South Balkan Development Initiative

East-West

Transport Corridor Feasibility Study Phase I

Volume II DEVELOPMENT PLANS

FINAL REPORT

Presented to:
Ministry of Transport of Bulgaria
Ministry of Transport and Communications of Macedonia
Ministry of Public Works and Transport of Albania

Bechtel International, Inc.

April 1998

In Association with:
Transportation and Economic Research Associates
Wilbur Smith Associates
Transproekt S.A.R.L. – Sofia
Economic Institute – Skopje

The U.S. Trade and Development Agency

The U.S. Trade and Development Agency, an independent agency of the U.S. federal government, provides grants that assist in the planning stage of infrastructure and industrial projects in middle-income and developing countries. Through the funding of feasibility studies, orientation visits, training grants, and various forms of technical assistance, TDA facilitates partnerships between American companies and foreign entities.

MAILING ADDRESS: Room 309, SA-16, Washington, D.C. 20523-1602
DELIVERY ADDRESS: 1621 North Kent Street, Suite 309, Arlington, VA 22209
Phone (703) 875-4357 • FAX (703) 875-4009

CONSULTANT TEAM

PRIMARY CONSULTANT

Bechtel International, Inc.
50 Beale St. P.O. Box 193965
San Francisco, CA, USA 94119-3965
Chief Operating Officer: Mr. Adrian Zakaria
8th Congressional District: California

SUBCONSULTANTS

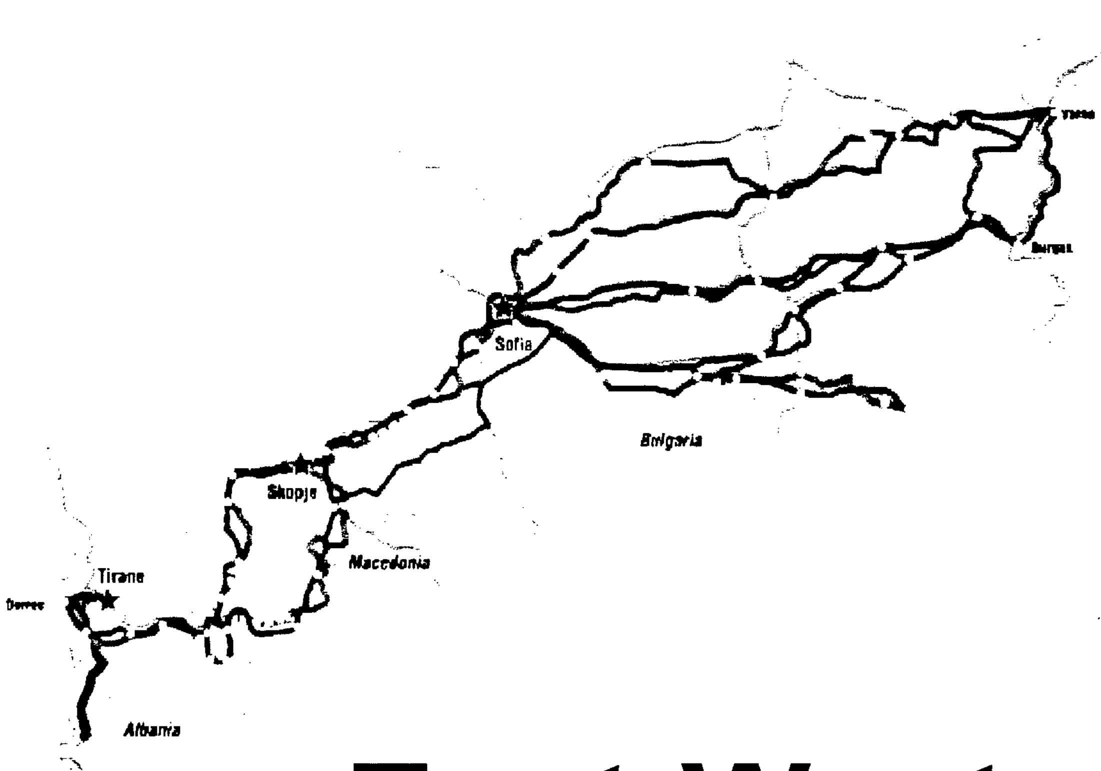
Transportation and Economic Research Associates, Inc. (TERA)
2721 Cooper Creek Road
Herndon, Virginia, USA 22071
Chief Operating Officer: Dr. Asil Gezen

Wilber Smith Associates
1301 Gervais St.
P.O.Box 92
Columbia, South Carolina, USA 29202-0092
Chief Operating Officer: Mr. Robert A. Hubard, P.E.

Transproekt S.A.R.L.
112 Rakovski Street
Sofia, Bulgaria
Chief Operating Officer: Mr. Christo Velev

Economics Institute
91000 Skopje, P.O. Box 250
Skopje, Mecedonia
Chief Operating Officer: Dr. Aleksandar Petroski

South Balkan Development Initiative



East-West

Transport Corridor Feasibility Study Phase I

Volume II
Development Plans

FINAL REPORT

Presented to:
Ministry of Transport of Bulgaria
Ministry of Transport and Communications of Macedonia
Ministry of Industry, Transport, and Trade of Albania

Bechtel International, Inc.

April 1998

In Association with:
Transportation and Economic Research Associates
Wilbur Smith Associates
Transproekt S.A.R.L. – Sofia
Economic Institute – Skopje

MAILING ADDRESS: Room 309, SA-16, Washington, D.C. 20523-1602
DELIVERY ADDRESS: 1621 North Kent Street, Suite 309, Arlington, VA 22209

Table of Contents

Illustrations and Tables

Figures **Page**

Tables

Page

On December 30, 1996, the Bulgarian Ministry of Transport – on behalf of the Bulgarian Ministry of Transport, the Macedonian Ministry of Transport and Communications, and the Albanian Ministry of Industry, Transport, and Trade – entered into a US Trade and Development Agency (TDA) funded contract with Bechtel International Inc. (Bechtel) to conduct a feasibility study of the Transport Corridor No. 8 East-West, Phase 1. The contract was approved officially by the TDA on February 27, 1997.

This study is funded by a TDA grant under the U.S. Government's South Balkan Development Initiative (SBDI). The 4-year SBDI program, established in fiscal year 1996, provides assistance to the governments of Bulgaria, Macedonia, and Albania to strengthen their transportation infrastructure links and improve the level and quality of transportation services along Corridor 8 (the East-West Corridor). The East-West Corridor is one of the nine priority transportation corridors of Europe, designated in the Pan-European Second Conference held in Crete on March 14-16, 1994. The Crete Conference Declaration, executed by 21 European nations, stipulates that there should be cooperation among nations in identifying missing links, bottlenecks, and poorly integrated regions along the nine priority corridors in cooperation with international financial institutions.

In performing this study, Bechtel is assisted by the following consulting companies:

- Transportation and Economic Research Associates, Inc.
- Wilbur Smith Associates, Inc.
- Transproekt S.A.R.L. – Sofia
- Economic Institute – Skopje

1.1 OBJECTIVES OF THE STUDY

The main objectives of the study are as follows:

- Survey and summarize existing characteristics of transport modes along the corridor
- Develop transportation forecasts for the corridor
- Develop and prioritize a conceptual list of projects for East-West Corridor implementation
- Develop possible approaches to project financing
- Recommend specific courses of action for TDA's and SBDI Coordinating Group's consideration

1.2 OVERVIEW OF THE SOUTH BALKAN DEVELOPMENT INITIATIVE

The SBDI was established in 1996 to assist Bulgaria, Macedonia, and Albania develop and integrate their transportation infrastructure. The objectives of the SBDI are threefold:

- To help the three countries upgrade their transportation infrastructure in order to increase trade and stimulate economic development
- To encourage the three countries to develop a regional approach to transport planning and use regional synergies to leverage new public and private capital
- To use the concrete experience of regional cooperation on transport infrastructure development to foster more regional cooperation and economic integration

To achieve the SBDI objectives and facilitate better coordination in transportation infrastructure development and rehabilitation activities, the three governments have established a Coordinating Group (CG) at the Deputy Transportation Ministerial level and a SBDI CG Secretariat office in Sofia.

Ten projects were begun with first-year (Fiscal Year 1996) funding under the SBDI 4-year program. These projects were based on an assessment carried out by TDA, and in consultation not only with the governments of the three countries, but also with international financial institutions. This economic prefeasibility study of the East-West Corridor No. 8 is one of these projects.

1.3 OVERVIEW OF THE EAST-WEST TRANSPORT CORRIDOR

The East-West Corridor comprises highway and railway routes that connect the Port of Durres on the Adriatic Sea with the Ports of Varna and Burgas on the Black Sea through the countries of Albania, Macedonia, and Bulgaria. The total distance of the corridor varies between 1,220 and 1,350 km depending on the specific highway/railway route taken along the corridor. During the fourth Coordinating Group Meeting held in Skopje on March 27, 1997, the group approved the expansion of the definition of the corridor to include the 160 km highway and rail segment between Plovdiv and Svilengrad up to the Turkish border. This allows the corridor to capture traffic that moves between Turkey, the Middle East, and parts of Southeast Asia, via Bulgaria and Macedonia, and the European countries. The Port of Vlore on the Adriatic Sea was added as a second gateway to the corridor during the seventh Coordinating Group Meeting held in Tirana, Albania on December 9 - 10, 1997.

Figure 1-1 depicts the highway corridor and Figure 1-2 shows the railway corridor through the three countries of Albania, Macedonia, and Bulgaria.

1.3.1 Corridor Description through Albania

Starting with Albania, there are two alternate highway routes and a single railway route that connect the Port of Durres with the capital city of Tirana. Each of these routes is approximately 40 km in length. Also, there is a single highway route and a single parallel railroad route, along the East-West Corridor, that connects the Port of Durres with the Albanian/Macedonian border through the towns of Rrogozhine, Elbasan, Kafasan, and Pogradec. The road has a total length of 150 km. The rail line has a total length of 138 km and ends at Lin, 2.6 km short of the Macedonian border. A 25-km road segment connects Tirana with Elbasan and shortens the length of the corridor to 120 km. The Port of Durres is linked with the Port of Vlore via the Albanian major north-south transport artery. This highway and railway route passes through the towns of Kavaje, Rrogozine, Lushnje, and Fier. Rrogozhine is the town link between the Port of Vlore and the route from Durres to the Macedonian border.

1.3.2 Corridor Description through Macedonia

Continuing through Macedonia, along the East-West Corridor, there are two alternate highway routes between the Albanian and the Bulgarian borders. These are the northern route and the central route. The northern route, with a total length of 302 km, connects the Albanian town of Kafasan (or Tushemisht) with the towns of Podmolje, Botun, Kicevo,

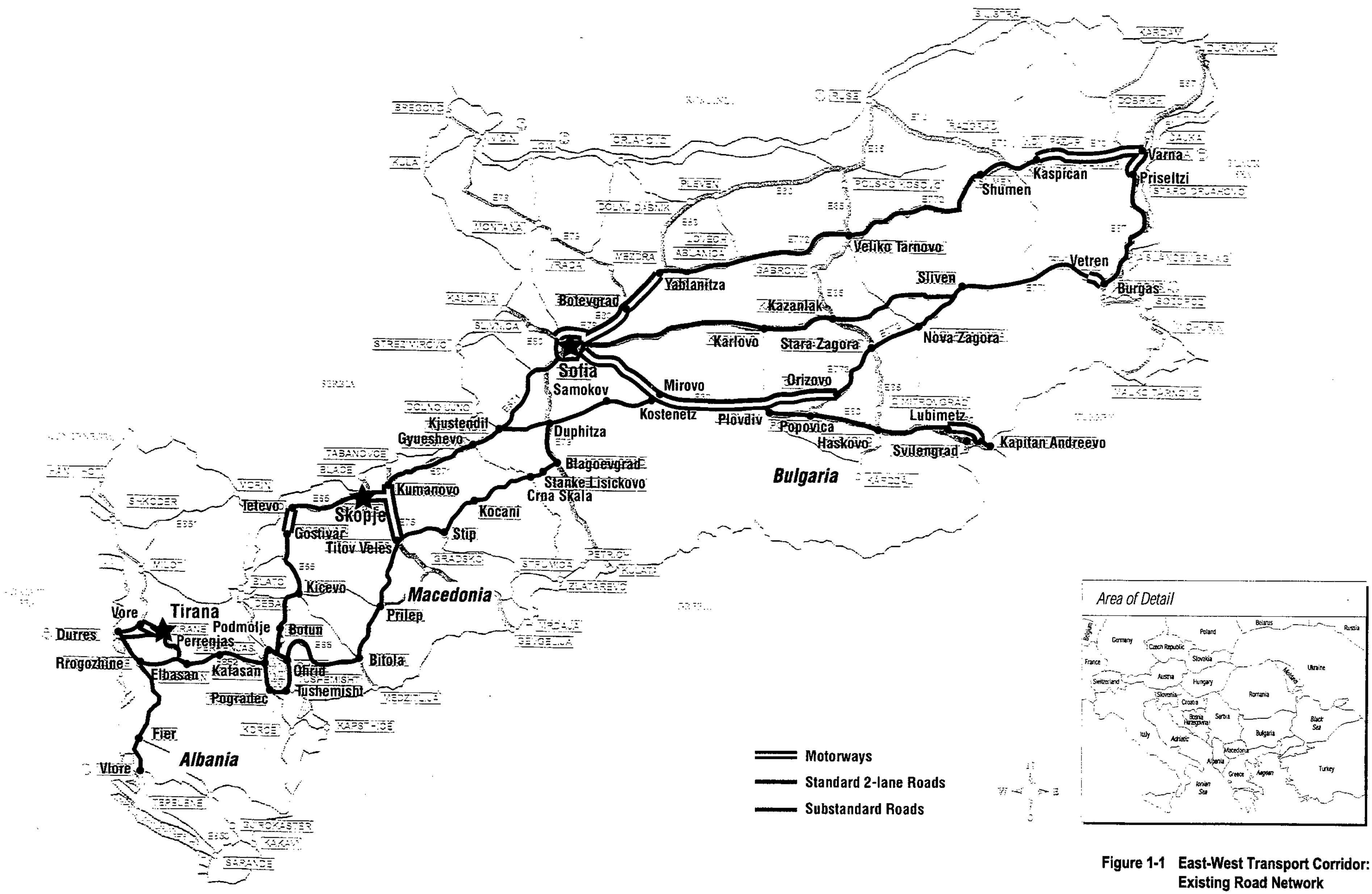


Figure 1-1 East-West Transport Corridor: Existing Road Network

5_14

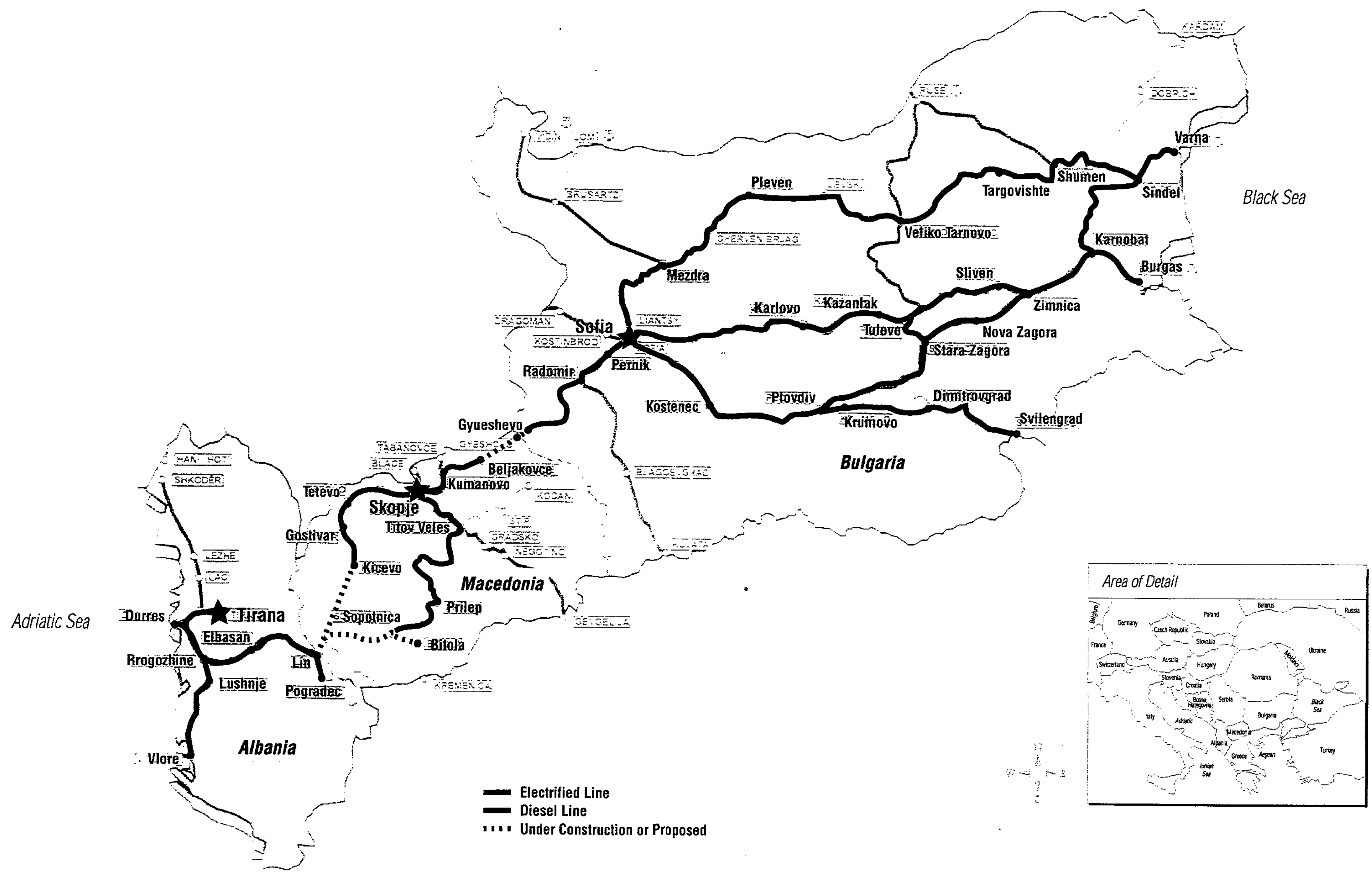


Figure 1-2 East-West Transport Corridor: Existing Rail Networks

5_13

Gostivar, Tetovo, Skopje, Miladinovci, Kumanovo, Kriva Palanka, and Deve Bair at the Bulgarian border. The central route, on the other hand, with a total length of 339 km, connects the town of Kafasan (or Tushemisht) with the towns of Ohrid, Resen, Bitola, Prilep, Titov Veles, Kocani, Delcevo, and Crna Skala at the Bulgarian border. Both routes pass mostly through mountainous and hilly terrain. The routes are interconnected with a highway between Miladinovci and Titov Veles, which is part of the European north-south route (Corridor No. 10).

There are also two potential alternate railroad routes along the East-West Corridor between the Albanian border town of Lin and the Macedonian capital of Skopje. The northern route would go from Lin through Kicevo, Gostivar, and Tetovo to Skopje, with a total length of 182 km. The segment between the Albanian border town of Lin and Kicevo has not been built yet; therefore, it represents a 66.7 km gap in the continuity of the rail corridor (65 km of this gap is in Macedonia). The central route, on the other hand, would have a length of approximately 240 km and would connect the town of Lin with the towns of Sopotnica, Prilep, Titov Veles, and Skopje. Also, the segment from Lin to Sopotnica has not been built yet, and represents another gap in the continuity of this rail corridor. Between Skopje and the town of Gyueshevo, on the Bulgarian border, there is one railroad that passes through Kumanovo and Beljakovce. This route has a total length of 123 km, with a 55-km section between Beljakovce and the Bulgarian border currently under construction.

1.3.3 Corridor Description through Bulgaria

Within Bulgaria, there is one major highway/railway route along the East-West Corridor between the towns of Deve Bair/Gyueshevo and the capital city of Sofia. These routes, passing through Kjustendil, Radomir, and Pernik, have a total length of 112 and 160 km, respectively. There is a 2.5-km missing railroad link between the Macedonian border and Gyueshevo.

Between Sofia and the Ports of Varna and Burgas, there are three alternate highway routes. The northern highway route, with a length of 463 km, connects the city of Sofia with the Port of Varna via the cities of Botevgrad, Koritna, Veliko Tarnovo, and Shumen. The central route, with a length of 385 km, connects Sofia with the Port of Burgas via the cities of Karlovo, Kazanlak, Sliven, Karnobat, and Ajtos. There is a 134-km road connecting the Ports of Varna and Burgas. The southern route, with a length of 432 km, connects Sofia with the Port of Burgas via the cities of Ihtiman, Plovdiv, Stara Zagora, Nova Zagora, Sliven, Karnobat, and Ajtos. The East-West Corridor also includes the road connecting the city of Plovdiv with the Bulgarian/Turkish border via the cities of Haskovo, Harmanli, Ljubimetz, Svilengrad, and Kapitan Andreevo; the total length of this road is 151 km. There is a road connection between the southern route at Mirovo (near Kostenetz) and the Macedonian central route at the Macedonian/Bulgarian border town of Crna Skala. This road, starting at the Macedonian Border, passes through the cities of Blagoevgrad, Dupnitza, and Samokov; its total length is 140 km. A 42-km section connects this road with the town of Kjustendil on the Deve Bair – Sofia segment.

There are also three alternate railway routes that connect Sofia with the two Ports of Varna and Burgas. The northern railway connects Sofia and Varna through the towns of Mezdra, Pleven, Levski, Veliko Tarnovo, Shumen, and Sindel; its total length is approximately 532 km. The central railway connects Sofia and Burgas through the towns of Karlovo, Kazanlak, Sliven, Karnobat, and Ajtos; its total length is 340 km. The southern railway connects Sofia and Burgas through the towns of Kostenec, Plovdiv, Stara Zagora, Nova Zagora, Iyambol, Karnobat, and Ajtos; its total length is 437 km. There is a railroad link, with a total length of 174 km, between the Ports of Varna and Burgas through the towns of Sindel, Karnobat, and Ajtos. The corridor also includes the railroad connecting the city of Plovdiv with the Turkish border via the towns of Dimtrovgrad, Harmanli, Svilengrad, and Kapitan Andreevo; its total length is about 163 km.

1.4 STRATEGIC SIGNIFICANCE OF THE EAST-WEST CORRIDOR

The importance of a transcontinental East-West Corridor across the Balkans connecting the Black Sea to the Adriatic has long been recognized as an important undertaking for integrating the economies of the South Balkan region with Europe, the Middle East, the Caucasus, and Central Asia. The land connection between the Albanian Adriatic coast and western Black Sea shores had been an active trading route during the Roman Empire. Since the break-up of the U.S.S.R. and transition of central and eastern European nations to market-oriented economies, this corridor has been recognized by the European Union as an effective means of achieving economic integration within the region, as well as between the South Balkan region and neighboring regions.

The Pan-European second Transport Conference held in Crete between March 14 and 16, 1994, designated the East-West Corridor as one of the nine priority transportation corridors of Europe. The Conference Declaration emphasized the need for social market economy and free and fair competition; development of sustainable mobility while respecting environmental protection; compatibility of institutional, regulatory, and administrative frameworks to ensure a coherent transport system across Europe; facilitation of transit at border points; reduction of obstacles and delays; coordination in the planning and financing of trans-European networks and transport infrastructure to ensure interoperability and interconnection; and geographically balanced development between central and peripheral regions.

Recognizing the importance and potential for the East-West Corridor, the governments of Italy, Albania, Macedonia, Bulgaria, and Turkey executed a Memorandum of Understanding (MOU) on February 18, 1994, in Sofia confirming their commitment and willingness to put their efforts together in connecting Durres to Varna and Burgas. The signatories to the MOU noted that this project is of utmost interest and would be a substantial contribution to the development of transport infrastructures in the Black Sea Economic Cooperation Agreement region, the membership of which extends to the Caspian region.

The strategic importance of the East-West Corridor has been reiterated and confirmed in subsequent conferences and bilateral meetings notably, and most recently, the Black Sea Conference in Kiev in May 1997, and the Meeting of the Ministers of Transport for the Development of the Corridor VIII – Asia Transcontinental Link held in the Bulgarian Port of Burgas September 1-3, 1997.

The region's strategic importance must be viewed from the larger context of transport and trade developments within and outside the region. These include the proposed construction of a trans Balkan oil pipeline paralleling the East-West Corridor.

1.5 DEVELOPMENT OF AN INTEGRATED CORRIDOR TRANSPORT PLAN

The economic and strategic significance of the East-West Corridor mandates that a unique approach to its development be adopted. This unique approach departs from the traditional basis of project justification that is demand driven and relies more on the provision of modern well equipped port gateways on the Black and the Adriatic seas connected by transcontinental highway and railway corridors that meet international and European standards.

1.5.1 Objectives of the East-West Corridor Development

The overall objective of the East-West Corridor Plan is the development of a safe, continuous, operationally efficient transport corridor that conforms to the applicable European and international design standards. Such an objective needs to be translated in spatial terms, in physical terms, and in diurnal terms. The specific spatial components of the corridor presented in this report comprise the following:

- The Ports of Burgas and Varna serving as the Black Sea shipping gateways to the corridor
- Northern, central, and southern highway and railroad routes that link the port cities of Varna and Burgas with the city of Sofia
- A main highway and railroad route between the cities of Sofia and Skopje
- A northern and a central highway and railroad routes between the city of Skopje and the Albanian border
- A main highway and railroad route between the Macedonian/Albanian borders and the capital city of Tirana and the port cities of Durres and Vlore
- The Ports of Durres and Vlore serving as the Adriatic Sea shipping gateway to the corridor

In physical terms, the provision of a world class corridor translates into:

- Modern and well-equipped ports that can adequately and efficiently handle all types of commodities, including containerized traffic
- Highway routes that conform to the Trans-European Motorway (TEM) design standards; that are completely access-controlled and with cross-sections that include at least two lanes in each direction and profiles that have a maximum grade of 6 percent or less
- Railroad routes that conform to the International Union of Railroads (UIC) standards for intercontinental trunk lines

In terms of time, three time frames have been designated for the implementation of the improvement program:

- A short-term action time frame that spans the period between 1998 and 2003

- An intermediate-term strategic time frame between 2003 and 2010
- A long-term vision time frame between 2010 and 2020

1.5.2 Technical Approach to Corridor Development

Each transport sector on the East-West Corridor (highways, railroads, and ports) has a unique development history, spatial characteristics, growth potential, competitive advantages and disadvantages, developmental requirements, and financial (financing) requirements (constraints) for operation and capital improvement. As such, a unique and tailored approach has been developed for the identification and development of future improvement requirements for each sector.

Underlying assumptions have been made in this study about how transport demand in the corridor will grow as the economies of Albania, Macedonia, and Bulgaria develop. These assumptions are well rooted in the experience of other European countries. A straight-forward methodology was used to factor traffic demand for highways, and to assume capacity and design improvements needed for railways and the development of ports. The methodology is based on strategic objectives and realistic optimism, regarding the importance of the South Balkan countries in terms of economic potential as stability is sustained in the region, domestically, regionally, and internationally.

The study effort has recognized the simple fact that economic development along the East-West Corridor is interdependent on the strategic and phased improvement to infrastructure, primarily transportation systems. This study outlines the specific transportation improvements to meet immediate capacity needs and long-term "vision" of the corridor over a 20-year time frame. It is consistent with the direction and emphasis placed upon the corridor in other recent independent studies. It comprehensively presents the immediate, strategic, and long-term improvement framework that must be implemented to make the vision a reality.

Following is a summary of the development approach for each sector:

Highways

The following multi-step approach has been formed for the development of highway improvement needs:

1. Identify highway improvement requirements that emanate from capacity constraints in the short-, intermediate-, and long-terms. Improvements accomplished in a specific time frame are carried over to the following time frame.
2. Superimpose on the above, improvements that realize the strategic objectives of the East-West Corridor development in accordance with the justification criteria outlined in Section 2.1.
3. Adjust improvement projects within each time frame to take into consideration on-going national plans, priority designation discussed above, and coordination between the three member countries' plans.

Railroads

The method adopted for the development of the railroad improvement program relies mainly on the realization of the strategic objective of the East-West Corridor; that is to develop an efficient, safe, continuous rail route that conforms to International Union of Railroads (UIC) standards. Railroad improvement projects have been identified in accordance with this strategy.

Ports

Master plans for the improvement and expansion of the ports of Varna, Burgas, and Durres have been recently developed. The Port of Vlore will soon be the subject of a master planning effort for its development as well. The Bechtel team has packaged individual components of these master plans and grouped them for implementation within each of the three identified time frames.

1.5.3 Future Transport Development Time Frame

Implementation of future transport improvement programs along the East-West Corridor has been grouped into one of three time-frames:

1. **A Short-Term Time Frame (1998-2003)**. Projects to be implemented within this time frame would have the following characteristics:
   - Relieve obvious capacity bottlenecks within the transport "pipeline" linking the Black Sea ports with the Adriatic Sea ports.
   - Enhance operational safety features of various transport links along the corridor.
   - Put in place important strategic building blocks towards the realization of an efficient, safe, continuous international East-West Transport Corridor.
2. **An Intermediate Term Strategic Time Frame (2003-2010)**. Projects selected for implementation within this time frame would have the following characteristics:
   - Complete a primary highway route conforming to international design standards that links the Ports of Varna and Burgas on the Black Sea with the Ports of Durres and Vlore on the Adriatic Sea
   - Provide a continuous rail/highway primary link between the Black and Adriatic seas using intermodal transfers to bridge the missing rail links along the corridor
   - Provide modern container terminals in at least one port on each sea
   - Add strategic building blocks towards realization of the corridor's objectives
3. **A Long-Term Vision Time Frame (2010-2020)**. Characteristics of projects slated for implementation within this time frame include:
   - Complete at least one secondary highway route linking the east and west ports of the corridor
   - Provide a primary and continuous railroad link between the two ports on the Black Sea and the two ports on the Adriatic Sea

- Implement full-service, modern, and efficient ports at Varna, Burgas, Durres, and Vlora

1.5.4 Prioritization of East-West Corridor Improvement Projects

The physical conditions of the transport facilities comprising the East-West Corridor vary considerably and are explained in detail in Volume 1 of this report. It is obvious that substantial investment in new improvement projects will be required to bring up these conditions to the levels stipulated in the overall objective of the corridor development. Limited resources however dictate that a measure of prioritization be introduced that can be used to match improvement projects with available resources.

Prioritization in this context addresses allocation of defined and limited resources to one of a number of alternative projects along the East-West Corridor. Bechtel recommends, however, proceeding with master plan development; assessment of technical and financial feasibility for specific projects; and necessary rehabilitation, modernization, and improvement projects for all segments of the Corridor, regardless of priority ranking.

Ideally, project prioritization should be based on detailed analysis of financial viability, economic soundness, functional role in the overall transport infrastructure, and the project's contribution to the achievement of the strategic objectives of the East-West Corridor. The following criteria are presented to help guide the prioritization process:

Financial Viability and Financing

- Projects than can be financed by the private sector
- Projects that can be financed through outright grants from donor countries and organizations
- Projects that can be financed through public/private partnerships without placing any additional claims on the debt capacity of national governments
- Projects that can be financed through user charges.

Economic Soundness

- Projects with positive benefit/cost ratios
- Projects with significant job creation potential
- Projects with significant impacts on economic development

Functional Role in the Transport Network

- Completion of projects currently under way
- Projects that promote traffic safety
- Projects that relieve existing serious capacity bottlenecks.

Contribution to the Corridor's Strategic Objectives

- Projects that help achieve the strategic objectives of the development of the East-West Corridor
- Projects that provide for a continuous uninterrupted corridor
- Projects that link the region with trade partners, particularly in the Middle East and Central Asia

Information available and developed through the course of this study do not permit prioritizing individual projects for each mode of transport and for each of the three member countries. As each group of the recommended projects undergo due diligence, prioritization ought to be addressed, at each country's level, then coordinated through the SBDI Coordinating Group for the three member countries.

Based solely on achieving the strategic objectives of the East-West Corridor, the major facilities and transport links have been prioritized as follows:

First Priority

- The Port of Burgas as the primary Black Sea gateway to the corridor.
- The Port of Durres as the primary Adriatic Sea gateway to the corridor
- The highway and railroad routes that link Varna, Burgas, Orizovo, Kapitan Andreevo, Plovdid, Sofia, Gyueshevo, Kumonovo, Skopje, Kicevo, Ohrid, Kafasan, Elbasan, Tirana, Durres, and Vlore as the primary highway and railroad routes.

Second Priority

- Port of Varna as the second Black Sea gateway to the corridor
- Port of Vlore as the second Adriatic Sea gateway to the corridor.
- The northern highway and railroad routes that directly link Varna with Sofia and the rest of the corridor

Third Priority

- The central highway and railroad routes that link the Port of Burgas with Sofia and the rest of the corridor.

1.6 CORRIDOR IMPROVEMENT PROJECTS

Following is a summary of the major projects recommended for implementation along the East-West Corridor during the short-, intermediate-, and long-term time frames.

1.6.1 Short-Term Projects – 1998-2003

1.6.1.1 Short-Term Highway Projects

Albania

- Construct 4-lane motorways on a separate alignment, parallel to the following highway segments:
  - Durres - Vore (25 km)
  - Tirana - Elbasan (38km)
- Increase capacity by expanding the following segments of 2-lane highways into 4-lane expressways:
  - Durres - Ndog - Tirana (41 km)
- Increase capacity and safety conditions by rehabilitating the following highway segments to meet international standards for 2-lane highways:
  - Durres - Rrogozhine - Elbasan (83 km)
  - Rrogozhine - Fier (49 km)
  - Kafasan - Pogradec (16 km
  - Elbasan - Kafasan (71 km)

Macedonia

- Widen and upgrade existing 2-lane highway into a 4-lane motorway:
  - Skopje - Tetevo (36 km)
- Increase capacity by widening the following segments of 2-lane highways into 4-lane expressways:
  - Pogradec - Ohrid (30 km)
- Upgrade the following highway segment to meet international standards for 2-lane highways:
  - Titov Veles - Prilep (73 km)
- Construct a new standard 2-lane highway at an elevation higher than that of existing alignments:
  - Kriva Palanka - Deve Bair (11 km)

Bulgaria

- Construct 4-lane motorways on a separate alignment, parallel to the following highway segments:
  - Varna - Burgas (87 km)
  - Orizovo - Kapitan Andreevo (108 km)

- Increase capacity by widening the following segment of 2-lane highways into 4-lane expressways:
  - Karnare - Kazanlak (60 km)

1.6.1.2 Short-Term Railway Projects

Albania

- Renew existing track and structures, and implement radio block communication system for the following railway sections:
  - Durres - Rrogozhine - Pogradec (156 km)
  - Rrogozhine - Vlore (86 km)
  - Build a new rail line between Lin and the Macedonian Border (2.6 km)

Macedonia

- Complete the construction of the rail line between Beljakovce and the Bulgarian border (55 km)
- Reconstruct the section of railway between Kumanovo and Beljacovice (31 km)
- Implement radio block communications systems between D. Petrov and Kicevo
- Build a TTOF (intermodal terminal on the Macedonian/Albanian border); a distance of about 1.4 kilometers

Bulgaria

- Complete double track on railway sections between Sofia - Radomir (7 km), and between Stara Zagora - Zimnica (61 km)
- Install automatic block signal system between Sindel and Varna (35 km)
- Upgrade track on section of railway between Sofia, Mazdra and Varna (61 km)
- Build a new rail line between Gyueshevo and the Macedonian Border (2.5 km)
- Re-align railway, complete trackwork, install automatic block signal system and electrify line between Plovdiv and Svilengrad (143.8 km)

1.6.1.3 Short-Term Port Projects

Albania

Port of Durres

- Modernize physical facilities – rehabilitate operational areas, and relocate administration buildings
- Improve protection and safety standards – rehabilitate breakwater, re-align and widen access channel
- Construct a new passenger ferry terminal

Port of Vlore

- Develop a comprehensive master plan
- Upgrade and modernize facilities and equipment

Bulgaria

Port of Burgas

- Build and expand Terminal 1 – general and liquid cargoes
- Build and expand Terminal 2 – bulk cargoes
- Build and expand Terminal 3 – ro-ro ferry terminal
- Construct new Terminal 4 – container terminal

Port of Varna

- Consolidate facility capacity into passenger ferry and container terminal operation
- Expand facilities through addition of grains terminal and other improvements
- Upgrade and rehabilitate the Varna breakwater
- Dredge Channel 2 to a depth of 12.5 meters

1.6.2 Intermediate-Term Strategic Projects - 2003-2010

1.6.2.1 Intermediate-Term Highway Projects

Albania

- Construct 4-lane motorways on a separate alignment, parallel to the following highway segments:
  - Durres - Rrogozhine (39 km)
  - Rrogozhine - Kafasan (106 km)
  - Rrogozhine - Vlore (83 km)
  - Kafasan - Pogradec (16 km)

Macedonia

- Construct 4-lane motorways on a separate alignment, parallel to the following highway segments:
  - Gostivar - Podmolje (99 km)
  - Podmolje - Pogradec (35 km)
  - Kumanovo - Deve Bair (79 km)
- Upgrade the following highway segment to meet international standards for 2-lane highways:

- Titov Veles - Bulgarian Border (128 km)

Bulgaria

- Construct 4-lane motorways on a separate alignment, parallel to the following highway segment:
  - Burgas - Orizovo (190 km)

1.6.2.2 Intermediate-Term Railway Projects

Albania

- Upgrade signalling system to centralized traffic control system between Durres and Pogradec

Macedonia

- Install automatic block signal and centralized traffic control systems between Komanovo and the Bulgarian border (86 km)
- Install automatic block system between D. Petrov and Kicevo, and extend centralized traffic control system from Skopja to Kicev (86 km)

Bulgaria

- Re-route and re-rail locally between D. Petrov and Kicevo
- Complete double track (7 km) and install centralized traffic control, and automatic block signal systems between Sofia and Radomir
- Install centralized traffic control, and automatic block signal system between Plovdiv and Burgas (290 km)
- Reconstruct and upgrade line, and install centralized traffic control and automatic block signal systems between Gyueshevo and Radomir
- Re-align track, install new rail, and re-space ties between Sofia and Plovdiv
- Continue the project to renew track, electrify line, and install centralized traffic control and automatic block signal systems between Plovdiv and Svilengrad-143.8 km

1.6.2.3 Intermediate-Term Port Projects

Albania

Port of Durres

- Design and construct a new 140 meter quay
- Design and construct a new 670 meter, 11.5 meter deep quay
- Reconstruct navigational channel, to 12.5 meter deep, 60-80 meters wide, and 4.8 km long

- Design and contruct an international container terminal

Port of Vlore

- Implement phased development of the port according to master plan

Bulgaria

Port of Varna

- Build new container terminal at Varna Lake site.

Port of Burgas

- Continue with implementation of master plan

1.6.3 Long-Term Vision Projects – 2010-2020

1.6.3.1 Long-Term Highway Projects

Albania

- Complete motorway construction program started during the intermediate time frame
- Continue with highway upgrading and modernization to meet service requirements

Macedonia

- Construct 4-lane motorway on a separate alignment, parallel to the following highway segment:
  - Ohrid - Titov Veles (187 km)

Bulgaria

- Construct 4-lane motorway on a separate alignment, parallel to the following highway segment:
  - Dupinitza - Macedonian border (55 km)

1.6.3.2 Long-Term Railway Projects

Albania

- Upgrade signalling system to centralized traffic control between Durres and Vlore and between Rrogozhine and Pogradec
- Electrify line between Durres and Lin

Macedonia

- Electrify line between Gyueshevo - Skopje - Kicevo - Kafasan.

- Install centralized traffic control and automatic block signal system between Kumonovo and the Bulgarian border, and between Skopje and Kicevo.
- Construct new line between Kicevo and Kafasan (65 km)

Bulgaria

- Upgrade the remainder of corridor lines to UIC standards

1.6.3.3 Long-Term Port Projects

Albania:

Port of Durres

- Develop commercial opportunities on port properties/services.

Port of Vlore

- Develop commercial opportunities on port properties/services

Bulgaria:

Port of Burgas

- Develop commercial opportunities on port properties/services.

Port of Varna

- Develop commercial opportunities on port properties/services.

1.7 COST ESTIMATE FOR IMMEDIATE ACTION PROJECTS

Order of magnitude cost estimates have been assembled for short term action projects and are presented in Section 7 of this report. Table 1-1 is a summary of these estimates by mode of transport and by country.

Table 1-1
Short-Term Projects
Estimated Cost by Country, Mode, and Total
(Million US$, 1997)

	Highways (US$ M)	Railways (US$ M)	Ports (US$ M)	Total (US$ M)
Albania	456	85	100	641
Macedonia	229	266	-	495
Bulgaria	645	386	421	1,452
Total	**1,330**	**737**	**521**	**2,588**

1.8 FINANCING OPTIONS

Financing options identified for the implementation of the recommended projects include:

- Public financing through the establishment of a transport trust fund or directly through national budget allocation
- Private financing through granting concessions to build, operate, and transfer to the government specific transport facilities
- Public/private partnerships through the formation of special purpose transport authorities, and the institution of shadow tolling schemes, or granting of operating concessions.
- Direct borrowing from international financial institutions, commercial banks, and/or other governments
- Grants from donor countries

The selection of one or more of the above financing options will need to be made for any specific transport project along the East-West Corridor in consideration of the following features:

- Mode of transport and the unique requirements of highways, railways, and ports
- Engineering features which may require special services and equipment
- Financial viability of the project to attract equity partners
- Economic viability to spur business activity in a region
- Strategic significance in serving the broader corridor needs
- Operational performance of existing sector infrastructure

1.9 NEXT IMPLEMENTATION STEPS

The following next steps are recommended for immediate consideration by the SBDI Coordinating Group in order to further the development of the East-West Corridor:

1. Engage a Financial Advisor to develop specific financing proposals for the implementation of the immediate action projects for each of the three member countries.
2. Consider the formation of a public/private transport authority as the vehicle for the implementation of each country's motorway program.
3. Commission the following specific prefeasibility studies:
    - Linkage of Albania and Macedonia railroads and the provision of a TOFFC inter-modal transfer terminal on the Macedonian side
    - Assess Albania's existing transport infrastructure, particularily relating to the connectivity of the Ports of Durres and Vlore to the East-West Corridor
    - Rehabilitation, upgrading, and electrification of the Plovdiv - Svilengrad railway route
    - Prioritization of development projects at the Port of Varna

4. Commission the following specific feasibility studies:
   - Rehabilitation of the Durres - Lin railway (feasibility study underway)
   - Technical and financial feasibility of the Tirana - Elbasan motorway and railroad route
   - Rehabilitating and widening of the highway sections between Durres - Tirana, Durres - Rroghozine, and Rroghozine - Fier to standard 2-lane highways
   - Development of the Port of Burgas Container Port - Terminal No. 4.
5. Commission the following specific master planning studies:
   - Updated master plan for the Port of Durres
   - Development of a new master plan for the Port of Vlore
6. Commission preliminary engineering and final design work for the following projects:
   - Titov Veles - Prelip highway
   - Varna - Burgas motorway
   - Orizovo - Kapitan Andreevo motorway
   - Development of Terminals Nos. 1, 2, and 3 at the Port of Burgas
7. Complete the following construction projects:
   - Rehabilitation of the Durres - Tirana - Elbasan - Kafasan highway
   - Construction of the Kriva Palanka - Deve Bair highway
   - Construction of the Beljacovice - Bulgarian border railway
   - Rehabilitation of the Kumanovo - Beljakovce railway
   - Construction of the Gyueshevo - Macedonian border railway
8. Begin construction on the following projects:
   - The Port of Durres rehabilitation and modernization project
   - The Port of Durres passenger ferry terminal
   - Skopje - Tetevo motorway

1.10 COVERAGE OF VOLUME 1

Volume 1 of the East-West Corridor Feasibility Study summarizes and synthesizes the physical, operational, and institutional conditions of transport routes and terminals comprising the corridor. It is based on a careful review of more than 40 recent documents and reports addressing various elements of the corridor from the planning and engineering viewpoint. A listing of these documents is provided in Appendix A. The report is also based on the Bechtel team's field visits and interviews of transport officials in Bulgaria, Macedonia, and Albania. Transport routes and terminals visited include: the highways connecting Sofia with the ports of Varna and Burgas; the highway connecting Sofia, Skopje, and Ohrid to the Albanian border; railway construction sites between Kumonovo and the Bulgarian border;

and the ports of Varna, Burgas, and Durres. Due to the civil unrest in Albania, no site visits were conducted for the highway and rail routes south and east of Tirana.

