*			*Maintenance Costs (US$)*			
	Lifting	*Medium*	*Capital*	*Lifting*	*Medium*	*Capital*	*Total*
2007	7	3	3	510,909	568,586	1,354,392	2,433,887
2008	7	3	3	510,909	568,586	1,354,392	2,433,887
2009	7	3	3	510,909	568,586	1,354,392	2,433,887
2010	2	1	3	145,974	189,529	1,354,392	1,689,894
2011	2	0	3	145,974	-	1,354,392	1,500,366
2012	0	0	1	-	-	451,464	451,464
2013	0	0	1	-	-	451,464	451,464
2014	1	0	0	72,987	-	-	72,987
2015	1	0	0	72,987	-	-	72,987
2016	1	0	0	72,987	-	-	72,987
2017	2	0	0	145,974	-	-	145,974
2018	2	0	0	145,974	-	-	145,974
2019	2	0	0	145,974	-	-	145,974
2020	2	0	0	145,974	-	-	145,974
2021	2	0	0	145,974	-	-	145,974
2022	2	0	0	145,974	-	-	145,974
2023	2	0	0	145,974	-	-	145,974
2024	2	0	0	145,974	-	-	145,974
2025	15	0	0	1,094,806	-	-	1,094,806
2026	15	0	0	1,094,806	-	-	1,094,806
2027	15	0	0	1,094,806	-	-	1,094,806
2028	15	3	0	1,094,806	568,586	-	1,663,392
2029	15	3	0	1,094,806	568,586	-	1,663,392
2030	15	3	15	1,094,806	568,586	6,771,958	8,435,350
2031	15	4	15	1,094,806	758,115	6,771,958	8,624,878
2032	15	4	15	1,094,806	758,115	6,771,958	8,624,878

The hypothesis that has been followed in estimating the number of km per year for each maintenance type is that, according to the rules indicated in the line maintenance chapter, the Railway Administration should make a complete maintenance cycle per each type, every 25 years after the completion of rehabilitation works on the rehabilitated sections (track class of the decree 70"H" of 09.11.1995 after rehabilitation works is "3", corresponding to E2 track classification for speed and traffic). For the non rehabilitated sections such as stations, this time should be 15 years.

In the case of "without project" scenario, maintenance needs have been quantified and their cost have been assessed in the following Table 9.1.1-4.

Also for maintenance in case of "without project", the estimation of the number of km per year has been based on the decree 70"H" of 09.11.1995, according to which, in case of wooden sleepers and jointed rails, the maintenance cycle should be carried out every 15 years for E5 railway category (the current line category).

Anyway, in case of "without project", the estimation has been made following a prudential analysis: according to this analysis, the maintenance needs envisaged cannot be much higher than the real maintenance carried out in the last years by UTY. In fact UTY, for a priority policy of resources allocation, in the last years concentrated its investments on other lines, thought to be more strategic for the UTY network, and this will be presumably done also in the future. Anyway, the proposed "without project" scenario for maintenance forecast is assumed to be the minimum, in order to maintain the line in the lowest technical conditions for operation. It is not possible to envisage a future in which the line operation, for lack of maintenance, will be suspended.

Table 9.1.1 – 6 Line maintenance costs "without project

Rehabilitation works for Kungrad - Beyneu Line (Kungrad-Border section) Line maintenance costs "without project"							
Year	Required Maintenance (km)			Maintenance Costs (US$)			
	Lifting	Medium	Capital	Lifting	Medium	Capital	Total
2007	20	15	8	1,459,741	2,842,930	3,611,711	7,914,382
2008	20	15	8	1,459,741	2,842,930	3,611,711	7,914,382
2009	20	15	8	1,459,741	2,842,930	3,611,711	7,914,382
2010	20	15	8	1,459,741	2,842,930	3,611,711	7,914,382
2011	20	15	8	1,459,741	2,842,930	3,611,711	7,914,382
2012	20	15	8	1,459,741	2,842,930	3,611,711	7,914,382
2013	20	15	8	1,459,741	2,842,930	3,611,711	7,914,382
2014	20	15	8	1,459,741	2,842,930	3,611,711	7,914,382
2015	15	7	8	1,094,806	1,326,701	3,611,711	6,033,217
2016	15	7	8	1,094,806	1,326,701	3,611,711	6,033,217
2017	15	7	8	1,094,806	1,326,701	3,611,711	6,033,217
2018	15	6	8	1,094,806	1,137,172	3,611,711	5,843,689
2019	10	6	8	729,870	1,137,172	3,611,711	5,478,753
2020	10	6	8	729,870	1,137,172	3,611,711	5,478,753
2021	5	6	8	364,935	1,137,172	3,611,711	5,113,818
2022	5	6	8	364,935	1,137,172	3,611,711	5,113,818
2023	5	4	8	364,935	758,115	3,611,711	4,734,761
2024	5	4	8	364,935	758,115	3,611,711	4,734,761
2025	5	4	8	364,935	758,115	3,611,711	4,734,761
2026	13	4	8	948,832	758,115	3,611,711	5,318,657
2027	13	4	8	948,832	758,115	3,611,711	5,318,657
2028	13	4	8	948,832	758,115	3,611,711	5,318,657
2029	13	4	8	948,832	758,115	3,611,711	5,318,657
2030	13	4	8	948,832	758,115	3,611,711	5,318,657
2031	13	4	8	948,832	758,115	3,611,711	5,318,657
2032	13	4	8	948,832	758,115	3,611,711	5,318,657

Differences between maintenance costs "without the project" and "with the project Option 1" correspond the maintenance costs savings related to Option 1.

Lighter maintenance cycles, as:

1. reconstruction of a ballast section,
2. grinding of rails,
3. inspection for analysis of present condition of a track and
4. minor ancillary works,

has not been taken into consideration in this analysis because their weight is reduced and their quantities will be approximately the same in case of "with" or "without" the project.

9.1.2 Benefits from Safety devices works

Not applicable.

9.1.3 Benefits from Telecommunication system

The Consultant has specified a large number of benefits to be generated by the rail telecom infrastructure improvement. The approach used for the economic impact assessment by the Consultant has been very prudent and some of these benefits, which are described below, have been excluded from the analytical calculation. The existence of additional benefits can only further improve (providing this would be necessary) the good performance of the project.

Direct benefits are expected to derive from performance improvements in the following domains:

- Telecommunication maintenance and operation cost;
- Traffic management and train delays;
- Revenues from leasing excess capacity to third parties;
- Train operational improvement;
- Energy costs;
- Enterprise management;
- Installation of powerful communications links between railways in the region.

The indirect benefits are difficult to be quantified and have not been considered in the analytic calculation, anyway they are important and contribute to the evaluation of an economic investment:

- Installation of further set of equipment using standard technologies;
- Creation of the infrastructure required for the installation of more advanced traffic control, operation, maintenance systems;
- Creation of the infrastructure necessary to fit real-time freight tracking systems requested by customers.

Telecommunication maintenance and operation costs

Base Case

The costs for telecommunication maintenance and operation in Uzbekistan in 2003 were the following:

- maintenance cost 1,426 $/km;
- operation cost 311 $/km.

These costs were estimated by the Consultant, in the framework of the Central Asia Railways Telecommunications Project, from available data taken directly from Uzbek railways, from specific studies (Rail Maintenance Central Asia Project (1998) - Tacis/Traceca Programme) and from similar data of Central Asian railways, taking into account also specific economic indicators (GDP, average salary for technical staff, etc.).