In addition, the Bechtel team interviewed several of the transportation officials and operators of Bulgaria and Macedonia in the highway, railroad, and port fields. Information was also sought from representatives of other U.S. and international organizations active in the South Balkan region. A listing of those officials and representatives is provided in Appendix B.

1.11 COVERAGE OF VOLUME 2

Volume 2 presents the planning framework for the development of the East-West Corridor, traffic forecasts for all highway routes along that corridor, and the process by which transport improvement projects are identified, selected, and prioritized. This volume also includes an order of magnitude cost estimate for the immediate action (short-term) projects and options for financing them.

Section 2 Framework for Improving Corridor Transport

This section presents a framework for the justification and the identification of transport improvement projects along the East-West Corridor. It starts with a proposed reasoning for the justification of transport infrastructure improvements. Then it presents an overview of an integrated plan for the development of the East-West Corridor. The final section presents the proposed time frames for packaging specific transport improvement projects within the overall strategic plan.

2.1 JUSTIFICATION FOR IMPROVEMENT OF TRANSPORT INFRASTRUCTURE

Improvement of transport infrastructure includes physical, operational, institutional, and regulatory elements. This section focuses on the physical elements which include either the addition of new facilities or the expansion and structural enhancement of existing facilities.

Transport infrastructure improvements can be justified for one or more of the following reasons:

- Imbalance in demand/capacity relationship; that is when existing traffic demand (or anticipated future demand) exceeds present transport capacity or supply
- Meeting reasonable safety standards that correspond to the function and classification of the transport facility
- Conformance to international and European design standards
- Ensuring transport corridor continuity
- Achieving specific strategic objectives

A brief discussion of each of the above reasons with specific reference to the East-West Corridor follows.

2.1.1 Demand Based Needs - Imbalance in Demand/Capacity Relationship

Imbalance in the demand/capacity relationship is the most common reason for improving transport infrastructure.

Demand/capacity relationships are normally measured in terms of the desired quality of transport service along the transport facility. Quality of transport service ranges from excellent (level of service of "A") to extremely poor (level of service of "F"). Transport literature offers exhaustive definitions and limitations of such terms as demand, capacity (or supply), and level of service for various transport facilities. These will not be repeated here but will be implicitly used in the analysis.

The Bechtel team's field visits as well as information collected from various sources in the region indicate that there are few existing capacity constraints on most of the transport facilities along the East-West Corridor. Various segments of these facilities had previously handled, in an adequate fashion, much more traffic in the 1989/1990 time frame than is currently being handled. As a result of the political and economic problems that plagued the region during the early '90s, traffic has been declining on most of the regions' transport facilities, including roads, railways, and ports. Traffic levels on many of these facilities bottomed out during 1994/1995 and in many instances, have recently started to trend upward.

The Port of Burgas is an example where the volume of traffic for 1996 has indeed matched the level achieved in 1989.

There are some existing bottlenecks on certain transport facilities, especially as transport routes enter and leave large cities (such as Skopje, Sofia, and Tirana) and mix with heavy local traffic.

Future demand/capacity imbalances can only be measured once future traffic demands are estimated for various modes of transport. This is addressed in the following section. It is important to note though that needed transport improvements can be implemented in the short, intermediate, or long term depending on the degree, timing, and type of future demand/capacity imbalance.

The methodology used in forecasting traffic along the corridor will depend on work already accomplished in this area as well as on the level of detail and coverage of collected information. The objective is to make forecasts somewhere between pessimistic and optimistic alternatives.

The philosophy behind the forecasting methodology will depend on whether improvements along the corridor correspond to a "demand" or a "supply" strategy.

A demand strategy implies that existing transport facilities are overly crowded and can not accommodate existing and likely future demands and that new and/or improved facilities will be provided to accommodate this *proven demand.* A supply strategy, on the other hand, assumes that existing transport facilities, while in poor physical and operating conditions, are not fully utilized. The mere provision of improved facilities will create demands either by opening up previously inaccessible areas, improving economic productivity, and/or reducing the cost of transport. Observations and information collected thus far for the region indicate that a supply strategy will be prevalent along the east-west corridor.

2.1.2 Meeting Safety Standards

Regardless of the traffic level that a transport facility is called upon to handle, such a transport facility should have minimum safety standards that ensure the safety of all its users. Minimum safety standards correspond to the characteristic, function, and classification of the transport facility.

Safety standards address a diverse array of features that range from such simple elements as striping, markings, and installation of safety and warning signs to complex elements such as re-routing a transport facility around a town or a village to avoid pedestrian conflicts and other safety concerns. Careful reconnaissance and surveys of transport facilities are needed in order to spot safety violations and omissions of safety features and to prescribe the right treatment for each situation.

During Bechtel's reconnaissance of the East-West Corridor facilities, several categories of safety concerns were noted that need immediate action. Some of these concerns are receiving adequate attention from responsible transport agencies in the region. It is important that transport improvements be justified on the basis that they enhance the safety performance of transport facilities, regardless of the present or anticipated future traffic levels on the facility.

2.1.3 Conformance to International and European Design Standards

The United Nations – Economic Commission for Europe Initiative (U.N. – ECEI) designated both Trans-European Railway (TER) and Trans-European Motorway (TEM) networks that serve as the main transport arteries in Europe. These networks link the main political, industrial, and service centers of all European countries with each other and form continuous corridors that criss-cross the continent east to west and north to south. Some routes in each of these designated networks also link Europe with other regions in Asia and the Middle East. In order to ensure design uniformity and high operating standards in all routes comprising these international corridors, the U.N. – ECEI established a set of minimum technical standards to be targeted for achievement (in the short term) by all European countries (and especially in Central and Eastern Europe) in the design and construction of various routes along these corridors. These minimum criteria and standards are generally independent of the level of traffic carried on these routes and are intended to streamline transport operation and performance. For motorways, these criteria and standards cover such issues as geometric design standards that include maximum gradient, minimum curvature, minimum number and width of lanes, necessity of grade separation, minimum vertical clearances, etc. For railways, they cover such design elements as nominal minimum speed for passenger and freight trains, maximum axle loads, minimum weight and strength of rail, geometric characteristics, grade crossings, minimum design elements for passenger stations, etc.

Several routes on the East-West Corridor (Corridor No. 8) have been designated part of the TER or the TEM. These routes will have to be upgraded to conform to the European standards in order to meet the objectives of the European Transport Network Program. Again, such minimum upgrades will have to be performed regardless of the level of traffic that the transport facility is called upon to handle.

Another (more stringent) set of technical standards for railroads has been established and published in the European Agreement on Main International Railway Lines (AGC - Annex II) and the European Agreement on Important Combined Transport Lines and Related Installation (AGTC - Annex III and IV). These agreements have been signed by Bulgaria and Macedonia, as long-term objectives for their respective railway networks.

2.1.4 Ensuring Transport Corridor Continuity

A designated international or regional transport facility must be continuous between its intended origin and destination in order to fulfill its function. Moreover, such a facility must offer a consistent quality of service along its entire length. For example, a ferry link (across a river) along a motorway that is designated part of the TEM network should be bridged with a permanent structure even though the short-term economic justification for such a bridge may not be up to par.

An example of a discontinuous route along Corridor No. 8 is the railway route linking the ports of Varna and Burgas with the Port of Durres. This route is discontinuous at two locations; between the Bulgarian town of Gyueshevo and the City of Kumonovo in Macedonia (a distance of 60 km) and between the city of Kicevo in Macedonia and the Albanian border town of Lin (a distance of about 65 km). Building these two segments of this rail line is necessary to maintain the continuity of the rail route along the corridor.

2.1.5 Achieving Specific Strategic Objectives

Transport improvements are implemented in many parts of the world to achieve specific strategic objectives that are believed vital to the political and economic security of a country or a region. The designation of the East-West Corridor as an internationally important corridor was a direct response to specific strategic objectives in the region that resulted from the U.N. blockade of certain international transport routes serving the South Balkan region.

There is an implied hierarchy in advancing a specific reason or reasons to justify transport facility improvements. Since funds for transport improvements are limited, it is important to prioritize the implementation of candidate projects, considering among other criteria the above-discussed reasons. Obviously, safety comes first since safety improvements could save lives and property. Next to safety is the relief of existing bottlenecks that result from demand/capacity imbalances. Next to that is the conformance to European and international design standards. Corridor continuity and meeting strategic objectives occupy the fourth and fifth place interchangeably and in many instances could be interdependent. Sometimes, using one reason to justify certain improvements could answer all concerns raised by all the other reasons. For example, upgrading an existing two-lane rural highway to a full fledged four-lane controlled-access motorway (reason: to conform to U.N. – ECEI standards for TEM networks) would meet many other criteria as well. It would answer any safety concerns on the existing road, provide enough capacity to meet future demands, meet a country's strategic objective, and help provide corridor continuity.

2.2 FRAMEWORK FOR CORRIDOR DEVELOPMENT

The economic and strategic significance of the East-West Corridor No. 8 requires a unique approach to its development. This unique approach departs from the traditional basis of project justification that is driven by demand and relies more on the provision of modern well-equipped port gateways on the Black and the Adriatic seas connected by transcontinental highway and railway corridors that meet international and European standards. In physical terms, the provision of a world-class corridor translates into:

- Modern and well equipped ports that can adequately and efficiently handle all types of commodities, including containerized traffic.
- Highway routes that conform to the Trans-European Motorway (TEM) design standards; which is completely access-controlled and with a cross section that includes at least two lanes in each direction and a profile that has a maximum grade of 6 percent or less.
- Railroad routes that conform to the International Union of Railroads (UIC) standards for intercontinental trunk lines.

Three highway and railroad routes in parts of Bulgaria and two highway and railroad routes in parts of Macedonia, in addition to one set of routes in Albania, have been identified that constitute the elements of Corridor No. 8 (see Figures 1-1 and 1-2). Due to the scarcity of resources, it is obvious that bringing up these routes to the desired standards has to be scheduled in terms of time and space.

In terms of time, three time frames have been designated for implementation of the corridor improvement program:

- A short-term immediate action time frame that spans the period between 1998 and 2003
- An intermediate strategic time frame between 2003 and 2010
- A long-term vision time frame between 2010 and 2020

In terms of space, a primary highway and a primary railroad route have been designated within the corridor that should receive priority attention of the three member governments. The year 2010 has also been targeted as the year when these primary routes are upgraded to the desired international standards. The year 2020 has been designated as the target year for completing improvements to the rest of the corridor routes.

In the case of the four ports of Varna, Burgas, Durres, and Vlore, the year 2020 has been designated for the realization of the master plans developed for Varna and Burgas and are under development for Durres and Vlore.

This section presents a summary of issues and methods used to forecast transport demand for the East-West Corridor. First, a brief overview is presented of the forecast methods applied in other recent studies in the South Balkan countries. Then, factors affecting transport demand by mode are discussed. Finally, the specific methodology used to forecast transport demand for the roadway sector in the East-West Corridor is discussed, including a summary of statistical analysis performed to validate the use of the traffic growth rates.

Understanding the forecast methodology is vital to a discussion of highway improvements identified to meet needed capacity, as presented in the next section of the report.

3.1 PREVIOUS CORRIDOR FORECASTS

The preceding section outlined five reasons for improving transport infrastructure in the South Balkan region. The first reason is the imbalance between supply and demand of transport facilities. Supply of transport facilities is easily measured and quantified. Existing traffic demands, likewise, can be compared against supply by observation and measurement. By contrast, future traffic demand is an unknown quantity that must be forecasted based on reliable methods.

Over the past several years, the Balkan region has endured internal as well as external hardships that negatively affected each of the three countries' economies as measured in their economic output or Gross National Product (GNP). The negative GNP growth was the culmination of negative growth in general economic activities, industrial and agricultural production, import and export activities, and private/public investments. This has resulted in fluctuating patterns in the volume of transport movements as well as in the level of performance of transport entities throughout the region.

Fluctuation in transport volume in the region renders future traffic forecasting extremely difficult. This has been reflected in many of the regional and country specific studies that have been carried out by various consultants over the last few years. These studies employed different methods in forecasting future traffic demands:

- a "global method" (i.e., transport movements for an entire mode not broken down by route or segment of a route)
- a "bandwidth method" (i.e., bracketing traffic forecasts within bandwidths that correspond to threshold capacities of various classes of transport routes)
- an "index method" (i.e., assigning a specific year an index of 100 and relating future years to that index)

A recent forecast analysis for the South Balkan region was prepared by the consulting firm Gibb Limited as part of the *Balkan Transport Study*, completed in July 1997. The Gibb forecast was based on a well thought-out methodology which considered local and international traffic movements. Traffic forecasts for various corridors in the region were expressed in three bandwidths showing the capacity breakpoints for single carriageway, wide single carriageway (used in the UK but not in the region) and two-lane dual carriageway. Although this approach helps identify potential bottlenecks and the need for future widening of specific roads, it does not allow the financial analysis of these projects as privatized "tollway" ventures. Rather, one must develop specific forecast numbers for various segments of a road in order to evaluate the financial and economic performance of the entire roadway.

The *Bonifica Report* prepared in September 1996, for the Bulgarian Transport System, developed traffic forecasts for the road and rail network of Bulgaria. An "all-or-nothing" method was used, which assigns all the transport demands to the minimum paths based on travel time. Low and high traffic forecasts (with a considerable wide range in between) were developed for the year 2010 for main segments of both networks. The forecasts were considered an initial approximation of the maximum demand that can be placed on a certain transport facility. The forecasts were expressed in number of passengers and tons of freight on each main segment of the road and rail network. They were not translated, to Bechtel's knowledge, to vehicular and train movements that can be used to measure any future demand/capacity imbalances to identify the need for specific transport improvements. Therefore, these forecasts are not considered an appropriate yardstick to evaluate the financial and economic justification for any specific transport project.

3.2 FACTORS AFFECTING EAST-WEST CORRIDOR TRANSPORT DEMAND

Ideally, a comprehensive forecast analysis should include the definition of the types of traffic handled along the East-West Corridor. Below are the four categories into which the types of traffic fall:

- Domestic traffic whereby both origin and destination of a trip are within the boundary of one country
- Regional traffic whereby the origin of a trip is in one country and the destination is in another country
- International traffic whereby either the origin or the destination of a trip is in one of the three countries in the South Balkan region, and the other end of the trip in a country outside the South Balkan region
- Through traffic whereby both ends of the trip are in a country outside the South Balkan region but with the route of the trip going through one or more of the three countries in the region.

Transport patterns and future traffic volumes in the region cannot be analyzed on an individual country basis or even on a regional basis. They must be evaluated in the context of the European-Asian trade and other international trade patterns that pass through the corridor.

Consideration should be given to the excellent strategic location of the region in accommodating these trade patterns. Major factors that should influence future transport demand in the East-West Corridor include:

- The Ports of Duress and Vlore as important gateways on the Adriatic Sea not only to the countries of the region but also to central and eastern Europe.
- The excellent overland connection, passing through Bulgaria and Macedonia, between Europe on one side and Turkey, the Middle East, and many parts of Central Asia on the other.

- The potential of the Port of Burgas as a container superport, receiving third and fourth generation containerships and transferring loads onto smaller containerships that would call at smaller ports in the Black Sea region.
- The role of the Port of Varna in handling train ferry movements between Europe and countries of the Central Asian republics.
- Strategic locations of Sofia and Skopje as the crossroads between east-west and north-south transport routes, as inter-modal container transfer centers.

Many other factors will affect transport demand in the East-West Corridor. Today, the majority of all traffic on both the highway and railroad routes of the East-West Corridor is domestic traffic. Regional and international traffic constitute a relatively small percent of total traffic, especially in Macedonia and Albania. However, segments of the corridor constitute important links with international corridors, such as the highway and railroad segment between Kapitan Andreev and Sofia that links Central Asia and the Middle East, with central and western Europe.

In the future, domestic traffic is expected to continue to be the dominant type of traffic in the East-West Corridor. Within each country, levels of domestic traffic and its growth potential are highly sensitive to:

- Spatial distribution of economic activities around the country
- Regional specialization and interdependencies of economic activities
- Location and size of major population centers
- Vehicle ownership levels

Regional traffic will assume greater significance in the future in linking Albania, Macedonia, and Bulgaria with the outside world through sea transport. Future growth of regional traffic is dependent on:

- The level of economic and social cooperation between the three countries
- The simplification of border crossing procedures
- The realization of the Ports of Varna and Burgas on the Black Sea and the Ports of Durres and Vlore on the Adriatic Sea becoming true gateways to the South Balkan countries

International and through traffic will likewise assume greater significance in the future in linking Albania, Macedonia, and Bulgaria, with the outside world through land and sea transport. Future growth of international and through traffic will be influenced by:

- The realization of important international connections such as the Bosphorous rail tunnel and the Bulgaria-Romania Bridge at Vidin
- The provision of adequate capacity
- The upgrading of safety standards
- The conformance to international design standards
- The simplification and facilitation of border crossing procedures in terms of cost and time of passage

- The provision of adequate road services and amenities

All of the above factors will contribute to a reduction of travel time and cost, and an increase in the competitiveness of this international corridor in comparison with other competing corridors. Different sections of the East-West Corridor will experience traffic growth at different rates, particularly due to the impacts of regional and international traffic. Highway traffic may grow faster at the beginning, then fall off after opening rail connections. Traffic growth along certain segments of the corridor will also depend on improving and adding new capacity to the ports.

In view of the complexity and interdependency of the above issues, there is a need to develop comprehensive and non-traditional economic and transport forecasting methods to address the movement of regional goods and markets. These techniques will take into consideration the "quantum leap" or growth that is expected to occur in central and eastern Europe, as well as in central Asia, and offer competitive routes and terminals that can capture a fair share of these markets. A comprehensive forecasting methodology would recognize that there are other alternative routes and terminals that are, or will be, available to serve these markets, and compete with these alternatives using efficient, modern, and lean transport operations. This comprehensive forecasting methodology is beyond the limited resources of this study, since, it requires the development of a "super-regional trade and traffic model" covering Europe, the Middle East, and central Asia.

Short of building such a comprehensive super-regional model of traffic movements between countries of Europe and Asia, an alternative approach is to rely on empirical methods. A review of empirical data for European countries shows that a strong correlation exists between vehicle ownership and GNP as predictive indicators of growth in traffic demand on the highway system. These variables are broad and comprehensive indicators of economic change, representing that as different markets develop, each creates demand for commercial and passenger traffic movements. Vehicle ownership, vehicle usage, and GNP are the indicators for predicting the rate of change in traffic demand on the highway system.

The empirical data for European countries suggest the following guidelines for developing empirically based traffic growth factors:

- Vehicle ownership and the rate of growth in traffic volumes on East-West Corridor highways will increase proportionally to stages of economic growth and infrastructure development in Albania, Macedonia, and Bulgaria.
- During early stages of economic growth, the rate of growth in vehicle ownership, and consequently in highway traffic volumes, will increase steadily but at an annual rate diminished some by a lack of adequate infrastructure to support a more rapid growth rate.
- During middle stages of economic growth, as infrastructure is built and economies grow and expand significantly, vehicle ownership will increase more rapidly, resulting in a proportional increase in the annual growth of highway traffic volumes.
- During later stages of economic development, as a country and its economic activities mature and grow at a sustained annual rate, growth in vehicle ownership will moderate to a lower annual rate, as growth in traffic reaches an infrastructure "saturation point."

- For each of the three countries – Albania, Macedonia and Bulgaria – the rate of economic development and proportional growth rates in vehicle ownership will differ due to the current level of institutional and economic development.

These general guidelines were used to develop an empirical forecasting methodology that reflects the expectations for each of the three countries in economic and infrastructure development. The methodology and validation of the traffic growth rates are discussed in the next section.

3.3 TRAFFIC FORECASTS – HIGHWAYS

The empirical forecasting methodology developed for this study focuses on the expected periods of economic activity that are likely to occur in Albania, Macedonia, and Bulgaria over the next 20 years. The forecasts represent the potenial change in domestic and regional travel that will occur as the economy of each country experiences stages of growth and expansion. Highway transport for goods as well as for passengers in each of the three member countries, as in other emerging and developing countries, is a growing industry.

3.3.1 Empirical Based Forecast Methodology

A step-by-step process was applied in this study, to evaluate and determine forecast growth factors to adjust existing traffic volumes on highways to expected future year levels. This forecast methodology is straight-forward and based on empirical evidence from data compiled for countries throughout Europe, representing different stages of economic development.

Based on the data, assumptions were first made about specific "target" levels of vehicle usage and economic growth for each of the three countries for the year 2020. These target assumptions were used to interpolate levels for intermediate years. These determined vehicle ownership levels and economic growth were then used to calculate growth factors based on the calculation of a "travel propensity index" for each of the periods of growth evaluated between 1995 and 2020. The final step, was a series of statistical "validity" tests which confirmed the use of the growth rates for the East-West Corridor analysis.

Each of these steps is explained in more detail in the following sections.

3.3.1.1 Step 1: Evaluating Data From Other European Countries

The empirical-based forecasting methodology draws upon data developed over many years, representing the experience of countries at different stages of development. The data suggests a strong correlation exists between the rate of growth in vehicle ownership per 1,000 people, and the rate of growth in the Gross National Product (GNP). Understanding this relationship provides the basis for a predictive tool for growth in highway traffic volumes in countries with limited historical patterns, but with dynamic growth potential, as is the case in Albania, Macedonia, and Bulgaria.

Table 3-1 is a summary of key variables considered in the empirical model, including the number of vehicles, vehicle ownership per 1,000 people, and GNP per capita (the Purchasing Power Parity or PPP was used in reporting GNP in accordance with World Bank estimates). A review of this data shows how the level of per capita vehicle ownership varies across

European countries. For countries with GNP per capita above US$ 10,000, all of the countries show a vehicle ownership level above 300 vehicles per 1,000 people, except for Greece which has the lowest GNP (US$ 11,710) of these countries and the lowest vehicle ownership level at 279 vehicles per 1,000 people. For the higher end GNP countries (Austria, Belgium, Denmark, France, Germany, Norway, and Switzerland) all have a GNP per capita over US$ 20,000 and vehicle ownership level above 450 vehicle per 1,000 people, except for Denmark (375).

Table 3-1
Motor Vehicle Ownership and GNP per Capita for European Countries (1995)

Country	Passenger and Commercial Vehicles	Vehicle Ownership Per 1,000 People[1]	GNP Per Capita in 1995 US $[2]
Albania	*162,500*	*50*	*2,250*
Austria	4,240,195	533	21,250
Belgium	4,672,684	464	21,660
Bulgaria	*1,668,066*	*199*	*4,480*
Denmark	1,947,712	375	21,230
Finland	2,150,950	424	17,760
France	30,040,000	519	21,030
Germany	42,877,911	529	20,070
Greece	2,950,836	279	11,710
Hungary	2,389,423	232	6,410
Italy	32,577,500	560	19,870
Macedonia	*327,269*	*169*	*4,000*
The Netherlands	6,571,141	428	19,950
Norway	2,020,040	468	21,940
Poland	3,894,298	101	5,400
Portugal	3,242,500	308	12,670
Romania	1,526,600	66	4,360
Russia	23,405,000	79	4,480
Spain	16,686,632	425	14,520
Sweden	3,912,033	446	18,540
Switzerland	3,457,085	491	25,860
Turkey	3,803,853	61	5,580
United Kingdom	27,436,878	472	19,260

Source: 1) Vehicle information: Compiled by the American Automotive Manufactures Association;
2) GNP data: World Bank, from World Developing Indicators

By comparison, the data show how at the lower end the poorer countries, in terms of GNP per capita, have a proportionally low vehicle ownership level. The data for the lowest end GNP countries (Albania, Bulgaria, Hungary, Macedonia, Poland, Romania, Russia, and Turkey) all have a GNP per capita less than US$ 6,000 per capita and a vehicle ownership less than 200 vehicles per 1,000 people, with the exception of Hungary with a GNP per capita (US$ 6,400) and vehicle ownership rate (232) roughly falling between the poorer and richer European countries.

The level of motorization in Bulgaria and Macedonia is modest compared to all of the western European countries. National vehicle ownership in 1995 was 199 vehicles (including passenger cars and commercial vehicles) per 1,000 people in Bulgaria and 169 vehicles per 1,000 people in Macedonia. Vehicle ownership in Albania is estimated at 50 vehicles per 1,000 people, a very low level equivalent to developing countries of Africa and Asia, and a long way to catch up with the status of the more developed European countries.

Figure 3-1 is a "scatter diagram" of the vehicle ownership and GNP data for the European countries. The graph is another way of investigating the relationship between vehicle ownership and the economic parameter GNP. The graph shows how the countries are grouped using 1995 data. Clearly, the poorer countries based on the GNP per capita, are grouped at the lower-end of the vehicle ownership scale. In contrast, the richer countries based on GNP per capita are grouped at the higher end of the vehicle ownership scale.

Another variable to consider is average annual vehicle usage (or "kilometers driven") and what it reveals for the three member countries is modest compared to average European standards. Today, in the South Balkan countries, it is estimated that the average passenger car is driven an average of only 7,000 kilometers per year, while the average commercial vehicle is more intensively used, driven an average of 12,000 km per year.

3.3.1.2 Step 2: Forecast Assumptions for Vehicle Usage and Economic Growth

The data presented above for other Euopean countries is important to understand in order to guide judgements about how Albania, Macedonia, and Bulgaria are likely to develop over the next 20 years.

Over the past several years, the Balkan region has endured internal as well as external hardships that negatively affected each of the three countries' GNPs. The negative GNP growth was the culmination of negative growth in the general economic activities, industrial and agricultural production, import and export activities, and private and public investment. This has resulted in negative and fluctuating patterns in the volume of transport movements as well as in the level of performance of transport entities throughout the region.

The three member countries are in the middle of a transition from a centrally managed and directed economy into a free market economy. This entails the enacting of new laws and regulations, the privatization of state-owned enterprises, and concomitant adjustments in the countries' monetary and fiscal policies. Therefore, long-term economic projections are either non-existent or unreliable, being contingent on many assumptions and external developments. With consideration of these institutional and economic uncertainties, it is necessary to make some estimates of how the economies of these three countries will grow and what will be the impact on the growth of commercial and passenger vehicle traffic over the next 20 years. Estimates are based on the guidelines and experience of other European countries for comparative stages of economic growth.

As Albania, Macedonia, and Bulgaria expand their economies and the real per capita income of their people, vehicle ownership is expected to grow significantly over the next 2 decades. Applying "comparative analysis," it is expected that the overall experience for Bulgaria and Macedonia will be to achieve vehicle ownership levels between 300 and 400 per 1,000 people by the year 2020. This would represent nearly a doubling of current vehicle ownership levels. Albania, on the other hand, starting from a very low base would experience a more vigorous growth in vehicle ownership levels approaching the 160 vehicle ownership level per 1,000 people, by the year 2020, more than three times current estimates. These expectations are consistent with the long term growth objectives of each of the three member countries.

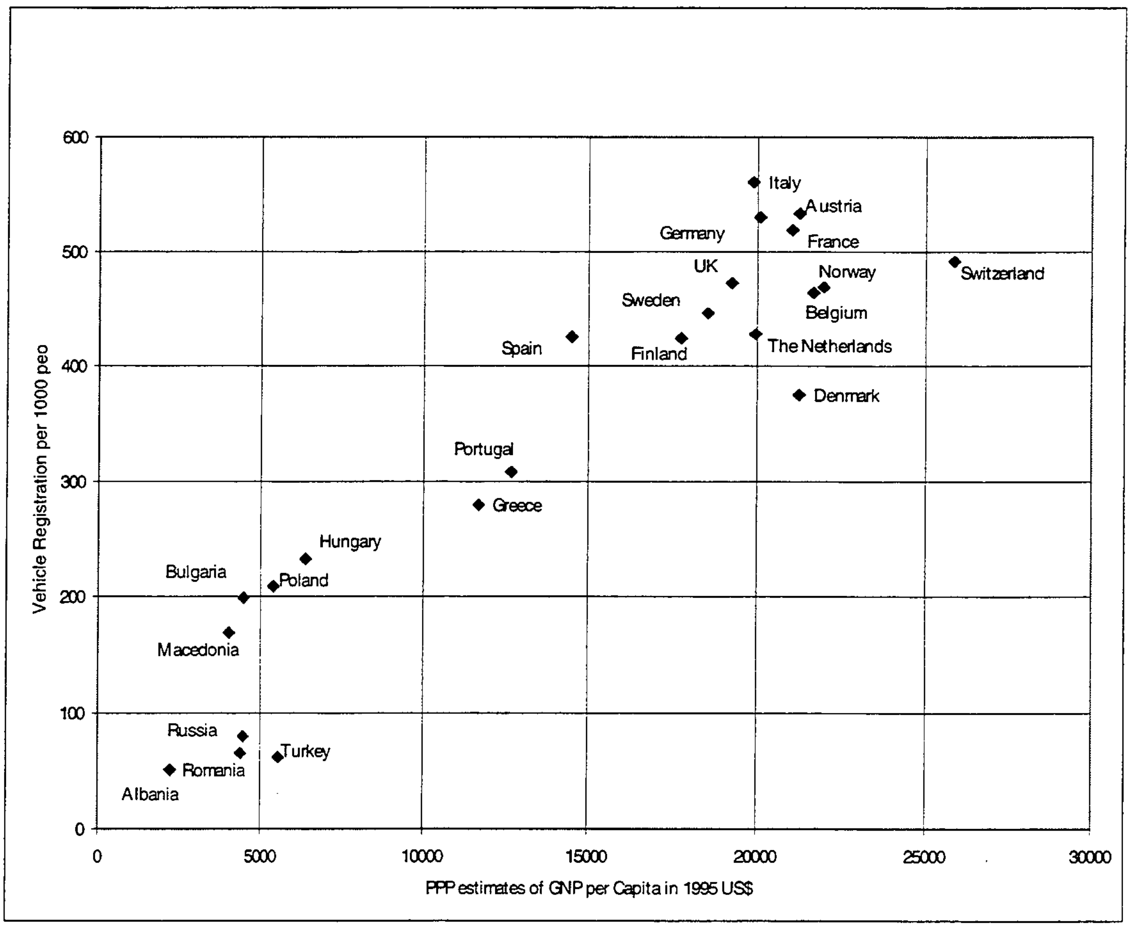


Figure 3-1 Scatter Diagram of GNP vs. Vehicle Registration

Vehicle usage in each of the three member countries is expected to increase significantly by the year 2020. Another expectation is that the proportion of light and heavy vehicles in the traffic stream will change over time. Trends in other European countries show that as vehicle ownership increases, the proportion of heavy vehicles in the traffic stream will decline. Overall, passenger cars are expected to be driven on the average, a distance of 12,000-14,000 kilometers, while commercial vehicles would achieve a distance of between 18,000 and 20,000 kilometers, both by the year 2020. These assumptions are based on comparisons made to other European countries at similar levels of economic development related to the GNP levels that each of these three countries set as targets.

Table 3-2 presents a summary of the estimated 1995 and expected 2020 vehicle usage for commercial and passenger vehicles, and for weighted average values for Albania, Macedonia, and Bulgaria, based on the assumptions discussed above. The proportion of light and heavy vehicles in the traffic stream was calculated for 1995 from traffic statistics published by the highway department of each member country. Experience of more developed countries indicates that as vehicle ownership and economic activities increase, the percent of heavy vehicles in the traffic stream decreases. In medium-developed countries, the percentage ranges between 25 and 35 percent, while in developed countries the range is between 10 and 15 percent. Estimates of heavy vehicles in the traffic stream were made for each of the three member countries for the year 2020, to match their expected level of economic development.

3.3.1.1 Step 3: Calculating Growth Factors Using A Travel Propensity Index

The forecasting methodology developed further applies the analysis of expected changes in vehicle ownership and usage for different stages of economic development, by applying three basic characteristics for each of the three countries:

1. **Average Annual Vehicle Kilometer Driven** (AAVD). For Albania, Macedonia, and Bulgaria, specific estimates have been made for vehicle usage by vehicle type for 1995 and 2020 data, resulting in "target" levels for the weighted average of all vehicles. Interpolated values were then calculated for intermediate years 2003 and 2010.
2. **Vehicle Ownership Per 1,000 Persons** (VRPP). The current levels listed in Table 3-1 show values for Albania, Macedonia, and Bulgaria as 50, 169, and 199 respectively, in 1995. Based on the analysis of other Euopean countries and the assumptions discussed in the preceding section, assumed values were made for 2020 for each of the three countries based on the expected growth in GNP.
3. **Travel Propensity Index** (TPI). A TPI is defined by multiplying these two attributes: AAVD by VRPP. It is assumed that travel demand growth factor along the East-West Corridor will grow in direct proportion to the travel propensity index.

Table 3-3 presents a summary of the empirical-based forecast results for the years 2003, 2010, and 2020 for each country. The forecasts were derived by first estimating the forecast vehicle usage and ownership levels for the year 2020, assuming each country reaches a "target" level of economic growth. Therefore, the 2020 forecasts are judgements resulting from the analysis of data for other European countries. Forecasts for 2003 and 2010 were interpolated from the 1995 and assumed 2020 levels. Having vehicle ownership and usage levels for each year, the TPI is then computed.

Table 3-2
Estimate of Vehicle Usage by Country, 1995 and 2020

Country/ Type of Vehicle	Year	Average Kilometers Driven Per Year	Vehicle Mix (%)	Annual Kilometers Driven
ALBANIA				
Light	1995	7,000	0.625	4,375
Heavy	1995	14,000	0.375[1]	5,250
Weighted Average	–	–	–	9,625
Light	2020	12,000	0.70	8,400
Heavy	2020	18,000	0.30	5,400
Weighted Average	–	–	–	**13,800***
MACEDONIA				
Light	1995	7,000	0.75	5,250
Heavy	1995	14,000	0.25	3,500
Weighted Average	–	–	–	8,750
Light	2020	14,000	0.80	11,200
Heavy	2020	20,000	0.20	4,000
Weighted Average	–	–	–	**15,200***
BULGARIA				
Light	1995	7,000	0.65	4,550
Heavy	1995	14,000	0.35[2]	4,900
Weighted Average	–	–	–	9,450
Light	2020	14,000	0.77	10,780
Heavy	2020	20,000	0.23	4,600
Weighted Average	–	–	–	**15,380***

1 Albania National Roads Project Report: Traffic Survey on Roads, undated

2 Preparation of Traffic Forecasts and Investments Programs for the Years 2000 and 2010 for the Development of the Bulgarian Transport System, In Consideration of the Transition to a Free Market Economy, prepared by Bonifica, Doxiadis Associates and T.E.C.N.I.C., September 1996.

* Calculated and assumed values for 2020 are based on comparative data for other European countries and target levels of economic growth expected within each of the three countries.

Table 3-3
Assumed Growth in Vehicle Usage, Vehicle Ownership and Travel Propensity Index, 1995 to 2020

Year	Vehicle Usage Annual Km Driven	Vehicle Ownership Per 1,000 People	Travel Propensity Index+	Annual Growth Rate For Period
ALBANIA				
1995	9,625[1]	50	481	–
2003	10,500	74	777	6%
2010	12,000	112	1,344	10%
2020	13,800*	160*	2,208	5%
MACEDONIA				
1995	8,750	169[2]	1,479	–
2003	10,088	193	1,948	3.5%
2010	12,556	241	3,026	6.5%
2020	15,200*	295*	4,484	4%
BULGARIA				
1995	9,450	199[3]	1,881	–
2003	10,719	231	2,477	3.5%
2010	13,088	294	3,848	6.5%
2020	15,380*	370*	5,691	4%

[1] Source: Albania National Roads Project; 15464-ALB, Document of World Bank, May, 1996
[2] Source: Macedonia Roads Report, undated.
[3] Source: National Statistical Institute, (http://www.onlinebg.com), Statistical Yearbook 1996.
* Growth Assumptions for 2020 see Table 3-2. Intermediate years interpolated from 1995 and 2020.
+Travel Propensity Index = (Vehicle Usage * Vehicle Ownership Per 1,000 People) /1000

The calculated empirical TPI rates yield the following directly proportional roadway traffic growth factors:

- Albania traffic volumes will grow by 6 percent per year up to 2003, increase 10 percent per year between 2003 and 2010, and grow at 5 percent per year between 2010 and 2020.
- Macedonia and Bulgaria traffic volumes will grow more modestly at 3.5 percent per year up to 2003, increase 6.5 percent per year between 2003 and 2010, and grow at 4 percent per year between 2010 and 2020.

These growth rates for the three time frames reflect an evolving trend in traffic growth over the next 20 years. It is anticipated that the short-term will be a period of preparation and organization, arrangement for financing, design, and construction for some of the key projects along the primary routes of the corridor. As such, roadway capacity to accommodate significant traffic growth will not yet be available, and growth in traffic will be somewhat subdued, equaling the rate of growth in the economy. It is expected that Albania will, however, experience a higher growth rate than Macedonia and Bulgaria during this period, due to its much lower starting base of vehicle ownership.

As new highway infrastructure within and outside the South Balkan region is implemented, the intermediate years are expected to show a more vigorous level of growth in the three countries. The introduction of well-designed and operationally efficient motorways will induce economic growth in and between the three countries and will facilitate their links with the outside world. Therefore, a growth rate in the range of one and a half to two times the anticipated growth in GNP would be reasonable to assume for traffic growth in each of the three countries.

By 2010, vehicle ownership rates will have reached 250-300 vehicles per 1,000 people in Macedonia and Bulgaria and about 115 in Albania. Growth in traffic would subside then to a level equivalent to GNP growth in Macedonia and Bulgaria and about 1.5 times the GNP growth for Albania.

These assumed traffic growth factors are used to adjust existing traffic volumes for different roadway segments on the East-West Corridor highway network, to the milestone years of 2003, 2010 and 2020 forecast levels. The Bechtel team has assumed that traffic on all segments of the highway network in each country will grow at the same annual rate in order to simplify calculation and analysis. Obviously, various segments will actually grow at different rates depending on the specific location and service environment. For example, it is expected that highway segments near major cities will grow at a faster rate than segments far removed from such cities. Likewise, short segments connecting main towns will grow at faster rates than long segments connecting the same size towns (gravity principle of traffic forecasting).

Much more resources than that available for this study are needed to differentiate between growth rates for various segments in the corridor. It is believed though that this simplifying assumption will not materially affect the recommendations for physical improvements of the highway infrastructure, particularly in the short term. The results are discussed in the next section of this report regarding cpacity improvements.

3.3.2 Confirming Use of the Empirical Forecast Methodology and Growth Factors

In order to test and confirm use of the empirical forecast methodology and the growth factors previously discussed, statistical tests were developed and evaluated. These tests include regression analysis estimating the statistical "fit" between vehicle ownership data and the GNP per capita of a country. Vehicle ownership is an important variable used in the empirical forecasting methodology discussed in Section 3.3.1. The statistical testing validates that a relationship does exist between GNP, vehicle ownership levels, and the rates of growth of each parameter.

3.3.2.1 Validation Tests Using Statistical Analysis

The data presented in Table 3-1 was used in the statistical tests. This empirical data collected for the European countries show actual vehicle ownership for countries at different levels of economic development. Vehicle ownership per 1,000 people (that includes passenger as well as commercial vehicles) was used to represent the transportation parameter while the

"Purchasing Power Parity" (PPP) estimates of GNP per capita, were used to represent the economic parameter.

Figure 3-1 presents the results of the first statistical test examined – a simple "scatter diagram." A conclusion drawn from the scatter diagram is vehicle registration per 1,000 people increases with income levels and growth or size of the country. Although the distribution of the data points do not lie on a perfectly straight line, it appears that they are clustered about a straight line, suggesting that a direct relationship does exist between vehicle ownership levels and the growth or size of the economy.

In the second test, some inferential methods in regression and correlation analysis were applied. These methods test assumptions about population and vehicle ownership levels, and the standard deviations of these variables within their distribution of values and statistical conditions of "normality".

Figure 3-2 shows the results of these statistical tests as a "residual plot," similar to the scatter diagram. This second test of the relationship suggests a strong statistical fit between GNP and vehicle ownership levels. Putting it into statistical terms, the residual plot shows "no violation of linearity or constant standard deviation, indicating that the residuals fall roughly in a horizontal band centered and symmetric about the x-axis."

The third statistical test prepared is a "normal probability plot" presented in Figure 3-3. This plot confirms that for each GNP value, the corresponding vehicle ownership values are "normally distributed" using GNP values on a percentile basis. Again, the results of this test show a positive finding that a linear relationship exists between GNP and vehicle ownership levels.

All three of these statistical data tests confirm the regression analysis and assumptions made in applying this data set in using the GNP variable to predict vehicle usage levels.

The fourth validity applied linear regression, a commonly used descriptive tool for examining the relationship between two (or more) variables for making predictions. The least-squares criterion was employed for finding the linear regression line that best fits the set of data points.

Figure 3-4 presents the results of the linear regression. The estimated equation, although it shows a relatively straight-line graph, suggests results are not best suited for evaluating an economic indicator such as GNP. In fact, such evaluation would be misleading in the long run, since it would predict that vehicle ownership would keep increasing with GNP along a straight line, when it would logically reach some saturation level and begin to taper off.

Considering the limitations of the linear regression results, in the final step of the validity testing, a polynomial regression equation was evaluated, in order to plot as a curve the transition between pairs of data points. This method reduces and measures the reduction in the errors made in prediction, by using a more complex regression equation.