Under the base case, because of the condition and the age of the equipment and considering the present trend, these expenses are expected to increase at a rate of at least 5% per year. There would be little or no opportunity for staff redundancies. There would inevitably be an increase in expenditures on parts and factory repairs. This leads to doubling of maintenance charges in fifteen years.

It is expected that equipment will wear out beyond possibility of repair, and that progressive abandonment and cannibalisation of components of the system would take place, as in some case is just happening.

Project Case

In a new digital system, the operations and maintenance costs are extremely low. In complete contrast to the present situation, all circuits will be automated and solid state, with no wear as such, nor staff intervention required completing a connection.

Maintenance and operations charges would then be approximately 4% of the initial cost of the equipment, and 0,20 $/m of laid fibre optic cable. This would be in line with west European practice. It is expected that operations and maintenance costs would increase at 2% per year.

The saving streams (difference between base and project case) for maintenance and operation during the evaluation period are shown in Table 9.1.3-1.

In the transition period, some training programmes for professional development of the staff have to be foreseen. The implementation of these courses is not a cost from the economic point of view because they increase the value of the personnel.

Other benefits would include reduced space requirements of the new equipment, which are much lower than that for the old one. No new buildings are foreseen, and extensive space may be liberated in existing facilities for other purposes. The fact that existing equipment should, sometime, be used transitorily for other lines, has been considered to bring negligible benefits into the railways telecommunications system.

Traffic management and train delays

Traffic management failures cause train delays and wasted hours. The existing situation is expected to become worst and worst in a very short time. This is because of the age of all the existing equipment whereby the equipment age has already exceeded the technical life. The new implemented telecommunication system would reduce the number of failures producing train cost saving and reduction of train hourly costs.

Few information on traffic failures and accidents were available. But, even if larger bases of information on traffic failures were available, they might not be representative of the real situation. In other words in some cases few traffic accidents recorded can't persuade experts that the system is properly operating. On the contrary the reduction of traffic accidents is generated by exogenous factors first (as it is for example the drastic traffic reduction after the collapse of Soviet Union) and then by the poor performance of the railways system.

The estimation performed, under this condition, aims at reconstructing a more likely situation vis-à-vis the future perspective.

<u>*Base Case*</u>

The total number of failures on the whole network for previous years has been uniformly assigned to the network to estimate the number of failures along the line; the obtained figure has been checked by comparison of the ratio failure/km recorded for lines in similar conditions in the area. The estimated number of failures along the lines during 2004 were 286. This figure is apparently high but it reflects the poor performance of the systems especially for lines where the existing equipment is very old while the technical life span for such equipment is 25 years.

Every failure generates an average delay, which has been estimated to be 180 minutes on average, being 322 $ the average train hourly cost in 2003 (average value for freight and passenger train). The average train cost has been evaluated taking into consideration a breakdown of operation costs (labour impact, average salary for technicians, energy, etc.) both for passenger and freight trains.

The base case considers that, in accordance with the present trend, the existing number of train hours wasted due to traffic management incidents will be increasing by 5% per year.

<u>*Project Case*</u>

Due to the poor condition of the existing equipment as before explained the project is expected to reduce delay troubles by at least 40% on the section concerned. Delays will then increase at a rate of 2% per year.

In Table 9.3.1-1 it is shown the saving streams derived from delay reduction.

Revenues from leasing excess capacity to third parties

Optical fibre cables and digital switching equipment allow additional or reserve telecommunications capacity at very low marginal cost. The technical recommendations specified a level of capacity superior to the foreseen needs of the railways, thus creating the option of leasing excess capacity to third parties.

Conservative assumptions have been made saying that costs of renting of telecom facilities is reflecting the cost-opportunity of the resource in the Uzbek economy. The following two paragraphs will be providing more details on how possible benefits can be derived for the Uzbek society.

There are two types of excess capacity:

- Spare channel capacity on the railways operational network
- Laid fibres not activated by the railways operational network, (dark fibres).

Spare Channel Capacity

This type of capacity could be of benefit to GSM operators, companies wishing to create IT links between different locations, internet providers.

But in the proposed technical solution, the potential client has not direct access to the system; it means that in order to use the available excess capacity further investments are needed for creating the necessary interfaces. These aspects renders obtaining of these benefits extremely unlikely. Consequently, taking into consideration also the region crossed by the railway line, the Consultant has not considered this possible benefit in the evaluation.

Dark Fibres

This type of capacity will be used by worldwide telecommunications operators who will have the means and opportunity to install the electronic technology necessary to use the optical fibres surplus to railways needs, without investing in cables.

Indicative international rates are 2-3 $/m/year per fibre pair. For the purpose of this study a more realistic rate of 1,0 $/m/year has been taken, also in anticipation of rate declines.

Taking into consideration that 10 of the 32 fibres specified in the technical recommendation, will be reserved for railways (4 to use immediately and 6 for future needs), the potential excess capacity will lie in the 22 residual fibres in 11 pairs.

For the purpose of this evaluation 11 packages (each consisting of one fibres pair) have been considered, in order to simulate the progressive utilisation of the cable capacity (one package to be activate every two years from the entering into operation of the system).

Train operational improvement

Modernisation of the telecommunications systems would certainly have a positive effect on these functions:

- Communications with the dispatching centres;
- Communications between operational and rolling stock maintenance units;
- Management of switches, level crossings;
- Station-to-station dedicated telephone lines for safety and other purposes;
- Dedicated telephone lines for work crews, for track and catenary maintenance;
- Ground to train radio, and other radio communications, which might pass through the fibre.

The improvement of these operations would bring better utilisation of locomotives, wagons, passenger cars, faster train formation, and more efficient terminal operations.

All the above issues will most probably turn into an optimisation of the use of the rolling stock, reducing the cycle time for both wagons and locomotives and consequently increasing their utilisation. So the comparison between "base case" (progressive deterioration of the operational asset utilisation) and "project case" (reduction of lost time for operational assets in asset utilisation at the terminals and in train formation) will be bringing benefits into the project.

Such train operational improvement depends on the telecommunications infrastructure; however not entirely on this. Consequently, the Consultant has made a conservative assumption and didn't include these benefits in the analytical evaluation.

Energy costs

After project implementation, benefits involving energy cost are expected to derive from two different improvements:

- a more efficient dispatching of energy for traction, with for example an easier possibility to identify abnormal load demands;
- a reduction of energy consumption by the new installed telecommunications equipment, respect to the present.

This benefit has not been included in the analytic evaluation as there are not useful and reliable available data for assessment these benefits.

Enterprise management

With the project implementation, reduction of cost of enterprise management (maintenance, commercial, financial, warehouse) is foreseeable.

This benefit would be determined by the real improvement of data transfer facilities and data communication system applied to the following operation:

- Accounting systems, cost controls, invoicing;
- Freight and wagon tracking systems;
- Locomotive, wagon, and track maintenance management systems;
- Warehouse management, stock control, purchasing of consumables, and spare parts;
- Border crossing communication and management (e.g. in collaboration with neighbouring state railways and customs authorities);
- Ticketing and reservation systems.

The new telecommunication system will be a primary step for the introduction of advanced solution for the above mentioned aspects, but they needs further implementation. Consequently, the implementation of a new rail telecom system will be in any case generating benefits in the management of the enterprise (for instance facilitating and speeding data transfer), but other investment will be needed for further improvement and personnel training (for instance for new ticketing and reservation system and devices) and other decision should be taken sometime for modifying the organisational structure.

Consequently, the estimation of the benefits by comparison of "base case" and "project case" is complex but also difficult because of the lack or reliable information due to continuous changes in the railway management organisation. Hence, the Consultant has made a conservative assumption and has excluded these benefits from the analytic evaluation.

Indirect benefits

The indirect benefits have not been included in the analytical calculation. Despite this fact, all these effect are really relevant to the development of the railways in the countries directly involved and they will add an incredibly positive impetus mainly to those countries interested in using the rail network in the area for freight transit (like for instance China and Europe).

Installation of further set of equipment using standard technologies

As mentioned in the basic criteria, the implementation of solutions using standards technology is probably the most important step of this study. The installation of this equipment on this railway line has to be seen as an important step for favouring the adoption of standard technology.

Creation of the infrastructure required for the installation of more advanced traffic control, operation, maintenance systems

Also in this case, the installation of new telecom system along the line is the necessary prerequisite for installing more advanced solutions in other domains (traffic control, operation, maintenance), those being the domains related to a centralised vital functions management more then local functionality. Again, the consideration of the cost for telecom to be "sunk cost" is a valid one and it is in the step of taking the decision of implementing further functions.

Creation of the infrastructure necessary to fit real-time freight tracking systems requested by customers

The new telecom system is necessary for having real-time tracking systems requested by customers. This system can make the rail system more competitive vis-à-vis other transport mode and can have influences in both financial and economic terms.

Table 9.1.3 - 1 Streams of costs and benefits for the telecom system

		COSTS	BENEFITS ($/1000)		
		($/1000)	Savings		Revenues
Year	Year	Capital cost	Maintenance & Operation	Train delays	Leasing excess capacity (dark fibres)
1	2006	3.921,0	-	-	-
2	2007	3.921,0	-	-	-
3	2008	-	621,8	153,0	328,0
4	2009	-	655,9	163,7	328,0
5	2010	-	691,7	175,0	656,0
6	2011	-	729,4	186,9	656,0
7	2012	-	769,1	199,5	984,0
8	2013	-	810,8	212,8	984,0
9	2014	-	854,6	226,9	1.312,0
10	2015	-	900,7	241,6	1.312,0
11	2016	-	949,2	257,2	1.640,0
12	2017	-	1.000,2	273,7	1.640,0
13	2018	-	1.053,7	291,0	1.968,0
14	2019	-	1.110,1	309,3	1.968,0
15	2020	-	1.169,3	328,6	2.296,0
16	2021	-	1.231,6	348,9	2.296,0
17	2022	-	1.297,0	370,3	2.624,0

18	**2023**	-	1.365,8	392,8	2.624,0
19	**2024**	-	1.438,1	416,6	2.952,0
20	**2025**	-	1.514,2	441,6	2.952,0
21	**2026**	-	1.594,1	468,0	3.280,0
22	**2027**	-	1.678,0	495,8	3.280,0
23	**2028**	-	1.766,3	525,0	3.608,0
24	**2029**	-	1.859,1	555,8	3.608,0
25	**2030**	-	1.956,6	588,2	3.608,0
26	**2031**	-	2.059,0	622,4	3.608,0
27	**2032**	-	2.166,7	658,3	3.608,0
28	**2033**	-	2.279,8	696,2	3.608,0
29	**2034**	-	2.398,8	736,0	3.608,0
30	**2035**	-	2.523,7	777,9	3.608,0

As far as the economic and financial analysis is concerned, a very conservative approach has been additionally adopted for the revenues from leasing excess capacity and so an additional reduction factor (set to 0,5) has been introduced.

9.2 Option 2

Option 2 benefits are divided in:

1. benefits deriving from the upgrading works related to infrastructure (stations included) and power supply,
2. benefits deriving from works for signaling and safety devices replacement,
3. benefits deriving from works for new telecom system installation.

These three groups of benefits, as the investment costs, have been treated separately.

9.2.1 Benefits from Infrastructure and power supply works

Running time savings

As calculated in chapter 5.5.3, the following time savings have been considered should Option 2 be carried out.

Time savings have been assumed in comparison with "do nothing" scenario, where "do nothing" means that the line will not be upgraded in the terms of this study, but will in any case be taken in operation with the on going maintenance cycles, according to current UTY finance flows and UTY priority schedule for the whole network.

Time savings from 2007 to 2017:

- 170 minutes for passenger trains,
- 110 minutes for freight trains.

Time savings from 2017 to the following years:

- 210 minutes for passenger trains,
- 149 minutes for freight trains.

Benefits related to time savings As a consequence of the time savings a number of benefits have been included in the calculation. The methodological approach is given for Option 2.

Replaced materials residual value

According to the age of the dismantled rails and their quantities, the following Table 9.2-1 calculates the rails residual value.

Table 9.2 – 1 Rails residual value according to age of the dismantled rails and their quantities

Rehabilitation of Kungrad-Beyneu railway line - Kungrad-Border section			
Rails residual value for Option 2			
	km of PW replaced	Unit value	Net value
('000 Gross Tonnes)	*(km)*	*(US$/km)*	*(US$)*
800-1000	145.4	7,293	1,060,402
700-800	54.6	18,233	995,495
total	**200**		**2,055,897**

Infrastructure maintenance costs savings

Also for Option 2, according to the line maintenance procedures, to line maintenance costs per km per cycle and typology and according to the estimation of maintenance needs after the works have been completed, Consultant estimated the following maintenance costs related to Option 2.

Table 9.2 – 2 Maintenance costs related to Option 2

Rehabilitation works for Kungrad - Beyneu Line (Kungrad-Border section)							
Line maintenance costs for OPTION 2							
Year	*Required Maintenance (km)*			*Maintenance Costs (US$)*			
	Lifting	*Medium*	*Capital*	*Lifting*	*Medium*	*Capital*	*Total*
2007	7	3	0	510,909	568,586	-	1,079,495
2008	2	0	0	145,974	-	-	145,974
2009	0	0	0	-	-	-	-
2010	0	0	0	-	-	-	-
2011	0	0	0	-	-	-	-
2012	0	0	0	-	-	-	-
2013	0	0	0	-	-	-	-
2014	1	0	0	72,987	-	-	72,987
2015	1	0	0	72,987	-	-	72,987
2016	1	0	0	72,987	-	-	72,987
2017	1	0	0	72,987	-	-	72,987
2018	1	0	0	72,987	-	-	72,987
2019	1	0	0	72,987	-	-	72,987
2020	1	0	0	72,987	-	-	72,987
2021	2	0	0	145,974	-	-	145,974
2022	2	0	0	145,974	-	-	145,974
2023	2	0	0	145,974	-	-	145,974
2024	2	0	0	145,974	-	-	145,974
2025	15	0	0	1,094,806	-	-	1,094,806
2026	15	0	0	1,094,806	-	-	1,094,806
2027	15	0	0	1,094,806	-	-	1,094,806
2028	15	2	0	1,094,806	379,057	-	1,473,863
2029	15	3	0	1,094,806	568,586	-	1,663,392
2030	15	3	15	1,094,806	568,586	6,771,958	8,435,350
2031	15	4	15	1,094,806	758,115	6,771,958	8,624,878
2032	15	4	15	1,094,806	758,115	6,771,958	8,624,878

It has been assumed that, in the years following the complete rehabilitation of line and stations, capital and medium maintenance will be suspended for about 20-25 years, while lifting maintenance will be reduced at its minimum.

In the case of "without project" scenario, maintenance needs have been quantified and their cost have been assessed in Table 9.1.1-4.

Differences between maintenance costs "without the project" and "with the project Option 2" correspond the maintenance costs savings related to Option 2.

Also for Option 2 lighter maintenance cycles has not been taken into consideration in this analysis.