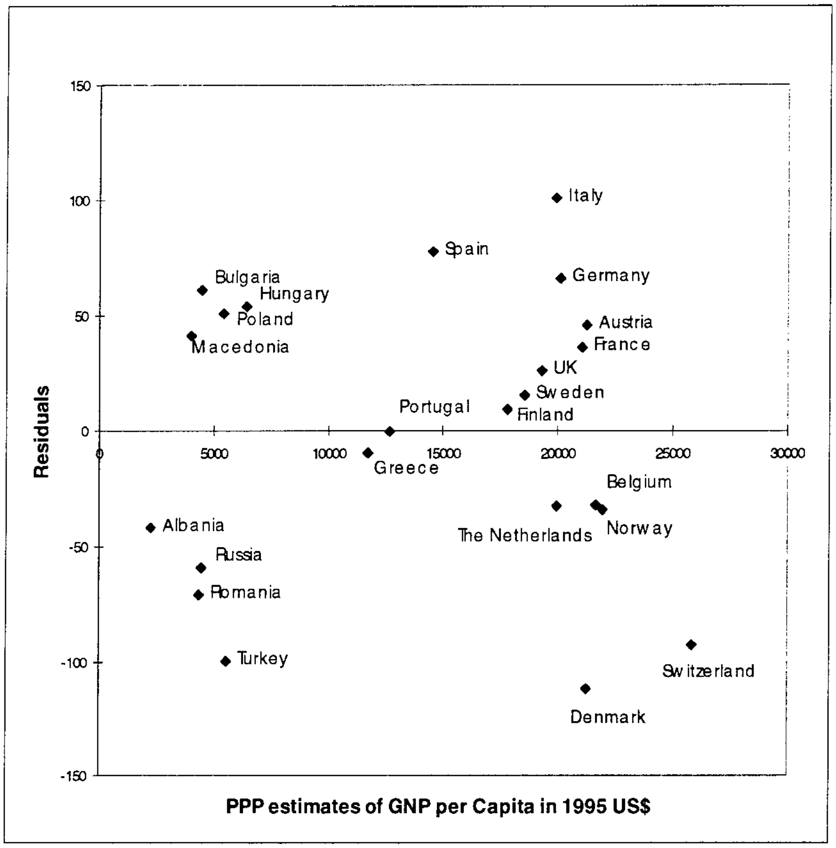


Figure 3-2 Residual Plot of GNP Distribution

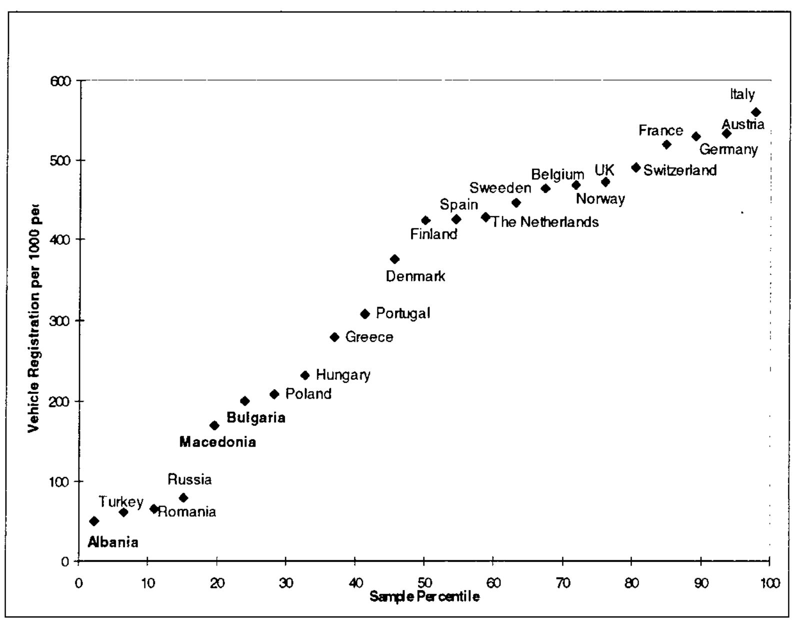


Figure 3-3 Normal Probability Plot Vehicle Ownership Versus GNP

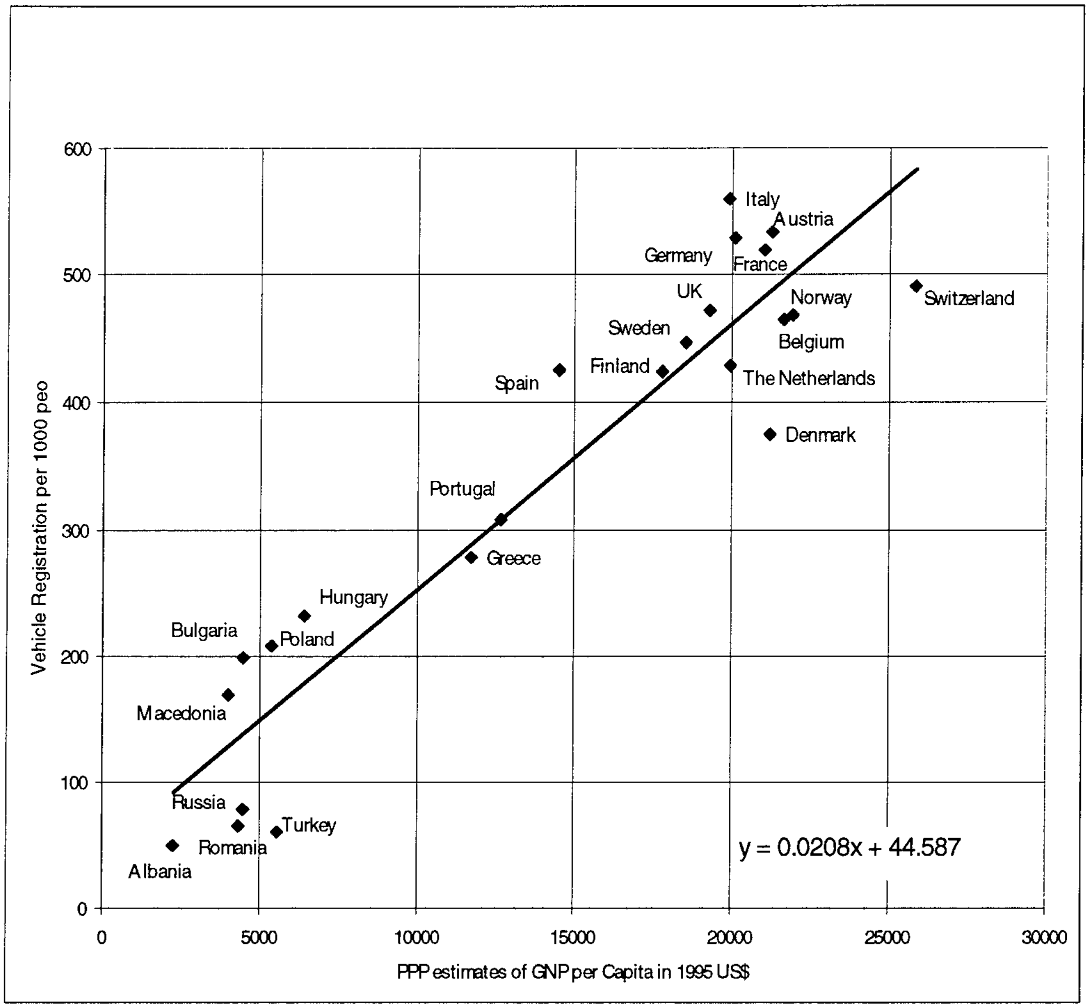


Figure 3-4 Linear Regression of GNP and Vehicle Registration Levels

Figure 3-5 shows the graph for the estimated "Second Order Polynomial" regression equation. The results show by using the polynomial regression equation, the total squared error for the vehicle ownership predictions of the 21 countries sampled has been reduced. Or simply stated, this final test indicates strongly that GNP per capita is extremely useful for predicting vehicle ownership per person, with a prediction reliability of 88 percent accuracy.

The estimate and graph of Second Order Polynomial Regression results yield some relevant observations about the use of vehicle ownership and GNP as predictive variables:

1. Vehicle ownership grows at a faster rate than GNP for countries with a GNP level of about US$ 12,500 or less (e.g., Greece, Portugal, and Spain).
2. Vehicle ownership and GNP grow in countries at approximately the same level where the GNP ranges between US$ 12,500 to US$ 17,500.
3. Vehicle ownership reaches a level of saturation and grows at a rate less than the GNP for countries with a GNP roughly between US$ 17,500 to US$ 22,000.

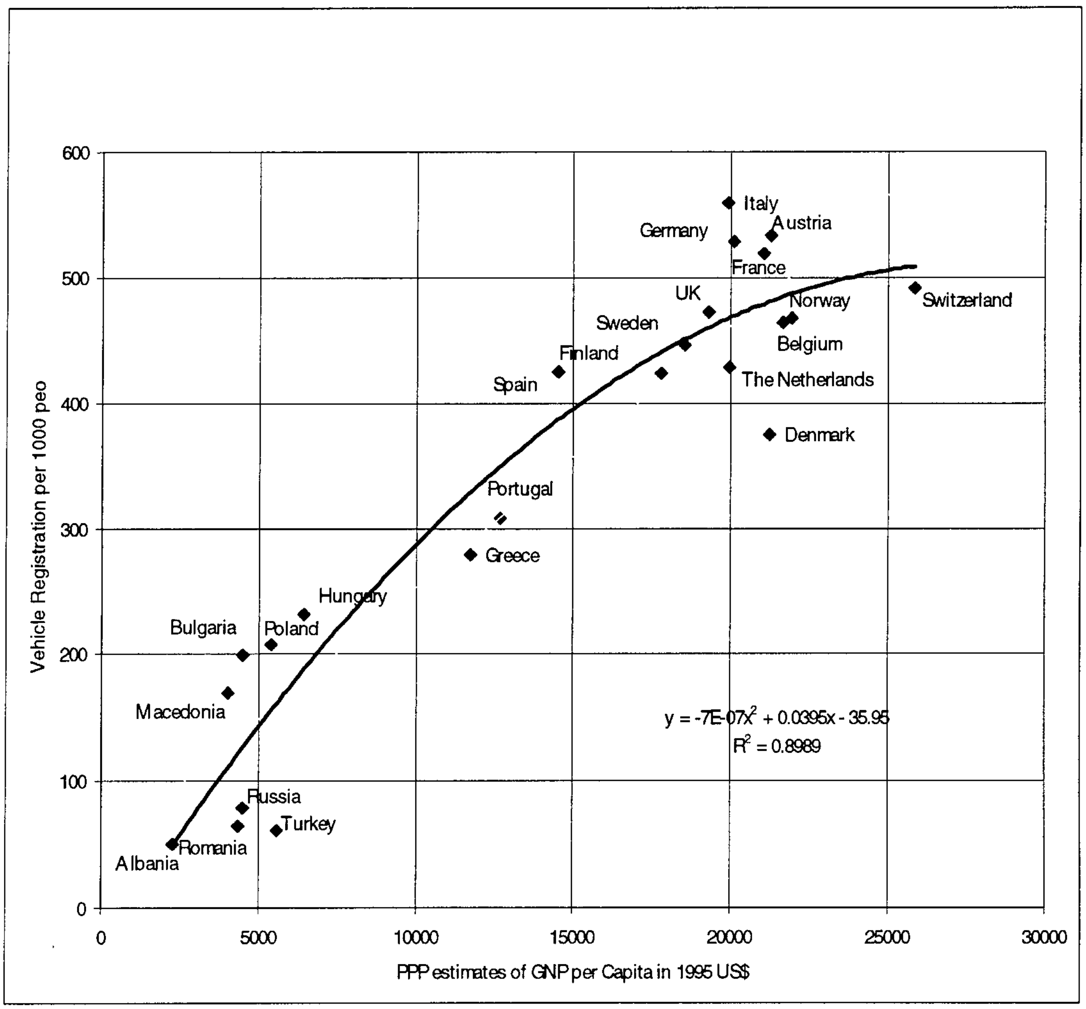


Figure 3-5 Second Order Polynomial Regression with Coefficient of Determination (R^2) of GNP vs. Vehicle Registration

Another observation that can be made from the inferential analysis is that with a relatively small difference in GNP, for example, between US$ 17,750 (Finland) to US$ 21,940 (Norway), the vehicle ownership levels are drastically different for some comparative countries, such as Denmark (375) and Italy (560). The Second Order Polynomial Regression line seems to separate large from small countries. In Figure 3-5, note the grouping of Germany, Italy, and France versus the grouping of Denmark, the Netherlands, Belgium, and Switzerland. Note also that Austria is a small country, it is less dense than its neighbors and requires more area to be covered by its inhabitants, resulting in a higher vehicle ownership level and a relative grouping with the larger countries.

3.3.2.2 Comparing Results of the Statistical Model and the Empirical Forecasts

The findings illustrate that the growth factor forecasts for each of the three countries and the assumptions made are consistent with the trend line and experience of other European countries. As the economies of each of these three countries grow, the level of vehicle ownership and usage will increase to levels approaching patterns exhibited in other European countries, as they evolve through periods of economic growth.

Table 3-4 is a summary of the study forecast GNP, vehicle ownership and average annual Daily Traffic (AADT) growth rates, for Albania, Macedonia, and Bulgaria for the years 1995, 2003, 2010 and 2020.

Figure 3-6 is a graph of the empirical method-produced forecast, discussed in the preceding sections, showing vehicle ownership and GNP "superimposed" trends for each of the three countries, graphed against the second order polynomial regression equation line. The resulting growth trend lines for Albania, Macedonia, and Bulgaria, are all consistent with the trend line produced using the regression line for the other European countries.

In summary, the statistical tests and these final graphs of the forecast traffic growth rates, validate the use of the growth factors being used in this study to forecast traffic on the highway system in the East-West Corridor. The result of applying the growth factors produce traffic forecasts for all segments of roadway evaluated in the study.

Table 3-4
Summary of Projected Growth in GNP, Vehicle Ownership, and Highway Traffic Volumes for Selected Years from 1995 to 2020

	1995 Level	Annual Growth Rate (%)	2003 Level	Annual Growth Rate (%)	2010 Level	Annual Growth Rate (%)	2020 Level
ALBANIA							
GNP[1]	2,250	5	3,324	4	4,375	3	5,878
VEHICLES[2]	50	10.6	74	6.1	112	3.6	160
AADT[3]	–	6	–	10	–	5	–
MACEDONIA							
GNP[1]	4,000	3.5	5,267	5.5	7,662	4	11,342
VEHICLES[2]	169	1.7	193	3.2	241	2	295
AADT[3]	–	3.5	–	6.5	–	4	–
BULGARIA							
GNP[1.]	4,480	3.5	5,899	5.5	8,581	4	12,703
VEHICLES[2]	199	1.9	231	3.5	294	2.3	370
AADT[3]	–	3.5	–	6.5	–	4	–

[1] Gross National Product as measured by the World Bank Purchasing Power Parity Index
[2] Vehicle Ownership Level Per 1,000 People
[3] Average Annual Daily Traffic volume growth rate (applied to compound factor for each year between existing traffic volumes and future year traffic horizon years)

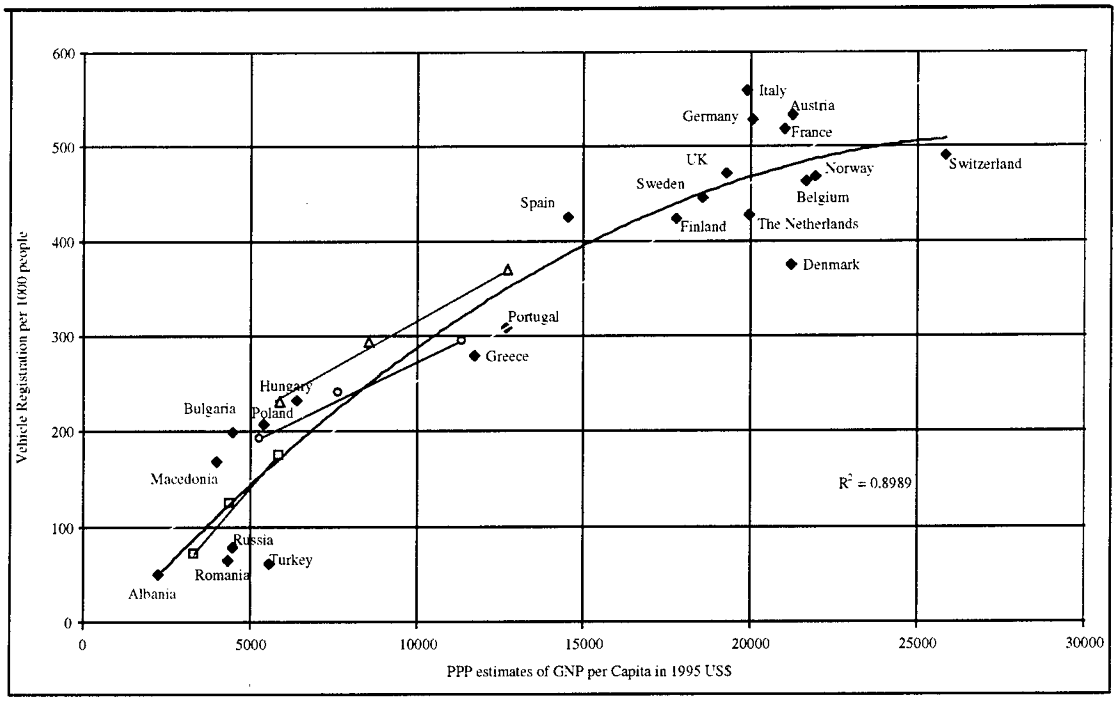


Figure 3-6 Second Order Polynomial Regression Graph With East-West Corridor GDP and Vehicle Ownership Forecast

This section presents the methodology and results for identifying necessary highway improvement projects along the East-West Corridor to meet the strategic objectives of the corridor development. This process has been divided into two parts: first is the identification of highway projects required to balance existing (and forecast) traffic demands and corresponding practical capacity of any particular highway segment; while the second part considers additional improvement projects necessary to achieve the strategic objectives of the East-West Corridor development and to bring the highway routes up to internationally acceptable standards.

4.1 HIGHWAY IMPROVEMENT PLANS RESULTING FROM CAPACITY CONSTRAINTS

Several factors were taken into consideration when developing recommendations for highway improvements along the East-West Corridor. This section covers improvement plans resulting from imbalances between demand and supply (i.e., capacity constraints).

Capacity constraints for all highway routes along the East-West Corridor were quantified. Identification of highway segments that are (or anticipated) to experiencing shortfalls in accommodating traffic demands served as points-of-departure to more qualitative factors that could then be examined more effectively. As presented in Section 2.1.1, capacity constraints are indicators of existing and/or future imbalances in highway demand/capacity relationships, and are often the principal reason for transport infrastructure improvement programs. The Bechtel team used capacity constraints in its initial screening process to identify needs-based highway improvement programs for Albania, Macedonia, and Bulgaria.

Demand/capacity relationships are measured traditionally in terms of desired quality of service along the highway facility in question. For this purpose, volume/capacity (v/c) ratios were calculated for the different segments of all routes comprising the East-West Corridor. The v/c ratio compares actual traffic volumes (v = peak hour volumes) against a measure of the physical capacity of the segment (c = practical capacity). The v/c ratios for segments along the East-West Corridor, and corresponding highway improvement projects, were calculated according to the following methodology that is also presented in a graphical format in Figure 4-1:

1. Dividing highway routes comprising the East-West Corridor into specific segments
2. Determining existing and forecast traffic volumes (estimate "v") for each segment
3. Defining local (terrain) and geometric characteristics of highway segments
4. Calculating the practical capacity for each highway segment (estimate "c")
5. Calculating v/c ratio for each highway segment
6. Developing appropriate improvement schemes for segments that exhibit v/c ratios greater than 0.80

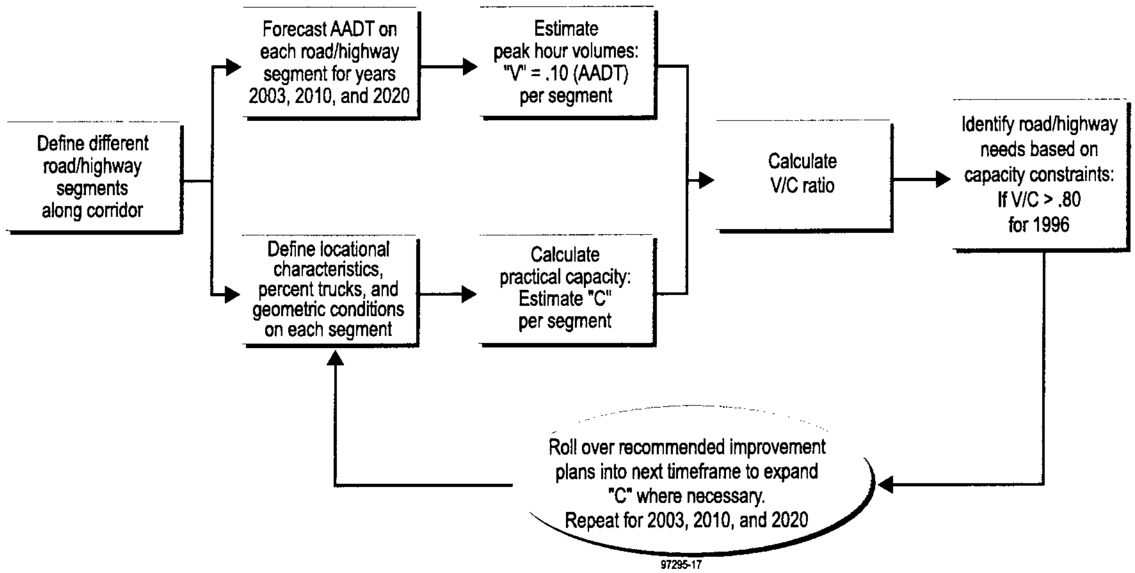


Figure 4-1 Demand-Based Improvement Methdodology

The following describe each of the above steps in detail:

1. **Segmentation of Highway Routes**. In order to estimate volume/capacity relationships for highways along the East-West Corridor, it is necessary to divide each of these highways into manageable segments. The criteria used for segment designation included a combination of some or all of the following elements:

   - Reasonable length of route
   - Homogenous traffic volume along most of the segment
   - Segments serve as links between principal towns and cities
   - Homogeneous geometric characteristics, particularly related to cross-section characteristics

   Highways in Albania were divided into 16 segments, which varied in length between 2.5 km and 37 km. Macedonia has 26 distinct highway segments, varying in length between 4.5 km and 81.8 km. In Bulgaria, the highway routes were divided into 30 segments, with lengths varying between 9 km and 129 km. In total, the entire East-West corridor highway routes were divided into 72 distinct segments.

2. **Existing and Forecast Traffic Volumes (Estimate "v").** Traffic volumes on each of the highway segments are measured in Average Annual Daily Traffic (AADT) volume. AADT calculation includes both light and heavy vehicles. Actual 1996 AADT figures for each of the highway segments were taken from published reports, from existing documents obtained from the Highway Department of each of the three member countries, and as compiled by Bechtel's local consultants. These volumes serve as the benchmark for the base year upon which to forecast future traffic. Methodology for forecasting future traffic is discussed in detail in Section 3, along with the presentation and reconciliation of average annual traffic growth for each of the three member countries. In general, traffic forecasts were based on the following premises:

- Adopt a global overview of the traffic growth in relation to growth in GDP for each of the three member countries, vehicle ownership levels, and vehicle usage rates
- Target growth in average auto ownership and car usage levels for each of the three member countries that are commensurate with each one's level of economic development and growth potential, guided by experience of more developed European countries
- Calculate the Travel Propensity Index (TPI) for each country as the product of car ownership and vehicle usage for each of the three milestone time frames
- Assume that highway traffic on the corridor's highways will grow at the same rate as the growth in the travel propensity index

On the bases of the above, Section 3 presented average annual growth rates for each of the three milestone time frames and for each of the member countries as shown below in Table 4-1.

Table 4-1
Milestone Average Annual Growth Rates

Time Frame	Country	Annual Growth Rate (percent)
Short-Term: 1996 – 2003	Bulgaria	3.5
	Macedonia	3.5
	Albania	6.0
Intermediate-Term: 2003 – 2010	Bulgaria	6.5
	Macedonia	6.5
	Albania	10
Long-Term: 2010 – 2020	Bulgaria	4.0
	Macedonia	4.0
	Albania	5.0

Traffic growth rates were estimated for the national highway network of each of the three member countries and not for individual highway segments. It was assumed that traffic on each segment of the highway network, within each country, will grow at the same annual rate as the traffic growth rate of the entire network. This is a simplifying assumption designed to facilitate the application of the above-described methodology within available time and resources for the study. It is recognized, however, that traffic on different segments of each highway network will grow at different rates, depending on the location, traffic service environment, and connectivity of any particular segment. For example, it is expected that traffic on highway segments near major cities will grow at a faster rate than segments that are farther removed from major cities. Traffic on short segments connecting principal towns is expected to grow at a faster rate than on longer segments which connect towns of similar size (as per the gravity principle of trip distribution).

Given that highway improvement and expansion programs are implemented in "lumps" (i.e., a 2-lane highway can only be widened by adding another two lanes or multiples thereof), it is not believed that the simplifying assumption which was adopted for the forecasts will materially affect the recommendations for physical improvements of the highway infrastructure, particularly in the short-term.

It was further assumed that peak-hour volumes (v) on all highway segments would represent 10 percent of their respective AADT volumes. The resulting v's (peak-hour volumes) reflect actual (and estimated) future demand on the different segments of highways on the East-West Corridor. Estimate of peak-hour volumes are essential to the calculation of demand/capacity relationships.

3. **Definition of Local (Terrain) and Geometric Characteristics of Highway Segments.** The practical capacity of a highway segment according to the Highway Capacity Manual is dependent on the following five factors:

   - Terrain characteristics (e.g., flat, rolling, mountainous)
   - Percent of heavy vehicles in the traffic stream
   - Number of lanes
   - Lane widths
   - Lateral clearance to obstructions on either side of the roadway from outer side of traffic lanes

   Actual data for the above characteristics were obtained from several sources, including field observations, route descriptions in existing reports and studies, input provided by highway departments of member countries, and reports prepared by the Bechtel teamslocal consultants in Macedonia and Bulgaria. In the absence of accurate information, assumptions were made, particularly related to the percent distribution of flat, rolling, and mountainous terrain for certain highway segments. These characteristics are summarized in Appendix A.

4. **Calculation of Practical Capacity for Each Highway Segment (Estimate "c").** The calculation of the practical capacity (capacity under prevailing conditions) for highway segments on the East-West Corridor were performed using the methodology and equations provided in the Highway Capacity Manual (HCM) for different highway types.
   The following equations were used:

   For

2-lane Standard Highway	*C = 2,000 * W(c) * T(c)*
4-lane Motorway	*C = 2,000 * 2* W(c) * T(c)*
4-lane Expressway	*C = 2750 * 2 * W(c) * T(c)*
6-lane Expressway	*C = 2750 * 3 * W(c) * T(c)*

Where

C	=	capacity (mixed vehicles per hour, total for both directions)
W(c)	=	adjustment factor for lane width and lateral clearance
T(c)	=	adjustment factor for percentage of trucks in the traffic stream

The adjustment factors were obtained from empirical tabulations included in the HCM, which were based on specific highway characteristics. All representative factors were calculated and applied directly to the practical capacity equation to yield a "c" for each segment of the highway network.

5. **Calculation of v/c Ratio per Highway Segment.** After estimating both "v" and "c" for each highway segment, the v/c ratios were calculated. The v/c ratios reflect the following demand/capacity relationships:

v/c < 1.0	*indicates that highway segment can accommodate additional traffic*
v/c = 1.0	*indicates a balance between demand and capacity*
v/c > 1.0	*indicates that existing capacity is insufficient to meet indicated demand*

Highway segments that exhibit a v/c ratio above 1.0 normally imply slower average speed for traffic, existence of traffic bottlenecks, and a general deterioration in the serviceability and performance of the highway.

The previous steps were first carried out for current (1996) conditions of the highway segments yielding current v/c ratios. Since the first time frame assumed for this study covers the period until 2003, physical improvement schemes are proposed for those segments that yield a v/c ratio above 0.8. The goal is to increase the capacity of the highway segment to a level that would allow it to accommodate additional growth in traffic at a reasonable level of service.

It is assumed that the proposed physical improvements will be completed during the short-term time frame; i.e., by the year 2003. These improvements are assumed as complete in the short-term when determining improvements for the next time frame that spans the period between 2003 and 2010. In other words, highway segments will exhibit the improved characteristics at the beginning of the intermediate time frame.

In determining the intermediate-term improvements, the above five steps were carried out for each highway segment including the improvements from the short-term time frame, which resulted in a different set of v/c ratios. A similar process was carried out for the long-term time frame.

For example, for 1996 the 22-km segment of roadway between Durres and Kavaje, in Albania, registered a v/c ratio of 1.45. It was recommended that this section be upgraded and widened into a 4-lane expressway by 2003. By 2003, the forecast v/c ratio for the same segment is 0.45. Given that 0.45 is well below 0.80, no further highway improvements were made for the intermediate time frame.

In addition to rolling over the improved physical characteristics between time frames, it was further assumed that the ratio of heavy to light vehicles in the traffic stream would decrease from one time frame to the next. These reductions reflect the experiences of developed countries, where the percentage of heavy vehicles in the traffic stream drops, relative to light vehicles, as personal incomes and general motorization levels increase. This is covered in more detail in Section 3.

4.2 HIGHWAY IMPROVEMENT NEEDS BASED ON DEMAND ANALYSIS

After calculating v/c ratios for highway segments along the East-West Corridor, segments exhibiting ratios greater than or equal to 0.80 were identified and targeted for improvement. As mentioned in Section 4.1, the goal was to lower these v/c ratios to a more acceptable level by recommending highway improvement schemes that in effect increase the practical capacity ("c"). These improvement schemes are presented in Tables 4-2 through 4-10 for each of the highway segments, grouped by country and representative time frame. It must be noted that the proposed improvement plans are based strictly on the results of this study's capacity analysis. No conceptual feasibility studies were performed to ascertain the engineering viability of the proposed improvements, or the evaluation of other alternative route/alignment or design. These studies will have to be performed separately for each of the projects.

Table 4-2
Albania: Volume/Capacity Analysis and Proposed Improvements
Short-Term Plan (1998 - 2003)

Highway Segment	Length (km)	Number of Lanes	Existing AADT	Peak Hourly Volume (V)	Practical Capacity (C)	V / C Ratio	Proposed Short-Term Improvements
DURRES-VORE- TIRANA							
Durres-Vore	22.9	2	10171	1017	1021	1.00	Widen to a 4-lane expressway
		2	10171	1017	632	1.61	Widen to a 4-lane expressway
Vore-Kashar	2.5	2	9650	965	1242	0.78	Widen to a 4-lane expressway
		2	9650	965	800	1.21	Widen to a 4-lane expressway
Kashar-Tirana	6.5	4 (M)	9650	965	2900	0.33	
DURRES-NDROG-TIRANA							
Dures-Ndrog	20	2	9400	940	648	1.45	Widen to a 4-lane expressway
Ndrog-Tirana	21	2	10000	1000	1102	0.91	Widen to a 4-lane expressway
		2	10000	1000	713	1.40	Widen to a 4-lane expressway
DURRES-KAFASAN							
Durres-Kavaje	22	2	12220	1222	840	1.45	Widen to a 4-lane expressway
Kavaje - Rrogozhine	17	2	8400	840	840	1.00	Widen to a 4-lane expressway
Rrogozhine - Peqin	44	2	11850	1185	889	1.33	Widen to a 4-lane expressway
Peqin-Elbasan		2	6850	685	889	0.77	
Elbasan - Librazhd	25	2	3826	383	434	0.88	Improve geometric standards
Librazhd - Kafasan	37	2	3610	361	406	0.89	Improve geometric standards
Kafasan - Pogradec	16	2	1334	133	420	0.32	
		2	1334	133	182	0.73	

M = Motorway
E = Expressway

Table 4-2 (cont'd)
Albania: Volume/Capacity Analysis and Proposed Improvements
Short-Term Plan (1998 - 2003)

Highway Segment	Length (km)	Number of Lanes	Existing AADT	Peak Hourly Volume (V)	Practical Capacity (C)	V / C Ratio	Proposed Short-Term Improvements
RROGOZHINE-VLORE							
Rrogozhine-Lushnje	20	2	11217	1122	798	1.41	Widen to a 4-lane expressway
		2	11217	1122	448	2.50	Widen to a 4-lane expressway
Lushnje-Fier	29	2	7600	760	749	1.01	Widen to a 4-lane expressway
		2	7600	760	399	1.90	Widen to a 4-lane expressway
Fier-Vlore	34	2	3100	310	861	0.36	
		2	3100	310	525	0.59	
TIRANA-ELBASAN							
Tirana-Elbasan	38	2	6142	614	959	0.64	Build a 4-lane motorway with a 5 km tunnel through the mountain
		2	6142	614	623	0.99	
		2	6142	614	371	1.66	Improve standards

M = Motorway
E = Expressway

Table 4-3
Albania: Volume/Capacity Analysis and Proposed Improvements
Intermediate-Term Plan (2003 - 2010)

Highway Segment	Length (km)	Number of Lanes	Existing AADT	Peak Hourly Volume (V)	Practical Capacity (C)	V/C Ratio	Proposed Intermediate-Term Improvements
DURRES-VORE- TIRANA							
Durres-Vore	22.9	4 E	14428	1443	3878	0.37	
		4 E	14428	1443	2778	0.52	
Vore-Kashar	2.5	4 E	13689	1369	4125	0.33	
		4 E	13689	1369	3025	0.45	
Kashar-Tirana	6.5	4 (M)	13689	1369	3000	0.46	
DURRES-NDROG-TIRANA							
Dures-Ndrog	20	4 E	13334	1333	2833	0.47	
Ndrog-Tirana	21	4 E	14185	1419	4180	0.34	
		4 E	14185	1419	3080	0.46	
DURRES-KAFASAN							
Durres-Kavaje	22	4 E	17334	1733	3740	0.46	
Kavaje - Rrogozhine	17	4 E	11916	1192	3740	0.32	
Rrogozhine - Peqin	8	4 E	16809	1681	3905	0.43	
Peqin-Elbasan	36	2	9717	972	924	1.05	Improve geometric standards
Elbasan - Librazhd	25	2	5427	543	680	0.80	
Librazhd - Kafasan	37	2	5121	512	350	1.46	Add climbing lanes
Kafasan - Pogradec	16	2	1892	189	462	0.41	
		2	1892	189	231	0.82	Improve Standards

Table 4-3 (cont'd)
Albania: Volume/Capacity Analysis and Proposed Improvements
Intermediate-Term Plan (2003 - 2010)

Highway Segment	Length (km)	Number of Lanes	Existing AADT	Peak Hourly Volume (V)	Practical Capacity (C)	V/C Ratio	Proposed Intermediate-Term Improvements
RROGOZHINE-VLORE							
Rrogozhine-Lushnje	20	**4 E**	15912	1591	3603	0.44	
		4 E	15912	1591	2503	0.64	
Lushnje-Fier	29	**4 E**	10781	1078	3438	0.31	
		4 E	10781	1078	2338	0.46	
Fier-Vlore	34	2	4397	440	903	0.49	
		2	4397	440	567	0.78	
TIRANA-ELBASAN							
Tirana-Elbasan	38	4 M	8713	871	2840	0.31	
		4 M	8713	871	1880	0.46	
Truck volume reduced by 12%							

M = Motorway
E = Expressway

Table 4-4
Albania: Volume/Capacity Analysis and Proposed Improvements
Long-Term Plan (2010 - 2020)

Highway Segment	Length (km)	Number of Lanes	Existing AADT	Peak Hourly Volume (V)	Practical Capacity (C)	V / C Ratio	Proposed Long-Term Improvements
DURRES-VORE- TIRANA							
Durres-Vore	22.9	4 E	28116	2812	3988	0.71	
		4 E	24727	2473	2888	0.86	
Vore-Kashar	2.5	4 E	23460	2346	4235	0.55	
		4 E	23460	2346	3135	0.75	
Kashar-Tirana	6.5	4 (M)	23460	2346	3080	0.76	
DURRES-NDROG-TIRANA							
Dures-Ndrog	20	4 E	22852	2285	2915	0.78	
Ndrog-Tirana	21	4 E	24311	2431	4263	0.57	
		4 E	24311	2431	3163	0.77	
DURRES-KAFASAN							
Durres-Kavaje	22	4 E	29708	2971	3850	0.77	
Kavaje - Rrogozhine	17	4 E	20421	2042	3850	0.53	
Rrogozhine - Peqin	8	4 E	28808	2881	3988	0.72	
Peqin-Elbasan	36	2	16653	1665	1350	1.23	Upgrade to a 4-lane expressway
Elbasan - Librazhd	25	2	9301	930	750	1.24	Upgrade to a 4-lane expressway
Librazhd - Kafasan	37	2	8776	878	600	1.46	Upgrade to a 4-lane expressway
Kafasan - Pogradec	16	2	3243	324	518	0.63	
		2	3243	324	380	0.85	Upgrade to a 4-lane expressway

Table 4-4 (cont'd)
Albania: Volume/Capacity Analysis and Proposed Improvements
Long-Term Plan (2010 - 2020)

Highway Segment	Length (km)	Number of Lanes	Existing AADT	Peak Hourly Volume (V)	Practical Capacity (C)	V / C Ratio	Proposed Long-Term Improvements
RROGOZHINE-VLORE							
Rrogozhine-Lushnje	20	4 E	27270	2727	3713	0.73	
		4 E	27270	2727	2613	1.04	
Lushnje-Fier	29	4 E	18476	1848	3520	0.52	
		4 E	18476	1848	2420	0.76	
Fier-Vlore	34	2	7536	754	924	0.82	Upgrade to a 4-lane expressway
		2	7536	754	588	1.28	Upgrade to a 4-lane expressway
Tirana-Elbasan							
Tirana-Elbasan	38	4 M	14932	1493	2900	.51	
		4 M	14932	1493	1960	.76	

M = Motorway
E = Expressway

Table 4-5
Macedonia: Volume/Capacity Analysis and Proposed Improvements
Short-Term Plan (1998 - 2003)

Highway Segment	Length (km)	Number of Lanes	1996 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V/C Ratio	Proposed Short-Term Improvements
for heavy vehicles							
Kafasan - Struga	12.0	2	2553	255	1012	0.25	
Struga - Podmolje	7.1	2	6299	630	1693	0.37	
for light vehicles							
Pogradec - Ohrid	15.0	2	11754	1175	1311	0.90	Widen to a 4-lane expressway
	15.0	2	2110	211	1469	0.14	
Ohrid - Podmolje	4.9	2	9411	941	1296	0.73	
			9411	941	988	0.95	Widen to a 4-lane expressway
NORTHERN ROUTE							
Podmolje - Botun	14.7	2	4306	431	929	0.46	
Botun - Kicevo	38.6	2(3)	2394	239	1233	0.19	
Kicevo - Gostivar	45.5	2(3)	3913	391	1435	0.27	
			3913	391	1122	0.35	
Gostivar - Tetevo	21.2	4 (M)	7179	718	3360	0.21	
Tetevo - Skopje	42.7	2	8167	817	1417	0.58	
			8167	817	975	0.84	Build a 4-lane motorway
Skopje Ring Road	16.0	4 to 6	15818	1582	4565	0.35	
		4 (E)	15818	1582	3465	0.46	
Skopje - Miladinovci	25.6	2 to 6 4 (M)	5751	575	3320	0.17	
Miladinovci - Kumanovo	16.5	4 (M)	4979	498	2520	0.20	
Kumanovo - Stracin	34.2	2 (3)	4373	437	975 .	0.45	

Table 4-5 (cont'd)
Macedonia: Volume/Capacity Analysis and Proposed Improvements
Short-Term Plan (1998–2003)

Highway Segment	Length (km)	Number of Lanes	1996 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V/C Ratio	Proposed Short-Term Improvements
Stracin - Kriva Palanka	26.6	2 (3)	2159	216	1122	0.19	
			2159	216	953	0.23	
Kriva Palanka Ring Road	4.5	2	2800	280	1217	0.23	
Kriva Palanka - Deve Bair	13.3	2 (3)	2800	280	758	0.37	
CENTRAL ROUTE							
Ohrid - Bitola	65.6	2 (3)	2605	261	1093	0.24	
			2605	261	1095	0.24	
Bitola - Prilep	39.4	2	2806	281	1509	0.19	
			2806	281	1150	0.24	
Prilep - Titov Veles	81.8	2	2889	289	1033	0.28	
			2889	289	788	0.37	
Titov Veles - Stip	36.4	2	3377	338	No Data Available		
Stip - Krupishte	10.2	2	2536	254			
Krupishte - Kocani	17.5	2	5069	507			
Kocani - M. Kamenica	28.4	2	1295	130			
M. Kamenica - Delcevo	24.7	2	1732	173			
Delcevo - Bulgarian border	11.0	2	2000	200			
Titov Veles - Miladinovci	40.0	4	6357	636	3320	0.19	
		(M)	6357	636	2520	0.25	

* Best Judgement Applied

** Estimated Hourly Volume in Both Directions

Table 4-6
Macedonia: Volume/Capacity Analysis and Proposed Improvements
Intermediate-Term Plan (2003–2010)

Highway Segment	Length (km)	Number of Lanes	2003 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V / C Ratio	Proposed Intermediate-Term Improvements
for heavy vehicles							
Kafasan - Struga	12	2	3248	325	1012	0.32	
Struga - Podmolje	7.7	2	8014	801	1693	0.47	
for light vehicles							
Pogradec - Ohrid	15	**4E**	14954	1495	4785	0.31	
	15	2	2685	268	1469	0.18	
Ohrid - Podmolje	4.9	**4E**	11973	1197	4785	0.25	
			11973	1197	3795	0.32	
NORTHERN ROUTE							
Podmolje - Botun	14.8	2	5478	548	929	0.59	
Botun - Kicevo	38.6	2(3)	3046	305	1233	0.25	
Kicevo - Gostivar	45.8	2(3)	4978	498	1435	0.35	
			4978	498	1122	0.44	
Gostivar - Tetevo	21.2	4 (M)	9134	913	3360	0.27	
Tetevo - Skopje	36	**4 (M)**	10391	1039	3320	0.31	
			10391	1039	2520	0.41	
Skopje Ring Road	16	4 to 6	20125	2012	4565	0.44	
		4 (E)	20125	2012	3465	0.58	
Skopje - Miladinovci	25.6	2 to 6 4 (M)	7317	732	3320	0.22	
Miladinovci - Kumanovo	16.5	4 (M)	6335	633	2520	0.25	
Kumanovo - Stracin	37.1	2 (3)	5564	556	975	0.57	

Table 4-6 (cont'd)
Macedonia: Volume/Capacity Analysis and Proposed Improvements
Intermediate-Term Plan (2003–2010)

Highway Segment	Length (km)	Number of Lanes	2003 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V / C Ratio	Proposed Intermediate-Term Improvements
Stracin - Kriva Palanka	26.6	2 (3)	2747	275	1122	0.24	
			2747	275	953	0.29	
Kriva Palanka Ring Road	4.5	2	3562	356	1217	0.29	
Kriva Palanka - Deve Bair	13	2 (3)	3562	356	758	0.47	
CENTRAL ROUTE							
Ohrid - Bitola	65.6	2 (3)	3314	331	1093	0.30	
			3314	331	1095	0.30	
Bitola - Prilep	39.4	2	3570	357	1509	0.24	
			3570	357	1150	0.31	
Prilep - Titov Veles	84	2	3676	368	1033	0.36	
			3676	368	788	0.47	
Titov Veles - Stip	36.4	2	4296	430	No Data Available		
Stip - Krupishte	10.2	2	3227	323			
Krupishte - Kocani	17.5	2	6449	645			
Kocani - M. Kamenica	28.4	2	1648	165			
M. Kamenica - Delcevo	24.7	2	2204	220			
Delcevo - Bulgarian border	11.0	2	2545	254			
Titov Veles - Miladinovci	40	4	8088	809	3320	0.24	
		(M)	8088	809	2520	0.32	

* Best Judgement Applied
** Estimated Hourly Volume in Both Directions

M = Motorway
E = Expressway

Table 4-7
Macedonia: Volume/Capacity Analysis and Proposed Improvements
Long-Term Plan (2010 - 2020)