9.2.2 Benefits from Safety devices works

It is well known, that the introduction of modern technologies has impacts on a wider area of technical and business system functioning.

When defining the benefits brought about by modern technologies, it must be established, that in the majority of cases these are multiplicative effects which are difficult to be quantified in advance, valued in money and contributed to only one factor.

The analysis of the effectiveness of the project was focused only on the evaluation of the main measurable effects to be produced by the investments.

The modernization of the signaling and safety devices belongs to a cluster of measures which can exert impacts on:

a. Rationalization of system operation;
b. Rationalization of equipment maintenance;
c. Increase in line capacity;
d. Improvement of transport service quality.

As the Consultant did not obtain reliable data of service quality (i.d. news about failures, accidents, delays etc) only the first three above benefits have been investigated.

Workers need for signaling system maintenance

The appendix to the Instruction 7-U from May, 14, 1999 (By Signaling and Economical Department of the Uzbekistan Temir Yo'l recommend a method for calculation of the contingent which shall carry out maintenance work of devices and equipment of technological sites.

Consultant used this Instruction derived from Soviet Railway Rules, where:

1. Specifications of number of workers of the signaling systems are developed on the basis of maintenance work times in view of differentiation of periodicity of manufacture of works (Table E of Annex VIII).

   Maintenance work of devices of marshalling yards are developed depending on capacity of marshalling yard.

In specifications of number of workers, requirements of standard codes of operating rules, safety precautions regulations, statutory acts on traffic security and other statutory acts working on the railway transportation, are taken into account.

2. In specifications of number are included: time for spadework, service of the work area, regulated breaks, supervision of performance of the works connected to operation of devices, carried out by workers from other services, participation in commission surveys, performance of technical actions on increase of reliability of work of devices, carrying out of technical study.
3. On sites with constant using double-track traffic on each track, norm of service to apply with factor 0,8.
4. The norm of service at imposing on automatic block system of coded track circuits is applied with factor 0,85.
5. At service of devices which life time has expired from 1 year till 5 years, before their modernization, norm of service are to apply with factor 0,95; after expiring of the term from 5 till 10 years and over 10 years factors are accordingly equal 0,9 and 0,35.

Benefits with the investments of Signaling Alternative 2 can be shown as follow:

Operational costs

Decrease of operational needs due to the increased availability of the new safety devices between Jaslyk and Karakalpakia (full remote control from Tashkent of Ayapbergen, Berdakh, Ak-Tobe, Kiyiksay).

The relative saving will be of 19 station supervisors.

The cost per unity may be evaluated of 2590 $/year (see Table G of Annex VIII).

Therefore operational cost saving will be 49.210 $/year.

Maintenance costs

Decrease of ordinary maintenance needs.

Accordingly above Specifications, the present maintenance need for the interlockings and the automatic block system from Jaslyk to Karakalpakia (section interested to option 2) may be evaluated in **22** man (Table F-1 of Annex VIII).

As the new interlocking will be put in the place of others whose life times were expired since more 5-10 years, we can evaluate the maintenance need equal the basic (**14** man, Table F-1 of Annex VIII).

With the investment will occur as well:

1. Reduction of major maintenance
2. Decrease of materials of ordinary maintenance
3. Decrease of failures

The overall cost saving of the above three points can be evaluated at least of about 10% of present need (about **3** man, Table F-1 of Annex VIII).

The cost saving is than the cost of **11** unities.

The average cost per unity may be evaluated of 2800 $/year (see table G).

Maintenance cost saving will be of 30.800 $/year.

Benefits with the investments of Signaling Alternative 3 can be shown as follow:

Operational costs

Decrease of operational needs due to the increased availability of the new safety devices between Kungrad and Karakalpakia (full remote control from Tashkent of Ayapbergen, Berdakh, Ak-Tobe, Kiyiksay, Raushan, Kunkhodja, Kyrk-Kyz Barsa-Kelmes, Ajiniyaz, Abadan, Kuanysh, Ayapbergen, Berdakh, Ak-Tobe, Kiyiksay).

Save of 53 station supervisors and 6 traffic operators.

The cost per unity may be evaluated of 2590 $/year for station supervisors and of 2970 $/year for traffic operators.

Than operational cost saving will be 155.090 $/year.

Maintenance costs

Decrease of ordinary maintenance needs.

Accordingly above Specifications, the present maintenance need for the interlockings and the automatic block system from Kungrad to Karakalpakia (section interested to Alternative B) may be evaluated in 54 man (Table F-2 of Annex VIII).

As the new interlocking will be put in the place of others whose life times were expired since more 5-10 years, we can evaluate the maintenance need equal the basic (34 man, see Table F-1 and F-2 of Annex VIII).

With the investment will occur as well:

1. Reduction of major maintenance
2. Decrease of materials of ordinary maintenance
3. Decrease of failures

The overall cost saving of the above points can be evaluated of about 10% of present need (about 6 man, see Tables F-1 and F-2 of Annex VIII).

The cost saving is than the cost of 26 unities.

The average cost per unity may be evaluated of 2.800 $/year.

Finally, maintenance cost saving will be of 72.800 $/year.

Total costs saving

Table 9.2.2 – 1 Total cost savings for safety devices

labour saving	Yearly costs (thousand $)
Alternative 2	
operational	49.210
maintenance	30.800
Total	80.010
Alternative 3	
operational	155.090
maintenance	72.800
Total	227.890

"With" and "without" scenarios

Following standard practice, the financial justification of the Project shall be based on a comparison of the discounted incremental costs and benefits flows associated with the "with" and the "without" Project Scenarios.

The "with project" situations relates to the costs and benefits arising from the realization of both the Project alternatives.

The "with project" scenarios are foreseen for both alternatives:

- the renewal of the ancient Electric Relay Interlocking Installations (ERII) of the relevant section by the activation of Electric Relay Interlocking Installations of new generation;
- the construction with renewed equipment of Automatic Block Line Systems (ABLS) and Cab signalling of the relevant line sections;
- the insertion of the new equipments into the existing Central Post (P.C.).

On the other hand, the "without" Project scenario is based on a realistic assumption of what would happen, should the Project not be implemented.

To the purpose of the economic and financial analyses, it shall be assumed that the "without project" scenario would imply:

- an increase in the provision cost of materials for carrying out safety devices maintenance, since current obsolete equipment spare parts are becoming increasingly expensive, given the incoming lack of a regular industrial production;
- extra-costs due to the need of avoiding further deterioration of the quality of service in terms of traffic regularity and safety. The extra costs will be necessary because current maintenance is expected not to be able to prevent an increase of failures on the devices.

In order to develop the economic and financial analyses these extra-costs can be quantified in 25% of the total costs of current maintenance which have, for safety devices, the structure of the Table 9.2.2-2.

Table 9.2.2-2 Structure of current safety devices maintenance costs

Cost item	share
Material	15 %
Energy	1%
Maintenance services	2%
Remuneration in connection with work	4%
Wages and compensations	41%
Other costs	5%
Overhead costs	32%
Total	100%

Therefore wages and remuneration in connection with work are the 45% of the total maintenance cost for signaling. (The same evaluation we find on Norms of Technological designing of devices of automatics and telemechanics on the railway transport, Moscow, Ministry of Railways, 1985).

In the line sections involved by scenarios the labour costs can be evaluated as follow:

Kungrad-Karakalpaia: need 54 man

As said the average cost per unity may be evaluated of 2800 $/year

The labour cost will be 151.200 $/year

Therefore the total cost of current maintenance of Kungrad-Karakalpaia amounts on:

151200 x 100 / 45 = 336.000 $/year

Finally the extra costs are:

Kungrad-Karakalpaia 336000 x 0,25 = 84.000 $/year.