Highway Segment	Length (km)	Number of Lanes	2010 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V / C Ratio	Proposed Long-Term Improvements
for heavy vehicles							
Kafasan - Struga	12	2(3)	5048	505	1012	0.50	
Struga - Podmolje	7.7	2	12454	1245	1693	0.74	
for light vehicles							
Pogradec - Ohrid	15	4 E	23239	2324	4785	0.49	
	15	2	4172	417	1469	0.28	
Ohrid - Podmolje	4.9	4 E	18607	1861	3480	0.53	
			18607	1861	3795	0.49	
NORTHERN ROUTE							
Podmolje - Botun	14.8	2	8513	851	929	0.92	Build a 4-lane motorway
Botun - Kicevo	38.6	2(3)	4733	473	1233	0.38	
Kicevo - Gostivar	45.8	2(3)	7736	774	1435	0.54	
			7736	774	1122	0.69	
Gostivar - Tetevo	21.2	4 (M)	14194	1419	3360	0.42	
Tetevo - Skopje	36	4 (M)	16147	1615	3320	0.49	
			16147	1615	2520	0.64	
Skopje Ring Road	16	4 to 6	31274	3127	4565	0.69	
		4 (E)	31274	3127	3465	0.90	Provide a 6-lane expressway throughout
Skopje - Miladinovci	25.6	2 to 6 4 (M)	11370	1137	3320	0.34	
Miladinovci - Kumanovo	16.5	4 (M)	9844	984	2520	0.39	
Kumanovo - Stracin	37.1	2 (3)	8646	865	975	0.89	Build a 4-lane motorway

Table 4-7 (cont'd)
Macedonia: Volume/Capacity Analysis and Proposed Improvements
Long-Term Plan (2010 - 2020)

Highway Segment	Length (km)	Number of Lanes	2010 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V/C Ratio	Proposed Long-Term Improvements
Stracin - Kriva Palanka	26.6	2	4269	427	1122	0.38	
			4269	427	953	0.45	
Kriva Palanka Ring Road	4.5	2	5536	554	1217	0.46	
Kriva Palanka - Deve Bair	13	2 (3)	5536	554	758	0.73	
CENTRAL ROUTE							
Ohrid - Bitola	65.6	2 (3)	5150	515	1093	0.47	
			5150	515	1095	0.47	
Bitola - Prilep	39.4	2	5548	555	1509	0.37	
			5548	555	1150	0.48	
Prilep - Titov Veles	84	2	5712	571	1033	0.55	
			5712	571	788	0.73	
Titov Veles - Stip	36.4	2	6677	668	No Data Available		
Stip - Krupishte	10.2	2	5014	501			
Krupishte - Kocani	17.5	2	10022	1002			
Kocani - M. Kamenica	28.4	2	2560	256			
M. Kamenica - Delcevo	24.7	2	3424	342			
Delcevo - Bulgarian border	11.0	2	3954	395			
Titov Veles - Miladinovci	40	4	12568	1257	3320	0.38	
		(M)	12568	1257	2520	0.50	

* Best judgement applied
**Estimated hourly volume in both directions

M = Motorway
E = Expressway

Table 4-8
Bulgaria: Volume/Capacity Analysis and Proposed Improvements
Short-Term Plan (1998 - 2003)

Highway Segment	Length (km)	Number of Lanes	1996 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V/C Ratio	Proposed Short-Term Improvements
MACEDONIAN BORDER - SOFIA							
Gyueshevo - Kyustendil	22	2	2468	247	1036	0.24	
			2468	247	714	0.35	
Kyustendil - Pernik	59	2	3734	373	1146	0.33	
			3734	373	681	0.55	
			3734	373	354	1.05	Provide climbing lanes on mountainous sections and improve design geometrics
Pernik - Sofia	31	4 E	18761	1876	2911	0.64	
			18761	1876	1480	1.27	Improve design geometrics and add a third climbing lane for trucks on mountainous sections
	112						
Sofia Ring Road		2(4) E	x	x	x	x	
NORTHERN ROUTE							
Sofia - Botevgrad	64	4 M	13552	1355	3200	0.42	
			13552	1355	1520	0.89	Provide a third lane on steep uphill grade (over 6%)
Botevgrad - Yablanitza	39	4 M	6973	697	2120	0.33	
			6973	697	1120	0.62	
Yablanitza - Ablanitza	49	2	1887	189	1027	0.18	
			1887	189	648	0.29	
Ablanitza - V. Tarnovo	79	2	4348	435	1074	0.40	
			4348	435	695	0.63	

Table 4-8 (cont'd)
Bulgaria: Volume/Capacity Analysis and Proposed Improvements
Short-Term Plan (1998 - 2003)

Highway Segment	Length (km)	Number of Lanes	1996 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V/C Ratio	Proposed Short-Term Improvements
V. Tarnovo - Targovishte	99	2	2666	267	959	0.28	
			2666	267	570	0.47	
			2666	267	318	0.84	Provide climbing lanes on mountainous sections and improve design geometrics (most critically near Antonovo)
Targovishte - Shumen	43	2	6113	611	1019	0.60	
Shumen - Kaspichan	18	2	4235	424	1067	0.40	
Kaspichan - Varna	72	4	4235	424	2900	0.15	
		Motorway	4235	424	1120	0.38	
CENTRAL ROUTE							
Sofia - Karnare	129	2	3167	317	895	0.35	
			3167	317	271	1.17	Provide climbing lanes on mountainous sections and improve design geometrics (especially where many turns)
Karnare - Karlovo	13	2	11544	1154	501	2.31	Widen to a 4-lane expressway and improve design geometrics
Karlovo - Kazanlak	47	2	11745	1175	531	2.21	Widen to a 4-lane expressway and improve design geometrics
			11745	1175	292	4.03	Widen to a 6-lane expressway and improve design geometrics
Kazanlak - Sliven	62	2	2713	271	1111	0.24	
Sliven - Vetren	92	2	3609	361	862	0.42	
			3609	361	448	0.81	Provide 4 lanes on sections of heavy truck traffic (especially on Sliven-Karnobat)
Vetren - Burgas	20	4(M)	3609	361	2280	0.16	

Table 4-8 (cont'd)
Bulgaria: Volume/Capacity Analysis and Proposed Improvements
Short-Term Plan (1998 - 2003)

Highway Segment	Length (km)	Number of Lanes	1996 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V / C Ratio	Proposed Short-Term Improvements
Macedonian border- Blagoevgrad	25	2			Truck Traffic		
Blagoevgrad - Dupnitza	30	2	6684	668	Data		
			6684	668	Not		
Dupnitza - Kostenetz/Mirovo	77	2	2429	243	Available		
			2429	243			
SOUTHERN ROUTE							
Sofia - Kostenetz/Mirovo	74	4(M)	14554	1455	1360	1.07	Provide a third lane on steep uphill grade (over 6%)
Kostenetz - Plovdiv	83	4(M)	3221	322	3000	0.11	
			3221	322	2200	0.15	
Plovdiv - Orizovo	28	4(M)	8222	822	2920	0.28	
Orizovo - Stara Zagora	62	2	3024	302	988	0.31	
			3024	302	608	0.50	
Stara Zagora - Sliven	71	2	7020	702	1003	0.70	
extension to the Turkish border							
Popovitza - Haskovo	45	2	5197	520	1146	0.45	
			5197	520	774	0.67	
Haskovo - Lubimetz	51	2	6861	686	1146	0.60	
			6861	686	774	0.89	Build a 4-lane motorway
Lubimetz - Svilengrad	19	4(M)	6861	686	3100	0.22	
Svilengrad - Kapitan Andreevo	8	2	6861	686	1450	0.47	

M = Motorway
E = Expressway

Table 4-8 (cont'd)
Bulgaria: Volume/Capacity Analysis and Proposed Improvements
Short-Term Plan (1998 - 2003)

Highway Segment	Length (km)	Number of Lanes	1996 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V/C Ratio	Proposed Short-Term Improvements
Port of Varna and Burgas Connection							
Varna - Priseltzi	9	4(M)	4680	468	1560	0.30	
Priseltzi - Burgas	125	2	4680	468	1193	0.39	
			4680	468	837	0.56	
			4680	468	424	1.10	Build a 4-lane motorway

* Best judgement applied
** Estimated hourly volume in both directions

Table 4-9
Bulgaria: Volume/Capacity Analysis and Proposed Improvements
Intermediate-Term Plan (2003 – 2010)

Highway Segment	Length (km)	Number of Lanes	2003 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V / C Ratio	Proposed Intermediate-Term Improvements
MACEDONIAN BORDER - SOFIA							
Gyueshevo - Kyustendil	22	2	3140	314	1064	0.30	
			3140	314	756	0.42	
Kyustendil - Pernik	59	2	4751	475	1185	0.40	
			4751	475	723	0.66	
			4751	475	640	0.74	
Pernik - Sofia	31	**4-5 E**	23869	2387	3108	0.77	
			23869	2387	4070	0.59	
Sofia Ring Road		2(4)		x		x	
NORTHERN ROUTE							
Sofia - Botevgrad	64	**4-5 M**	17242	1724	3280	0.53	
			17242	1724	2960	0.58	
Botevgrad - Yablanitza	39	4 M	8872	887	2200	0.40	
			8872	887	1240	0.72	
Yablanitza - Ablanitza	49	2	2401	240	1051	0.23	
			2401	240	672	0.36	
Ablanitza - V. Tarnovo	79	2	5532	553	1098	0.50	
			5532	553	719	0.77	
V. Tarnovo - Targovishte	99	2	3392	339	980	0.35	
			3392	339	589	0.58	
			3392	339	442	0.77	
Targovishte - Shumen	43	2	7777	778	1135	0.69	

Table 4-9 (cont'd)
Bulgaria: Volume/Capacity Analysis and Proposed Improvements
Intermediate-Term Plan (2003 - 2010)

Highway Segment	Length (km)	Number of Lanes	2003 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V / C Ratio	Proposed Intermediate-Term Improvements
Shumen - Kaspichan	18	2	5388	539	1090	0.49	
Kaspichan - Varna	72	4 M	5388	539	2960	0.18	
			5388	539	1240	0.43	
CENTRAL ROUTE							
Sofia - Karnare	129	2 (3)	4029	403	916	0.44	
			4029	403	720	0.56	
Karnare - Karlovo	13	**4 E**	14687	1469	2695	0.54	
Karlovo - Kazanlak	47	**4 E**	14943	1494	3108	0.48	
		6 E	14943	1494	2764	0.54	
Kazanlak - Sliven	62	2	3452	345	1137	0.30	
Sliven - Vetren	92	2	4592	459	887	0.52	
		4 E	4592	459	2118	0.22	
Vetren - Burgas	20	4(M)	4592	459	2280	0.20	
Macedonian border- Blagoevgrad	25	2			Truck Traffic		
Blagoevgrad - Dupnitza	30	2	8504	850	Data		
			8504	850	Not		
Dupnitza - Kostenetz/Mirovo	77	2	3090	309	Available		
			3090	309			

Table 4-9 (cont'd)
Bulgaria: Volume/Capacity Analysis and Proposed Improvements
Intermediate-Term Plan (2003 - 2010)

Highway Segment	Length (km)	Number of Lanes	2003 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V / C Ratio	Proposed Intermediate-Term Improvements
SOUTHERN ROUTE							
Sofia - Kostenetz/Mirovo	74	**4-5 M**	18517	1852	2960	0.63	
Kostenetz - Plovdiv	83	4	4098	410	3080	0.13	
			4098	410	2280	0.18	
Plovdiv - Orizovo	28	4	10461	1046	3000	0.35	
Orizovo - Stara Zagora	62	2	3847	385	1011	0.38	
			3847	385	632	0.61	
Stara Zagora - Sliven	71	2	8931	893	1106	0.81	Improve geometric standards
extension to the Turkish border							
Popovitza - Haskovo	45	2	6612	661	1185	0.56	
			6612	661	822	0.80	Improve geometric standards
Haskovo - Lubimetz	51	**4(M)**	8729	873	3200	0.27	
			8729	873	2400	0.36	
Lubimetz - Svilengrad	19	4(M)	8729	873	3100	0.28	
Svilengrad - Kapitan Andreevo	8	2	8729	873	1450	0.60	

Table 4-9 (cont'd)
Bulgaria: Volume/Capacity Analysis and Proposed Improvements
Intermediate-Term (Plan (2003 - 2010)

Highway Segment	Length (km)	Number of Lanes	2003 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V / C Ratio	Proposed Intermediate-Term Improvements
Port of Varna and Burgas Connection							
Varna - Priseltzi	9	4(M)	5954	595	1560	0.38	
Priseltzi - Burgas	125	4 M	5954	595	3320	0.18	
			5954	595	2520	0.24	
			5954	595	1680	0.35	

* Best judgement applied
** Estimated hourly volume in both drections

Table 4-10
Bulgaria: Volume Capacity Analysis and Proposed Improvements
Long-Term Plan (2010 - 2020)

Highway Segment	Length (km)	Number of Lanes	2010 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V/C Ratio	Proposed Long-Term Improvements
MACEDONIAN BORDER - SOFIA							
Gyueshevo - Kyustendil	22	2	4879	488	1099	0.44	
			4879	488	798	0.61	
Kyustendil - Pernik	59	2	7383	738	1209	0.61	
			7383	738	765	0.97	Build a 4-lane motorway
			7383	738	553	1.33	
Pernik - Sofia	31	4-5 E	37092	3709	3190	1.16	Widen to a 6-lane expressway
			37092	3709	4070	0.91	
Sofia Ring Road		2(4)		x		x	
NORTHERN ROUTE							
Sofia - Botevgrad	64	4-5 M	26794	2679	3400	0.79	
			26794	2679	2960	0.91	Extend length of climbing lanes
Botevgrad - Yablanitza	39	4 M	13786	1379	2280	0.60	
			13786	1379	1340	1.03	Provide climbing (truck) lanes on uphill grade
Yablanitza - Ablanitza	49	2	3731	373	1074	0.35	
			3731	373	695	0.54	
Ablanitza - V. Tarnovo	79	2	8596	860	1138	0.76	
			8596	860	758	1.13	Build a 4-lane motorway
V. Tarnovo - Targovishte	99	2	5271	527	1015	0.52	
			5271	527	627	0.84	Build a 4-lane motorway
			5271	527	466	1.13	

Table 4-10 (cont'd)
Bulgaria: Volume Capacity Analysis and Proposed Improvements
Long-Term Plan (2010 – 2020)

Highway Segment	Length (km)	Number of Lanes	2010 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V/C Ratio	Proposed Long-Term Improvements
Targovishte - Shumen	43	2	12086	1209	1161	1.04	Build a 4-lane motorway
Shumen - Kaspichan	18	2	8373	837	1122	0.75	
Kaspichan - Varna	72	4 M	8373	837	3060	0.27	
			8373	837	1340	0.62	
CENTRAL ROUTE							
Sofia - Karnare	129	2-3	6261	626	937	0.67	
			6261	626	720	0.87	Extend length of climbing lanes
Karnare - Karlovo	13	4 E	22824	2282	2778	0.82	
Karlovo - Kazanlak	47	4 E	23221	2322	3190	0.73	
		6 E	23221	2322	2970	0.78	
Kazanlak - Sliven	62	2	5364	536	1163	0.46	
Sliven - Vetren	92	2	7135	714	912	0.78	
		4 E	7135	714	2200	0.32	
Vetren - Burgas	20	4(M)	7135	714	2280	0.31	
Macedonian border- Blagoevgrad	25	2					
Blagoevgrad - Dupnitza	30	2	13215	1321			
			13215	1321			
Dupnitza - Kostenetz/Mirovo	77	2	4802	480			
			4802	480			

Table 4-10 (cont'd)
Bulgaria: Volume Capacity Analysis and Proposed Improvements
Long-Term Plan (2010 - 2020)

Highway Segment	Length (km)	Number of Lanes	2010 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V/C Ratio	Proposed Long-Term Improvements
SOUTHERN ROUTE							
Sofia - Kostenetz/Mirovo	74	4-5 M	28775	2877	2960	0.97	Extend length of climbing lanes
Kostenetz - Plovdiv	83	4(M)	6368	637	3160	0.20	
			6368	637	2360	0.27	
Plovdiv - Orizovo	28	4(M)	16256	1626	3080	0.53	
Orizovo - Stara Zagora	62	2	5979	598	1035	0.58	
			5979	598	656	0.91	Build a 4-lane Motorway
Stara Zagora - Sliven	71	2	13879	1388	1330	1.04	Build a 4-lane Motorway
extension to the Turkish border							
Popovitza - Haskovo	45	2	10275	1028	1209	0.85	
			10275	1028	1100	0.93	Build a 4-lane Motorway
Haskovo - Lubimetz	51	4(M)	13565	1356	3280	0.41	
			13565	1356	2480	0.55	
Lubimetz - Svilengrad	19	4(M)	13565	1356	3100	0.44	
Svilengrad - Kapitan Andreevo	8	2	13565	1356	1450	0.94	Build a 4-lane Motorway

Table 4-10 (cont'd)
Bulgaria: Volume Capacity Analysis and Proposed Improvements
Long-Term Plan (2010 – 2020)

Highway Segment	Length (km)	Number of Lanes	2010 AADT	Peak Hourly Volume (V)*	Practical Capacity (C)**	V / C Ratio	Proposed Long-Term Improvements
Port of Varna and Burgas Connection							
Varna - Priseltzi	9	4(M)	9253	925	1560	0.59	
Priseltzi - Burgas	125	4(M)	9253	925	3320	0.28	
			9253	925	2520	0.37	
			9253	925	1680	0.55	

* Best judgement applied
** Estimated hourly volume in both directions

4.3 RECOMMENDED HIGHWAY IMPROVEMENT PROJECTS

The demand analysis described in Section 4.1 aided the Bechtel team in identifying highway infrastructure improvements along the East-West Corridor on the basis of existing or forecast capacity constraints. As shown in Section 4.2, many improvement schemes were identified with the purpose of increasing practical capacity, ranging from improving the geometric characteristics of existing highways, the addition of climbing lanes on sections with steep up-grades, to widening of existing 2-lane highways to 4-lane expressways and motorways.

However, there are other reasons than capacity constraints that can justify highway improvements along the East-West Corridor as discussed in Section 2. Therefore, the improvement proposals developed through the demand analyses process were further measured against another set of factors and criteria. These factors include the following:

- Adherence to internationally acceptable safety standards
- Conformance to international and European motorway standards for primary routes along the corridor
- Provision of continuous highway routes along the East-West Corridor with homogeneous characteristics
- Meeting the strategic objectives of the East-West Corridor development

These factors were extracted directly from a set of goals which focus on the economic and strategic significance of the corridor and its most important components. The goals are as follows:

- Development of a continuous, safe, and operationally efficient primary highway corridor by the target year of 2003
- Development of primary highway corridor routes that conform to Trans-European Motorway (TEM) standards by 2010
- Development of secondary road corridor routes that conform to (TEM) standards by 2020

These goals reflect the recommendations and objectives developed for Corridor No. 8 (East-West Corridor) in Crete, during the Pan-European Conference in 1994. The East-West Corridor was one of nine transport corridors identified as having significant economic importance within Europe. In order to meet the traffic demands of an increasingly unified Europe, significant highway improvement programs, particularly in central and eastern Europe, must be undertaken.

Therefore, the improvement schemes proposed in Section 4.2 were examined and measured against the above targets and objectives to arrive at a set of recommended highway improvement projects for the East-West Corridor.

In general, major highway improvement projects consisted of the construction of 4-lane motorways, the expansion of 2-lane highways into 4 or 6-lane expressways, and the rehabilitation or construction of 2-lane standard highways. Typical cross sections of each are presented in Figures 4-2, 4-3, and 4-4, respectively.

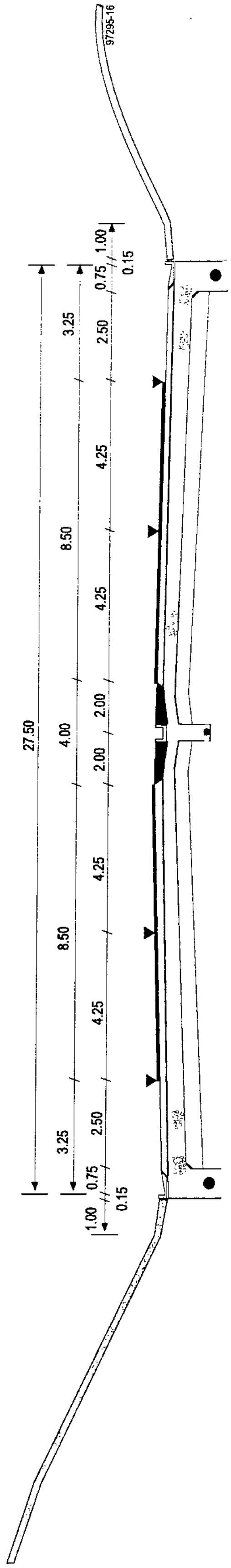
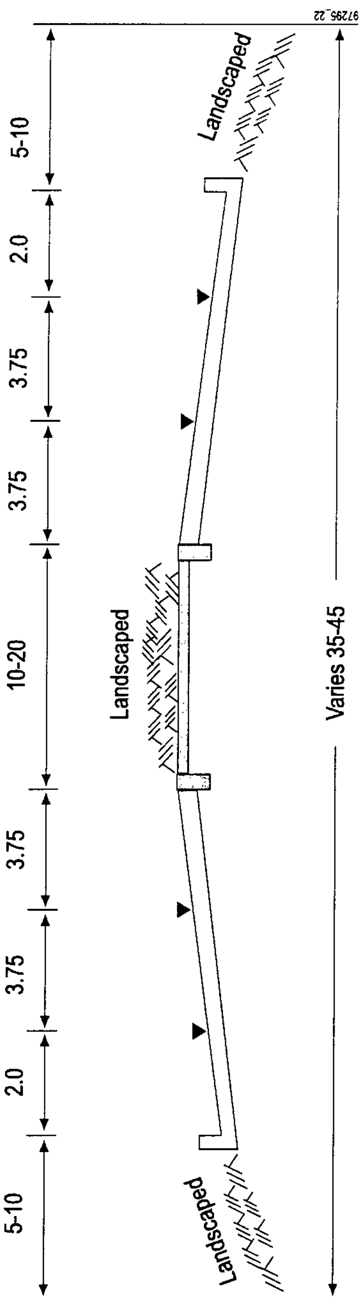


Figure 4-2 Typical Cross Section: 4-Lane Motorway



Not to Scale

Figure 4-3 Typical Cross Section: 4-Lane Rural Expressway

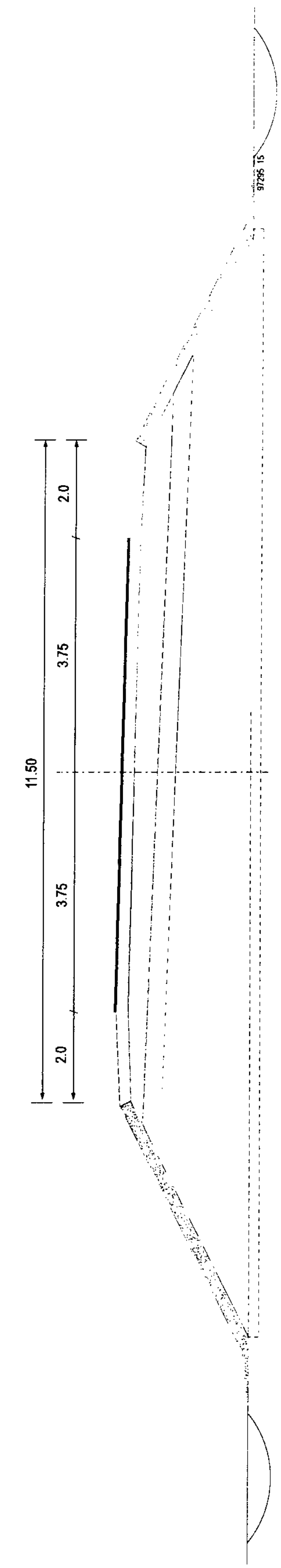


Figure 4-4 Typical Cross Section: 2-Lane Rural Highway

4.3.1 Short Term Immediate Action Plan - Year 2003 Plan

Albania

Even though the capacity analysis indicates the need to widen certain segments of the highway corridor from 2-lane roads to 4-lane expressways, the strategic objectives of the corridor development dictate that a primary motorway route be built through Albania by the year 2010, with certain sections built by 2003. The motorway sections that should be completed by 2003 would run parallel to the following, existing highway segments:

- Durres - Vore, 25.4 km
- Tirana - Elbasan, 38 km, including a 5 km tunnel section through mountains

In addition to the motorway program outlined above, the capacity analysis shows that the following sections of 2-lane roads should be widened to 4-lane expressways in order to meet increasing traffic demands by the same target year, 2003:

- Durres - Ndog - Tirana, 41 km
- Durres - Rrozhine - Elbasan, 83 km
- Rrogozhine - Fier, 49 km
- Kafasan - Pogradec, 16 km ($US 16 million)

We recommend that the segment Durres - Ndog - Tirana be widened to a 4-land expressway (following proper feasibility and economic viability studies), but that the other three segments be upgraded only to standard 2-land highways. That is because motorways will need to be implemented in parallel to these three segments in the intermediate term timeframe inorder to meet the starategic objectives of the East-West corridor development. Forecasted traffic volumes for the foreseeable future will not support 4-lane expressways in addition to parallel motorways along these segments of the corridor.

In addition to the motorway and expressway projects outlined above, the capacity analysis further shows the need to rehabilitate and upgrade the existing substandard 2-lane highway, between Elbasan and the Macedonian border, into a standard design 2-lane highway. This project also includes the provision of bypasses around towns, and the streamlining of the horizontal and vertical geometrics along the highway. Implementation of this project is currently underway with financing provided by the World Bank, the Kuwait Fund, and PHARE. This section of highway provides a key link along the East-West Corridor and should be completed as soon as possible.

- Elbasan - Kafasan (Macedonian Border), 71.1 km

Macedonia

In general, the strategic recommendations for Macedonian highway improvements coincide with the results of the capacity analysis. The motorway program recommended for the year 2003 consists of the following section:

- Skopje - Tetevo, 35.7 km

The capacity analysis also resulted in the need to widen the following 2-lane section of the existing highway into a 4-lane expressway:

- Pogradec - Ohrid, 30 km

The 2-lane section of the highway listed below is currently classified as substandard. Although the capacity analysis does not foresee any capacity constraints on this section in the near future, it is recommended that it be upgraded to a standard design 2-lane highway by 2003 due to its strategic importance as an important feeder to the primary East-West Corridor and to improve its safety standards.

- Titov Veles - Prilep, 72.6 km

It is further recommended that current plans to build a new 2-lane road between Kriva Palanka and Deve Bair be implemented as soon as possible. Even though the capacity analysis suggests that the existing highway between these two towns will sufficiently handle traffic demand in the immediate-term, the construction of a new highway, at a higher elevation, is justified because of the potential flooding of the existing route that will result from the construction of a hydroelectric dam at this site.

- Kriva Palanka - Deve Bair, 11 km

Bulgaria

In general, the short-term capacity analysis for Bulgaria indicates the need for several geometric improvement projects throughout the country's east-west highway routes. For the most part, these projects call for the provision of additional climbing lanes in steep sections, and the overall standardization of design geometrics for substandard sections. These improvements are listed in Table 4-8 in Section 4.7. The Bulgarian Highway Department is currently upgrading many of the country's highways. It is assumed that the additional projects given in the capacity analysis will be implemented through this government's routine highway construction and maintenance programs. Total length of these improvement projects amounts to 324 km.

In addition to the above mentioned highway upgrading program, the capacity analysis identified the need for the following expressway project:

- Karnare - Kazanlak, 60 km

The capacity analysis did not show the immediate need to upgrade many segments on the east-west highways to a motorway standard, but in order to meet the strategic objectives of the corridor development, it is recommended to build the following motorways, on parallel alignments to existing highway sections:

- Varna - Burgas, 87 km
- Orizovo - Kapitan Andreevo, 108 km

Figure 4-5 depicts the recommended status of the highways in the East-West Corridor in the year 2003.

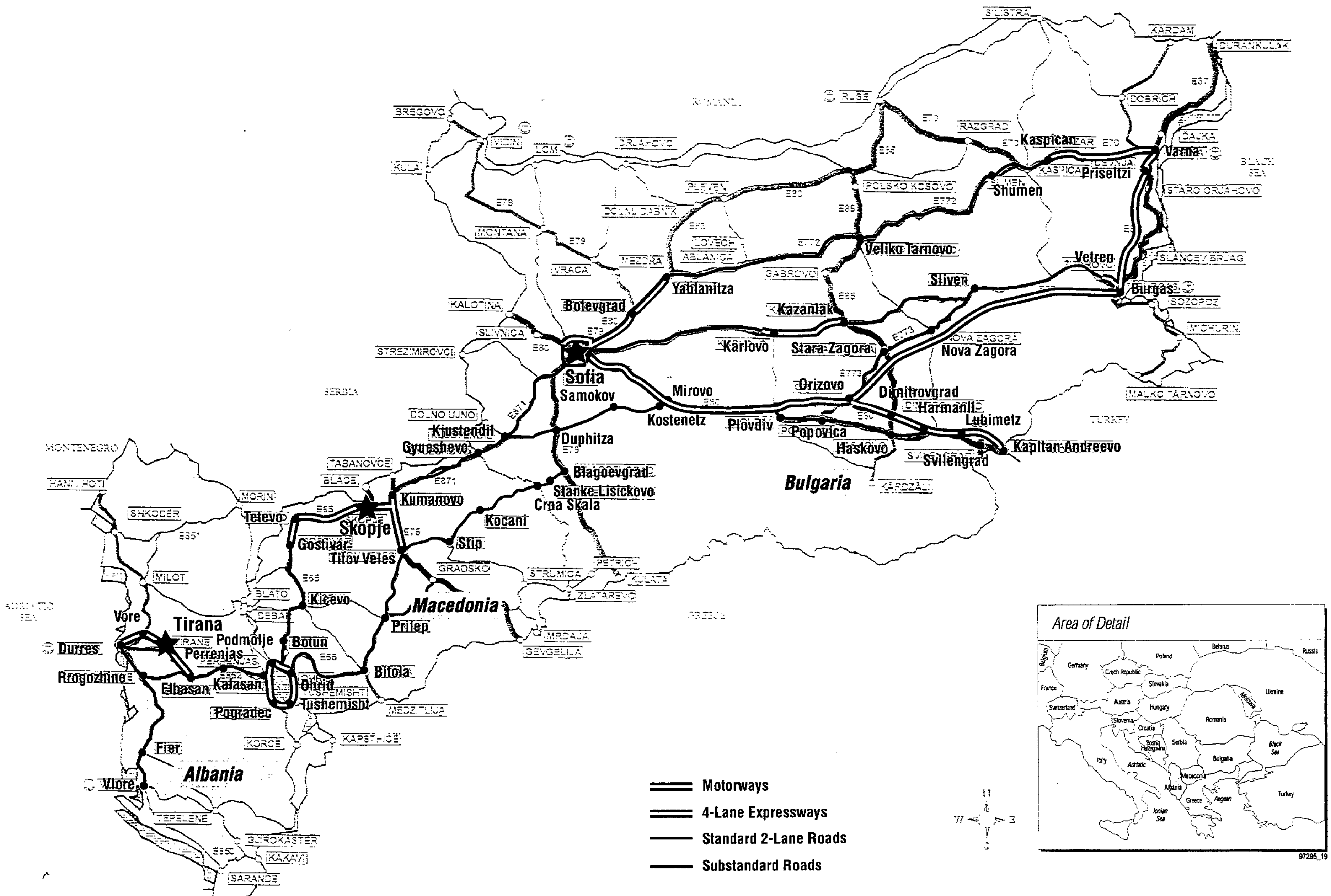


Figure 4-5 East-West Transport Corridor: Proposed Year 2003 Road Network

4.3.2 Intermediate-Term Strategic Projects - Year 2010 Plan

The following section presents the recommended highway improvement program, by country, for the intermediate term time frame:

Albania

The capacity analysis performed for Albania for the intermediate-term (2003 through 2010), indicates that no major highway improvement projects will be required to meet forecast traffic demands for this time frame. However, in order to meet the strategic objectives of the East-West Corridor development, it is recommended that the following motorway segments be implemented by the year 2010, preferably on a separate and parallel right-of-way to existing highways:

- Durres - Rrogozhine, 39 km
- Rrogozhine - Kafasan, 106 km
- Rrogozhine - Vlore, 83 km
- Kafasan - Pogradec, 16 km

Macedonia

The capacity analysis yielded no need for additional highway improvements for Macedonia for the intermediate time frame. However, in order to meet the strategic objective of providing one primary motorway route along the East-West Corridor, the following motorway segments are recommended:

- Gostivar - Podmolje, 98.8 km
- Kumanovo - Deve Bair, 78.6 km
- Podmolje - Pogradec, 34.9 km

In addition to the preceding motorway segments, the safety objective of upgrading the corridor highways dictate that the following section be upgraded from a substandard to a standard 2-lane highway:

- Titov Velez - Bulgarian Border, 128.2 km

Bulgaria

The results of the capacity analysis suggest that there will be no major capacity constraints on the Bulgarian highway network in the intermediate-term. The improvement projects identified through the capacity analysis are relatively minor, calling for improved design geometric on a couple of sections of the corridor's southern route (107 km). However, the strategic objective of the corridor development dictates that a motorway be built parallel to the following section of the existing highway:

- Burgas - Orizovo, 190 km

The intermediate strategic highway improvement program for Albania, Macedonia, and Bulgaria is presented in graphical form in Figure 4-6.

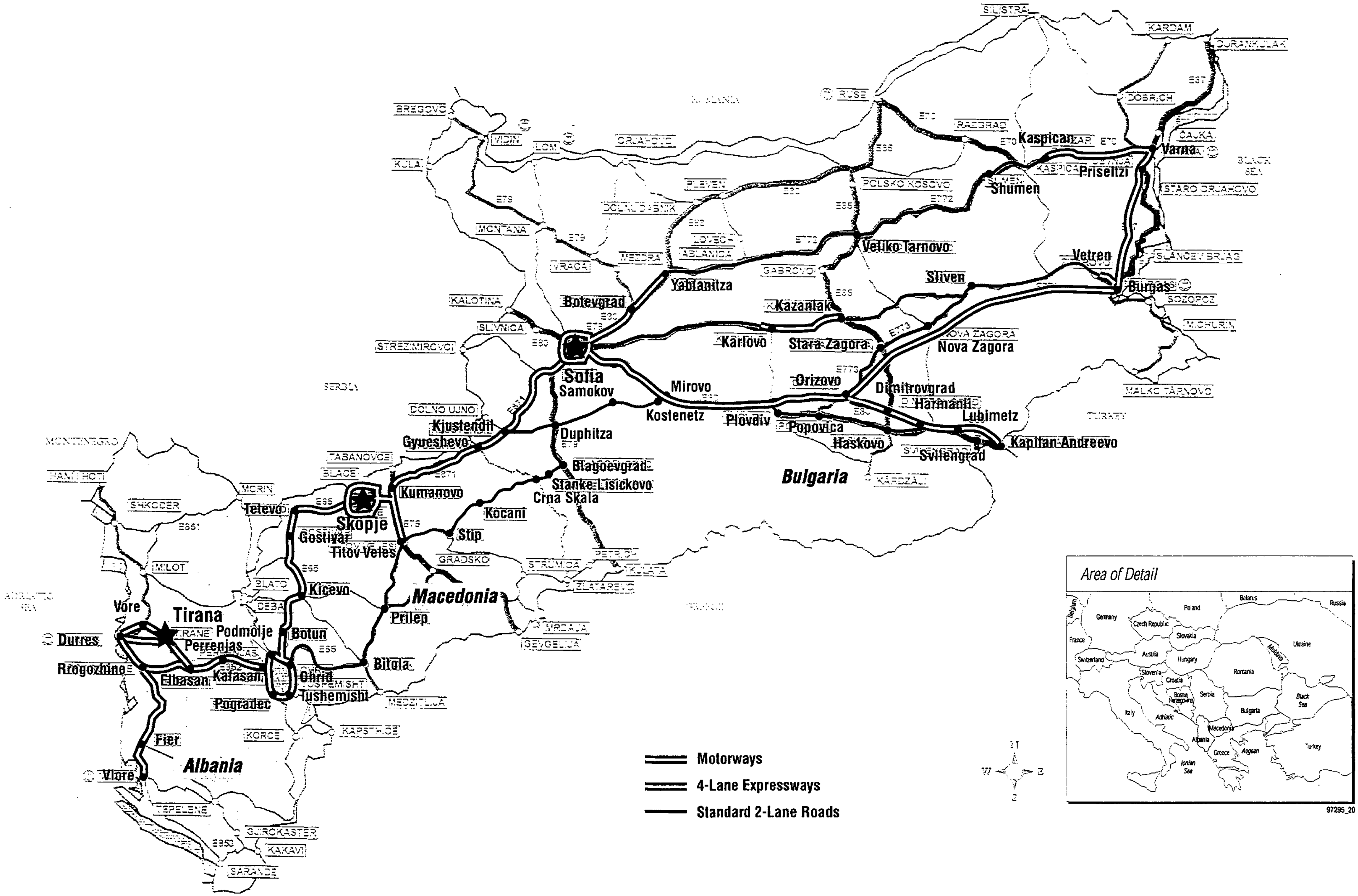


Figure 4-6 East-West Transport Corridor: Proposed Year 2010 Road Network

4.3.3 Long-Term Vision – Year 2020 Plan

The following is a brief description of the recommended long-term plan, with a focus on its major components.

Albania

The results of Albania's 2010 highway capacity analysis are presented in tabular form in Section 4.2. Most of the long-term improvements identified were part of the strategic recommendations in earlier time frames. Therefore, no further recommendations are given for the long-term. There will undoubtedly be several bottlenecks, particularly around and through main cities in Albania, that will emerge along the East-West Corridor routes that will need physical and/or operational treatments. Continuing measurements and studies will be needed to identify and treat such bottlenecks before they represent significant impedance of traffic flow along the corridor.

Macedonia

The 2010 capacity analysis for Macedonia suggests that capacity constraints can be alleviated in the long run with the construction of motorways and expressways on the highway sections specified. Due to these sections' strategic importance within the East-West Corridor, these long-term improvement plans were components of strategic recommendations for earlier time frames. For example, according to the 2010 capacity analysis, a motorway should be constructed parallel to the Podmolje - Botun section of existing highway by 2020. However, this particular project was a component of the strategic recommendation for the time frame between 2003 and 2010.

In order to meet the strategic objectives of the East-West corridor development, the construction of the following motorways is recommended during this time frame:

- Ohrid - Titov Veles, 186.8

Bulgaria

The 2010 capacity analysis for Bulgaria is presented in Section 4.2. Aside from basic geometric improvements needed to raise standards for existing 2-lane highways (240 km), the capacity analysis suggests that motorways be built parallel to several sections of Bulgaria's highway network. Most of these suggestions have been incorporated into motorway programs for earlier time frames and therefore are no longer pertinent. In addition, the results from the capacity analysis suggest that certain sections of the central route through Bulgaria be expanded into 6-lane expressways. However, this suggestion is superseded by the long-term strategic recommendation to build a tolled motorway parallel to the following highway section:

- Macedonian Border - Dupnitza, 55 km

The long-term highway improvement program for Albania, Macedonia, and Bulgaria is presented in graphical form in Figure 4-7.

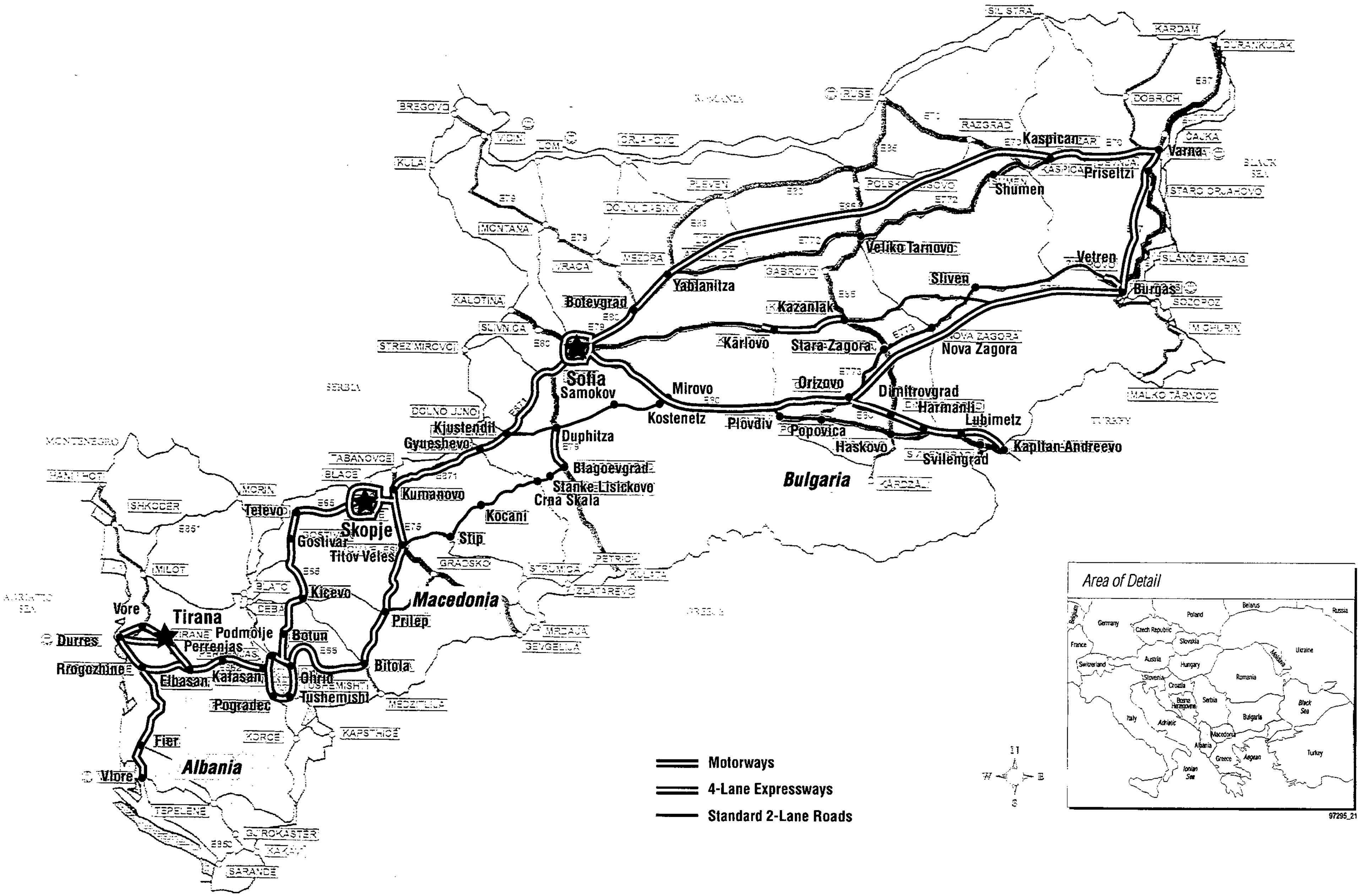


Figure 4-7 East-West Transport Corridor: Proposed Year 2020 Road Network

In summary, the recommended highway improvement program for the East-West Corridor, for the three milestone time frames is presented in Table 4-11:

Table 4-11
Summary Recommend Highway Improvement Programs

	Short-Term Intermediate Action (km)	Intermediate-Term Strategy (km)	Long-Term Vision (km)	TOTAL (km)
Motorways (km)				
Albania	63	244	–	**307**
Macedonia	36	212	187	**435**
Bulgaria	195	219	343	**757**
Expressways (km)				
Albania	190	–	–	**190**
Macedonia	30	–	–	**30**
Bulgaria	60	–	–	**60**
Geometric Improvements (km)				
Albania	71	–	–	**71**
Macedonia	84	128	–	**212**
Bulgaria	324	107	240	**671**
Total (km)	1052	910	770	**2732**

This section presents the technical characteristics of the rail system infrastructure in the three member countries, existing construction and rail improvement plans, and proposed improvement projects that will bring these rail routes into conformance with the International Union of Railroad (UIC) standards. The section also presents a time-phased program for implementation of the proposed projects.

5.1 PRESENT RAILWAY INFRASTRUCTURE

5.1.1 Albanian Railways (HSH)

The Albanian railway network consists of 677 km of single track of which 477 km is mainline and 230 km is secondary line sidings and industrial lines. The railway was built after World War II to modern standards. The main line minimum curve radius is 500 m, except for mountain areas where it is 300 m. The gradients are up to 13 percent for a line length of 30 km and up to 18 percent between Elbasan and Prenjasi on a 35-km stretch. The line was designed for 100 km/hr speed in plain areas and 60/65 km/hr in the mountains. The axle load design is for 20 tons. The rail used in the main line is type 49 (216 km) with the balance being type 43. HSH is using wooden sleepers, of poor quality and many of which are decayed. This has resulted in gauge widening and speed restrictions to a maximum 45 km/hr for passenger trains, and 25 km/hr for freight trains. Beginning in 1986, HSH has used concrete bi-block ties to completely resleep 30 km of track and installed bi-block ties on an alternate basis (one in four) on a 100 km track stretch, in order to maintain gauge. The concrete bi-block sleepers are manufactured in Albania under Stedeff/Freuch license and are designed for 140 km/hr. However, the ballast is of poor quality and of insufficient thickness; 150 mm instead of 250 mm as required by HSH standards.

There are major tunnels on the Elbasan - Pogradec line at km 91/92; 95/97; 99/102; 107/108; 112/123; and 126/130 (3.5 km). East of Elbasan there is a well-constructed infrastructure consisting of long span bridges over mass concrete piers and concrete/masonry retaining walls, extensive protecting arches, and structures against fallen rocks. The tunnels have passing clearance as per UIC kinematics gauge GB1, adequate for piggyback traffic even on 300-m-radius curves.

Signaling System

Ninety percent of all train movements are executed without signaling protection. The main line is only 30 percent signaled (133 km) and consists of local electric interlocking and light signals. From Durres to Pogradec, the only segments with local electrical interlocking and light signals run between Durres - Mallna - Rrogozhine. Most of the network train operations are based on VHI radio communications between stations and written licensing orders. The VHF radio system operates reasonably well and train operations and communications depend on it, signaled territory included.

Telecomunications

Except for three short sections, Milot - Preshen, Rrogozhine - Lushnje, and Bajza - Tuz which have quad cable, communication for the network is provided by obsolete aerial line and VHF radio. However, most of the aerial line has deteriorated and/or has been vandalized.

5.1.2 Macedonian Railway (MZ)

The Macedonian railway network is a single track of 696 km, which includes 226 km of direct (through) station tracks. The main track (North - South Magistrale) is 278 km with 233 km of electrified territory. There are 101 km of additional industrial tracks under MZ management.

The maximum permitted speeds on the main line are 110 to 120 km/hr; however, the Skopje - Veles segment has a maximum speed of between 90 and 100 km/hr. The Kumanovo - Beljakovce line (30 km), presently under reconstruction, has a maximum speed of 100 km/hr. The Beljakovce - Bulgarian border line (55 km) which is under construction is designed for 100 km/hr. Both lines will permit 22.5 tons/axle. The design has been completed on one 65 km planned extension from Kicevo to the Albanian border. An alternate route under consideration would connect Bitola with the Albanian border. Either one of the extensions will constitute the final link for the East-West Corridor. On the Veles - Bitola line speed restrictions have been imposed because of the age and condition of the rail. There are also speed restrictions of 75 km/hr on curves and tunnels. Axle loads have been restricted to 18 tons because of poor track conditions. Moreover, there are speed restrictions at level crossings in populated areas (75 to 85 km/hr).

Electrification

The Tabanovici - Skopje - Veles - Gevgelja main line is electrified at 25 kv, 50 Hz. Substations are located at approximately 8 km intervals. A total of 232 km of main line and 83 km of station tracks are electrified. The system is modern and in sound condition. The Kumanovo - Beljakovce line is under reconstruction and the new Beljakovce - Bulgarian border line will use diesel traction. However, provisions were made for future line electrification.

Signaling System

On the main line there are automatic block systems from Tabanovici to Klisura. From Klisura to Gevgelja (47 km), only the station limits are interlocked and there is no interlocking between stations. On the Tetevo - Kiervo branch, the stations between Gostivar and Kiervo have electrical interlocking. The rest of the stations on this branch have mechanical interlocking. On the Veles - Bitola line, all stations have mechanical interlocking, except for Bitola and Veles, which are electrically interlocked. Moreover, Veles is part of the main line automatic block. Train protection equipment has been purchased for the main North - South Line but has not been installed because of lack of funds.

Telecommunications

The backbone of the MZ communications system is 46-pairs, 275 km, of buried copper cable that runs from Tabanovici to Gevegelija. Along this line there are five switch stations at Skopje, Kumanovo, Trubarevo, Veles, and Gevegelija. There are three more switch stations at Kicevo, Gostivar, and Bitola. The MZ telecom line extends northward through Serbia to Belgrade.

The switching equipment is in good condition and does not have to be replaced. The branch lines have aerial wire communications that should be replaced due to very poor condition and performance. However, the line from Gostivar to Kicevo does not need replacement as it is served by buried cable that was installed in 1960.

The headquarters in Skopje and all terminals are connected with the intermediate stations by desktop communication consoles. At each block signal on the main line there is a telephone connected to headquarters. The system has data transmission capabilities for computer equipment use. Radio communication is used at Trubarevo and Gevegelija for switching purposes.

5.1.3 Bulgarian Railways (BDZ)

The Bulgarian railway network is 4031 km, of which 3071 km is single track and 960 km is double track. Approximately 65 percent or 2650 km is electrified.

The maximum design speed is 130 km/hr, but is possible only on a 93-km segment. Because of the number of curves under 300m radius and gradients over 15 per thousand, most portions of the railway only permit speeds of between 80 and 100 km/hr.

Electrification

Of the 4,031 km railway network, about 65 percent (or 2650 km) is electrified. The line is fed by AC 50 HZ 27.5 kV electricity current with voltage variation between 19 kV and 29 kV. There are 47 substations, each one assigned to approximately 53 km of track.

Signaling System

BDZ employs automatic block signal to only 347 km, or 8.6 percent, of its network. The automatic block signal system is installed on the Sofia - Karlov line which is 165 km (USSR, 1972), the Sofia - Plovdiv line which is 164 km (BDZ/ZAT 1985), and a few other short sections.

Most of the BDZ territory (79 percent) is governed by a semiautomatic block system and stations are covered by entry and exit signals with no block signals between them. Since the distance between two adjacent stations represents a permissible block, the system greatly limits the traffic capacity of the lines.

The rest of the network (12.4 percent) relies on telephone blocking for traffic operations. For train protection, BDZ uses an ATP (automatic train protection) system installed between Sofia and Plovdiv (164 km) to control train speed according to signal aspects (cab-signal system). The ATP is installed along the route and on 103 locomotives.

Centralized traffic control (CTC) is installed on the Sofia - Karlovo line (165 km) and on the Sofia - Plovdiv double-track line (156 km).

Telecommunications

The BDZ transmission lines consist of 3550 km quad composite cable for trunk lines which are installed underground along the track. Some of the lines are saturated. Aerial wire is used on some branch lines (750 km) including the Radomir and Gyueshevo lines. The wires are very old and deteriorated.

The BDZ telephone exchange networks consist of a three-tier system. Tier one has 10,500 lines located in Sofia, Gorna Orjahovitsa, Varna, Stara Zagora, and Plovdiv. This is a step-by-step exchange which uses Siemens technology dating back to 1930. However, this system is being replaced by a digital version. The tier two exchanges are used for 19 secondary cities and account for 6,200 lines and are also being replaced with new technology. The tier three system accounts for 9000 lines and uses newer technology. There is also a limited interconnection between the BDZ PABX and the public telephone network at Sofia, Plovdiv, and Varna.

A train radio is used for train traffic control and orders are transmitted from a dispatcher to locomotive drivers. At present, 400 main-line locomotives and EMUs are provided with necessary radio mobile equipment. In addition, 450 shunting locomotives are fitted with radios for local operation in station areas. The radio system covers approximately 1600 km. The system will be expanded when the Ruse to Gorna Orjahovitsa line is completed, as a radio system is planned on Line 5 to the Greek border.

The BDZ data network infrastructure consists of a telex-extensive network and a 0.25 packet-switching system. The telex system transmits train consist information, wagon contents, etc.

The telex system also serves as a back-up data network. The X.25 system, implemented in 1984 by SYSCOM of Liechtenstein, consists of packet switches at Sofia, Plovdiv, Gorna O, and Varna. Secondary sites and border-crossing sites are linked to main nodes via packet assembler/disassembler systems (PADS). The core is also linked to the main computing and information center and BDZ headquarters in Sofia. The lack of a comprehensive management information system (MIS) with adequate applications is a drawback; however, the MIS is going to be upgraded soon.

5.2 ANALYSIS OF THE PRESENT RAILWAY CORRIDOR STATUS

5.2.1 Albania (HSH)

The Durres - Mallna - Rrogozhine line is the final stretch of the East-West Corridor. The track consists of mixed 49- and 43- type rails as well as wooden and partial bi-block concrete sleepers. Due to decayed wood sleepers, there is gauge widening at various locations. To alleviate the problem, bi-block concrete ties have been installed on some sections of the line. Although the line was designed for 100 km/hr and 65 km/hr in the mountain areas with 20 ton/axle, the maximum permitted speed is now 45 km/hr for passenger trains and 25 km/hr for freight trains due to the bad condition of the track. Axle loads much higher than permitted have contributed heavily to the present track condition.

Up to Elbasani, maximum gradients are as much as 13 percent. East of Elbasani, the gradients are up to 18 percent, and curves become sharper at a minimum 300 m radius. In this area, there are also major tunnels starting from km 91 to 130. All tunnels have passing clearance as per UIC GB1 standard, allowing for piggyback transports.

Between Durres - Rrogozhine - Kraste, the stations have local relay interlocking and light signals. There is no signaled territory between Kraste and Pogradec, and train operations are executed with VHF radio communications between stations. Communications along the line are provided by VHF radio and aerial wire line on some segments. Most of the aerial lines have deteriorated or been vandalized.

5.2.2 Macedonia (MZ)

The Kumanovo - Beljakovce line (31 km) is actually under reconstruction and is being laid with mono block concrete sleepers and used UIC 49 jointed rail. There will be a new CWR 49 installed in the future.

The Beljakovce Bulgarian border line (55 km) under construction is anticipated to be operational by the year 2000. According to MZ, 40 percent of the earthwork, including partial tunneling, has been completed at a cost of $90 million. The total cost is estimated to be $330 million.

The ultimate link in the East-West Corridor could be the Kicevo - Albanian border extension (55 km). The rail on the Skopje - Kicevo branch is type 49. The maximum axle load permitted is 22.5 tons. Maximum design speeds on Gosce Petrov-Kicevo line are 80/100 km/hr.

The line between Gostivar and Kicevo is exposed to infrequent landslides that result in track requiring restoration/rerouting. Because of the repairs, an alternate route from Bitola to the Albanian border is being considered and would link with HSH. However, the following drawbacks must be considered:

- The axle load between Veles and Bitola is restricted to 18 tons
- The rail is old and worn out on some segments of the line
- The sleepers are in bad shape
- Due to the general condition of the track there are speed restrictions
- There are tunnels that do not meet UIC GB standards

5.2.3 Bulgaria (BDZ)

Corridor 8: Gyueshevo - Radomir - Sofia - Plovdiv - Karnobat (Primary Corridor)

The primary corridor length is 734.5 km and includes 581.5 km plus 153 km from Karnobat - Varna. 646 km of the primary corridor is electrified territory and 420.7 km is double track.

The Sofia - Plovdiv line (156 km) is the backbone of the BDZ. It is a double track, electrified line governed by a new automatic block and train control system. In spite of its modern technological infrastructure, the traffic capacity is relatively low on some segments due to adverse track geometry and nonrelational freight train operations. The line is provided with Centralized Traffic Control (CTC) and Automatic Train Protection (ATP) systems. The Sofia - Plovdiv section is characterized by step gradients over 15 percent, and small radius curves (300m) on several segments as described below.

Km 30 to 36 (from Sofia); Km 66 to 72; and Km 79 to 83

Because of the curves in this area, passenger train speeds are restricted to 75 km/hr. On the same segment, a tilt train can pass at 95 km/hr. The segment between km 66 and 88 has curves with a radius of 400 to 600 m. At km 93-94, a 500 m curve limits passenger train speed to 120 km/hr. Figure 5-1 shows the radius of curves between Sofia and Iftuman.

The Sofia - Plovdiv section has intensive freight train operational activity. Between Sofia and Iskar there is the Smirnenski classifications' yard that classifies freight trains from lines 1 and

3. The intensive freight traffic, traveling at low speeds because of high line gradients, significantly reduces line capacity. In addition, level-crossing operations at intermediate stations also have an adverse impact on line traffic capacity.

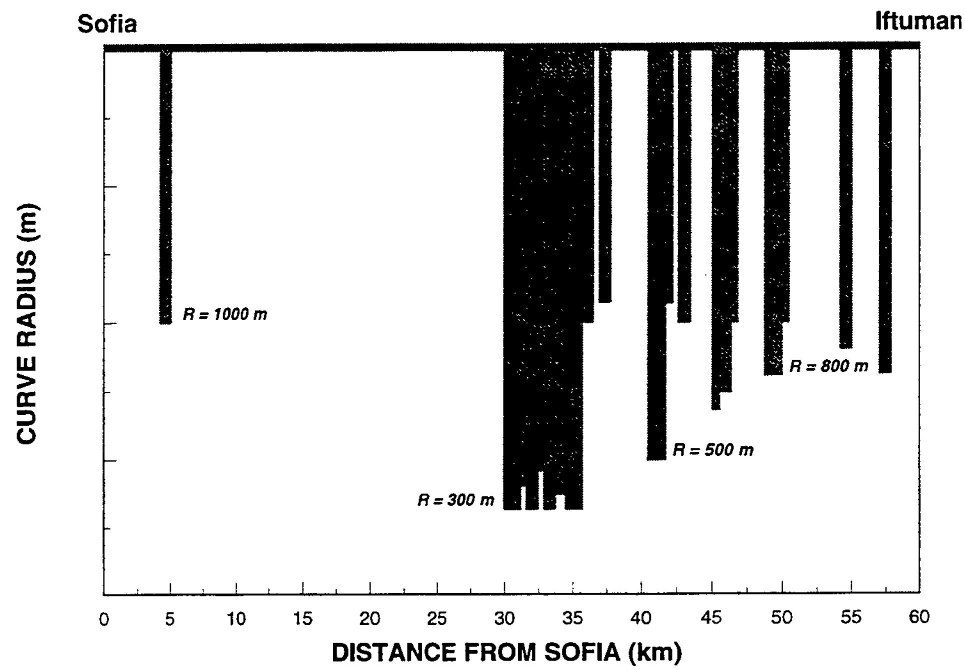


Figure 5-1 The Radius of Curves Between Sofia and Iftuman

Plovdiv Stara Zagora Karnobat - Burgas Line (290 km)

This line is electrified and partially double tracked. Lines 1 and 3, and branch lines converge in Corridor No. 8. This creates a dense freight train operating line with bottlenecks on the single track segments between Stara Zagora and Nova Zagora, where all the technical capacity of the section (81 percent) has been used. The line is provided with a semiautomatic signal system. Figure 5-2 shows the present traffic capacity for Corridor No. 8 (Plovdiv - Burgas).

Gyeshevo - Radomir - Permik - Sofia Line

This segment consists of the Gyueshevo - Radomir Line 6 and the Radomir - Pernik - Sofia Line 5. The line has a semiautomatic signal system. Gyueshevo - Radomir is a single, non-electrified line with very low traffic. Radomir - Sofia is an electrified, partially double track line, with a semiautomatic signal system. (See Table 5-1.)

Karnobat - Varna Segment

This is an electrified partially double track line with a semiautomatic signal system.

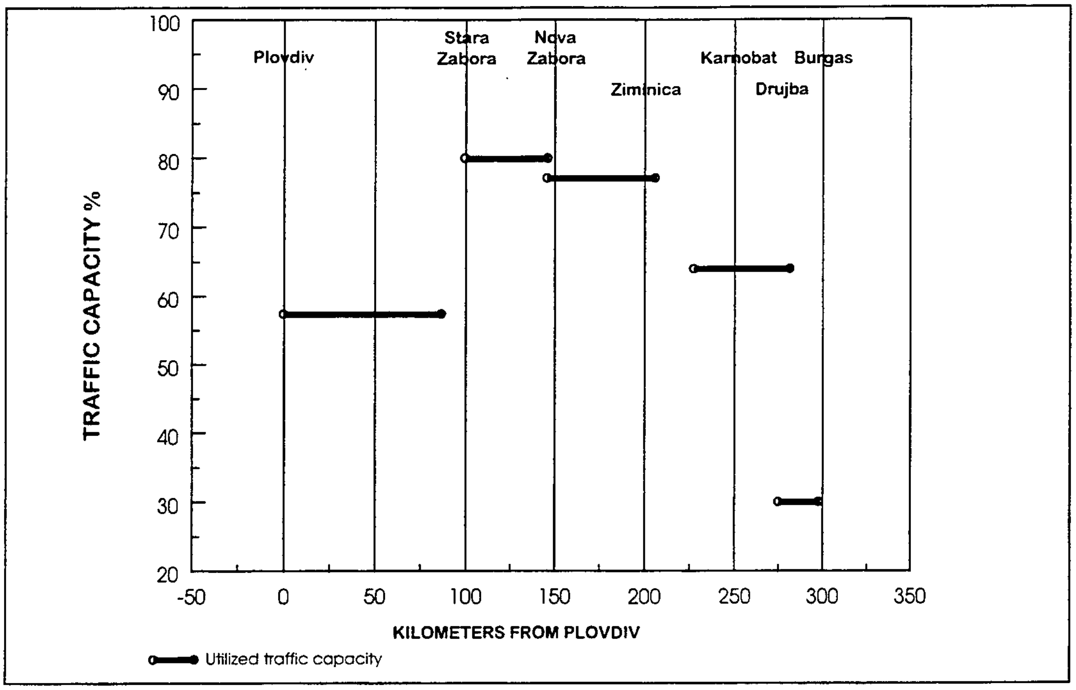


Figure 5-2 Traffic Capacity Utilization Line 8 to Plovdiv to Burgas

Plovdiv - Dimitrovgrad - Svilengrad Line 1

Plovdiv - Dimitrovgrad - Svilengrad is a single track nonelectrified line, except for 8.3 km between Plovdiv and Krumovo, which is double tracked and electrified. The present status of the line is described in Table 5-2.

Sofia - Mezdra - Gorna Orjahovica - Varna Line 2 (531.5 km)

This is a fully electrified double track line. Except for a 4.8 km automatic block, the signal system is semiautomatic. Maximum permissible speed is between 100 to 120 km/hr, except for the Sofia-Iliantis segment where the maximum speed is 60 km/hr.

Table 5-3 shows the present status of the line. The segment between Sofia and Mezdra runs through a mountainous area with many small curves of 200 m radius at km 32 and 52. Curves with 30 m radius are between km 14 and 77. In passing the mountain area, passenger trains may run at a maximum of 50 km/hr. The traffic capacity of the line is relatively low because of the present signal system, level crossing operations at intermediate stations, and track occupancy at terminal stations. Figure 5-3 shows traffic capacity use between Sofia and Yasen.

Table 5-1
Gyueshevo - Sofia - Burgas TER Line (Corridor No. 8) and Karnobat - Varna Line
Present Status

Rail Segment	km	Track (km)		Electrif. (km)	Signal System*	Max. Speed (Pass.)	# Train Pairs/Day	
		Single	Double				Pass.	Freight
Gyueshevo Kjustendil	34.1	34.1			SA	55	3	0
Kjustendil Radomir	54.5	54.5			SA	90	17	14
Radomir Batanovsti	7.6		7.6	7.6	SA	80	35	20
Batanovsti Pernik	6.9	6.9		6.9	SA	90	35	15
Pernik Sofia	32.4	29.2	3.2	32.4	SA	95	54	5
Sofia Iskar	9.5		9.5	9.5	AB	75	82	10
Iskar Kuzichene	4.8		4.8	4.8	AB	120	82	25
Kuzichene Septemvri	88.4		88.4	88.4	AB	120	64	19
Septemvri Plovdiv	53.0		53.0	53.0	AB	110	58	17
Plovdiv Mihajlovo	81.6	65.5	16.1	81.6	SA	100	32	10
Mihajlovo Stara	22.3		22.3	22.3	SA	100	38	27
Stara Zagora Nova Zagora	33.0	24.5	8.5	33.0	SA	60	26	26
Nova Zagora Zimnica	59.5	36.5	23.0	59.5	SA	80	32	22
Zimnica Karnobat	34.1		34.1	34.1	SA	120	51	39
Karnobat Drujba	42.3		42.3	42.3	SA	110	41	41
Drujba Burgas	17.5		17.5	17.5	SA	110	41	32
Total	581.5	251.2	330.3	492.9				

KARNOBAT - VARNA SEGMENT

Rail Segment	km	Single	Double	Electrif. (km)	Signal System*	Max. Speed (Pass.)	Pass.	Freight
Karnobat Sindel	118.0	62.6	55.4	118.0	SA	100	21	17
Sindel Varna	35.0		35.0	35.0	SA	100	63	41
Total	153.0	323.0	90.4	153.0				

* SA = Semi-automatic signal system (local mechanical or electrical interlocking)
AB = Automatic block signaling system

Table 5-2
Plovdiv - Svilengrad Segment

Rail Segment	km	Track (km)		Electrif. (km)	Signal System	Max. Speed (Pass.)	# Train Pairs/Day		Observations
		Single	Double				Pass.	Freight	
Plovdiv Krumovo	8.3		8.3	8.3	AB	100	56	31	BDZ planned electrification 140 km Krumovo - Svilengrad
Krumovo Dimitrovgrad	69.5	69.5			SA	1200	22	16	
Dimitrovgrad Simeonovgrad	23.0	23.0			SA	85	14	26	
Simeonovgrad Svilengrad	42.7	42.7			SA	80	12	10	
TOTAL	143.5	135.2	8.3	8.3					

Table 5-3
Sofia - Mezdra - Varna TER Line Present Status
Karnobat - Varna Segment

Rail Segment	km	Track (km)		Electrif. (km)	Signal System	Max. Speed (Pass.)	# Train Pairs/Day		Observations
		Single	Double				Pass.	Freight	
Sofia Iliantsi	4.8		4.8	4.8	AB	60	91	9	Automatic Block System
Iliantsi Mezdra	83.0		83.0	83.0	SA	110	79	22	Semi-automatic interlocking
Mezdra Yasen	93.7		93.7	93.7	SA	115	88	20	
Yasen Levski	51.6		51.6	51.6	SA	110	50	35	
Levski G. Orjahovitsa	54.0		54.0	54.0	SA	110	38	30	
G. Orjahovitsa Shumen	137.4		137.4	137.4	SA	110	33	28	
Shumen Kaspican	23.0		23.0	23.0	SA	110	41	20	
Kaspican Sindel	49.0		49.0	49.0	SA	120	35	13	
Sindel Razdelna	6.0		6.0	6.0	SA	100	51	41	
Razdelna Varna	29.0		29.0	29.0	SA	100	63	27	
TOTAL	531.5		531.5	531.5					

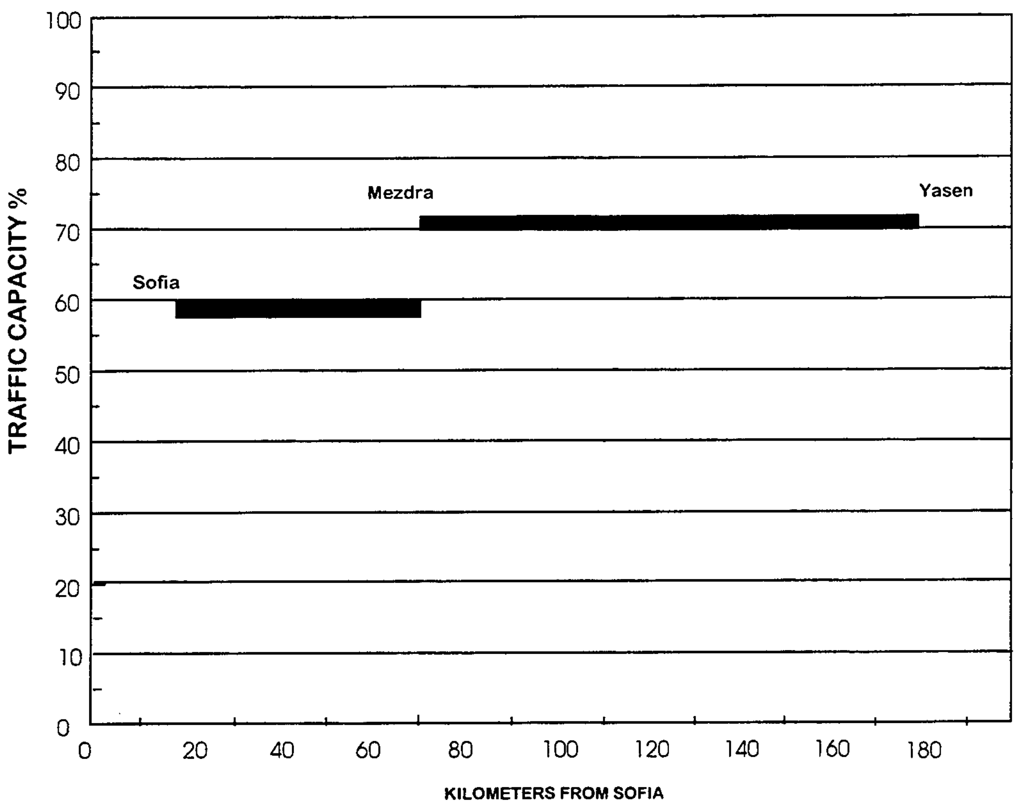


Figure 5-3 Track Capacity Utilization – Sofia - Yasen

5.3 PRESENT CONSTRUCTION AND RAIL IMPROVEMENT PROJECTS

5.3.1 Albania

Track renewal work on the Durres - Tirana line (35 km) started in 1997, using UIC 49 type rail, at an estimated cost of $9 million. Italy is providing a $6 million grant for this work which is scheduled for completion by 1998. A second segment, Rrogozhine - Elbasan (40 km), is due for renewal, with the work planned to start in 1999. The estimated cost is $9.6 million, with a target completion date of 2001. There are also plans to reinstate the deteriorated signaling system of Mallna - Rrogozhine and Rrogozhine - Kraste, at an estimated cost of $3.5 million. New telecommunications equipment will be added to replace the obsolete and vandalized lines. The estimated cost for this work is $3 million.

5.3.2 Macedonia

Kumanovo - Beljakovce Line (31 km)

Reconstruction of the Kumanovo - Beljakovce line consists of reballasting, and installing new mono block concrete sleepers and UIC 49 type rail. The estimated cost is $ 8 million, with the line expected to be operational by 2000. Reconstruction work is well underway.

Beljakovce - Bulgarian Border (55 km)

This new line is under construction in difficult terrain, and is expected to be operational by 2000. The track would consist of mono-block concrete sleepers with SK 14 fastenings, and UIC 49 type rail. Design speed is 100 km/hr. According to MZ, 40 percent of the track route work has been completed, including partial tunneling. Automatic signaling block will be installed between Kumanovo and the Bulgarian border at an estimated cost of $27 million. Telecommunications for this line are estimated to cost $2.5 million and consist of fiber optics, cable dispatching line, telephone switches, and public communication systems. For the construction of the line, the Macedonian government has spent approximately $90 million. The total cost of the line is estimated at $330 million, including related infrastructure and dams.

5.3.3 Bulgaria

The BDZ railway infrastructure has deteriorated due to lack of funds for proper maintenance and repairs. A railway restructuring project was developed under financial assistance from EBRD and IBRD to streamline the railway, rehabilitate its infrastructure and necessary rolling stock, and transform BDZ into a commercial entity able to perform in the new market economy. In order to implement the project, a coordination unit was formed as part of the strategic development department. Rehabilitation and restructuring plans have been drawn for short-term (2005), medium-term (2010), and long-term (2020).

The Bulgarian Government has elaborated development plans for upgrading standardization to UIC norms and construction of the missing link to Macedonia. The plans are for short-, medium- and long-term, as shown in Table 5-4 below.

Table 5-4
BDZ Development Plan

Term	Planned Action
Short-Term to 2003	Reconstruction and upgrade of railway line between Radomir - Gyueshevo to permit speeds of 120-140 km/hr.
Medium-Term to 2010	Reconstruction and upgrade at Plovdiv - Dimitrovgrad - Svilengrad line to allow speed of 160 km/hr. Electrification of the line with a total length of 140 km.
Long-Term to 2020	Construction of combined transport terminals in Sofia and Dimitrovgrad.

5.4 EXISTING TRAFFIC CONDITIONS

5.4.1 Albania

As noted in Volume 1, freight tonnage declined on the Albanian railroads from an average of 8 million tons in the 1980s to approximately 0.5 million tons in 1994. The upheavals in the Albanian economy that occurred with the collapse of communism drained away most freight traffic from the railway. This decline in freight traffic can be attributed to the collapse of the mining sector in Albania, including chrome, nickel, and phosphates, formerly the mainstay of HSH rail freight.

Passenger traffic also collapsed from a peak of 12 million passengers during the 1980s to about 4.1 million passenger in 1994.

It is clear that the physical set up of the Albanian railroads is capable of accommodating significant growth in freight and passenger traffic from the levels recorded in 1994. The railroad, with its basic physical plant, can cater to much more traffic if certain geometric, structural, signaling, and communication improvements are implemented. Therefore, capacity of the railroad physical plant is not expected to constitute any constraint to expanding traffic volume any time soon.

5.4.2 Macedonia

Both freight tonnage and passenger operations declined drastically between 1989 and 1995. Freight traffic declined by 75 percent from 8 million tons to only 2 million tons, and passenger traffic declined 80 percent from 55 million trips in 1989 to 11 million in 1995. Obviously, carrying capacity of the railroad will not constitute any constraint to traffic growth in the foreseeable future.

5.4.3 Bulgaria

Freight traffic on the Bulgarian railroad declined from a peak of 82.5 million tons in 1987 to a current level of 30 million tons, a reduction of more than 60 percent. In January 1994, train services were rationalized by reducing the frequency of stopping at marshaling yards. Forty percent of BDZ's tonnage is now moved in block trains. Eight marshaling yards were closed, and marshaling is now concentrated in six mechanized yards at Sofia, Plovdiv, Varna, Goma, Ruse, and Burgas. The 1994 rail reform saw the introduction of delivery schedules within three time bands of 24, 36, and 48 hours.

Passenger traffic has not shown such a sharp decline as freight traffic. In 1994, passenger trips amounted to 65 million compared to 109 million during 1986 – a decline of about 40 percent.

As part of the railway restructuring project, lightly used services on 1,000 km of lines (one fourth of the network) are being targeted for closure or hiving off. About one third of the total, 340 km, is proposed for closure, while 185 km of the branch lines are set to be transferred to the industrial plants which they will serve. BDZ proposes that local authorities take responsibility for passenger service on another 540 km, with the railway handling their operation under contract.

The Bulgarian railroad has enough free capacity to absorb growth in both passenger and freight traffic well into the 21st century. Such capacity will be further enhanced with the implementation of the on-going restructuring program. Additional capacity will be added through upgrading the network to conform to European standards.

5.5 RAIL TRANSPORT FORECAST

There are various studies in progress, or completed, dealing with the East-West Corridor. Some of the studies have traffic projections to the year 2015 or beyond. Investigations of several studies resulted in the following railway traffic projected data.

5.5.1 Albania

Available traffic forecasts for Albanian railroads are dated. Because of last year's political unrest, a detailed reassessment of the future traffic levels on the Albanian railroads is needed.

5.5.2 Macedonia

The Macedonia Railway (MZ) has more specific traffic projections related to the East-West Corridor (Beljakovce - Gyueshevo railway link) as shown in Table 5-5:

Table 5-5
MZ Traffic Projections

Year	2000	2003	2010	2015
Passenger Trips (thousands)	860	1,020	3,110	3,320
Passenger- km	77	100	458	493
Net Tons (thousands)	1,100	1,680	3,450	4,650
Net Ton km (millions)	126	187	437	590

Assuming that an average passenger train consists of 7 cars, 60 seats per car, and 65 percent seat occupancy, the average passenger trainload would be 275 passengers. A lighter train schedule during weekends would result in 365-52 = 313 days of full passenger train schedules per year. The number of passenger pairs of trains/day are outlined in Table 5-6.

Table 5-6
Passenger Trains per Day (pairs)

	Year		
	2003	2010	2015
No. of passenger trains/day (Pairs)	6	18	20

According to present UIC standards, trains used for international combined traffic (carrying containers and all kinds of loading units) should have a gross tonnage of 1,200 tons. This standard is to be increased to 1,500 gross tons. Besides international combined traffic, the East-West Corridor will execute regular freight traffic as direct trains consisting of one or more groups of wagons. These trains would have lower tonnage than the combined traffic trains. The following mix average gross tonnage per train is anticipated:

- Year 2003 – 1050 gross tons/train
- Year 2010 – 1130 gross tons/ train
- Year 2015 – 1220 gross tons/train

Considering a 55 percent wagon use and a 20 percent seasonal peak, the number of trains would be as indicated in Table 5-7.

Table 5-7
Freight Trains per Day (pairs)

	Year		
	2003	2010	2015
Total Net Tons (million)	1.680	3.450	4.650
Average Gross Ton/Train	1050	1130	1220
Number of Trains (pairs) per Day	10	18	23

The total forecast number of passenger and freight trains is outlined in Table 5-8.

Table 5-8
Total Trains per Day (pairs)

	Year		
	2003	2010	2015
Passenger trains (pairs)	6	18	20
Combined freight trains (pairs)	10	18	23
Total	16	36	43

As with any forecast, future traffic could be either lesser or much greater than the projections. However, one fact is certain; the work for the construction of the new line between Beljakovce to the Bulgarian border is well underway and over 40 percent of the work has been completed. Moreover, the track bed has been designed for double track and provisions made for clearances which are necessary for the introduction of electrification.

5.5.3 Bulgaria

A global traffic forecast for the Bulgarian rail system is presented in Table 5-9 below.

Table 5-9
Bulgaria Rail Demand Forecast

	1995	2010	2020
Passenger trips * 1,000/day	335	802	1477
Net tons 1,000/day	84	250	323

5.6 DEVELOPMENT OF RAIL CORRIDOR IMPROVEMENT PLAN

The development of the rail improvement plan for Corridor No. 8 has to be made in the context of its role and importance in the international and European rail networks. Therefore, such a plan needs to conform to the Pan-European Transport development and gradually conform to the standards promulgated by the International Union of Railroads (UIC).

The most pressing problem of the east-west railroad corridor is the existence of two significant gaps that would connect the east-west line with the Bulgarian railroad to the east and the Albanian railroad to the west. The closure of these two gaps would provide a continuous railroad corridor extending from the Ports of Varna and Burgas on the Black Sea to the Ports of Durres and Vlore on the Adriatic Sea.

5.6.1 Pan-European Transport Development

The 1996 Pan-European Conference in Crete set the guidelines for further development of a Pan-European transport infrastructure. Three priorities were established:

- Short-term priorities to be implemented in the next 5 years

- Medium-term priorities addressing the Trans-European network. For Central and Eastern Europe, it addresses several priority transport corridors for development by the year 2010.
- Long-term plan with European infrastructure development with no time established.

As a result of the conference, nine transport corridors have been designated in Central and Eastern Europe. In June 1997, the third Pan-European Transport conference, held in Helsinki, added Corridor No. 10 to the previous list and a branch C. The continuous efforts of the European community to build a general, integrated market have created the imperious need for continent-wide reliable and balanced transport systems. The Maastricht Treaty has outlined the need for trans-European transport networks to enhance the mobility and trade between the European community and Central and Eastern European/CIS countries. It has, however, stopped short of recognizing the impact and the full implications of Corridor No. 8 as a Trans-Continental network between Europe and Central Asia and Middle East.

UIC plays an essential role in directing and monitoring the coherence of rail transport development, supporting the individual endeavors of its members, and enhancing the railway competitiveness, especially in the international field to allow financial recovery. The 3 percent annual growth of all transportation modes in western Europe, combined with drawbacks such as the socio-economic cost of the damage and pollution caused by transport, congestion, energy waste, and accidents, provides the opportunity for rethinking the general transport policy and placing railways in a very favorable position. This provides the government authorities with a solid reason to seek improvement of the competitive conditions for the railway transportation mode. This is of particular interest and need for the Central, Eastern European and CIS countries to ensure a national policy of top priority development of their rail systems under UIC-directed international cooperative activities.

In addition to UIC's coordinating efforts, the Community of European Railways (CER) has the role of coordinating and monitoring the application of Directive 91/440 in the development of community railways. UIC and CER have joined efforts towards shifting the balance of the transport in Europe through the following:

- Coordination of investments through the preparation of master plans for high speed and combined transport networks.
- Public contribution for funding key infrastructure rail projects that do not offer financial return on investments for the railway at short- or medium-term but are of great social and economic value to the community and the country. Of much greater importance are the new lines under construction between Beljakovce and the Bulgarian border and the new rail link between Albanian and Macedonian, yet to be built, both part of the East-West Corridor.
- Harmonization of competitive conditions between modes, including payment of infrastructure charges, internalization of external effects, and labor legislation.
- Development of international cooperation by removal of technical and administrative obstacles.
- Development and enforcement of intermodal complementary on both passenger and freight traffic.

Based on international railway cooperation, new high-speed networks to Central and Eastern Europe have been devised. Strategic action plans have been elaborated and are being progressively implemented for the freight sector. Harmonization of rolling stock, infrastructure and safety equipment is being recommended. International railway harmonization is further enhanced through information technology projects and cooperation as well as adoption of common computer applications.

5.6.2 UIC Recommendations to be Applied to International Lines, Including the East-West Corridor

For main international railway lines, the parameters recommended by the UIC (Annex II) should be considered as main objectives in national development plans. Any deviations from the recommended values should be regarded as exceptional. The international lines have been divided in two categories:

- Existing lines where some improvements are possible and feasible. However, when geometric improvements cannot be done, exceptions could be taken for such lines.
- New lines to be built should meet minimum geometric parameters. However, their geometric characteristics could be freely selected above minimum requirements. These lines could be specialized for passenger traffic or for mixed/combined traffic. Table 5-10 lists the infrastructure parameters for international railway lines.

Table 5-10
Infrastructure Parameters for new International Line

Item	Existing or Reconstructed Lines	New Lines	
		Passenger Traffic Only	Passenger and Goods Traffic
		B1	B2
1. Number of tracks		2	2
2. Vehicle Loading Gauge	UIC#/B		UIC C1
3. Minimum Distance between Track centers	4.0m	4.2m	4.2m
4. Nominal minimum speed	160 km/h	300km/h	250km/h
5. Axle load			
Locomotives	22.5t	–	22.5t
Railcars and rail motor Sets (<300km/h)	17t	17t	17t
Carriages	165	—	16t
Wagons			
<100km/h	20t	—	22.5t
<120km/h	20	—	20t
<140km/h	18t	—	18t
6. Authorizes mass per Linear Meter	85	—	8t
7. Test Train (bridge Design)	UIC71	—	UIC71
8. Maximum Gradient	—	35mm/m	12.5m/=

Number of Tracks

High traffic capacity and timed operations are possible on double or multi-track lines.

Clearances

For existing lines where C_1 gauge is not feasible, UIC B gauge should be used. It offers the following clearances for vehicles:

- For transport of ISO containers: 2.44 m wide and 2.90 m high on flat container wagons having a loading height of 1.18 m above rail head
- For transport of swap-bodies: 2.5 m wide and 2.6 m high on ordinary flat wagons
- For transport of semi-trailers on recon wagons

In addition, the following vehicle dimensions are recommended:

- 4 m high, 2.5 m wide on special wagons with a loading height 60 cm above rail level
- 4 m high and 2.5 m wide on depressed wagons with normal bogies
- 2.9 m high and 2.44 m wide on regular flat wagons
- Swap-bodies 2.5 m wide on ordinary flat wagons.

Minimum Distance Between Track Centers

On existing double track lines the distance between track centers varies between 3.5 and 4 m. When track are renewed, the distance should be increased to 4 m if feasible. For new line, the design distance between track centers should be 4.2 m

Nominal Minimum Speed

The nominal minimum speed determines the geometric parameters of the line (radius and superelevation) and the safety installations (braking distances and braking coefficient of rolling stock). The nominal speed selected (160 km/hr) is the general practice on sections with tangent track or wide radius curves. On new lines much higher nominal speeds can be adopted. On existing lines maximum speeds are a function of the radius of the curves.

Axle Load

For locomotives the allowed axle load is 22.5 tons on line where normal mass per axle is 20 tons. This is because locomotive suspension is much less aggressive for the track and the ratio of the number of locomotive axles to the total number of axles is very low. Other allowed axle loads include:

- Rail cars and rail motor sets – 17 tons/ axle
- Coaches – 16 tons/axle
- Wagons – 20 tons/axle corresponding to UIC class C
- New mixed or combined traffic lines – 22.5 tons/axle up to 100 km/hr

- A Speed of 120 km/hr limits axle load for mixed or combined traffic to 20 tons. For speeds of 140 km/hr, only 18 tons/axle is permitted.

All the above load/axle values are for wheel diameters of not less than 840 mm.

Permitted Mass Per Linear Meter

According to the UIC Class C4 standard, the permitted mass per meter length over buffers is 8 tons.

Test Train (Bridge Design)

On new lines for mixed or combined traffic, the UIC 71 test train is used. There is no-international standard set for new passenger lines.

Maximum Gradient

On existing lines the gradient cannot be changed. On new lines for mixed or combined traffic the maximum value is 12.5 mm/m. For new passenger lines the maximum value is 35 mm/m.

Minimum Platform Length at Principle Stations

The UIC recommends a minimum length of 400 m.

Minimum Utile Siding Length

The minimum utile length indicated by UIC is 750 m. This permits stabling of a goods train of 5000 tons (8 tons/m) or 1,500 gross tons at 2 tons/m.

Level Crossings

New main international lines should be built without any level crossing. On existing main international lines level crossing should be replaced where economically feasible by over or under-passes.

Some of the parameters previously listed will not be met by existing lines. The UIC technical characteristics for international combined lines are listed in Annex III of the UIC. These characteristics refer to both existing and new lines. The specifications also apply to ferry boat services which is an integral part of the railway network. Table 5-11 outlines technical requirements.