9.2.3 Benefits from Telecommunication system

As for Option 1.

9.3 Benefits arising from the diverted traffic

According to the findings of the traffic study which has investigated both Uzbek and Kazakh statistics a part of the trade concerning Uzbekistan is actually using Keles to reach either Aktau or Astrakhan and then its final destination.

Actually the routing including Kungrad – Beyneu is much shorter in terms of kilometres and so it is clear that this traffic can be re-routed providing that the line will be reacting properly to the trade market requirement which is expected to be the case after the rehabilitation.

The estimation of such benefits has been cautiously taken into account by the following hypothesis:

- 50 % (45,000 tonnes/year) of the traffic nowadays interesting Keles for reaching Aktau will be diverted;

- 20 % (16,000 tonnes/year) of the traffic nowadays interesting Keles for reaching Astrakhan will be diverted;
- in a very conservative fashion the number of tonnes diverted so estimated has been kept constant for the whole period of the analysis (30 year).

Based on the current tariffs on the present route, it has been estimated that on average the cost saving for re-routing of transporting freight is of around 950 US$ per wagon.

Using a very conservative approach, the final impact of this component has not been included in the evaluation.

10. Economic / Financial Evaluation of the Investments

10.1 Introduction

Following the standard practice, the economic and financial justification of the project has been mapped by way of comparison of the discounted cost and benefit streams associated with the "base case" (without project) scenario and the "project case" (with project) scenario.

10.2 Economic evaluation

The calculation of the economic profitability of the projects has been performed by assessing the social value of the project which is summarised by the following indicators:

- Net Present Value (NPV)
- Benefit/Cost Ratio (BCR),
- Internal Rate of Return (IRR).

These indicators result from the calculation, year-by-year, of the net benefits generated by each proposed project against the "base case" option, duly actualised at a base-year to ensure the necessary inter-temporal comparison of monetary flows occurring in different years.

The use of the above mentioned indicators allows for a comparison between alternative projects and a consequent ranking.

In the evaluation process the following common parameters have been defined.

- discount rate
- appraisal period
- base year for price and values.

In the following table are presented some assumptions and common parameters used in the evaluation process of the different alternatives:

Currency unit	US dollar
Implementing start year	2007
Implementing period (years)	Depending on the option
Base year for prices and values	2006
Operating period (years)	Minimum 30
Appraisal period (constructing period + operating period)	Depending on the option
Shadow discount rate	12%

Time schedule for disbursements is in accordance with the time schedule for implementation of the two Options under study.

Option 3 has been discarded already within technical analysis because the related investment is not consistent with the real needs and traffic volumes.

The operating period to be considered has been stated by the ToRs to be over 30 years, and the residual value of investments after that period has been considered to be negligible and consequently not included in the evaluation.

For the purpose of the economic evaluation, market financial costs previously described have been amended of the component related to the taxes (25%) while import taxes have non been considered in that evaluation. No standard conversion factor have been used for shadow-pricing components of the costs.

The results of the economic evaluation for the project alternatives are shown in Table 10.2-1 and Table 10.2-3.

TABLE 10.2 -1 Economic evaluation of Option 1

		COSTS (US$/1000)	BENEFITS (US$/1000)						
Year	**Year**	**Capital cost**	**Time savings**	**Residual value recovering**	**Maintenance**	**Rolling Stock**	**Signalling and Telecom**	**Traffic diversion**	**NPV (12%) (US$/1000)**
1	2006	-	-	-	-	-	-	-	-
2	2007	27.781,1	-	-	-	-	-	-	-24.804,5
3	2008	27.781,1	-	-	-	-	-	-	-46.951,4
4	2009	23.150,9	-	-	-	-	-	-	-63.429,8
5	2010	-	953,2	1.888,2	4.668,4	6.056,4	1.194,7	-	-54.049,0
6	2011	-	1.017,5	-	4.810,5	6.386,6	1.244,3	-	-46.412,1
7	2012	-	1.081,7	-	5.597,2	6.716,9	1.460,6	-	-38.885,4
8	2013	-	1.145,9	-	5.597,2	7.047,1	1.515,6	-	-31.961,8
9	2014	-	1.210,1	-	5.881,0	7.377,4	1.737,5	-	-25.416,5
10	2015	-	1.274,3	-	4.470,2	7.707,6	1.798,3	-	-19.917,0
11	2016	-	1.338,5	-	4.470,2	8.037,9	2.026,4	-	-14.806,3
12	2017	-	1.402,8	-	4.415,4	8.368,2	2.093,9	-	-10.126,1
13	2018	-	1.421,2	-	4.273,3	8.499,7	2.328,7	-	-5.885,1
14	2019	-	1.439,6	-	3.999,6	8.631,2	2.403,4	-	-2.109,8
15	2020	-	1.458,1	-	3.999,6	8.762,7	2.645,9	-	1.341,4
16	2021	-	1.476,5	-	3.725,9	8.894,2	2.728,5	-	4.415,3
17	2022	-	1.495,0	-	3.725,9	9.025,7	2.979,3	-	7.225,2
18	2023	-	1.495,0	-	3.441,6	9.025,7	3.070,6	-	9.705,9
19	2024	-	1.495,0	-	3.441,6	9.025,7	3.330,7	-	11.954,7
20	2025	-	1.495,0	-	2.730,0	9.025,7	3.431,8	-	13.891,6
21	2026	-	1.495,0	-	3.167,9	9.025,7	3.702,1	-	15.694,4
22	2027	-	1.495,0	-	3.167,9	9.025,7	3.813,8	-	17.314,5
23	2028	-	1.495,0	-	2.741,4	9.025,7	4.095,3	-	18.748,9
24	2029	-	1.495,0	-	2.741,4	9.025,7	4.218,9	-	20.038,8
25	2030	-	1.495,0	-	-2.337,5	9.025,7	4.348,8	-	20.864,4
26	2031	-	1.495,0	-	-2.479,7	9.025,7	4.485,4	-	21.601,3
27	2032	-	1.495,0	-	-2.479,7	9.025,7	4.629,0	-	22.266,7
28	2033	-	1.495,0	-	296,5	9.025,7	4.780,0	-	22.998,1
29	2034	-	1.495,0	-	296,5	9.025,7	4.938,8	-	23.657,8
30	2035	-	1.495,0	-	296,5	9.025,7	5.105,6	-	24.253,0
31	2036	-	1.495,0	-	296,5	9.025,7	5.105,6	-	24.784,5
32	2037	-	1.495,0	-	296,5	9.025,7	5.105,6	-	25.259,0
33	2038	-	1.495,0	-	296,5	9.025,7	5.105,6	-	25.682,7
34	2039	-	1.495,0	-	296,5	9.025,7	5.105,6	-	26.061,0
35	2040	-	1.495,0	-	296,5	9.025,7	5.105,6	-	26.398,8

IRR =	**16,4%**
NPV (12%) =	**26.398,8**
BCR =	**1,42**

TABLE 10.2-2 – Economic evaluation of Option 2

		COSTS (US$/1000)	BENEFITS (US$/1000)						
Year	**Year**	**Capital cost**	**Time savings**	**Residual value recovering**	**Maintenance**	**Rolling Stock**	**Signalling and Telecom**	**Traffic diversion**	**NPV (12%) (US$/1000)**
1	**2006**	-	-	-	-	-	-	-	-
2	**2007**	29.508,6	-	-	-	-	-	-	- 26.347,0
3	**2008**	29.508,6	-	-	-	-	-	-	- 49.871,1
4	**2009**	29.508,6	-	-	-	-	-	-	- 70.874,8
5	**2010**	12.295,3	-	-	-	-	-	-	- 78.688,6
6	**2011**	-	1.138,2	2.055,9	5.935,8	7.109,2	1.556,2	-	- 68.591,1
7	**2012**	-	1.206,9	-	5.935,8	7.455,8	1.772,5	-	- 60.297,0
8	**2013**	-	1.275,6	-	5.935,8	7.802,4	1.827,5	-	- 52.678,9
9	**2014**	-	1.344,2	-	5.881,0	8.149,0	2.049,4	-	- 45.641,8
10	**2015**	-	1.412,9	-	4.470,2	8.495,6	2.110,2	-	- 39.695,7
11	**2016**	-	1.481,6	-	4.470,2	8.842,2	2.338,3	-	- 34.179,6
12	**2017**	-	1.550,3	-	4.470,2	9.188,8	2.405,8	-	- 29.115,7
13	**2018**	-	1.570,6	-	4.328,0	9.332,8	2.640,6	-	- 24.528,4
14	**2019**	-	1.591,0	-	4.054,3	9.476,8	2.715,3	-	- 20.440,5
15	**2020**	-	1.611,4	-	4.054,3	9.620,8	2.957,8	-	- 16.707,4
16	**2021**	-	1.631,8	-	3.725,9	9.764,8	3.040,4	-	- 13.389,1
17	**2022**	-	1.652,2	-	3.725,9	9.908,8	3.291,2	-	- 10.358,7
18	**2023**	-	1.652,2	-	3.441,6	9.908,8	3.382,5	-	- 7.681,0
19	**2024**	-	1.652,2	-	3.441,6	9.908,8	3.642,6	-	- 5.256,4
20	**2025**	-	1.652,2	-	2.730,0	9.908,8	3.743,7	-	- 3.162,4
21	**2026**	-	1.652,2	-	3.167,9	9.908,8	4.014,0	-	- 1.219,4
22	**2027**	-	1.652,2	-	3.167,9	9.908,8	4.125,7	-	525,7
23	**2028**	-	1.652,2	-	2.883,6	9.908,8	4.407,2	-	2.083,7
24	**2029**	-	1.652,2	-	2.741,4	9.908,8	4.530,8	-	3.473,3
25	**2030**	-	1.652,2	-	- 2.337,5	9.908,8	4.660,7	-	4.388,0
26	**2031**	-	1.652,2	-	- 2.479,7	9.908,8	4.797,3	-	5.204,4
27	**2032**	-	1.652,2	-	- 2.479,7	9.908,8	4.940,9	-	5.940,9
28	**2033**	-	1.652,2	-	364,9	9.908,8	5.091,9	-	6.738,9
29	**2034**	-	1.652,2	-	364,9	9.908,8	5.250,7	-	7.458,1
30	**2035**	-	1.652,2	-	364,9	9.908,8	5.417,5	-	8.106,4
31	**2036**	-	1.652,2	-	364,9	9.908,8	5.417,5	-	8.685,3
32	**2037**	-	1.652,2	-	364,9	9.908,8	5.417,5	-	9.202,2
33	**2038**	-	1.652,2	-	364,9	9.908,8	5.417,5	-	9.663,6
34	**2039**	-	1.652,2	-	364,9	9.908,8	5.417,5	-	10.075,7
35	**2040**	-	1.652,2	-	364,9	9.908,8	5.417,5	-	10.443,6

IRR =	**13,4%**
NPV (12%) =	**10.443,6**
BCR =	**1,13**

10.3 Ranking of alternative solutions

The results of the economic assessment of the three considered project options are summarized in the following table, where Internal Rate of Return, Net Present Value (at a discount rate of 12%) and Benefit/Cost Ratio for Option 1 and Option 2 are compared.

	Option 1	*Option 2*
IRR	16.4	13,4
NPV (12% - ml US$)	26.4	10.4
BCR	1,42	1,13

Options present economic differences but not very relevant. Option 1 is preferable from a strictly economic point of view but in any case Option 2 represents a further evolution of the other which can be implemented also by resources internal to the Railways in a later stage with the consequent postponement of the investments.

10.4 Financial analysis

The financial intern rate of return was calculated by estimating and comparing financial flows with estimating financial flows for the same period considered for the economic analysis.

For the calculation of the financial rate of return, it has been considered only the financial flows of residual value recovering, maintenance, rolling stock, signaling, operation and maintenance of telecommunication system and leasing excess capacity of the telecommunication system.

Obviously the nature of the improvement doesn't allow changes in the tariff policy, consequently financial indicators are the following ones:

	Option 1	*Option 2*
IRR	13.9 %	11.6 %
NPV (6% - ml US$)	96.1	82.9
BCR	2.09	1.75

It is worth mentioning that the financial rate of return is in any case well over the reference discount rate of 6%. This means that the investment is profitable.

Nevertheless a financing mechanism should be carefully studied also taking into account data concerning the financial performance of the Uzbek Railways in last years.

Table 10.4 – 1 Financial Performance of UTY from 2001 to 2003 ***(million Soums)***

Item	2001	2002	2003
Revenue			
Freight traffic	102,028	191,091	268,140
Passenger traffic	5,789	8,894	11,480
Other operational revenue	24,216	34,667	55,234
Total revenue	132,033	234,652	334,854
Less Value Added Tax	16,200	24,611	36,169
Net revenues	**115,833**	**210,041**	**298,685**
Expenses	**82,966**	**148,851**	**232,527**
Profit before tax	32,867	61,190	66,158
Net profit before tax	32,306	58,289	74,953
Taxes	23,351	66,629	56,166
Net Profit	**8,955**	**-8,340**	**18,787**

After UTY was formed in 1994 the company made constantly a profit except in 2002. As shown in the above table a loss of 8,340 million soums was made that year. But there was a strong recovery in 2003 with a profit of 18,787 that is twice as much as in 2001.

It is certainly difficult to make accurate forecasts on how will evolve the financial situation of UTY during the duration of an external loan that may extend on twenty years.

As UTY has borrowed from external sources particularly from IFIs its liabilities have increased fast during recent years. The largest loans were the two loans of a total of USD 140 million received from ADB for financing the rehabilitation of the trunk line Chengeldy - Tashkent – Samarkhand – Bukhara – Khodjadavlet. EBRD lended for several projects including USD 44.4 million for the Uzbek Railways Freight Traction Renewal and Management Project and USD 75.5 million for the Locomotive Re-powering Project. The Japanese JBIC provided the equivalent of about USD 55 million for the Railway Passenger Transport Improvement Project. And it is reported that a credit of as much as USD 150 million could be granted for the construction of the new line Guzar – Boysun – Kumkurgan. External financing is also under consideration for the electrification of the Tashkent – Angren line.

Under those circumstances even if the envisaged new JBIC loan is supported by the government and not by UTY, international loans to UTY would consider a valuable amount not to say a valuable burden for the company for the reimbursement. This explains why UTY is less keen on making use of international financing. Thus it is reported that the 3rd ADB project under discussion will cover only under 40 % of the total cost of the project and amount to less than one third of the previous loans.

However the above should be considered, the project is largely profitable and the line is of interest for Uzbekistan to give access to Aktau and to Kazakh and Russian markets. Thus there is a more than a serious hope that it should be implemented. In this respect, it is worth mentioning that the present feasibility study is the proper tool for the Uzbek Railways for starting the promotion vis-à-vis the Uzbek Government of the project and to start the discussion about the inclusion of the project within the pipeline for financing project.