Train Performance Parameters and Minimum Infrastructure and Operating Standards

The train used for international combined transport should meet the following minimum standards as outlined in Table 5-12.

Table 5-11
Infrastructure Parameters for International Combined Transport Lines
(as per Annex III, UIC)

Item	Existing or Reconstructed Lines		New Lines
	At Present	Target Values	
Number of tracks	(not specified)		Double
Vehicle loading gauge		UIC B	UIC C_1
Minimum distance between track centers		4.0m	4.2m
Nominal minimum speed	100km/hr	120km/hr	120km/hr
Authorized mass per axle Wagons ≤ 100 km/hr ≤ 120km/hr	 20t 20t	 22.5t 20t	 22.5t 20t
Maximum gradient 1/	(not specified)		12.5mm/m

Note: In addition, to the loading clearances shown on Annex II, gauges C1 and B1 permit clearances for transport of containers/ swap-bodies 2.6 m wide and 2.0 m high on suitable wagons.

Table 5-12
Minimum Standards

Minimum Standards Parameter	Present	Target Value
Minimum nominal speed	100 km/hr	120 km/hr
Length of train	600 m	750 m
Weight of train	1,200 tons	1,500 tons
Axle load (wagons)	20 tons	22.5 tons at 100 km/hr

Minimum Standards for Railway Lines

- The lines used for combined transport shall have an adequate traffic capacity to avoid waiting times for combined transports.
- The infrastructure parameters of UIC Annex III should apply to railway lines executing combined transports.

Minimum Standards for Terminals

- The rail terminals should be easily accessible by road
- The terminals should be well connected with long distance lines and have access to fast combined traffic trains.

Minimum Standards for Intermediate Stations

- The stations should have sufficient track capacity to handle regular traffic and combined transports. The tracks should have loading gauges as per UIC B or C_1 standards.
- The length of the tracks should be sufficient to accommodate combined transport trains.

- At border stations in case of electric traction on both sides, tracks should be accessible by electric motive power units.
- Adequate capacity should be provided for trans-shipments, gauge interchange, wagon group exchange and frontier control, in order to ensure that minimum necessary stops are as short as possible. In principle, no stops at borders are recommended. However, if necessary to stop, the dwell time should be no more than 30 minutes.

5.7 PROPOSED EAST-WEST CORRIDOR RAIL IMPROVEMENT PROJECTS

5.7.1 Short-Term "Immediate Action" Projects (1998-2003)

The proposed developments are assumed to meet UIC standards for existing or new lines as per Annexes II, III, and IV. When this is not feasible exceptions are taken.

Albania

Durres - Pogradec (152 KM)

Renewal of track between Durres and Pogradec consists of reballast, installation of mono block concrete sleepers, and new rail UIC 49. For traffic control, a radi block system is recommended. The estimated cost is US$ 200 million and construction time is 3.5 years.

Lin - Macedonian Border (2.6 km)

Build a new line between Lin and the Macedonian border. The estimated costs is US$ 8 million.

Macedonia

Kumanovo - Beljakovce (31 km)

This line is under reconstruction (see Section 5.3, Macedonia).

Beljakovce - Bulgarian Border (55 km)

MZ is planning to install a $27 million signal system between Kumanovo and the Bulgarian border by the year 2000, when the lines become operational. However, this investment can not be justified because of low projected traffic. Instead, it is recommended that train operations be handled by a 900 MHz digital radio block system for ground/train communications as per UIC recommendations. The installation of an automatic block signalization system should be deferred for the intermediate period (2010). The anticipated cost for the radio system is $2.5 million.

G Petrov - Kicevo (103km)

This line needs resurfacing in several locations. There is also a need for regrading and track rerouting between Gostivar and Kicevo because of unstable rock areas. No cost estimates are possible at this time without a field investigation and assessment of the necessary earthwork. In addition to the anticipated Kicevo to Albanian border railway extension, there is an alternate route under consideration – the Bitola - Albanian border. A comparison study between the two routes is strongly recommended to establish the most feasible alternative. For train dispatching, a 900-MHz digital radio block system is recommended to service the entire MZ network including the Kicevo branch. The estimated cost is $5 million and installation time would be 2 years.

Bulgaria

BDZ rail development plans need to address timely and necessary improvements for the primary Corridor No. 8 (Gyueshevo - Sofia - Plovdiv - Burgas/Varna) to meet UIC standards for TER lines. Without timely upgrading and improvements, the primary Corridor No. 8 could not fulfill its designated role. In order to increase the corridor functionality and efficiency, the following upgrading and construction works are necessary.

Sofia - Radomir (47km)

Double the track between Batanovsti and Pernik (7 km) The estimated cost is $8.5 million and the construction time is 1.5 years. The signal system should be upgraded by installing automatic block and extending the CTC system from Sofia to Radomir at a cost of $11 million and an execution time of 2 years. New telecommunications fiber optics should be installed on the catenary at an estimated cost of $0.7 million.

Stara Zagora - Zimnica (92.5km)

Complete the double track between Stara Zagora and Nova Zagora (24.5 km) and Nova Zagora - Zimnica (36.5 km) to eliminate present bottlenecks. The doubling of track on these two segments is dictated by traffic capacity saturation, 81 percent between Stara Zagora and Nova Zagora, and 73 percent between Nova Zagora and Zimnica. The estimated cost for the 61 km double tracking is $70 million and construction time is 3 years.

Plovdiv - Burgas (290km)

Extend the automatic block system and CTC from Plovdiv to Burgas. The estimated cost is $75 million and installation time is 3.6 years.

Sindel - Varna (35km)

Install automatic block between Sindel and Varna at an estimated cost of $8.5 million and an installation time of 2 years.

Sofia - Mazdra Varna (531.5 km)

Upgrade 61 km of track. The estimated cost is $14.5 million and construction time is 2 years.

Gyueshevo - Macedonian Border (2.5km)

Construction of a new 2.5 km line, including a new 1.3 km tunnel. Construction has already been completed on a 1.3 km alignment and a tunnel has been partially built. The estimated cost is US$ 5 million and construction time is 2 years.

In addition, as an essential organizational approach and as per UIC Annex IV recommendations, the activity of the Smirenski classifications yard between Sofia and Iskar should be rationalized. The classification activity should be reduced by formation of O/D direct trains on the entire BDZ network and especially on Lines 1 and 3. The local freight traffic on Line 1 should be organized and executed during nonprime time with minimum switching activity at intermediate stations. By implementing these recommendations, the traffic capacity of the section would be greatly improved and BDZ competitiveness with the road mode will be significantly increased.

Plovdiv - Dimitrovgrad-Svilengrad (144km)

Electrification between Krumovo and Svilengrad (136 km) at a cost of US$ 25 million. Track renewal and new automatic block and CTC should also be installed to permit speeds of 140 to 160 km/hr. The total estimated cost is US$ 385 million and construction time is 4.5 years. this project is likely to extend into the intermediate-term time frame.

5.7.2 Intermediate Term "Strategic" Projects (2003-2010)

Table 5-13 shows proposed East-West rail corridor Developments, 1997 to 2020.

Albania

Durres - Pogradec

Upgrade signal to CTC. The estimated cost is $27 million and the estimated time is 3 years. The plan also calls for construction of a new line, Lin to the Macedonian border (2.6 km). The estimated cost of this line is $8 million and construction time is 2 years.

Macedonia

Kumanovo - Bulgarian Border (86km)

Install automatic block signal and CTC between the Komanovo - Bulgarian Border. The estimated cost is $25 million and the execution time is 2.6 years.

G Petrov - Kicevo (103 KM)

Install automatic block between G Petrov - Kicevo and extend CTC from Skopje to Kicevo. The estimated cost is $16 million and the execution time is 3 years.

Kicevo - Albanian Border (65km)

Complete the Kicevo - Albanian border route if the study indicates that it is more feasible route than the Bitola - Albanian alternative. The estimated cost is $287 million, which includes civil work, or signaling, and telecommunications systems.

Table 5-13
Proposed East-West Rail Corridor Developments
1998 to 2020

COUNTRY		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BULGARIA	**Sofia-Radomir (47 km)** Double track (7km)					■	■																	
	Sofia-Radomir Install CTC/AB						■	■																
	Stara Zagora - Zimnica Complete double track (61 km)		■	■	■																			
	Plovdiv - Burgas Install AB/CTC (290 km)				■	■	■	■																
	Sindel - Varna (35 km) Install AB			■	■																			
	Sofia - Mazdra - Varna Upgrade 61 km of track		■	■																				
	Sofia - Mazdra - Varna Realign track																			■	■	■		
	Gyueshevo - Macedonian Border (2.5 km) Construct new line		■	■																				
	Gyueshevo - Radonir (89 km) Reconstruct Upgrade, install CTC/AB										■	■	■											
	Gyueshevo - Radomir Electrification 89 km															■	■	■						
	Sofia - Plovdiv Track realignment, new rail, re-space ties										■	■	■											
	Karnobat - Sindel (118 km) Complete 63 km double track									■	■	■												
	Karnobat - Sindel Install AB; Karnobat - Varna - CTC													■	■									
	Plovdiv - Burgas (290 km) Re-rail and re-space ties Double tracking + Zimnitsa											■	■	■	■	■								
	Plovdiv - Svilengrad (144 km) Track renewal, CTC/AB, electrification.		■	■	■	■	■	■	■	■														
	Sofia - Gorna - Sindel Install CTC/AB												■	■	■	■	■							

Table 5-13
Proposed East-West Rail Corridor Developments
1998 to 2020

COUNTRY		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MACEDONIA	**Kumanovo - Beljacovice** Reconstruction 31 km	■	■	■																				
	Gyueshevo - Skopje - Kicevo - Kafasan Electrification															■	■	■	■					
	Beljacovice - Bulgarian Border New line (55 km)	■	■	■																				
	Kumanovo - Bulgarian Border CTC/AB													■	■	■								
	G. Petrov - Kicevo Radio block		■	■																				
	G. Petrov - Kicevo Local re-route and re-rail								■	■	■	■												
	Skopje - Kicevo CTC/AB												■	■	■									
	Kicevo - Kafasan New line 65 km													■	■	■	■	■						
ALBANIA	**Durres - Rrogozhine - Vlore - Dogradec** Track renewal and radio block	■	■	■	■																			
	Durres - Rrogozhine - Vlore - Dogradec Signal upgrade to CTC											■	■	■										
	Lin - Macedonian Border New line 3 km			■	■																			
	Durres - Lin Electrification															■	■	■	■					

NOTE: AB = Automatic Block Signal System
CTC = Centralized Traffic Control

Bulgaria

Gyueshevo - Radomir (89km)

Reconstruction and upgrading of infrastructure, including automatic blocks to allow for speeds of up to 120 km/hr. The estimated cost is $98 million and construction time is 3 years. Electrification of the line should also be carried out. The estimated cost is $15 million and construction time is 2.5 years.

Sofia - Plovdiv Line (156km)

Realign track between km 30 and km 37 as well as km 67 and km 87 from 300 to 500 m minimum radius to permit speeds of 100 km/hr for passenger trains (120 km/hr for tilt trains). New rail and respace sleepers should also be installed. The total estimated cost is $115 million and construction time is 4 years.

Karnobat - Sindel Segment (118km)

Complete the double track (63 km). The estimated cost is $67 million and construction time is 3 years. An automatic block system and CTC should be installed between Karnobat and Sindel and the CTC between Karnobat and Varna should be completed. The estimated cost is $32 million and the execution time is 2.3 years.

Plovdiv - Karnobat - Burgas (290km)

Rerail and respace sleepers at an estimated cost of $43 million. The construction time is 5 years.

Sofia - Mezdra – Gorna - Varna (531.5km)

Install automatic block between Iliantsi and Varna (527 km) and CTC. The estimated cost is $108 million and the execution time is 5 years.

The intermediate strategic rail improvement program for Albania, Macedonia, and Bulgaria is presented in Figure 5-3.

5.7.3 Long-Term "Vision" Projects (2010-2020)

Albania

Electrify the lines between Durres and the Port of Vlore, as well as the line between Durres, Tirana, and the Macedonian border.

Macedonia

Electrify the line between Gyueshevo, Skopje, Kicevo, and Kafasan.

Bulgaria

Upgrade the remainder of the corridor lines to UIC standards.

The long-term strategic rail improvement program for Albania, Macedonia, and Bulgaria is presented in Figure 5-4.

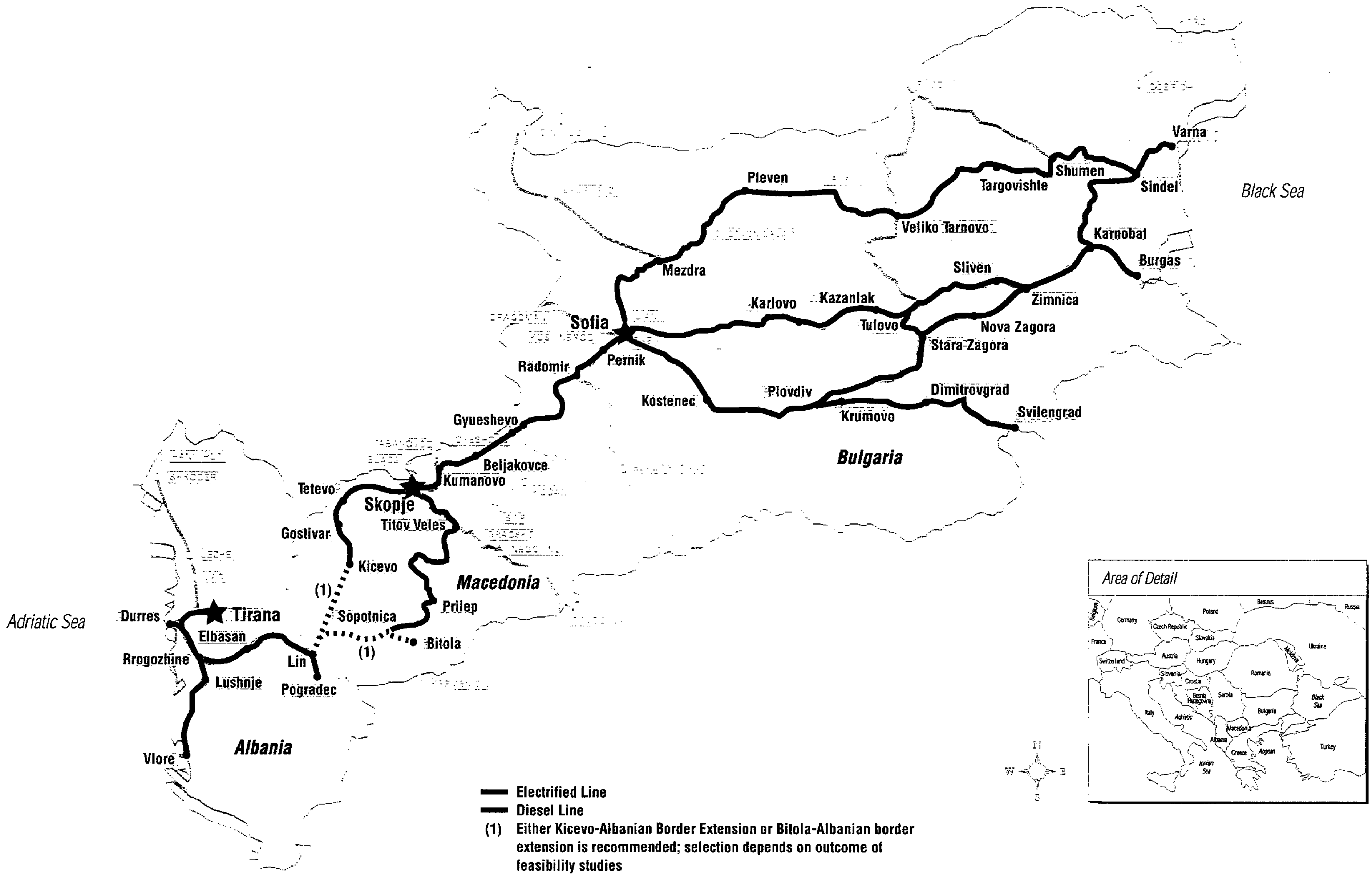


Figure 5-3 East-West Transport Corridor: Intermediate Term Rail Networks (2010)

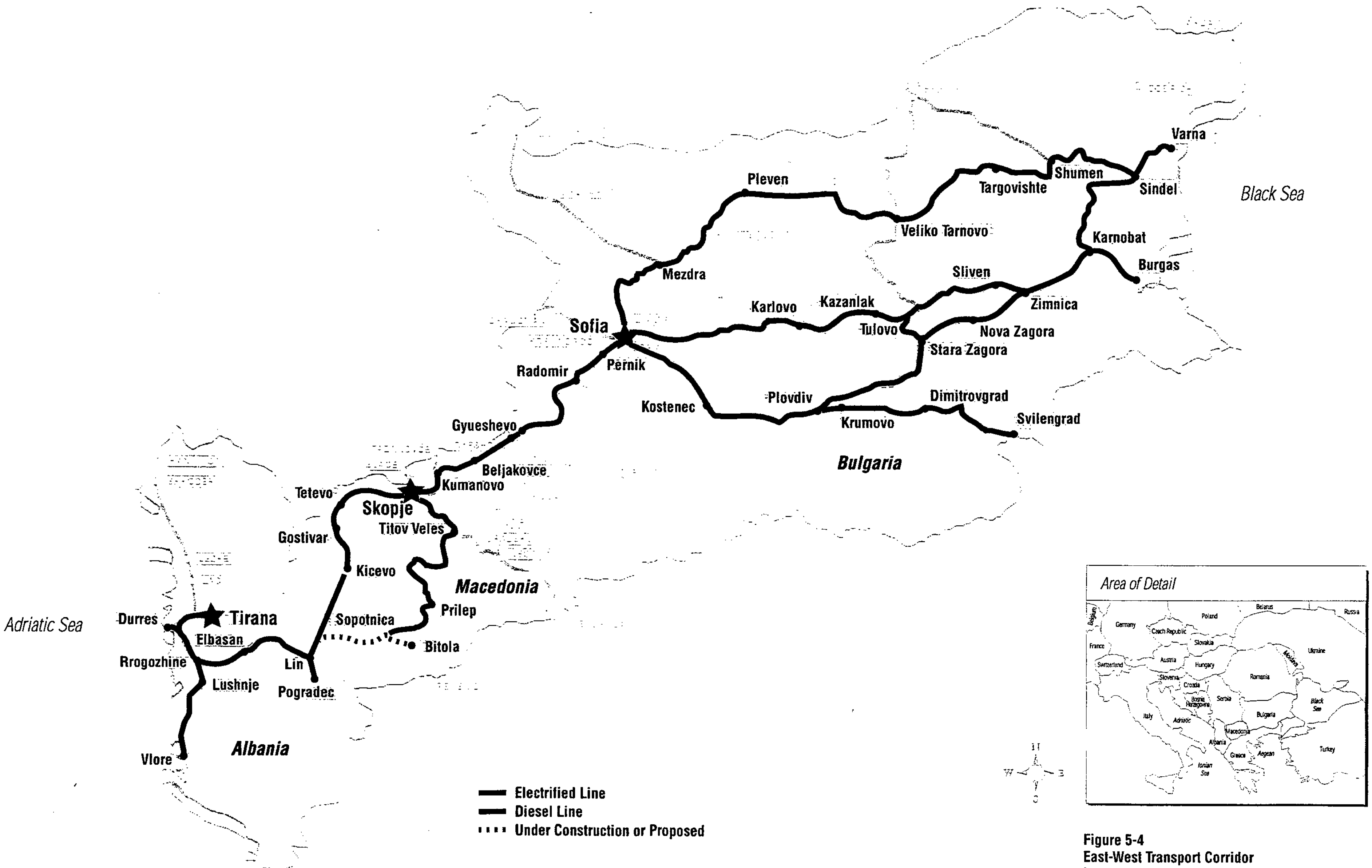


Figure 5-4
East-West Transport Corridor
Long-Term Rail Network (2020)

This section is a summary of proposed improvement plans for port facilities in Albania and Bulgaria. Improvement plans for port facilities are based on the expected growth in the economies of the three countries, and the resulting demand for marine transport services over the next 20 years.

The context for market demand for port facilities is discussed in the following sections. Emphasis is placed on the short-term plan improvements (2003) and the intermediate strategic improvement plans (2010) that have been identified in published master plans. Possible long-term improvement strategies are also briefly discussed.

6.1 PORT DEVELOPMENT PLANS

Port improvement needs are centered on the planned development and market expansion expected at each of the four existing sea ports in Albania (Durres and Vlore) and Bulgaria (Burgas and Varna). Each offers unique transport markets and development potential.

6.1.1 Port of Durres, Albania

The Port of Durres is the principal port for Albania, situated on the Adriatic Sea, 40 km from the capital of Tirana. The port is estimated to handle 85 percent of the traffic transferred to and from ships in Albania during active years. In the late 1980s, traffic was in the 2.6 to 2.8 million ton range annually. Because of civil unrest from political events, the economy has suffered and traffic at the port has declined to about 0.9 million tons in recent years. However, the port is considered a vital link to the outside world and an important transport infrastructure for future investment and linkage along the East-West Corridor trade routes.

Generally, the port facilities have deferred maintenance and are in need of rehabilitation and modernization to maintain and expand beyond past levels of ship-handling activities. A recent Port Master Plan, completed in 1995, identified the following improvements for the Port of Durres: rehabilitate operational areas, repair main breakwater, modernize navigation aids, and relocate the administration building. The plan also called for construction of a passenger ferry terminal and rehabilitation of a section of the port to accommodate roll-on–roll-off (ro-ro) vessels.

The Port of Durres Master Plan identified proposals to reorganize the Port of Durres Authority (PDA) to become a more autonomous port authority, creating separation in administrative structure and operations control from the Ministry of Transport. If implemented, this structure would allow for new accounting procedures, operational restructuring, the addition of commercial activities (including stevedoring, warehousing, and ancillary services), and port management.

The total cost of implementation of the Port of Durres Master Plan was estimated at US$ 22.2 million in 1995. It was projected that US$ 20 million would be funded through the World Bank IDA accounts, with PDA funding a 10 percent share of US$ 2.2 million.

6.1.2 Port of Vlore, Albania

The Port of Vlore was added to the East West Corridor Study during the SBDI Coordinating Group meetings held in Tirana, Albania, December 9-10, 1997. However, no information could be obtained regarding the Port of Vlore's existing conditions or future plans. Due to civil unrest within the country during the course of the study, study engineers were not allowed the freedom to travel, with the exception of a trip to Tirana and Durres. Therefore, no information was compiled.

The Balkan Transport Study in 1996, identified the Port of Vlore as handling small ships today and possibly in the future, being an oil or ferry port.

The Port of Vlore is about half way between the Port of Durres and the Greek border. Considering the strategic location along the Adriatic Sea, the Port of Vlore is considered a vital transport facility in Albania to facilitate the movement of goods within the East-West Corridor. At this time, a port improvement master plan is needed to assess existing infrastructure and future needs for improvement in the port area.

6.1.3 Port of Burgas, Bulgaria

A plan for the development of the Port of Burgas includes projects for the rationalization of facilities not only within the existing port, but also seaward of the existing facilities.

The Port of Burgas has initiated an aggressive plan to expand its storage and related facilities and port operations at the Merchant Harbor. This has come about as a result of two main factors: (1) the changing realities of intra- and interregional trade in terms of volume, cargo type, and direction following the collapse of trade with the former Council on Mutual Economic Assistance (CMEA) bloc, and (2) changing transport technologies, such as containerization, in response to a market-based economy emphasizing more consumer goods with higher value-to-weight ratio and greater sensitivity to faster service.

The future development of port facilities has been conceptualized in a Master Plan, which extends to the year 2015.[1] Under the Master Plan, expansion of four new terminal facilities are envisioned for the Merchant Harbor, all to be built on reclaimed land from the water side as shown in Figure 6-1. Each of the four terminals are discussed in this section

[1] Port of Burgas and consultants, *Development Up to 2015*, July 1996.

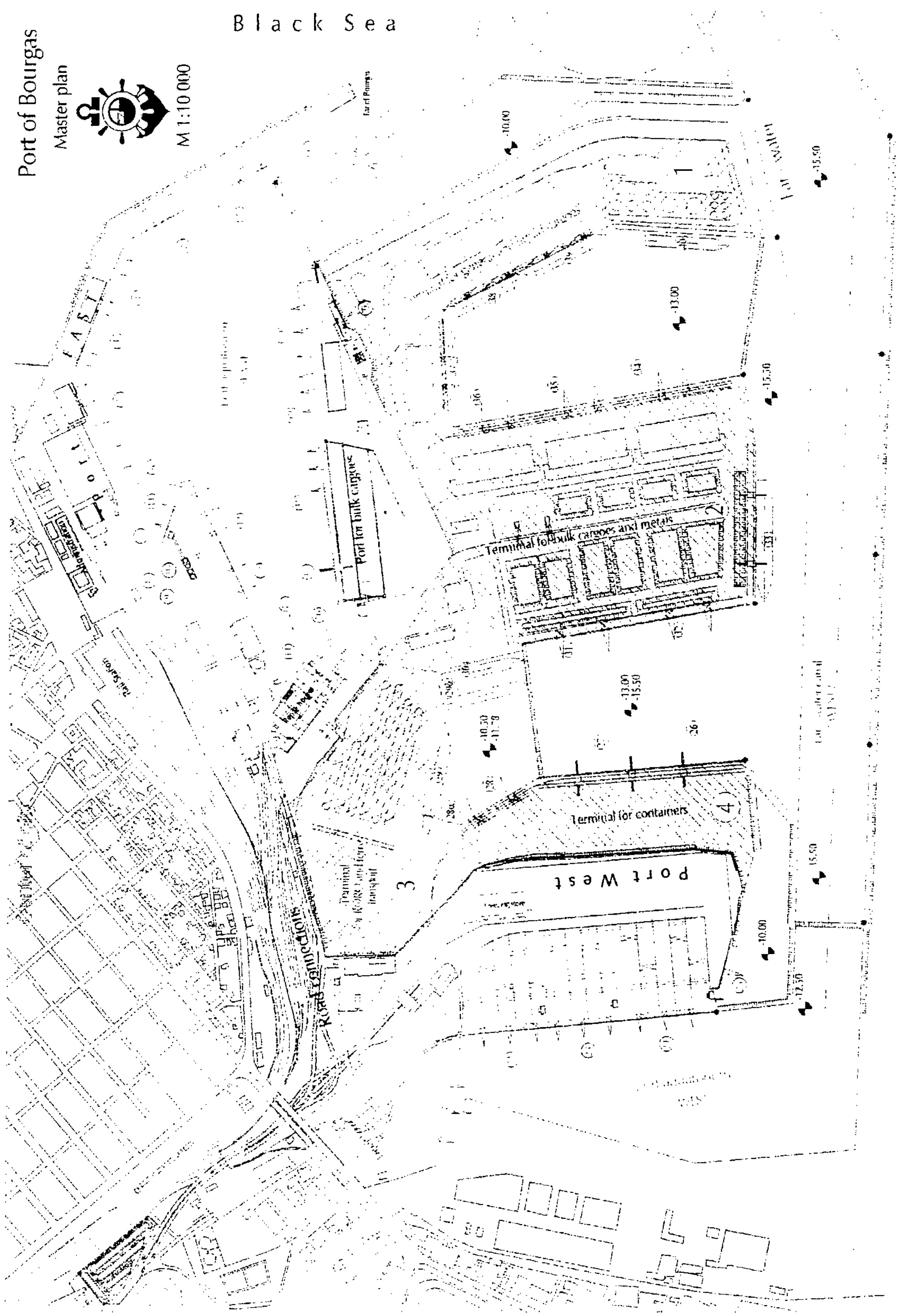


Figure 6-1 Port of Burgas – Master Plan

6.1.3.1 Port of Burgas: Terminal 1 – General and Liquid Cargoes

This terminal will be built as an extended finger pier from the south east corner of the Bulk Cargo Harbor. The east side of the pier will serve as a breakwater for the other terminals planned for development. By the year 2000 storage, rail and road access, scaffold bridges for handling liquid cargo, and berth facilities for a new Berth #40 will be operational. Three more new berths (#37, #38, and #39) and liquid storage tanks of 52,200 cubic meter capacity will be added gradually until 2015. The turning basin and berth water depths will be dredged and maintained at 13 meters (43 feet). At full development, the annual capacity of Berth #40 will be one million tons and Berths #37, #38, and #39, some 370 thousand tons. In 2000, the first year of operation for Berth #40, it is anticipated that 673,000 tons of liquid cargo (spirits, wine, benzene, kerosene, diesel, liquid fertilizers, and chemicals) will be handled. By 2005, an annual throughput of 905,000 tons will be reached. The capacity of one million tons per year in Berth #40 is expected to be reached by 2010. Berths #37, #38, and #39 will be used for handling general cargo. The total estimated cost for Terminal 1 is $75.8 million.

6.1.3.2 Port of Burgas: Terminal 2 – Bulk Cargoes

Terminal 2 would be developed by the government on environmental grounds. This project is included in the "Indicative Guidelines for the further development of Pan-European Transport Infrastructure." This terminal is envisioned as a large area consisting of six new berths (31 through 36) for dry bulk cargo and metals. The terminal will be built directly south of the existing Bulk Cargo Harbor facilities. In order to respond to expected increases in coal, coke, ore, and concentrate shipments, the port plans construction of Berth 31 by 2000 with an expected throughput of 3,098,000 tons. Water depth alongside the berth will be maintained at 13 meters (43 feet) allowing berthing of vessels of up to 100,000 DWT. By 2005, Berths #32 and #33 will start handling ore, ore concentrates, and clinker. Together with Berth #31, these berths in Terminal 2 are expected to handle 4 million tons of dry bulk cargo and 250,000 tons of general cargo by 2005. By 2010, two more berths (#35 and #36) will be added bringing the total throughput of Terminal 2 to 7,810,000 tons of dry bulk cargo and 780,000 tons of general cargo. Berth #34 will be added by 2015, so that Berths #34 through #36 located on the east side of the terminal will have a total throughput of 1,130,000 tons of general cargo. In addition, the bulk cargo berths of Terminal 2 (Berths #31 through #33) are expected to handle 8,310,000 tons in the same year. The total estimated cost of Terminal 2 is $68.2 million including dredging and on-shore facilities.

6.1.3.3 Port of Burgas: Terminal 3 – Ro-Ro Ferry Terminal

This terminal is envisioned as a ro-ro, ferry, and passenger ship facility consisting of three berths (#29, #29A, and #30). Initially, Berths #29A and #30 with depths alongside of 10.5 meters (35 feet) are planned to be operational by 2000, followed by Berth #29 in 2010. Berths #29A and #30 are planned for stern side ro-ro operations in both berths with port side operational capability also at Berth #30. The terminal will be supported by a large, fenced parking area for trucks, tractor trailers, and automobiles. During the first year of operation in 2000, Berths #29A and #30 are expected to handle 201,000 tons of ro-ro trades. By 2005, Berth #29A is projected to handle 283,000 tons of cargo by ferry service and Berth #30 about 415,000 tons of ro-ro traffic. By 2010, ferry traffic is expected to be handled at the new Berth #29 with an anticipated first year throughput of 400,000 tons, which will increase to 1,075,000 tons by 2015. Berths #29A and #30 are expected to handle 708,000 and 796,000 tons of ro-ro cargo in 2010 and 2015, respectively. It is understood that plans have been almost finalized to start a ro-ro service to Poti, Georgia, using the existing port facilities. The total cost of Terminal 3 is estimated at US$ 41.6 million, including the cost of the passenger terminal with customs and immigration facilities.

6.1.3.4 Port of Burgas: Terminal 4 - Container Terminal

This facility is designated as the port's container terminal. It is designed as a seaward extension from the eastern side of the existing West Harbor. Two berths (#25A and #25B) will be constructed on the southern end of the terminal, while three berths (#26 through #28) will be located along the eastern side. The port anticipates that Berths #27 and #28 will first be operational by 1999 followed by the addition of Berth #25A in 2000, Berth #26 in 2005, and Berth #25B in 2010. However, for any operation to commence at this terminal, it is necessary to construct the basic superstructure of Terminal 1, the eastern side of which is designed to serve as a new breakwater for all planned terminals in the Merchant Harbor. Terminal 4 will be developed as a BOT concession by a joint stock company, which would have a 50 percent participation by the port. Finalization of the concession awaits a new Port Law.

By 1999 the port projects a container traffic of 43,000 TEUs and another 128,000 tons of refrigerated and perishable cargoes. Cold storage facilities and outlets for refrigerated containers are planned in the backland area of Berth #28. Container traffic is expected to increase to 80,000 TEUs by 2000; to 131,600 TEUs by 2005; 191,800 TEUs by 2010; and 255,000 TEUs by 2015. In addition, refrigerated and perishable cargo traffic is projected to reach 190,000 tons by 2000; 212,000 tons by 2005; and 235,000 and 240,000 tons by 2010 and 2015, respectively. Berth #28 is principally designed to handle refrigerated and perishable goods, while the other berths will be reserved for container operations. The total cost of Terminal 4 including gantry cranes, container stackers, and other container handling equipment is estimated at US$ 54 million.

A prefeasibililty report on the development of this container terminal was published in August 1997 as part of the work being performed by SBDI's Transportation Advisory Services to the three member countries.

6.1.4 Port of Varna, Bulgaria

The Port of Varna includes two separate facilities: Varna East and Varna West. Figures 6-2 and 6-3 show the general layout and proximity of each port facility. Both of these facilities currently handle different marine transport functions and are discussed separately below. Future needs are assessed for the operations and strategies for expanding these facilities, land use management plans and recommendations to enhance the near- and long-term development of the overall port area, and port operations plans. Port improvement plans are discussed in subsequent sections based on immediate action and intermediate year improvements.

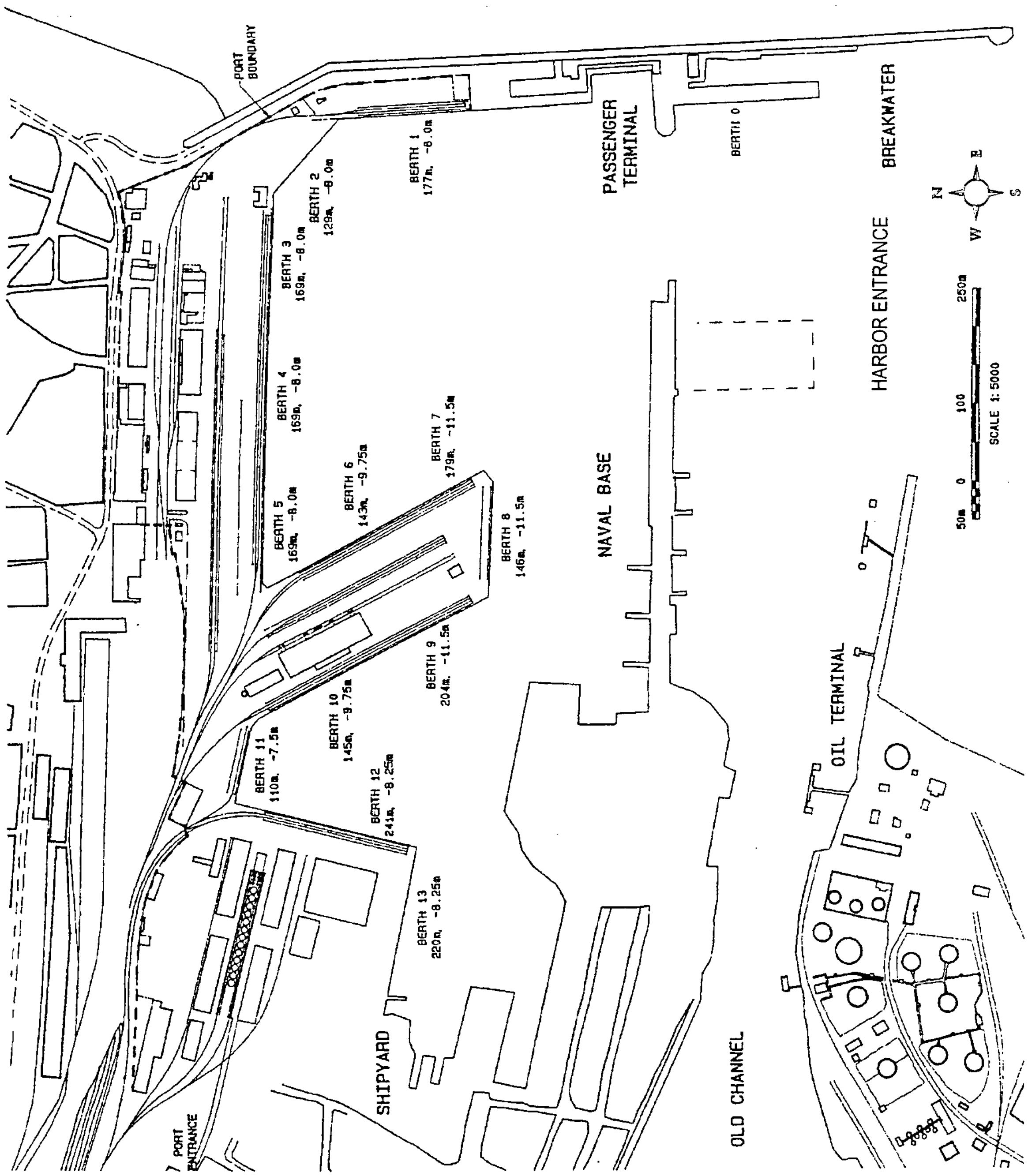


Figure 6-2 General Layout of Port of Varna East

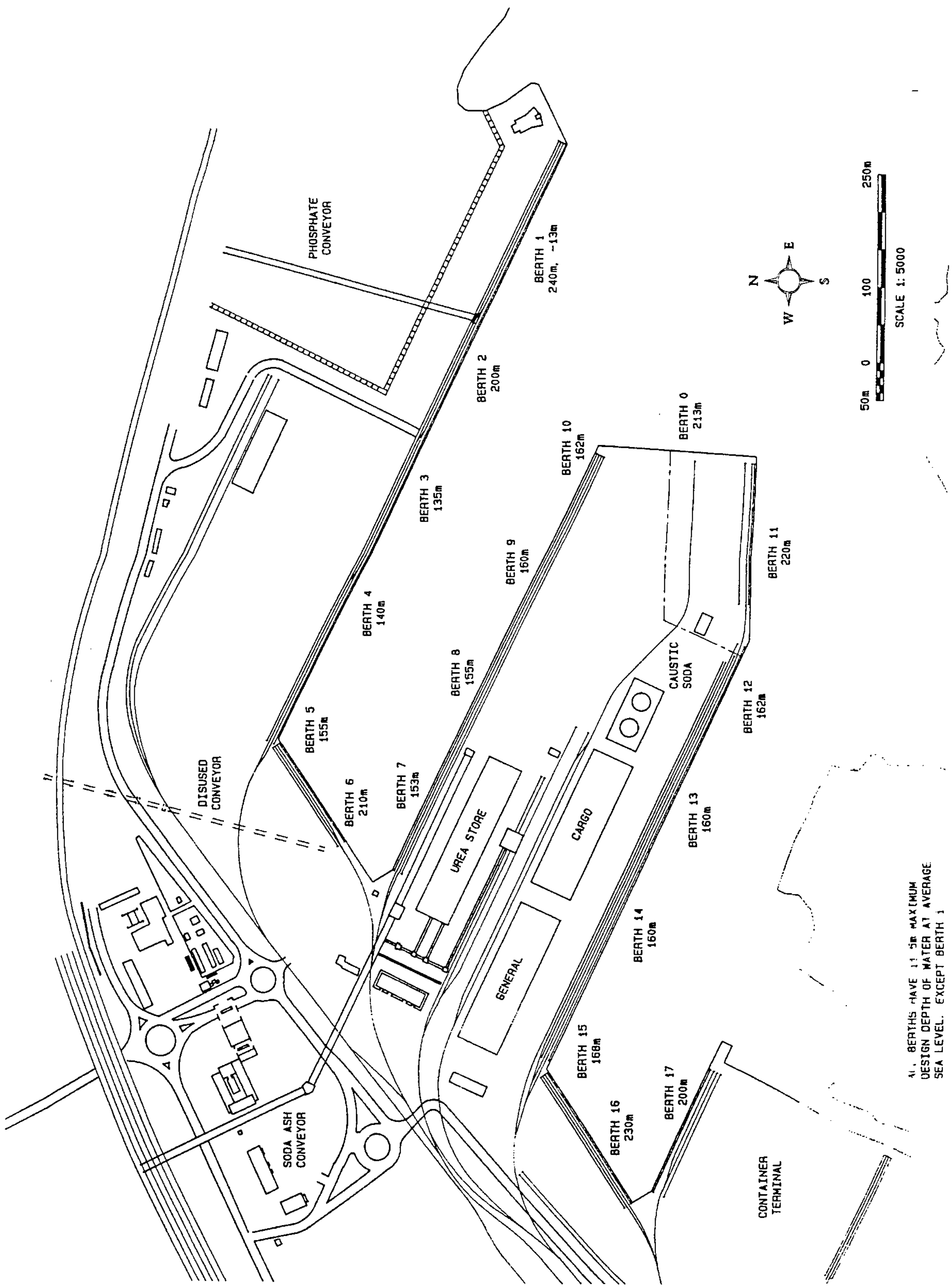


Figure 6-3 General Layout of Port of Varna West

6.1.4.1 Port of Varna East

The Port of Varna East handled 1.41 million annual tons in the early 1990s. Of these, about 35 percent was grain, 45 percent urea in bags, 10 percent containers, and the remaining 10 percent miscellaneous general cargo. The volume of bagged urea is forecast to reduce substantially with urea being transported increasingly in bulk through Port of Varna West.

In the short-term, the port will experience rising berth occupancies as the container operations expand and as general cargo transit and re-export traffic flourishes. In the longer term, however, the berth occupancy for the base case traffic is forecast to fall from 66 percent in the mid 90s to 43 percent in 2000 and 21 percent in 2005, assuming 8 berths are available. The number of berths in operation in the long-term can therefore be reduced, with the spare berths held in reserve for new types of cargo or trade.

The existing facilities at Port of Varna East are not particularly suited for a modern port, due to lack of water depth for large vessels and limited land area. In addition, much of the equipment is in poor condition and will require substantial overhaul or replacement. However, the restrictions on vessel size are not a problem for general cargo or ro-ro vessels. Another factor that needs to be taken into consideration is the port's proximity to the town of Varna, an important tourist and residential center.

It is, therefore, recommended that the long-term strategy should be to reduce the volumes handled at Port of Varna East, concentrating in future on general cargo traffic. The port would gradually be reduced in effective size, handling general cargo over Berths #7, #9,#10, and #12, with Berths #6 and #8 used as overflow capacity. Berths #0 and #1 would be used by the passenger terminal. Berths #2 and #3 would be available for tugs and pilot boats, while Berths #4 and #5 should be held in reserve available for new trades and cargoes.

Navigation Maritime Bulgaria has stated that it would prefer a combined container and ro-ro terminal. As a result, the Master Plan for a new container terminal includes an option for a ro-ro berth as a separate phase when the cost is justifiable. However, for other ro-ro services which could develop, it would be more appropriate to continue to use Port of Varna East rather than transfer to the new terminal. In the meantime, it is suggested to incorporate a return at the end of the quay to enable ro-ro vessels with stern ramps to use the Port of Varna East container berth.