10.5 Sensitivity and risk analysis for the economic analysis

Since project appraisal requires forecasting, the factors entering into the calculation of costs and benefits are inevitably subject to various degrees of uncertainty.

For Option 1, sensitivity and risk analyses on the inputs of the economic assessments have been developed to study and forecast the stability of the achieved results.

This kind of approach is particularly suited to take into account that the evaluations of the principal inputs for the economic assessment are relative to a preliminary design phase. In further steps of the project (detailed design and construction) the preliminary evaluation and assumption could not be totally confirmed. The sensitivity and risk analysis is able to consider this "indeterminacy in inputs determining".

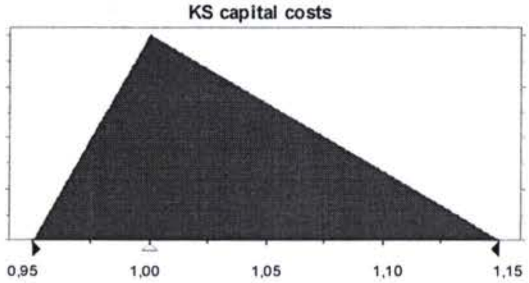
The key variables that have been subjected to the analysis are the following:

- capital cost
- benefit for users because of time savings
- benefit related to the residual value recovering
- track maintenance savings
- benefit for the operator for optimisation of the rolling stock because of the time savings
- benefits from signalling and telecommunications.

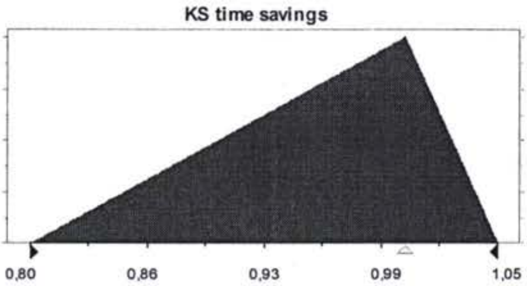
For the analysis has been used a random sampling method (also known as "Monte-Carlo methodology") on continuous probability distributions of the key variables. Usually, the considered probability distributions are not symmetrical (beta, triangular, etc.) so that the estimated value for the basic evaluation is not the average value of the distribution range, but rather the mode (likeliest value) of the distribution.

As the real probability distribution of the input (or target) variable is not known, a triangular distribution has been assumed, in accordance with the usual practice:

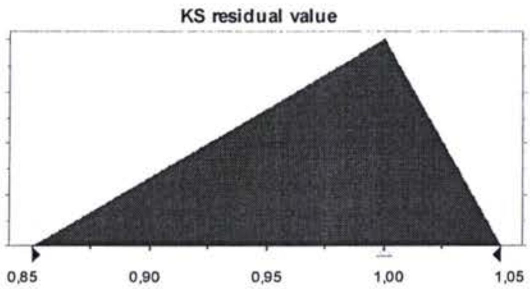
- for capital cost an asymmetric triangular distribution has been assumed with a variation between –5% and +15% from the estimated base value; this should be very conservative since 5% for contingencies has been already included in capital cost estimation;



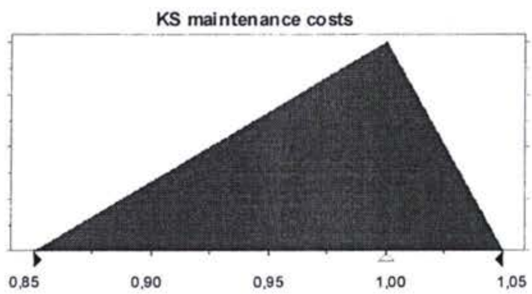
- for benefits to the user because of time savings it has been used an asymmetric triangular distribution variable between –20% and +5% from the estimated base value;



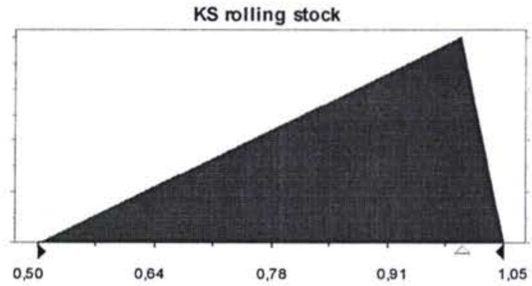
- for benefits related to residual value recovering an asymmetric triangular distribution has been assumed with a variation between –15% and +5% from the estimated base value.



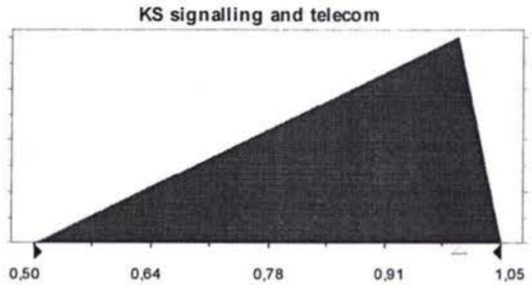
- for track maintenance savings an asymmetric triangular distribution has been assumed with a variation between -15% and +5% from the estimated base value.



- for benefits from optimisation of rolling stock an asymmetric triangular distribution has been assumed with a variation between -50% and +5% from the estimated base value.



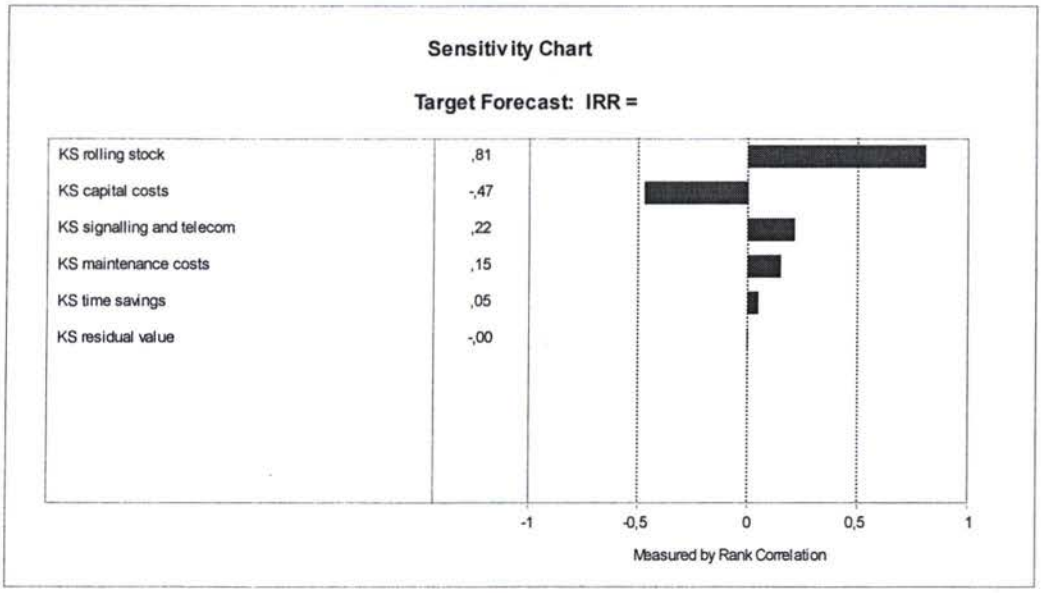
- for benefits from signalling and telecommunication savings an asymmetric triangular distribution has been assumed with a variation between -50% and +5% from the estimated base value.



For the analysis a series of 100.000 simulations has been performed (random samplings from all the probability distributions above described).

The described analytic–probabilistic approach allows to identify the sensitivity of the result respect to the key variables and to order them in an importance scale in relation to the their effect on the result. This kind of analysis is useful to recognise the more critical inputs regard to the achievement of the result and it allows adopting precautionary measures.

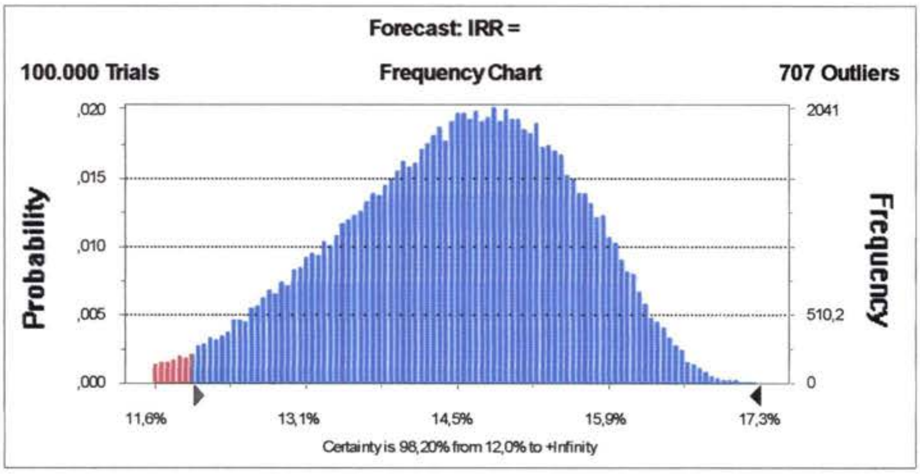
The following chart shows the sensitivity of IRR in regard to probability distributions of the key input variables.



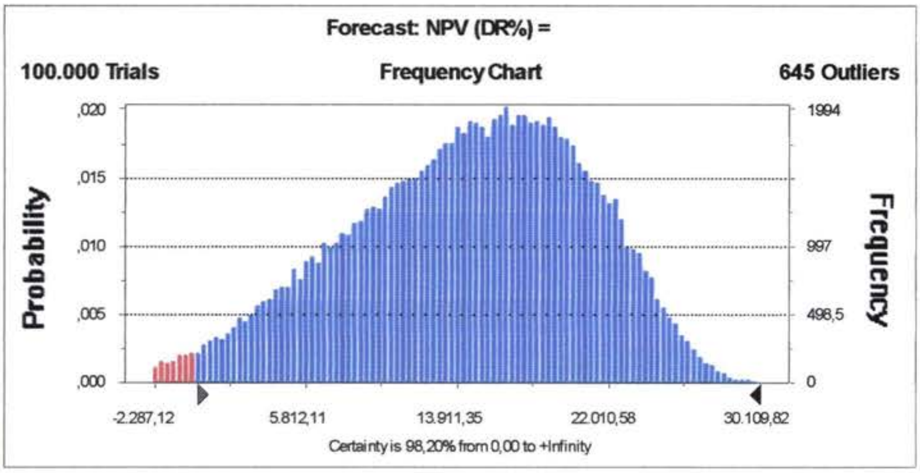
The calculations show, without considering outliers, that the combined probability that the economic indicators of the project are higher than the threshold values for the stability area; the stability are being: 12% for IRR, 0 for NPV(12%) and 1 for BCR.

The following diagrams show the distribution of the results for the three indicators.

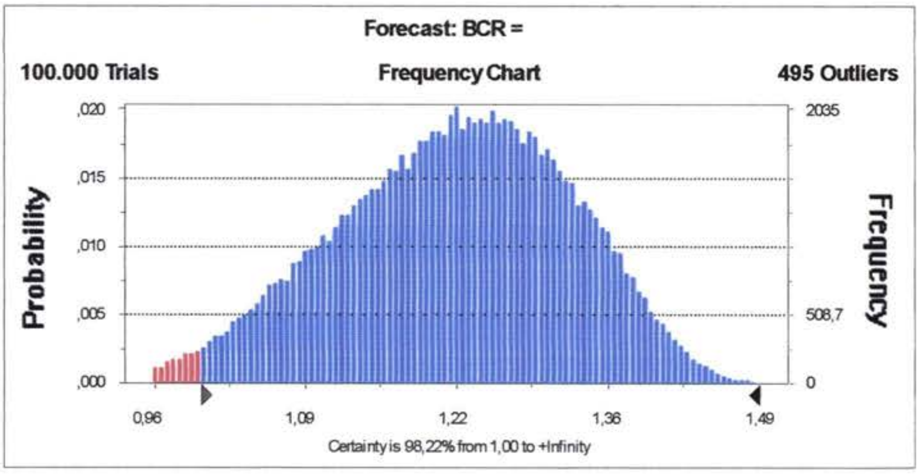
IRR is over 12% in the 98,2% of simulated cases.



NPV is over 0 in the 98,2% of simulated cases.



BCR is over 1 in the 98,22% of simulated cases.



The following table reports the distribution of the indicators for increase per cent (5%), considering also the previously excluded outliers.

Per cent	IRR	NPV(12%) (€/1000)	BCR
0%	10,3%	-10.096,48	0,86
10%	13,0%	5.476,78	1,08
25%	13,7%	10.098,51	1,15
50%	14,6%	15.096,46	1,23
75%	15,3%	19.349,91	1,30
90%	15,8%	22.486,16	1,35
100%	17,4%	31.098,20	1,51

The solution is over the stability threshold in more than the 98% of cases, which means that the sensitivity analysis has shown that the result of the economic analysis is absolutely stable.

Furthermore it has to be remarked that conditions for the sensitivity analysis have been severe and that for the purpose of the evaluation also 5% of the capital cost has been included as contingencies. This means that excluding the double counting (5% of contingencies and subsequently up to 15% in the probabilistic distribution) the solution is always over the threshold and so it is stable.

Additionally to that possible other benefits (i.e. diverted traffic) have not been considered in the analysis.

11. Conclusions

The present Feasibility Study for rehabilitation measures for the Kungrad - Kazakh Border railway sections has taken into consideration the following rehabilitation options:

Option 1 *mainly consists in the rehabilitation of the existing railway line between Kungrad and Kazakh border, excluding the rehabilitation of the stations (permanent way, buildings and passenger services) and including the power supply for 10 kV. It also includes works for the telecommunication system installation all over the line and it does not include any work for the safety devices.*

Option 2 *consists in the rehabilitation of the existing railway line between Kungrad and the border (as Option 1), including the rehabilitation of the stations. In the stations works include rehabilitation of the main track (running track), of the turnouts of the main track and of some platforms and buildings. Option 2 also includes, as Option 1, the power supply 10 kV and the telecommunication system construction. Finally Option 2 also envisages works for safety devices rehabilitation with two variants: only for the section from Jaslyk to the border (first priority) or all along the line.*

Also a third option for doubling and electrification of the line has been duly examined the technical feasibility analysis and discarded because not justified by the traffic interested to the line.

Consequently the economical/financial analysis has been used for selecting the most convenient one between the two remaining options.

As previously mentioned the Option 1 seems to be the most advantageous one in economic and financial terms and so it is recommended for the implementation. Nevertheless also economic/financial indicators for Option 2 are suitable and since this can be seen as a further improvement of the Option 1, could be that Option 2 could be implemented in the future in accordance with the traffic growth.

As far as the services to be rendered by the Consultant are concerned, only the most advantageous Option will be considered for the detailed design which will start immediately after the delivery of this report.

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