Operations at the Port of Varna East may therefore be divided into two phases, where the second phase implementation begins when the transit traffic reduces and the grain and container traffic start being handled at new terminals. The phases are described as follows:

> **Phase 1:** Berth #1 is made available for the use of the passenger terminal. Tugs and pilot boats would remain on Berths #2 and #3. Container operations continue to be handled on Berth #5, with the area behind Berths #3 and #4 being substantially used for container stacking. New container handling and stacking equipment is to be provided. ro-ro should be handled as at present by mooring stern-to the quay at Berth #1, or by using Berth #3. Trailers could be parked behind Berths #1 to #3. Other cargoes use Berths #6 through #12, with direct delivery from rail wagons at Berths #3 and #4 available in reserve. The steel transshipment traffic occupies large areas of storage space for

extended periods, and this must use the space between Berths #6, #7, #9, and #10 instead of behind Berths #3 and #4.

Phase 2: Once a dedicated grain terminal and a new container terminal have been commissioned elsewhere, the remaining general cargoes at Port of Varna East can be handled over 4 berths, with a further 2 berths as spare capacity. Other berths can then be kept in reserve for new cargoes or trades.

The above development strategy assumes that a new container terminal can be developed in Varna Lake at the Central Island site or, failing that, Kazashko. If, however, both of these prove unacceptable, it may be necessary instead to develop Port of Varna East as a long-term container terminal. In this case, the port would gradually handle less general cargo as the container traffic grew, the balance being transferred to Varna West. In this scenario, it is envisioned that ro-ro traffic also be handled at Varna East, using berth 6 initially, and then Berth #7 after the second phase of the development. However, both these activities use relatively large areas of land and this would limit the port's long-term maximum throughput.

There is a potential requirement for a refrigerated store. If this becomes a viable option, it is recommended that this is located at Port of Varna East, and the operation of it leased out.

It is recommended that container stripping and stuffing operations should be undertaken in warehouse No. 7 or at the Inland Storage Depot when these facilities are required. For the present low volumes it is uneconomical to consider the development of a CFS in either of the existing container terminals, particularly when neither is intended to be the long-term terminal. With regard to the remaining space in the Inland Storage Depot, selected areas could be leased out to private warehousing companies with or without Free Trade Zone status.

6.1.4.2 Port of Varna West

In the early 1990s, Varna West handled some 1.9 million annual tons of cargo, the majority for or from the adjacent Devnya industrial estate. It is recommended that this pattern be maintained, and development strategies concentrate on improving the performance of the port, particularly by improved organization and privatization or commercialization.

As a result, recommendations have been made concerning the fabric of the port. These recommendations are limited in extent and are as follows:

- The urea loading facility should be extended to cover both Berths #7 and #8 to cater to the forecast rise in bulk urea shipments. Such extension should allow for vessels on Berth #8 to overhang onto Berth #9. This will be especially useful as the current berths are somewhat short for the maximum predicted vessel size (155 m long compared to a 30,000 DWT vessel of typically 190 m). Additional bulk ship-loading equipment should be provided as the volumes increase.
- The urea bag-handling system should be modified to increase the handling rates and hence reduce costs.
- In theory, the bulk urea storage needs to be expanded. In allocating space therefore, provision should be made for this. However, by good coordination of deliveries and vessels, it may be possible to avoid this necessity.

- The construction of a dedicated, hazardous liquids berth cannot be justified on economic grounds based on the forecast traffic for Devoya, and is therefore not recommended. However, a potential site to the east of Varna West, north of the channel, has been identified and should be reserved for this use in case the circumstances change.
- The method of handling rock phosphate and apatite should be improved in order to reduce the amount of dust generated and cargo lost. The possibility of replacing the grab with a continuous unloader should be seriously investigated in conjunction with Agropolychim.
- Containers should continue to be handled on Berth #17 with minimal investment until a new container terminal is constructed elsewhere. Once complete, the gantry cranes and mobile equipment can be transferred to the new terminal. The berth would cease to be used for containers, and can be used for other cargoes as new traffic develops.
- Berth #0 is a viable location for a grain terminal as an alternative to Topolite.
- There is excess berth capacity for the forecast traffic: there are 17 berths plus one rented out. It is, therefore, recommended that Berths #6 and #16 are not used (and Berth #0 if the grain terminal is not built there). This should provide ample capacity, even if Berth #11 continues to be rented out. This assumes that general cargo continues to be handled at Varna East.
- It is recommended that the workshops have a major overhaul, and repairs be made to the paving in the areas of Berths #13 and #17.

Issues related to operations, land-use management policies, navigation, and shipping control for both the Port facilities at Varna are discussed in the text below.

6.1.4.3 Ports of Varna – Operational Considerations

The strategy of zoning port areas in both Varna East and Varna West has the objective of concentrating similar types of cargo-handling operations in one location. This approach has a number of advantages:

- It is the first stage in creating business units which can then be considered for private sector involvement
- The concentration of similar cargoes in the same location will allow cargo handling equipment to be allocated to the appropriate area
- Appropriate number of management and staff can be allocated to the areas on a permanent basis, which in turn will enable skill levels to be raised, and encourage a better understanding of the customers needs
- It will also allow the development of a cost and management accounting system, which in turn will provide valuable information to senior management

In the establishment and management of these business units/zones, it is recommended that senior management be guided by the following principles:

- The business units/zones should be established one at a time, to enable senior management to deal with any problems that may arise
- The start should be made with the most clear-cut units, such as containers, passenger terminal, etc.
- They should be established only after the proposed manager has received training and after the staff has been made aware of the proposed changes
- Only the appropriate number of staff and appropriate numbers and types of equipment should be allocated to each unit
- The cost and management accounting system, and MIS must be aligned to the units as established.

All strategies must conform to the mission, objectives, and targets in the Port of Varna's Strategic Plan. Although adjustments will need to be made as new facilities, such as container and grain terminals, are added, the operational zoning is proposed for the current port layout. Based on the operational and physical site considerations, strategies for improvements at the Port of Varna East, identify specific improvements and functions for each berth.

6.1.4.4 Port of Varna – Land-Use Management Policies

It has been proposed that the land-use policies and future intentions be incorporated within revised Municipality Development Plans. Land-use policies would be updated after a five-year review period in the lifetime of the Development Plan.

The land-use zoning proposals would be applied as a future development control tool and land-use changes would be determined by the municipalities and the Port of Varna officials in accordance with the defined zoning policies and statutory planning regulations. It is strongly recommended that the Port of Varna be included in the development control system so that the prior approval of the Port should be obligatory for all developments along the shore to ensure conformity with the coherent long-term strategy, assuring that appropriate sites for future port development are protected.

Changes to the land use pattern of four areas are recommended: Varna City and Island, Varna Lake, Besloslav Lake, and the Canal Areas. These identified land management policies should be incorporated into any land-use management plans, and as previously stated, adopted in both the new Regional Plan and the Municipality Development Plans for the future. A review of the land use plans should occur after 5 years within the lifetime of a 10-year plan.

6.1.4.5 Ports of Varna – Navigation and Ship Handling

Currently, overall control of vessel movements rests with the Harbor Master who is directly responsible to the Ministry of Transport. Surveying and dredging of the channels as well as the maintenance of navigational aids is carried out by the Organization for the Maintenance of Navigation and Basins, again under the control of the Ministry of Transport.

The Port of Varna is responsible for dredging the port areas. Also, through its Chief Pilot, the port is responsible for the control of pilots, tugs, and other marine craft, as well as the operation of the signal stations. This split responsibility, however, complicates marine matters and somewhat limits efficient operation. Therefore, navigation and ship-handling recommendations have been made in the master plan, to address the following requirements for efficient port operations:

- Vessel Traffic Control
- Marine Craft
- Navigation/Navigational Aids
- Responsibility for Marine Matters
- Port Rules and Regulations
- Commercial Port Activities

Given the fact that the Port of Varna officials are in a day-to-day position to have a better understanding of their customers' needs, and are more knowledgeable about commercial port considerations, it is recommended that more autonomy be given to the Port of Varna for overall port control and operations.

6.2 PORT IMPROVEMENTS BY TIME-FRAME

Recommendations for port improvements are based on available master plans for each port or recent studies. In some cases although improvements are identified, further studies are needed to determine specific costs for the projects.

6.2.1 Albania's Ports

6.2.1.1 Port of Durres

Table 6-1 presents a summary of the Port of Durres Improvement Plans. The Immediate Action Plan for the Port of Durres is consistent with projects defined by the Port of Durres Authority (PDA) and funding strategies by the World Bank IDA fund, representing a total investment of US$ 26 million, with a completion of these projects by the year 2000. These investments would address the immediate needs resulting from years of deferred maintenance at the port, through an updating and consolidation of physical facilities, and improvements to the port operations, safety, and marine protection facilities.

In addition, the port is in the process of selecting consultants for the design and construction of a passenger ferry terminal and other associated facilities. This project is funded by the European Investment Bank (EIB) at approximately US$ 13 million.

Intermediate- and long-range plans for the Port of Durres envision investments to expand the port-handling capacity, land development, and privatization of services to maximize commercial development and return on investments to assure solvency for the port.

6.2.1.2 Port of Vlore

No specific improvement plans have been identified for the Port of Vlore due to lack of information and access to the port facilities. Development of a Port Master Plan is recommended for the Immediate Action Plan time-frame.

6.2.2 Bulgaria's Ports

6.2.2.1 Port of Burgas, Bulgaria

Table 6-2 presents the Port of Burgas improvement plans. The focus is on implementation of an ambitious modernization and expansion of the port facilities within the development of four, specific functional terminal areas according to a long range master plan. These projects represent a total investment of US$ 380 million, with completion expected by 2003. The Government of Bulgaria is immediately seeking funding authority and participation by the private sector in these port development projects.

Some of these projects may be completed in the Intermediate Strategic Year 2010 time-frame. Long-range plans for the Port of Burgas envision further investments to expand the port handling capacity, land development, and privatization of services to maximize commercial development and return to assure continuing solvency for the port.

6.2.1.2 Port of Varna, Bulgaria

Table 6-3 is a summary of the Port of Varna improvement plans. Implementation of these improvements focus on consolidation and expansion of services at the two Port of Varna facilities. New passenger ferry service would be implemented at Varna East, while a new grain terminal would be added to consolidation of services at Varna West. These projects represent a total investment of US$ 41.0 million, with completion expected by 2003.

Intermediate strategic year 2010 improvement plans call for building a new container terminal to be located at a Varna Lake site. Long-range plans for the Port of Varna envision further investments to expand the port handling capacity, land development, and privatization of services to maximize commercial development and return to assure continuing solvency for the port.

Table 6-1
Port of Durres Improvement Plans

Description	Time Frame	Estimated Cost US$ Million 1997
Modernization of Physical Facilities – berths, rehabilitate operational areas, and relocate administration building	Immediate Action Plan – Year 2003	18
Protection and Safety - breakwater rehabilitation, access channel realignment, and widening	Immediate Action Plan – Year 2003	6
Construction of passenger ferry terminal	Intermediate Action Plan– Year 2003	13
Institutional, management assistance and design services	Immediate Action Plan – Year 2003	2
Subtotal for Immediate Action Plan - Year 2003		**39**
Design and construct a new 140 meter quay	Intermediate Strategic Plan – Year 2010	
Design and construct a new 670 meter, 11.5-meter-deep quay	Intermediate Strategic Plan – Year 2010	
Design and Construction of new container terminal	Intermediate Strategic Plan – Year 2003	
Reconstruct navigational channel, to 12.5 meter deep, 60-80 meters wide, and 4.8 km in length	Intermediate Strategic Plan – Year 2010	
Commercial development of port properties/services	Long-Term Vision	

Table 6-2
Port of Burgas, Identified Improvement Plans

Description	Time Frame	Estimated Cost US$ Million 1997
Terminal 1 – General/Liquid Cargoes	Immediate Action Plan – Year 2003	110
Terminal 2 – Bulk Cargoes	Immediate Action Plan – Year 2003	140
Terminal 3 – Ro-Ro Ferry Terminal	Immediate Action Plan – Year 2003	50
Terminal 4 – Container Terminal	Immediate Action Plan – Year 2003	78
Refrigerated Storage Capacity	Immediate Action Plan – Year 2003	Already operational
Subtotal for Immediate Action Plan – Year 2003		**380**
Commercial Development of Port Properties/Services	Long-Term Vision	NA

Table 6-3
Port of Varna, Port Improvement Plan

Description	Time Frame	Estimated Cost US$ Million 1997
Varna East - Consolidation of facility into passenger ferry and container capacity	Immediate Action Plan – Year 2003 Plan	14
Varna West - expansion to add grain terminal other improvements Upgrade and rehabilitate breakwater Dredge Channel 2 to depth of 12.5 meters	Immediate Action Plan – Year 2003 Plan	18
Subtotal for Immediate Action Plan - Year 2003		**41**
New Container Terminal at Varna Lake Site	Intermediate Strategic Plan – Year 2010	
Commercial Development of Port Properties/ Services	Long-Term Vision	

This section presents preliminary cost estimates and a discussion of financing options to implement the immediate action corridor improvement plan. The cost estimates are planning-level estimates, based on the limited amount of detail available for the recommended projects and, in most instances, are based on per-kilometer costs applying government data. The financing discussion focuses on options considered directly relevant to the current and near-term situation in the Balkan countries.

7.1 COST ESTIMATES FOR IMMEDIATE ACTION PLAN

Order of magnitude cost estimates for the immediate action corridor improvement plan were assembled from estimates published by transport ministries of member countries, supplemented by estimates developed in previous consulting reports. Cost estimates are provided for relatively large projects, while a lump sum allowance has been assumed for miscellaneous improvement projects. An indicative estimate was provided for those projects on which no prior estimating effort had been made. These indicative estimates are based on prior experience with similar projects and can vary significantly from a conceptual cost estimate when one is developed.

The purpose of assembling these cost estimates is to provide SBDI member countries, international financial institutions (IFIs), development and commercial banks, and the engineering and construction community with the approximate level of resources and financial commitments required to realize the initial strategic objectives of the East-West Transport Corridor. The estimates are presented by country and transport sector. All cost estimates are in U.S. dollars (US$) based on 1997 levels.

The recommended projects have been selected to meet capacity requirements of the transport facilities, where relevant, as well as to achieve the strategic objectives of the East-West Corridor Program. Brief summaries of these projects and order of magnitude cost estimate for each is provided by country in the following subsections.

7.1.1 Projects for Albania

Several significant highway, railway and port improvement projects are recommended for Albania during the short-term time frame. The relatively high level of investment required by these projects is necessitated by the long period of neglect that these transport sectors have endured over the last few years compounded by the damage inflicted on many of the transport facilities during the recent civil strife.

7.1.1.1 Highways Projects

Recommended improvements in Albania's highway system would include more than 320 kilometers of new roads and upgraded highway capacity, at a total cost of US$ 456 million.

These projects are summarized in Table 7-1.

Table 7-1
Albania – Highway Project Cost Estimates
Immediate Action Improvement Plan (Million US$, 1997)

Project Description	Construction Type	Length (Km)	Cost Per Km	Total Cost (US$ M)	Source
4-Lane Motorways:	New				
Durres - Vlore		25.4	1.7	44	General Roads Directorate, December 1997
Tirana - Elbasan		38	4.0	152	Indicative estimate
Subtotal:		**63.4**		**196**	
4-Lane Expressways:	Expansion				
Durres - Ndog - Tirana		41	1.0	41	Indicative estimate
Durres - Rrogozhine - Elbasan		83	1.0	83	Indicative estimate
Rrogozhine - Fier		49	1.0	49	Indicative estimate
Kafasan - Pogradec		16	1.0	16	Indicative estimate
Subtotal:		**189**		**189**	
Other Highway Improvement Projects:	Improvement				
Elbasan - Kafasan (Macedonian Border): rehabilitation of existing 2-lane highway to conform to international geometric design standards.		71.1	1.0	71	General Roads Directorate, December 1997
Total Highway Program		**323.5**		**456**	

7.1.1.2 Railway Projects

The railway projects involve the rehabilitation and modernization of some 154.7 kilometers connecting Durres, Tirana, and Vlore with Lin on the Macedonian border. The total estimated cost for these projects is US$ 205 million.

These projects are summarized in Table 7-2.

Table 7-2
Albania – Railway Project Cost Estimates
Immediate Action Improvement Plan (Million US$, 1997)

Project Description	Length (Km)	Cost Per Km	Total Cost (US$ M)	Source/Comment
Railway				
Durres - Rrogozhine - Vlore - Lin and Rrogozhine - Vlore: Renew track and structures and implement radio block system	152	0.53	80	Indicative estimate
Lin - Macedonian border: Construct new line	1.7	2.9	5	Indicative estimate
Total Railway Program	**154.7**		**85**	

7.1.1.3 Port Projects

Due to the scarcity of information on the ports of Vlore and Durres, a lump sum allowance is given for port projects, to be verified through upcoming detailed studies. The level of expenditure on the ports will depend, to a large extent, on the sources and amount of financing that can be raised/attracted from IFIs and private investors. The estimated total price for these port projects is US$ 100 millionthrough the year 2003.

The projects for Durres are summarized in Table 7-3.

Table 7-3
Albania – Port Project Cost Estimates
Immediate Action Improvement Plan (Million US$, 1997)

Project Description	Total Cost (US$ M)	Source/Comment
Durres:		
Modernize physical facilities	74	Indicative estimate
Improve protection and safety standards	6	Government estimate
Construction of passenger ferry terminal.	13	Government estimate
Structural organization	5	Government estimate
Vlore		
Develop comprehensive master plan	2	Indicative estimate
Total Port Program	**100**	

7.1.2 Projects for Macedonia

The total immediate action cost for the transport infrastructure in Macedonia amount to $ 495 million, as outlined below:

7.1.2.1 Highway Projects

Recommended improvements to Macedonia's highway network would include more than 149 kilometers, including new construction, capacity expansion, and geometric improvements. Total estimated cost is US$ 229 million. These projects are summarized in Table 7-4.

Table 7-4
Macedonia – Highway Project Cost Estimates
Immediate Action Improvement Plan (Million US$, 1997)

Project Description	Construction Type	Length (Km)	Cost Per Km	Total Cost (US$ M)	Source
4-Lane Motorways:					
Skopje - Tetevo	New	35.7	1.87	67	Basic Technical Indicators, Fund for National & Regional Roads, Macedonia
4-Lane Expressways:					
Pogradec - Ohrid	Expansion	30	1.0	30	Indicative estimate
Other Highway Improvement Projects:					
Titov Veles - Prilep: improve geometric design standards on existing 2-lane highway	Improvement	72.6	1.52	110	Basic Technical Indicators, Fund for National & Regional Roads, Macedonia
Kriva Palanka - Deve Bair: construct new standard 2-lane road on a new alignment.	New	11	2.0	22	Fund for National Highways, Macedonia
Subtotal:		**83.6**		**132**	
Total Highway Program		**149.3**		**229**	

7.1.2.2 Railway Projects

The most critical element in achieving the objective of the East-West Corridor development is the construction of the two railroad gaps that connect the Macedonian railroad to the Albanian railroad to the West, and the Bulgarian Railroad to the East. The latter is currently under construction but requires some $220 million to complete. It is recommended that top priority be given to this project by the international financial community.

Macedonia's short-term railway plan also includes rehabilitation of some 86 km of existing railroads.

Total railroad project costs are estimated at $ 226 million. These projects are summarized in Table 7-5.

Table 7-5
Macedonia – Railway Project Cost Estimates
Immediate Action Improvement Plan (Million US$, 1997)

Project Description	Length (Km)	Cost Per Km	Total Cost (US$ M)	Source/Comment
Railway				
Kumanovo - Beljacovice: Reconstruct line	31	1.0	31	Indicative estimate
Beljacovice - Bulgarian border: Build new line	55	4.18	230 *	Government estimate
G. Petrov - Kicevo: Implement radio block system.			5	Indicative estimate
Total Railway Program	**86**		**266**	

* The total cost of the project is $330.00 million. The Government of Macedonia has already invested $100.00 million during the last few years leaving $ 230.00 million to be raised during the short term (1998-2003)

7.1.3 Projects for Bulgaria

Transport infrastructure improvements in Bulgaria for the Immediate Action Plan signify fairly large investment for each of the sectors, highways, railways and ports.

7.1.3.1 Highways

Recommended improvements in Bulgaria's highway network would include more than 255 kilometers, comprising new construction, capacity expansion, and geometric improvements. Total estimated cost is US$ 645 million. These projects are summarized in Table 7-6.

Table 7-6
Bulgaria – Highway Project Cost Estimates
Immediate Action Improvement Plan (Million US$, 1997)

Project Description	Construction Type	Length (Km)	Cost Per Km	Total Cost (US$ M)	Source
4-Lane Motorway:	New				
Varna - Burgas		87	3.0	261	Highway Department
Orizovo - Kapitan Andreevo		108	3.0	324	Highway Department
Subtotal:		**195**		**585**	
4-Lane Expressways:	Expansion				
Karnare - Kazanlak		60	1.0	60	Indicative estimate
Total Highway Program		**255**		**645**	

7.1.3.2 Railway Projects

Railway improvement projects are geared at improving capacity and achieving other strategic corridor objectives. Total cost is estimated at US$ 386 million.

The projects are summarized in Table 7-7.

Table 7-7
Bulgaria – Railway Project Cost Estimates
Immediate Action Improvement Plan (Million US$, 1997)

Project Description	Length (Km)	Cost Per Km	Total Cost (US$ M)	Source/Comment
Railway				
Sofia - Radomir: double track, signal upgrade	7	2.9	20	Indicative estimate
Stara Zagora - Zimnica: double track	92.5	0.76	70	Indicative estimate
Sindel - Varna: Install automatic block system	35	0.26	9	Indicative estimate
Sofia - Mazdra Varna: Upgrade track	61	.24	15	Indicative estimate
Gyueshevo - Macedonian border: Construct new line	2.5	2	5	Indicative estimate
Plovdiv - Burgas; AB & CTC Upgrade	290	0.26	75	Indicative estimate
Plovdiv - Svilengrad: Realignment, trackwork, automatic blocking, signaling, and electrification	143.8	1.34	192*	Previous consultants' estimates
Total Railway Program			**386**	

*Total estimated cost of $386 million is spread 50/50 between short- and intermediate-term time frames

7.1.3.3 Port Projects

Project identification and cost estimates for the ports of Varna and Burgas are extracted from their respective master plans, which were performed recently for both ports. It is recognized that the projects identified are the first phase of a multiphase program intended to modernize and expand the two Gateway ports on the Black Sea. The short-term costs are estimated at US$ 268 million.

These projects are summarized in Table 7-8.

Table 7-8
Bulgaria – Port Project Cost Estimates
Immediate Action Improvement Plan (Million US$, 1997)

Project Description	Total Cost ($US M)	Source/Comment
Port		
Burgas: Build and expand Terminal 1	110	Port Master Plan
Burgas: Build and expand Terminal 2	140	Port Master Plan
Burgas: Build and expand Terminal 3	50	Port Master Plan
Burgas: Construct new Terminal 4	78	Port Master Plan
Varna: Consolidate facility into passenger ferry and container capacity.	14	Port Master Plan
Varna: Expand for addition of grains terminal and other improvements.	18	Port Master Plan
Varna: Upgrade and rehabilitate breakwater and dredge Channel 2 to depth of 12.5 m		
Total Port Program	**421**	

7.2 SUMMARY OF COST ESTIMATES FOR IMMEDIATE ACTION PLAN

Total cost estimates for the South Balkan Development Initiative have been categorized by country and transport mode and are presented in Table 7-9.

Table 7-9
Immediate Action Improvement Plan
Estimated Cost per Country, by Mode, and Total (Million US$, 1997)

	Highways (US$ M)	Railways (US$ M)	Ports (US$ M)	Total (US$ M)
Albania	456	85	100	641
Macedonia	229	266		495
Bulgaria	645	386	421	1,452
Total	**1,330**	**737**	**521**	**2,588**

7.3 FINANCING OPTIONS

Transport infrastructure projects can be financed in a number of ways, depending on institutional, political, and financial commitments. Factors considered include:

- Mode of transport and the unique requirements of highways, railways, and ports.
- Engineering features that may require special services and equipment.
- Financial viability/potential to attract equity partners.
- Economic viability/potential to spur business activity in a region.
- Strategic significance in serving the broader corridor needs.
- Operational performance of existing sector infrastructure.

Financing methods are discussed briefly in the following subsections.

7.3.1 Public Financing

Public financing is the traditional form of financing transport infrastructure. Two basic methods are described below:

- **Transport Trust Fund.** All transport user charges, revenues, and levies are deposited and used to finance the operation, maintenance and capital programs of that transport sector. In some countries, the trust fund runs a surplus (sometimes through curtailing public investment in the transport sector) that can be absorbed in the national budget or carried over for future transport financing. In most countries though, the trust fund runs a deficit that has to be met by transfers from the national budget.
- **National Treasury.** Deposits from all transport taxes, revenues and levies are used to fund transport operations and capital projects as part of the national budget allocation. The budgetary process can cause funding levels for transport projects to fluctuate annually as priorities and as the economy

7.3.2 Private Financing

Private financing of transport facilities can be accomplished through offering the private sector long term concessions that allow for recouping the investment. This can be accomplished through the collection of tolls, user charges, and, sometimes, through revenues generated by the transfer or development of property rights associated with the transport sector's right of way. In recent years, privatization has emerged as the preferred way of financing certain types of transport infrastructure, because of the inability of many government to set aside sufficient national resources to meet growing transport needs.

No single model for privatization is universally appropriate. The economic and political infrastructure within each country will determine how best to achieve privatization, and will dictate the process to be used. Full privatization can proceed in stages, evolving first through, corporation, transferring management and establishing private sector incentives while retaining government ownership; then transferring some of the ownership control, through partial sale, lease or franchise; and ultimately, leading to full private ownership.

7.3.3 Public / Private Partnership

This method of financing can take many forms, depending on the projects. Some of the more common forms of public/private partnership are discussed in the following sections.

7.3.3.1 Transport Authority

Under this method, a Transport Authority would be set up to manage, operate, maintain, and expand one or more transport facility. The Transport Authority would be an autonomous quasi-government body. The government would transfer to the Transport Authority the assets of any existing transport facility's (or facilities') operation and empower the Transport Authority to raise funds (and sometimes expropriate property) to finance the construction of added or new facilities. The Transport Authority would own the capital assets of existing facilities, assume responsibility for their operation, capture revenues from such operation from which it could leverage its own financing. The Transport Authority would do its financing by borrowing "off government balance sheet" with debt coverage being secured by the revenue stream from existing operation. Therefore, such borrowing will not affect the borrowing capacity and debt ceiling of the Government and can free these resources to finance other worthy projects.

A public/private partnership Transport Authority will offer the following advantages:

- Allow for more efficient expenditure of public funds
- Allow financing of transport projects without placing any burden on the Government budget, its credit rating, or borrowing capacity
- Expedite transport project implementation
- Reduce legal and financing cost usually associated with BOT projects
- Act as a catalyst for economic growth
- Create jobs
- Introduce market-driven efficiencies into the public sector

7.3.3.2 Shadow Toll Financing

This method is used to finance the construction of highways only. Under shadow toll financing, no charges would actually be levied on road users, but the government would pay private contractors a fee based on the number of vehicles using the newly constructed road. The money would come from the government annual allocation of funds to the highway sector. Since these shadow tolls would give operators an incentive, private contractors would build more and better roads to attract as much traffic as possible.

This method works best when no alternative facility is available along the same corridor and thus building toll roads would not be possible. It would also tend to spread the construction cost of the road over a much longer period of time than if the government were to finance the construction itself.

7.3.3.3 Operational Concession

Under this method, the government retains ownership of the physical transport plant and equipment and offer a long term concession to private parties to operate, improve, and expand the facility. Operational concession usually comes with a government guarantee to compensate the concessionaire for any operating losses but also offers sizable incentives for efficient operation. In order to increase traffic and maximize revenues, the concessionaire would have the incentive to invest his own money to expand the facilities, modernize equipment and introduce efficient operational methods. Both the government (the people) and the private contractor would benefit from this scheme.

7.3.4 Borrowing

The government could finance transport projects by borrowing from IFIs, development banks, other governments, individuals and corporations, and/or commercial banks. This method may not be feasible when a country's level of indebtedness has reached what would be considered a non-sustainable level (by financial institutions) and/or when the credit rating of the borrowing government could be subject to downgrades.

7.3.5 Grants

Many government agencies in developed countries offer outright grants to developing countries to help finance the planning, design, and/or the construction of parts of their transport infrastructure.

7.4 POSSIBLE STRATEGIES FOR IMMEDIATE ACTION

Programs for the improvement of transportation infrastructure include physical, operational, institutional, and regulatory elements. A preliminary review was made of financing structures that could work to fund and advance projects to completion within the East West Corridor. The review considered each of the above elements for Albania, Macedonia and Bulgaria.

Possible strategies for immediate action steps at this time, include:

1. The three countries should engage a financial advisor to structure for each country the most appropriate method (s) for financing its transport infrastructure.
2. Each of the three countries should consider formation of a Transport Authority as the organization to build, operate, and regulate transport projects within the corridor.

These recommendations are further discussed in the following subsections.

7.4.1 Engage a Financial Advisor

It is recommended that the three member countries engage a competent international financial advisor to structure for each country the most appropriate method(s) for financing its transport infrastructure. As stated earlier, methods for financing transport infrastructure vary in accordance with each country's economic and political situation; organizational, institutional, and financial characteristics of each mode of transport; and financing commitments made (or in progress) for specific large transport projects.

A preliminary scope of services for the financial advisor would be:

1. Start from a macro-economic standpoint and find out percent of national budgets that are being spent on transport by activity, i.e. administration, operation, maintenance, and new capital projects.
2. Compare the above with current experiences of other developing economies and with previous experience of developed economies when they were actively building their transport infrastructure.
3. Compare revenues generated by each transport sector (for each country) to allotted expenditure. Find out whether the transport sector is subsidizing the national treasury or vice versa.
4. Examine revenue sources and current charges for each transport sector and develop ways of optimizing these revenues, using experiences of similar countries.
5. Find out the maximum capacity of each country to internally finance their transport projects.
6. Examine each country's indebtedness, credit ratings, ability to commit to more loans and arrive at relevant conclusions concerning the transport sector.
7. Compile multilateral and bilateral commitments received by each country in financing transport sector projects.
8. Examine the cost/revenue estimates for the major transport projects in each country and develop alternative ways of financing these projects using the results of the foregoing analysis. Pay special attention to private financing through concessions, especially without sovereign guarantees.
9. Recommend an appropriate financing scheme for each major project.
10. Coordinate analysis and results of the work with key decision makers in each country as well as with IFIs international donor organization, commercial banks, etc.

Pending the completion of the financial advisory services, the following recommendations are made for consideration by the member countries, when considering the institutional framework for the implementation of their immediate action transport plan.

7.4.2 Establish a Transport Authority

For financing of highway improvements, the three member countries should consider organization of transport programs within the East West Corridor into a Transport Authority in each country, to work together to achieve the improvements identified in the plan. The financial advisor would evaluate the feasibility and recommend a specific structure for a Transport Authority in each country.

Experience in other countries shows that a Transport Authority when organized and functioning effectively, can assume the rights to:

- Improve and operate existing sections of roadways
- Design, build, finance, and maintain new sections of toll roads
- Collect tolls and other user fees on all sections of toll roads (existing as well as new)

For Albania, Macedonia and Bulgaria to formulate a Transport Authority, certain transfer of existing responsibilities might be made to the new authority:

- Strategic existing roadway assets including toll roads
- Land within the corridors where new toll highways are to be built
- Designs already completed for the new sections of highways or toll roads

The Transport Authority would be empowered, to the extent necessary to :

- Commission additional design contracts as may be required to complete the design of the new sections of the toll road.
- Expropriate additional land required for the new toll roads, and other sites ancillary thereto (construction camps, quarries, etc.)
- Commission additional forecasts (including traffic forecasts) and studies that may be required to put in place the necessary finance.

To raise the necessary finance to construct the new toll road, the Transport Authority would also be empowered to:

- Build up cash reserves from existing revenues immediately following its creation.
- Issue debt instruments (revenue bonds and other bank debt) and to borrow from the European Investment Bank (EIB), the World Bank, or other appropriate potential lenders.

The Transport Authority would be a public-private partnership, majority owned by the country government, with minority participation by private entities, potentially including international infrastructure companies and local contracting companies.

7.4.3 Explore Other Public/Private Initiatives

Public and private cooperation can potentially create the necessary funding for highway, railway and port infrastructure in the member countries. For Albania, Macedonia and Bulgaria, partnerships must be developed to leverage public and private funding capability.

By example, in nearby Slovenia the government is underway on an aggressive program to upgrade motorways. Already more than 122 kilometers of motorways have been built, with another 367 kilometers planned to be completed by the year 2004. Funding has been achieved through foreign loans, petrol taxes and MOTORWAY tolls.

The potential to generate foreign loans and investments in these Balkan countries is improved through the creation of organizations, such as a Transport Authority, that creates an opportunity to attract foreign investments. These investments can include sharing of knowledge and expertise transfer, and equity investments.

7.4.3.1 Concessions To Build New Highways

The framework for a private concessionaire (e.g. engineering/construction company) to build, operate, and transfer new highways in each of these three member countries, is limited in the immediate future without a government guarantee to compensate the concessionaire for any operating losses. The initial cost of these projects and the uncertainty regarding the market potential to generate adequate toll revenues, makes the concession arrangement a hard sell at this point in time. Financial partners would want to limit the risk and be more certain that the market potential is verifiable before committing private equity.

There may be concession arrangements that work for some limited corridors. The financial advisor should evaluate the potential for each of the recommended improvement projects. Creative financing arrangements that encourage foreign capital should be fully evaluated.

7.4.3.2 User Charges and Direct Grants For Highway Rehabilitation

The immediate action improvement plans calls for upgrading of many existing highways to improve capacity and achieve international design standards within the East-West Corridor. As vehicle ownership and traffic levels increase in each of the three countries, direct user charges including gas taxes and registrations, could be collected at reasonable levels, for deposit and use to a revolving highway trust fund.

The trust fund revenues could additionally be leveraged with direct grants obtained from the European Union and other international agencies, and with loans obtained from the European Investment Bank (EIB). The focus of these funding strategies would be for highway rehabilitation and capacity enhancements.

7.4.3.3 Railway Privatization

Worldwide, Privatization of railroads has not progressed very far in many countries. Only a handful of privately owned railroads exist outside the United States, and even restructuring of railroads to make them more market oriented has been accomplished on a very limited basis.

Key impediments to private finance of railways arise from a number of factors:

- Prospects that the project will be economically viable but will not be financially viable.
- Mismatch between the high capital costs plus long pay-back periods of many projects and the fact that financing instruments are usually of a shorter duration.
- Lack of commercial investors with a genuine long term interest in the ownership and operation of such infrastructure.
- Attitudes of stock markets in developed economies, together with the construction risk which have led to a lack of interest by the financial investors and the public, pre-construction period.

Three countries, Argentina, Great Britain, and the United States, have developed approaches that could be applied to the situation under consideration in the South Balkan countries.

The Argentinean Government is dividing its railroad into segments which it is franchising to operators who successfully bid for the operating rights. Implementation of this concept is currently under way and has encountered some success.

In the United States, the large privately owned railroads have spun off thousands of miles of lines to individual investors and consortia who operate them independently. The new companies remain an integral part of the national rail network but most often reflect a slimmed down, more efficient operation which is more customer-responsive and market oriented.

Privatization programs in Great Britain have developed in the pursuit of a variety of objectives: 1) diminution of the authority of public sector trade unions, 2) reduction of the impact of borrowing by the public sector, 3) wider share ownership by the public, and 4) improvement of business performance and efficiency.

One or more of the above models can be adapted by the proposed financial advisor to the specific situations encountered in Albania, Macedonia and Bulgaria.

7.4.3.4 Commercial Ports

Ports privatization throughout the world, is one of the more successful commercial efforts in the transport industry. There are many successful prioritization models that range from privatization of specific port activities (e.g. stevedoring, pilotage, warehousing, loading and unloading activities) to privatization of terminals of the port (e.g. container terminal, liquid bulk terminal, dry bulk terminal) to handing the entire port operations to the private sector.

In many instances, the state would retain ownership of the land infrastructure and super structure facilities, and engage private interests to operate the port or specific activities thereof. Port improvements and new facilities initiated by private parties normally reverts to the state at the end of the commission period.

As described in Section 4, the practical capacity ("c") of a highway segment is dependent on the following five factors:

- Terrain characteristics (e.g., flat, rolling, mountainous)
- Percent heavy vehicles in traffic stream
- Number of lanes
- Lane widths
- Lateral clearance to obstructions on either side of the roadway from either side of traffic lanes

Actual data for the above characteristics were obtained from several sources, including field observations, route descriptions in existing reports and studies, input provided by highway departments of member countries, and reports prepared by local consultants in Macedonia and in Bulgaria. Assumptions were made for certain highway segments in the absence of accurate information, particularly related to the percentage distribution of flat, rolling, and mountainous terrain. These characteristics are presented in Tables A-1 through A-12.

Table A-1
Albania: 1996 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	1996 Highway Characteristics								
			Terrain			% Heavy vehicles	Tc	Lane Width (m)	Shoulder Width (m)	Wc	Climbing Lanes
			Flat (%)	Rolling(%)	Mountainous(%)						
								Standard: 3.50-3.75 Acceptable: 3.25-3.50 Substandard: <3.25	Standard: 2 Acceptable: 1.0-2.0 Substandard: <1 None: 0		yes no N / A
DURRES-VORE- TIRANA											
Durres-Vore	22.9	2	90			44	0.63	3.50	1.00	0.81	N/A
		2		10		44	0.39	3.50	1.00	0.81	N/A
Vore-Kashar	2.5	2	50			35	0.68	4.00	1.00	0.92	N/A
		2		50		35	0.44	4.00	1.00	0.92	N/A
Kashar-Tirana	6.5	4 (M)	100			35	0.73	3.50	2.00	1.00	N/A
DURRES-NDROG-TIRANA											
Dures-Ndrog	20	2		100		42	0.40	3.50	1.00	0.81	N/A
Ndrog-Tirana	21	2	30			34	0.68	3.50	1.00	0.81	N/A
		2		70		34	0.44	3.50	1.00	0.81	N/A
DURRES-KAFASAN											
Durres-Kavaje	22	2	100			50	0.60	3.00	1.00	0.70	N/A
Kavaje - Rrogozhine	17	2	100			50	0.60	3.00	1.00	0.70	N/A
Rrogozhine - Peqin	8	2	100			43	0.64	3.00	1.00	0.70	N/A
Peqin-Elbasan	36	2	100			43	0.64	3.00	1.00	0.70	N/A
Elbasan - Librazhd	25	2		100		58	0.31	3.00	1.00	0.70	no
Librazhd - Kafasan	37	2			100	58	0.29	3.00	1.00	0.70	no

Table A-1 (cont'd)
Albania: 1996 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	1996 Highway Characteristics								
			Terrain			% Heavy vehicles	Tc	Lane Width (m)	Shoulder Width (m)	Wc	Climbing Lanes
			Flat (%)	Rolling(%)	Mountainous(%)						
Kafasan - Pogradec	16	2		80		60	0.30	3.00	1.00	0.70	no
		2			20	60	0.13	3.00	1.00	0.70	no
RROGOZHINE-VLORE											
Rrogozhine-Lushnje	20	2	50			56	0.57	3.00	1.00	0.70	N/A
		2		50		56	0.32	3.00	1.00	0.70	no
Lushnje-Fier	29	2	50			63	0.54	3.00	1.00	0.70	N/A
		2		50		63	0.29	3.00	1.00	0.70	no
Fier-Vlore	34	2	50			47	0.62	3.00	1.00	0.70	N/A
		2		50		47	0.38	3.00	1.00	0.70	no
TIRANA-ELBASAN											
Tirana-Elbasan	38	2	10			33	0.69	3.00	1.00	0.70	N/A
		2		20		33	0.45	3.00	1.00	0.70	no
		2			70	33	0.27	3.00	1.00	0.70	no

M = Motorway
E = Expressway

Table A-2
Albania: 2003 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2003 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width (m)	Shoulder Width (m)	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
								Standard: 3.50-3.75 Acceptable: 3.25-3.50 Substandard: <3.25	Standard: 2 Acceptable: 1.0-2.0 Substandard: <1 0		yes no N / A
DURRES-VORE- TIRANA											
Durres-Vore	22.9	**4 E**	90			**39**	0.71	**Standard**	**Standard**	**1.00**	N/A
		4 E		10		**39**	0.51	**Standard**	**Standard**	**1.00**	N/A
Vore-Kashar	2.5	**4 E**	50			**31**	0.75	Standard	**Standard**	**1.00**	N/A
		4 E		50		**31**	0.55	Standard	**Standard**	**1.00**	N/A
Kashar-Tirana	6.5	4 (M)	100			**31**	0.75	Standard	Standard	1.00	N/A
DURRES-NDROG-TIRANA											
Dures-Ndrog	20	**4 E**		100		**37**	0.52	**Standard**	**Standard**	**1.00**	N/A
Ndrog-Tirana	21	**4 E**	30			**30**	0.76	**Standard**	**Standard**	**1.00**	N/A
		4 E		70		**30**	0.56	**Standard**	**Standard**	**1.00**	N/A
DURRES-KAFASAN											
Durres-Kavaje	22	**4 E**	100			**44**	0.68	**Standard**	**Standard**	**1.00**	N/A
Kavaje - Rrogozhine	17	**4 E**	100			**44**	0.68	**Standard**	**Standard**	**1.00**	N/A
Rrogozhine - Peqin	8	**4 E**	100			**38**	0.71	**Standard**	**Standard**	**1.00**	N/A
Peqin-Elbasan	36	2	100			**38**	0.66	3.00	1.00	0.70	N/A
Elbasan - Librazhd	25	2		100		**51**	0.34	**Standard**	**Standard**	**1.00**	no
Librazhd - Kafasan	37	2			100	**51**	0.18	**Standard**	**Standard**	**1.00**	no

Table A-2 (cont'd)
Albania: 2003 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2003 Highway Characteristics									
			Terrain			% Heavy Vehicles	Tc	Lane Width (m)	Shoulder Width (m)	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
Kafasan - Pogradec	16	2		80		53	0.33	3.00	1.00	0.70	no
		2			20	53	0.17	3.00	1.00	0.70	no
RROGOZHINE-VLORE											
RROGOZHINE-VLORE											
Rrogozhine-Lushnje	20	4 E	50			49	0.66	Standard	Standard	1.00	
		4 E		50		49	0.46	Standard	Standard	1.00	
Lushnje-Fier	29	4 E	50			55	0.63	Standard	Standard	1.00	
		4 E		50		55	0.43	Standard	Standard	1.00	
Fier-Vlore	34	2	50			41	0.65	3.00	1.00	0.70	N/A
		2		50		41	0.41	3.00	1.00	0.70	no
TIRANA-ELBASAN											
Tirana-Elbasan	38	4 M	60			29	0.71	Standard	Standard	1.00	
		4 M		40		29	0.47	Standard	Standard	1.00	
Truck volume reduced by 12%											

M = Motorway
E = Expressway

Table A-3
Albania: 2010 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2010 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width (m)	Shoulder Width (m)	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
								Standard: 3.50-3.75 Acceptable: 3.25-3.50 Substandard: <3.25	Standard: 2 Acceptable: 1.0-2.0 Substandard: <1 0		yes no N / A
DURRES-VORE- TIRANA											
Durres-Vore	22.9	4 E	90			35	0.73	Standard	Standard	1.00	N/A
		4 E		10		35	0.53	Standard	Standard	1.00	N/A
Vore-Kashar	2.5	4 E	50			28	0.77	Standard	Standard	1.00	N/A
		4 E		50		28	0.57	Standard	Standard	1.00	N/A
Kashar-Tirana	6.5	4 (M)	100			28	0.77	Standard	Standard	1.00	N/A
DURRES-NDROG-TIRANA											
Dures-Ndrog	20	4 E		100		34	0.53	Standard	Standard	1.00	N/A
Ndrog-Tirana	21	4 E	30			27	0.78	Standard	Standard	1.00	N/A
		4 E		70		27	0.58	Standard	Standard	1.00	N/A
DURRES-KAFASAN											
Durres-Kavaje	22	4 E	100			40	0.70	Standard	Standard	1.00	N/A
Kavaje - Rrogozhine	17	4 E	100			40	0.70	Standard	Standard	1.00	N/A
Rrogozhine - Peqin	8	4 E	100			35	0.73	Standard	Standard	1.00	N/A
Peqin-Elbasan	36	2	100			35	0.68	**Standard**	**Standard**	**1.00**	N/A
Elbasan - Librazhd	25	2		100		47	0.38	Standard	Standard	1.00	no
Librazhd - Kafasan	37	2 (3)			100	**26**	0.30	Standard	Standard	1.00	no

Table A-3 (cont'd)
Albania: 2010 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2010 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width (m)	Shoulder Width (m)	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
Kafasan - Pogradec	16	2		80		48	0.37	3.00	1.00	0.70	
		2			20	48	0.19	Standard	Standard	1.00	
RROGOZHINE-VLORE											
Rrogozhine-Lushnje	20	4 E	50			45	0.68	Standard	Standard	1.00	N/A
		4 E		50		45	0.48	Standard	Standard	1.00	N/A
Lushnje-Fier	29	4 E	50			51	0.64	Standard	Standard	1.00	N/A
		4 E		50		51	0.44	Standard	Standard	1.00	N/A
Fier-Vlore	34	2	50			38	0.66	3.00	1.00	0.70	N/A
		2		50		38	0.42	3.00	1.00	0.70	
TIRANA-ELBASAN											
Tirana-Elbasan	38	4 M	60			27	0.73	Standard	Standard	1.00	N/A
		4 M		40		27	0.49	Standard	Standard	1.00	

The 2010 truck volume is obtained by reducing the 2003 truck volume by 8.5%

Librazhd - Kafasan truck volume reduced by half due to addition of climbing lanes

M = Motorway
E = Expressway

Table A-4
Albania: 2020 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2020 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width (m)	Shoulder Width (m)	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
								Standard: 3.50-3.75 Acceptable: 3.25-3.50 Substandard: <3.25	Standard: 2 Acceptable: 1.0-2.0 Substandard: <1 0		yes no N / A
DURRES-VORE- TIRANA											
Durres-Vore	22.9	4 E	90			35	0.73	Standard	Standard	1.00	N/A
		4 E		10		35	0.53	Standard	Standard	1.00	N/A
Vore-Kashar	2.5	4 E	50			28	0.77	Standard	Standard	1.00	N/A
		4 E		50		28	0.57	Standard	Standard	1.00	N/A
Kashar-Tirana	6.5	4 (M)	100			28	0.77	Standard	Standard	1.00	N/A
DURRES-NDROG-TIRANA											
Dures-Ndrog	20	4 E		100		34	0.53	Standard	Standard	1.00	N/A
Ndrog-Tirana	21	4 E	30			27	0.78	Standard	Standard	1.00	N/A
		4 E		70		27	0.58	Standard	Standard	1.00	N/A
DURRES-KAFASAN											
Durres-Kavaje	22	4 E	100			40	0.70	Standard	Standard	1.00	N/A
Kavaje - Rrogozhine	17	4 E	100			40	0.70	Standard	Standard	1.00	N/A
Rrogozhine - Peqin	8	4 E	100			35	0.73	Standard	Standard	1.00	N/A
Peqin-Elbasan	36	4 E	100			35	0.73	Standard	Standard	1.00	N/A
Elbasan - Librazhd	25	4 E		100		47	0.47	Standard	Standard	1.00	N/A
Librazhd - Kafasan	37	4 E			100	26	0.36	Standard	Standard	1.00	N/A

Table A-4 (cont'd)
Albania: 2020 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2020 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width (m)	Shoulder Width (m)	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
Kafasan - Pogradec	16	2		80		48	0.37	3.00	1.00	0.70	
		4 E			20	48	0.21	3.00	1.00	0.70	
RROGOZHINE-VLORE											
Rrogozhine-Lushnje	20	4 E	50			45	0.68	Standard	Standard	1.00	
		4 E		50		45	0.48	Standard	Standard	1.00	
Lushnje-Fier	29	4 E	50			51	0.64	Standard	Standard	1.00	
		4 E		50		51	0.44	Standard	Standard	1.00	
Fier-Vlore	34	4 (M)	50			38	0.71	Standard	Standard	1.00	
		4 (M)		50		38	0.51	Standard	Standard	1.00	
TIRANA-ELBASAN											
Tirana-Elbasan	38	4 (M)	60			27	0.73	Standard	Standard	1.00	
		4 (M)		40		27	0.49	Standard	Standard	1.00	

M = Motorway
E = Expressway

Table A-5
Macedonia: 1996 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	1996 Highway Characteristics: Terrain: Flat	Rolling	Mountainous	% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
for heavy vehicles											
Kafasan - Struga	12	2(3)			100	9	0.55	Standard	Acceptable	0.92	no
Struga - Podmolje	7.7	2	100			6	0.92	Standard	Acceptable	0.92	N/A
for light vehicles											
Pogradec - Ohrid	15	4 Expressway		100		5	0.87	Standard	Standard	1.00	N/A
	15	2		100		2	0.93	Acceptable	Acceptable	0.79	N/A
Ohrid - Podmolje	4.9	4	100			15	0.87	Standard	Standard	1.00	N/A
		Expressway		20		15	0.69	Standard	Standard	1.00	N/A
NORTHERN ROUTE											
Podmolje - Botun	14.8	**4(M)**			100	11	0.57	Standard	**Standard**	**1.00**	no
Botun - Kicevo	38.6	2(3)			100	11^	0.67	Standard	Acceptable	0.92	yes
Kicevo - Gostivar	45.8	2(3)		50		14^	0.78	Standard	Acceptable	0.92	yes
					50	14^	0.61	Standard	Acceptable	0.92	yes
Gostivar - Tetevo	21.2	4 (M)	100			19	0.84	Standard	Standard	1.00	N/A
Tetevo - Skopje	36	4 (M)	80			20	0.83	Standard	Standard	1.00	N/A
				20		20	0.63	Standard	Standard	1.00	no
Skopje Ring Road	16	**6(E)**	90			20	0.83	Standard	Standard	1.00	N/A
				10		20	0.63	Standard	Standard	1.00	N/A
Skopje - Miladinovci	25.6	2 to 6 4 (M)	100			20	0.83	Standard	Standard	1.00	N/A
Miladinovci - Kumanovo	16.5	4 (M)		100		20	0.63	Standard	Standard	1.00	yes
Kumanovo - Stracin	37.1	**4(M)**			100	20^	0.83	Standard	**Standard**	**1.00**	yes
Stracin - Kriva Palanka	26.6	2(3)		60		20^	0.71	Acceptable	Acceptable	0.79	yes

Table A-5 (cont'd)
Macedonia: 1996 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	1996 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat	Rolling	Mountainous						
					40	20^	0.53	10% Subst.. 90% Standard	Acceptable	0.90	yes
Kriva Palanka Ring Road	4.5	2	100			20	0.77	Acceptable	Acceptable	0.79	N/A
Kriva Palanka - Deve Bair	13	2 (3)			100	23^	0.48	Acceptable	Acceptable	0.79	yes
CENTRAL ROUTE											
Ohrid - Bitola	65.6	2 (3)		60		15^	0.77	Substandard	Acceptable	0.71	yes
					40	15^	0.60	Standard	Acceptable	0.92	yes
Bitola - Prilep	39.4	2	80			15	0.82	Standard	Acceptable	0.92	N/A
				20		15	0.63	Standard	Acceptable	0.92	no
Prilep - Titov Veles	84	2	50			15	0.82	Substandard	Substandard	0.63	N/A
				50		15	0.63	Substandard	Substandard	0.63	no
Titov Veles - Stip	36.4	2	NO DATA AVAILABLE					NO DATA AVAILABLE			NO DATA AVAILABLE
Stip - Krupishte	10.2	2									
Krupishte - Kocani	17.5	2									
Kocani - M. Kamenica	28.4	2									
M. Kamenica - Delcevo	24.7	2									
Delcevo - Bulgarian border	11.0	2									
Titov Veles - Miladinovci	40	4	80			20	0.83	Standard	Standard	1.00	N/A
		(M)		20		20	0.63	Standard	Standard	1.00	N/A

* Best judgement applied
**Estimated hourly volume in both directions
^ Truck ratio calculated on the basis of one half of the percentage of heavy vehicles shown, due to the existence of a climbing lane 2(3)

M = Motorway
E = Expressway

Table A-6
Macedonia: 2003 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2003 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous(%)						
for heavy vehicles											
Kafasan - Struga	12	2			100	9	0.55	Standard	Acceptable	0.92	no
Struga - Podmolje	7.7	2	100			6	0.92	Standard	Acceptable	0.92	N/A
for light vehicles											
Pogradec - Ohrid	15	**4 (E)**		100		5	0.87	Standard	Standard	1.00	
	15	2		100		2	0.93	Acceptable	Acceptable	0.79	
Ohrid - Podmolje	4.9	**4 (E)**	80			15	0.87	Standard	Standard	1.00	N/A
				20		15	0.69	Standard	Standard	1.00	N/A
NORTHERN ROUTE											
Podmolje - Botun	14.8	2			100	11	0.51	Standard	Acceptable	0.92	no
Botun - Kicevo	38.6	2(3)			100	11^	0.67	Standard	Acceptable	0.92	yes
Kicevo - Gostivar	45.8	2(3)		50		14^	0.78	Standard	Acceptable	0.92	yes
					50	14^	0.61	Standard	Acceptable	0.92	yes
Gostivar - Tetevo	21.2	4 (M)	100			19	0.84	Standard	Standard	1.00	N/A
Tetevo - Skopje	36	**4 (M)**	80			20	0.83	Standard	**Standard**	**1.00**	N/A
				20		20	0.63	Standard	**Standard**	**1.00**	no
Skopje Ring Road	16	4 to 6	90			20	0.83	Standard	Standard	1.00	N/A
		4 (E)		10		20	0.63	Standard	Standard	1.00	N/A
Skopje - Miladinovci	25.6	2 to 6 4 (M)	100			20	0.83	Standard	Standard	1.00	N/A
Miladinovci - Kumanovo	16.5	4 (M)		100		20	0.63	Standard	Standard	1.00	yes
Kumanovo - Stracin	37.1	2 (3)			100	20^	0.53	Standard	Acceptable	0.92	yes
Stracin - Kriva Palanka	26.6	2 (3)		60		20^	0.71	Acceptable	Acceptable	0.79	no

Table A-6 (cont'd)
Macedonia: 2003 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2003 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous(%)						
					40	20^	0.53	10 Subst andard 90 Standard	Acceptable	0.90	yes
Kriva Palanka Ring Road	4.5	2	100			20	0.77	Acceptable	Acceptable	0.79	N/A
Kriva Palanka - Deve Bair	13	2 (3)			100	23^	0.48	Acceptable	Acceptable	0.79	yes
CENTRAL ROUTE											
Ohrid - Bitola	65.6	2 (3)		60		15^	0.77	Substandard	Acceptable	0.71	yes
					40	15^	0.60	Standard	Acceptable	0.92	yes
Bitola - Prilep	39.4	2	80			15	0.82	Standard	Acceptable	0.92	N/A
				20		15	0.63	Standard	Acceptable	0.92	no
Prilep - Titov Veles	84	2	50			15	0.82	Substandard	Substandard	0.63	N/A
				50		15	0.63	Substandard	Substandard	0.63	no
Titov Veles - Stip	36.4	2	NO DATA AVAILABLE					NO DATA AVAILABLE			NO DATA AVAILABLE
Stip - Krupishte	10.2	2									
Krupishte - Kocani	17.5	2									
Kocani - M. Kamenica	28.4	2									
M. Kamenica - Delcevo	24.7	2									
Delcevo - Bulgarian border	11.0	2									
Titov Veles - Miladinovci	40	4	80			20	0.83	Standard	Standard	1.00	
		(M)		20		20	0.63	Standard	Standard	1.00	

^ Truck ratio calculated on the basis of one half of the percentage of heavy vehicles shown, due to the existence of a climbing lane 2(3)

M = Motorway
E = Expressway

Table A-7
Macedonia: 2010 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2010 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous(%)						
for heavy vehicles											
Kafasan - Struga	12	2(3)			100	9	0.55	Standard	Acceptable	0.92	no
Struga - Podmolje	7.7	2	100			6	0.92	Standard	Acceptable	0.92	N/A
for light vehicles											
Pogradec - Ohrid	15	4 E		100		5	0.87	Standard	Standard	1.00	N/A
	15	2		100		2	0.93	Acceptable	Acceptable	0.79	N/A
Ohrid - Podmolje	4.9	4 E	100			15	0.87	Standard	Standard	1.00	N/A
				20		15	0.69	Standard	Standard	1.00	N/A
NORTHERN ROUTE											
Podmolje - Botun	14.8	2			100	11	0.51	Standard	Acceptable	0.92	no
Botun - Kicevo	38.6	2(3)			100	11^	0.67	Standard	Acceptable	0.92	yes
Kicevo - Gostivar	45.8	2(3)		50		14^	0.78	Standard	Acceptable	0.92	yes
					50	14^	0.61	Standard	Acceptable	0.92	yes
Gostivar - Tetevo	21.2	4 (M)	100			19	0.84	Standard	Standard	1.00	N/A
Tetevo - Skopje	36	4 (M)	80			20	0.83	Standard	Standard	1.00	N/A
				20		20	0.63	Standard	Standard	1.00	no
Skopje Ring Road	16	4 to 6	90			20	0.83	Standard	Standard	1.00	N/A
		4 E		10		20	0.63	Standard	Standard	1.00	N/A
Skopje - Miladinovci	25.6	2 to 6 4 M	100			20	0.83	Standard	Standard	1.00	N/A
Miladinovci - Kumanovo	16.5	4 M		100		20	0.63	Standard	Standard	1.00	yes
Kumanovo - Stracin	37.1	2 (3)			100	20^	0.53	Standard	Acceptable	0.92	yes
Stracin - Kriva Palanka	26.6	2 (3)		60		20^	0.71	Acceptable	Acceptable	0.79	yes

Table A-7 (cont'd)
Macedonia: 2010 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2010 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous(%)						
					40	20^	0.53	10% Substandard 90% Standard	Acceptable	0.90	yes
Kriva Palanka Ring Road	4.5	2	100			20	0.77	Acceptable	Acceptable	0.79	N/A
Kriva Palanka - Deve Bair	13	2 (3)			100	23^	0.48	Acceptable	Acceptable	0.79	yes
CENTRAL ROUTE											
Ohrid - Bitola	65.6	2 (3)		60		15^	0.77	Substandard	Acceptable	0.71	yes
					40	15^	0.60	Standard	Acceptable	0.92	yes
Bitola - Prilep	39.4	2	80			15	0.82	Standard	Acceptable	0.92	N/A
				20		15	0.63	Standard	Acceptable	0.92	no
Prilep - Titov Veles	84	2	50			15	0.82	Substandard	Substandard	0.63	N/A
				50		15	0.63	Substandard	Substandard	0.63	no
Titov Veles - Stip	36.4	2	NO DATA AVAILABLE					NO DATA AVAILABLE			NO DATA AVAILABLE
Stip - Krupishte	10.2	2									
Krupishte - Kocani	17.5	2									
Kocani - M. Kamenica	28.4	2									
M. Kamenica - Delcevo	24.7	2									
Delcevo - Bulgarian border	11.0	2									
Titov Veles - Miladinovci	40	4	80			20	0.83	Standard	Standard	1.00	N/A
		(M)		20		20	0.63	Standard	Standard	1.00	N/A

^ Truck ratio calculated on the basis of one half of the percentage of heavy vehicles shown, due to the existence of a climbing lane 2(3)

M = Motorway
E = Expressway

Table A-8
Macedonia: 2020 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2020 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat	Rolling	Mountainous						
for heavy vehicles											
Kafasan - Struga	12	2(3)			100	9	0.55	Standard	Acceptable	0.92	no
Struga - Podmolje	7.7	2	100			6	0.92	Standard	Acceptable	0.92	N/A
for light vehicles											
Pogradec - Ohrid	15	4 E		100		5	0.87	Standard	Standard	1.00	N/A
	15	2		100		2	0.93	Acceptable	Acceptable	0.79	N/A
Ohrid - Podmolje	4.9	4 E	100			15	0.87	Standard	Standard	1.00	N/A
				20		15	0.69	Standard	Standard	1.00	N/A
NORTHERN ROUTE											
Podmolje - Botun	14.8	**4(M)**			100	11	0.57	Standard	**Standard**	**1.00**	no
Botun - Kicevo	38.6	2(3)			100	11^	0.67	Standard	Acceptable	0.92	yes
Kicevo - Gostivar	45.8	2(3)		50		14^	0.78	Standard	Acceptable	0.92	yes
					50	14^	0.61	Standard	Acceptable	0.92	yes
Gostivar - Tetevo	21.2	4 (M)	100			19	0.84	Standard	Standard	1.00	N/A
Tetevo - Skopje	36	4 (M)	80			20	0.83	Standard	Standard	1.00	N/A
				20		20	0.63	Standard	Standard	1.00	no
Skopje Ring Road	16	**6(E)**	90			20	0.83	Standard	Standard	1.00	N/A
				10		20	0.63	Standard	Standard	1.00	N/A
Skopje - Miladinovci	25.6	2 to 6 4 (M)	100			20	0.83	Standard	Standard	1.00	N/A
Miladinovci - Kumanovo	16.5	4 (M)		100		20	0.63	Standard	Standard	1.00	yes
Kumanovo - Stracin	37.1	**4(M)**			100	20^	0.83	Standard	**Standard**	**1.00**	yes
Stracin - Kriva Palanka	26.6	2(3)		60		20^	0.71	Acceptable	Acceptable	0.79	yes

Table A-8 (cont'd)
Macedonia: 2020 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2020 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat	Rolling	Mountainous						
					40	20^	0.53	10% Subst.. 90% Standard	Acceptable	0.90	yes
Kriva Palanka Ring Road	4.5	2	100			20	0.77	Acceptable	Acceptable	0.79	N/A
Kriva Palanka - Deve Bair	13	2 (3)			100	23^	0.48	Acceptable	Acceptable	0.79	yes
CENTRAL ROUTE											
Ohrid - Bitola	65.6	2 (3)		60		15^	0.77	Substandard	Acceptable	0.71	yes
					40	15^	0.60	Standard	Acceptable	0.92	yes
Bitola - Prilep	39.4	2	80			15	0.82	Standard	Acceptable	0.92	N/A
				20		15	0.63	Standard	Acceptable	0.92	no
Prilep - Titov Veles	84	2	50			15	0.82	Substandard	Substandard	0.63	N/A
				50		15	0.63	Substandard	Substandard	0.63	no
Titov Veles - Stip	36.4	2									
Stip - Krupishte	10.2	2									NO
Krupishte - Kocani	17.5	2	NO DATA		AVAILABLE			NO DATA	AVAILABLE		DATA
Kocani - M. Kamenica	28.4	2									AVAILABLE
M. Kamenica - Delcevo	24.7	2									
Delcevo - Bulgarian border	11.0	2									
Titov Veles - Miladinovci	40	4	80			20	0.83	Standard	Standard	1.00	N/A
		(M)		20		20	0.63	Standard	Standard	1.00	N/A

^ Truck ratio calculated on the basis of one half of the percentage of heavy vehicles shown, due to the existence of a climbing lane 2(3)

M = Motorway
E = Expressway

Table A-9
Bulgaria: 1996 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	1996 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat (%)	Rolling(%)	Mountainous(%)						
								Standard: 3.50-3.75 Acceptable: 3.25-3.50 Substandard: <3.25	Standard: 2 Acceptable: 1.0-2.0 Substandard: <1 None: 0		yes no N / A
MACEDONIAN BORDER - SOFIA											
Gyueshevo - Kyustendil	22	2	30			25	0.74	Acceptable	Substandard	0.70	no
				70		25	0.51	Acceptable	Substandard	0.70	no
Kyustendil - Pernik	59	2	30			27	0.73	Acceptable	Acceptable	0.79	no
				40		27	0.49	Acceptable	50% Acceptable 50%-0	0.70	no
					30	27	0.30	Acceptable	0	0.60	no
Pernik - Sofia	31	4 E		75		32	0.54	Standard	Acceptable	0.98	yes
					25	32	0.31	Standard	80%-0 20% Acceptable	0.87	yes
Sofia Ring Road		2(4) E	100					Acceptable / Standard	Standard	1.00	N/A
NORTHERN ROUTE											
Sofia - Botevgrad	64	4 M	20			24	0.80	Standard	Standard	1.00	yes
					80	24	0.38	Standard	Standard	1.00	yes
Botevgrad - Yablanitza	39	4 M		70		34	0.53	Standard	Standard	1.00	yes
					30	35	0.28	Standard	Standard	1.00	yes
Yablanitza - Ablanitza	49	2	50			40	0.65	Acceptable	Acceptable	0.79	no
				50		40	0.41	Acceptable	Acceptable	0.79	no
Ablanitza - V. Tarnovo	79	2	70			34	0.68	Acceptable	Acceptable	0.79	no
				30		34	0.44	Acceptable	Acceptable	0.79	no

Table A-9 (cont'd)
Bulgaria: 1996 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	1996 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
V. Tarnovo - Targovishte	99	2	30			33	0.69	Acceptable	Substandard	0.70	no
				50		33	0.45	Acceptable	60%-0 / 40% Substandard	0.64	no
					20	33	0.27	Acceptable	0	0.60	no
Targovishte - Shumen	43	2	100			41	0.65	Acceptable	Acceptable	0.79	N/A
Shumen - Kaspichan	18	2	100			35	0.68	Acceptable	Acceptable	0.79	N/A
Kaspichan - Varna	72	4 M	90			35	0.73	Standard	Standard	1.00	yes
					10	35	0.28	Standard	Standard	1.00	yes
CENTRAL ROUTE											
Sofia - Karnare	129	2	20			44	0.63	Substandard	Acceptable	0.71	yes
					80	44	0.21	Substandard	38% - 0 62% Acceptable	0.65	yes
Karnare - Karlovo	13	2		100		45	0.39	Acceptable	50%-0 50% Substandard	0.65	no
Karlovo - Kazanlak	47	2		90		32	0.45	Substandard	44% - 0 56% Substandard	0.59	no
					10	32	0.27	Substandard	0	0.54	no
Kazanlak - Sliven	62	2	100			42	0.64	40% Acceptable / 60% Standard	Acceptable	0.87	N/A
Sliven - Vetren	92	2	70			66	0.52	70% Acceptable / 30% Standard	Acceptable	0.83	no
				30		66	0.27	70% Acceptable / 30% Standard	Acceptable	0.83	no
Vetren - Burgas	20	4(M)	10			66	0.57	Standard	Standard	1.00	N/A
Macedonian border- Blagoevgrad	25	2									
Blagoevgrad - Dupnitza	30	2	80			No		Standard	25% - 0 75% - Standard	0.93	N/A
				20		Data		Standard	75% - 0 25% - Standard	0.78	no
Dupnitza - Kostenetz/Mirovo	77	2	40			Available		Standard	48%-Standard 33%-Acceptable / 19%-0	0.92	N/A

Table A-9 (cont'd)
Bulgaria: 1996 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	1996 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
					60			Standard	0	0.70	no
SOUTHERN ROUTE											
Sofia - Kostenetz/Mirovo	74	4(M)			100	28	0.34	Standard	Standard	1.00	yes
Kostenetz - Plovdiv	83	4(M)	30			31	0.75	Standard	Standard	1.00	yes
				70		31	0.55	Standard	Standard	1.00	yes
Plovdiv - Orizovo	28	4(M)	100			34	0.73	Standard	Standard	1.00	yes
Orizovo - Stara Zagora	62	2	70			45	0.63	Acceptable	Acceptable	0.79	no
				30		45	0.39	Acceptable	Acceptable	0.79	no
Stara Zagora - Sliven	71	2	100			43	0.64	Acceptable	Acceptable	0.79	N/A
extension to the Turkish border											
Popovitza - Haskovo	45	2	20			27	0.73	Acceptable	Acceptable	0.79	no
				80		27	0.49	Acceptable	Acceptable	0.79	no
Haskovo - Lubimetz	51	2	40			27	0.73	Acceptable	Acceptable	0.79	no
				60		27	0.49	Acceptable	Acceptable	0.79	no
Lubimetz - Svilengrad	19	4(M)	100			27	0.78	Standard	Standard	1.00	
Svilengrad - Kapitan Andreevo	8	2	100			27	0.73	Standard	Standard	1.00	

Port of Varna and Burgas Connection											
Varna - Priseltzi	9	4(M)			100	23	0.39	Standard	Standard	1.00	

Table A-9 (cont'd)
Bulgaria: 1996 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	1996 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
Priseltzi - Burgas	125	2	30			23	0.76	Acceptable	Acceptable	0.79	no
				38		23	0.53	Acceptable	Acceptable	0.79	no
					32	23	0.33	Acceptable	78% - 0 22% Acceptable	0.64	no

M = Motorway
E = Expressway

Table A-10
Bulgaria: 2003 Highway Characteristics

Highway segment	Length (km)	Lanes Number of	2003 Highway Characteristics: Terrain Flat (%)	Terrain Rolling (%)	Terrain Mountainous (%)	% Heavy vehicles	Tc	Lane width	Clearance	Wc	Climbing lanes
								Standard: 3.50-3.75 Acceptable: 3.25-3.50 Substandard: <3.25	Standard: 2 Acceptable: 1.0-2.0 Substandard: <1 None: 0		yes no N / A
MACEDONIAN BORDER - SOFIA											
Gyueshevo - Kyustendil	22	2	30			22	0.76	Acceptable	Substandard	0.70	no
				70		22	0.54	Acceptable	Substandard	0.70	no
Kyustendil - Pernik	59	2	30			24	0.75	Acceptable	Acceptable	0.79	no
				40		24	0.52	Acceptable	50% Acceptable 50%-0	0.70	no
					30	24	0.32	**Standard**	**Standard**	**1.00**	**yes**
Pernik - Sofia	31	**4-5**		75		29	0.57	Standard	**Standard**	**1.00**	yes
		E			25	**5*****	0.74	Standard	**Standard**	**1.00**	yes
Sofia Ring Road		2(4)	100					Acceptable / Standard	Standard	1.00	N/A
NORTHERN ROUTE											
Sofia - Botevgrad	64	**4-5**	20			21	0.82	Standard	Standard	1.00	N?A
		M			80	**5*****	0.74	Standard	Standard	1.00	yes
Botevgrad - Yablanitza	39	4		70		31	0.55	Standard	Standard	1.00	yes
		M			30	32	0.31	Standard	Standard	1.00	yes
Yablanitza - Ablanitza	49	2	50			37	0.67	Acceptable	Acceptable	0.79	no
				50		37	0.43	Acceptable	Acceptable	0.79	no
Ablanitza - V. Tarnovo	79	2	70			31	0.70	Acceptable	Acceptable	0.79	no
				30		31	0.46	Acceptable	Acceptable	0.79	no
V. Tarnovo - Targovishte	99	2	30			30	0.70	Acceptable	Substandard	0.70	no

Table A-10 (cont'd)
Bulgaria: 2003 Highway Characteristics

Highway segment	Length (km)	Lanes Number of	2003 Highway Characteristics								
			Terrain			% Heavy vehicles	Tc	Lane width	Clearance	Wc	Climbing lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
				50		30	0.46	Acceptable	60%-0 40% Substandard	0.64	no
					20	30	0.28	Acceptable	**Acceptable**	**0.79**	**yes**
Targovishte - Shumen	43	2	100			38	0.66	Acceptable	**Standard**	**0.86**	N/A
Shumen - Kaspichan	18	2	100			32	0.69	Acceptable	Acceptable	0.79	N/A
Kaspichan - Varna	72	4 (M)	90			32	0.74	Standard	Standard	1.00	N/A
					10	32	0.31	Standard	Standard	1.00	yes
CENTRAL ROUTE											
Sofia - Karnare	129	2 (3)	20			41	0.65	Substandard	Acceptable	0.71	yes
					80	**20******	0.36	**Standard**	**Standard**	**1.00**	yes
Karnare - Karlovo	13	**4 (E)**		100		42	0.49	**Standard**	**Standard**	**1.00**	yes
Karlovo - Kazanlak	47	**4 (E)**		90		29	0.57	**Standard**	**Standard**	**1.00**	yes
		6 (E)			10	29	0.34	**Standard**	**Standard**	**1.00**	yes
Kazanlak - Sliven	62	2	100			39	0.66	40% Acceptable / 60% Standard	Acceptable	0.87	N/A
Sliven - Vetren	92	2	70			63	0.54	70% Acceptable / 30% Standard	Acceptable	0.83	no
		4 (E)		30		63	0.39	**Standard**	**Standard**	**1.00**	yes
Vetren - Burgas	20	4 (M)	100			66	0.57	Standard	Standard	1.00	N/A
Macedonian border- Blagoevgrad	25	2				No Data Available					
Blagoevgrad - Dupnitza	30	2	80					Standard			N/A
				20				Standard			
Dupnitza - Kostenetz/Mirovo	77	2	40					Standard			N/A
					60			Standard			

Table A-10 (cont'd)
Bulgaria: 2003 Highway Characteristics

Highway segment	Length (km)	Lanes Number of	2003 Highway Characteristics								
			Terrain			% Heavy vehicles	Tc	Lane width	Clearance	Wc	Climbing lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
SOUTHERN ROUTE											
Sofia - Kostenetz/Mirovo	74	**4-5 (M)**			100	5***	0.74	Standard	Standard	1.00	yes
Kostenetz - Plovdiv	83	4 (M)	30			28	0.77	Standard	Standard	1.00	N/A
				70		28	0.57	Standard	Standard	1.00	yes
Plovdiv - Orizovo	28	4 (M)	100			31	0.75	Standard	Standard	1.00	N/A
Orizovo - Stara Zagora	62	2	70			42	0.64	Acceptable	Acceptable	0.79	no
				30		42	0.40	Acceptable	Acceptable	0.79	no
Stara Zagora - Sliven	71	2	100			40	0.70	Acceptable	Acceptable	0.79	N/A
extension to the Turkish border											
Popovitza - Haskovo	45	2	20			24	0.75	Acceptable	Acceptable	0.79	no
				80		24	0.52	Acceptable	Acceptable	0.79	no
Haskovo - Lubimetz	51	**4(M)**	40			24	0.80	**Standard**	**Standard**	**1.00**	N/A
				60		24	0.60	**Standard**	**Standard**	**1.00**	yes
Lubimetz - Svilengrad	19	4(M)	100			27	0.78	Standard	Standard	1.00	
Svilengrad - Kapitan Andreevo	8	2	100			27	0.73	Standard	Standard	1.00	
Port of Varna and Burgas Connection											
Varna - Priseltzi	9	4(M)			100	23	0.39	Standard	Standard	1.00	
Priseltzi - Burgas	125	**4 (M)**	30			20	0.83	**Standard**	**Standard**	**1.00**	N/A
				38		20	0.63	**Standard**	**Standard**	**1.00**	yes
					32	20	0.42	**Standard**	**Standard**	**1.00**	yes

*** Percent of heavy vehicles (on 4-lane expressway) reduced to 5% due to the addition of a climbing lane
**** Percent of heavy vehicles (on 2-lane highway) reduced to 20% due to the addition of a climbing lane

M = Motorway
E = Expressway

Table A-11
Bulgaria: 2010 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2010 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
								Standard: 3.50-3.75 Acceptable: 3.25-3.50 Substandard<3.25	Standard: 2 Acceptable: 1.0-2.0 Substandard: <1 0		yes no N / A
MACEDONIAN BORDER - SOFIA											
Gyueshevo - Kyustendil	22	2	30			19	0.79	Acceptable	Substandard	0.70	no
				70		19	0.57	Acceptable	Substandard	0.70	no
Kyustendil - Pernik	59	2	30			21	0.77	Acceptable	Acceptable	0.79	no
				40		21	0.55	Acceptable	50% Acceptable 50%-0	0.70	no
					30	21	0.35	Acceptable	Acceptable	0.79	yes
Pernik - Sofia	31	4-5		75		26	0.58	Standard	Standard	1.00	yes
		E			25	5***	0.74	Standard	Standard	1.00	yes
Sofia Ring Road		2(4)	100					Acceptable / Standard	Standard	1.00	N/A
NORTHERN ROUTE											
Sofia - Botevgrad	64	4-5	20			18	0.85	Standard	Standard	1.00	N/A
		M			80	5***	0.74	Standard	Standard	1.00	yes
Botevgrad - Yablanitza	39	4		70		28	0.57	Standard	Standard	1.00	yes
		M			30	29	0.34	Standard	Standard	1.00	yes
Yablanitza - Ablanitza	49	2	50			34	0.68	Acceptable	Acceptable	0.79	no
				50		34	0.44	Acceptable	Acceptable	0.79	no
Ablanitza - V. Tarnovo	79	2	70			28	0.72	Acceptable	Acceptable	0.79	no
				30		28	0.48	Acceptable	Acceptable	0.79	no
V. Tarnovo - Targovishte	99	2	30			27	0.73	Acceptable	Substandard	0.70	no

Table A-11 (cont'd)
Bulgaria: 2010 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2010 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
				50		27	0.49	Acceptable	60%-0 40% Subst	0.64	no
					20	27	0.30	Acceptable	Acceptable	0.79	yes
Targovishte - Shumen	43	2	100			35	0.68	Acceptable	Standard	0.86	N/A
Shumen - Kaspichan	18	2	100			29	0.71	Acceptable	Acceptable	0.79	N/A
Kaspichan - Varna	72	4 (M)	90			29	0.77	Standard	Standard	1.00	yes
					10	29	0.34	Standard	Standard	1.00	yes
CENTRAL ROUTE											
Sofia - Karnare	129	2-3	20			38	0.66	Substandard	Acceptable	0.71	yes
					80	20****	0.36	Standard	Standard	1.00	yes
Karnare - Karlovo	13	4 (M)		100		39	0.51	Standard	Standard	1.00	yes
Karlovo - Kazanlak	47	4 (E)		90		26	0.58	Standard	Standard	1.00	yes
		6 (E)			10	26	0.36	Standard	Standard	1.00	yes
Kazanlak - Sliven	62	2	100			36	0.67	40% Acceptable / 60% Standard	Acceptable	0.87	N/A
Sliven - Vetren	92	2	70			60	0.55	70% Acceptable / 30% Standard	Acceptable	0.83	no
		4 (E)		30		60	0.40	Standard	Standard	1.00	yes
Vetren - Burgas	20	4(M)	100			66	0.57	Standard	Standard	1.00	N/A
Macedonian border- Blagoevgrad	25	2									
Blagoevgrad - Dupnitza	30	2	80					Standard			N/A
				20				Standard			
Dupnitza - Kostenetz/Mirovo	77	2	40					Standard			N/A
					60			Standard			

Table A-11 (cont'd)
Bulgaria: 2010 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2010 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
SOUTHERN ROUTE											
Sofia - Kostenetz/Mirovo	74	4-5 (M)			100	5***	0.74	Standard	Standard	1.00	yes
Kostenetz - Plovdiv	83	4(M)	30			25	0.79	Standard	Standard	1.00	N/A
				70		25	0.59	Standard	Standard	1.00	yes
Plovdiv - Orizovo	28	4(M)	100			28	0.77	Standard	Standard	1.00	N/A
Orizovo - Stara Zagora	62	2	70			39	0.66	Acceptable	Acceptable	0.79	no
				30		39	0.42	Acceptable	Acceptable	0.79	no
Stara Zagora - Sliven	71	2	100			37	0.67	**Standard**	**Standard**	**1.00**	N/A
extension to the Turkish border											
Popovitza - Haskovo	45	2	20			21	0.77	Acceptable	Acceptable	0.79	no
				80		21	0.55	**Standard**	**Standard**	**1.00**	no
Haskovo - Lubimetz	51	4(M)	40			21	0.82	Standard	Standard	1.00	N/A
				60		21	0.62	Standard	Standard	1.00	yes
Lubimetz - Svilengrad	19	4(M)	100			27	0.78	Standard	Standard	1.00	N/A
Svilengrad - Kapitan Andreevo	8	2	100			27	0.73	Standard	Standard	1.00	
Port of Varna and Burgas Connection											
Varna - Priseltzi	9	4(M)			100	23	0.39	Standard	Standard	1.00	yes
Priseltzi - Burgas	125	4(M)	30			20	0.83	Standard	Standard	1.00	N/A
				38		20	0.63	Standard	Standard	1.00	no
					32	20	0.42	Standard	Standard	1.00	no

*** Percent of heavy vehicles (on 4-lane expressway) reduced to 5% due to the addition of a climbing lane

**** Percent of heavy vehicles (on 2-lane highway) reduced to 20% due to the addition of a climbing lane

M = Motorway
E = Expressway

Table A-12
Bulgaria: 2020 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2020 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
								Standard: 3.50-3.75 Acceptable: 3.25-3.50 Substandard: <3.25	Standard: 2 Acceptable: 1.0-2.0 Substandard: <1 0		yes no N / A
MACEDONIAN BORDER - SOFIA											
Gyueshevo - Kyustendil	22	2	30			19	0.79	Acceptable	Substandard	0.70	no
				70		19	0.57	Acceptable	Substandard	0.70	no
Kyustendil - Pernik	59	**4**	30			21	0.82	**Standard**	**Standard**	**1.00**	N/A
		M		40		21	0.62	**Standard**	**Standard**	**1.00**	yes
					30	21	0.41	**Standard**	**Standard**	**1.00**	yes
Pernik - Sofia	31	**6**		75		26	0.58	Standard	Standard	1.00	yes
		E			25	5***	0.74	Standard	Standard	1.00	yes
Sofia Ring Road		2(4)	100					Acceptable / Standard	Standard	1.00	N/A
NORTHERN ROUTE											
Sofia - Botevgrad	64	4(5)	20			18	0.85	Standard	Standard	1.00	N/A
		M			80	5***	0.74	Standard	Standard	1.00	yes
Botevgrad - Yablanitza	39	4(5)		70		28	0.57	Standard	Standard	1.00	yes
		M			30	29	0.34	Standard	Standard	1.00	yes
Yablanitza - Ablanitza	49	2	50			34	0.68	Acceptable	Acceptable	0.79	no
				50		34	0.44	Acceptable	Acceptable	0.79	no
Ablanitza - V. Tarnovo	79	**4**	70			28	0.77	**Standard**	**Standard**	**1.00**	N/A
		M		30		28	0.57	**Standard**	**Standard**	**1.00**	yes
V. Tarnovo - Targovishte	99	**4**	30			27	0.78	**Standard**	**Standard**	**1.00**	N/A
		M		50		27	0.58	**Standard**	**Standard**	**1.00**	yes
					20	27	0.35	**Standard**	**Standard**	**1.00**	yes
Targovishte - Shumen	43	**4 M**	100			35	0.73	**Standard**	**Standard**	**1.00**	N/A
Shumen - Kaspichan	18	2	100			29	0.71	Acceptable	Acceptable	0.79	N/A

Table A-12 (cont'd)
Bulgaria: 2020 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2020 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
Kaspichan - Varna	72	4	90			29	0.77	Standard	Standard	1.00	N/A
		M			10	29	0.34	Standard	Standard	1.00	yes
CENTRAL ROUTE											
Sofia - Karnare	129	2-3	20			38	0.66	Substandard	Acceptable	0.71	N/A
					80	20****	0.36	Standard	Standard	1.00	yes
Karnare - Karlovo	13	4 E		100		39	0.51	Standard	Standard	1.00	yes
Karlovo - Kazanlak	47	6		90		26	0.58	Standard	Standard	1.00	yes
		E			10	26	0.36	Standard	Standard	1.00	yes
Kazanlak - Sliven	62	2	100			36	0.67	40% Acceptable / 60% Standard	Acceptable	0.87	N/A
Sliven - Vetren	92	2	70			60	0.55	70% Acceptable / 30% Standard	Acceptable	0.83	no
		4 E		30		60	0.40	Standard	Standard	1.00	yes
Vetren - Burgas	20	4 M	100			66	0.57	Standard	Standard	1.00	N/A
Macedonian border- Blagoevgrad	25	2									
Blagoevgrad - Dupnitza	30	2	80					Standard			N/A
				20				Standard			
Dupnitza - Kostenetz/Mirovo	77	2	40					Standard			N/A
					60			Standard			
SOUTHERN ROUTE											
Sofia - Kostenetz/Mirovo	74	4-5 M			100	5***	0.74	Standard	Standard	1.00	yes
Kostenetz - Plovdiv	83	4	30			25	0.79	Standard	Standard	1.00	N/A
		M		70		25	0.59	Standard	Standard	1.00	yes

Table A-12 (cont'd)
Bulgaria: 2020 Highway Characteristics

Highway Segment	Length (km)	Number of Lanes	2020 Highway Characteristics								
			Terrain			% Heavy Vehicles	Tc	Lane Width	Clearance	Wc	Climbing Lanes
			Flat (%)	Rolling (%)	Mountainous (%)						
Plovdiv - Orizovo	28	4(M)	100			28	0.77	Standard	Standard	1.00	N/A
Orizovo - Stara Zagora	62	4(M)	70			39	0.71	Standard	Standard	1.00	N/A
				30		39	0.51	Standard	Standard	1.00	yes
Stara Zagora - Sliven	71	4(M)	100			37	0.72	Standard	Standard	1.00	N/A
extension to the Turkish border											
Popovitza - Haskovo	45	4(M)	20			21	0.82	Standard	Standard	1.00	N/S
				80		21	0.62	Standard	Standard	1.00	yes
Haskovo - Lubimetz	51	4(M)	40			21	0.82	Standard	Standard	1.00	N/A
				60		21	0.62	Standard	Standard	1.00	yes
Lubimetz - Svilengrad	19	4(M)	100			27	0.78	Standard	Standard	1.00	N/A
Svilengrad - Kapitan Andreevo	8	4(M)	100			27	0.78	Standard	Standard	1.00	N/A
Port of Varna and Burgas Connection											
Varna - Priseltzi	9	4(M)			100	23	0.39	Standard	Standard	1.00	yes
Priseltzi - Burgas	125	4(M)	30			20	0.83	Standard	Standard	1.00	N/A
				38		20	0.63	Standard	Standard	1.00	yes
					32	20	0.42	Standard	Standard	1.00	yes

*** Percent of heavy vehicles (on 4-lane expressway) reduced to 5% due to the addition of a climbing lane
**** Percent of heavy vehicles (on 2-lane highway) reduced to 20% due to the addition of a climbing lane

M = Motorway
E = Expressway