Tacis

TRACECA Programme:
Regional traffic database and forecasting model

Draft Final Report

September 1997

European Union
Tacis Programme

TRACECA: Regional Traffic Database and Forecasting Model
(Project No. WS.93.05/05.01/B008)

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1. INTRODUCTION AND PROJECT SYNOPSIS

1.1 This document represents the Draft Final Report for the Tacis project TRACECA Traffic Forecasting Model, Project No WW93.05/05.01/B008. The 'Project Synopsis' is shown in Table 1.1

1.2 This report describes the key components resulting from the project and specifically the database and modelling tools, the result of initial applications of these tools and case study tests and recommendations for the future mainstream, operation and development of these tools beyond the project.

1.3 This Draft Final Report is structured in five further sections.

1.4 Section 2 provides a review of project implementation and progress in the final reporting period. Sections 3 and 4 outline the database and traffic forecasting tools developed in the course of the study. Section 5 summarises the results of the case study analysis undertaken using these tools. Section 6 provides recommendations for the future maintenance and operation of the database and model. Further technical information is provided in a series of Annexes.

1.5 Table 1.1 show the 'Project Synopsis'.

Table 1.1 - Project Synopsis

Project Title	:	TRACECA Regional Traffic Database and Forecasting Model
Project Number	:	WW 93.05/05.01/B008
Country	:	All 8 TRACECA States

Wider Objectives: to assist in the prioritising of transport investment options in the region through the introduction of a quantitative planning tool which can simulate the impacts of investment.

Specific Project Objectives:

- introduction and establishment of computer-based planning tools in the eight TRACECA states including:
  - a common regional database of transport and trade flows and transport infrastructure and transport costs;
  - a multi-modal model for analysing scenarios and developing forecasts;
- application of the tools to:
  - create comprehensive multi-modal synoptics of existing and forecast future flows;
  - highlight bottlenecks of all types;
  - identify preferred locations for multi-modal transfer centres;
  - identify and catalogue specific road/rail/maritime and multimodal projects for detailed feasibility studies;
- transfer of know-how in transport database design and modelling.

Outputs/Activities:

- an Inception Mission and Inception Report (month 3);
- Phase 1A involving data acquisition and storage followed by Progress Report I (month 9);
- Phase 1B consisting of the development of scenarios and database, followed by Progress Report II (month 13);
- Phase 2 including synoptic forecasts and development of investment options, followed by Progress Report III (month 15);
- Phase 3 which is the handover of the computer equipment and software and support missions, followed by a draft Final Report (month 18) and Final Report (month 21).

Inputs:

- technical assistance;
- computers and other office equipment;
- database, forecasting and office-oriented computer software.

Project Starting Date	:	Mid-January 1996
Project Duration	:	21 Months

2. PROJECT IMPLEMENTATION

2.1 This Chapter describes the key stages of work and programme for the project, the method of working and in particular the involvement of local partners and the reports prepared and disseminated in the course of the project.

METHOD OF WORKING

2.2 The project team represented a combination of EU experts and local experts employed through local partner organisations nominated by a recipient organisation in each of the eight TRACECA countries.

2.3 Local partner inputs focused initially on data collection and processing under the guidance of a EU Expert Field Manager. As the project progressed local partners became more involved in preparing inputs to the model development including network coding and economic forecasting. Initial calibration of the model and construction of the database was undertaken primarily by EU experts prior to training local partner organisations in the application of these tools in the TRACECA Region.

2.4 A key objective has been to provide the local partners with both the database and modelling tools and technical know-how to sustain these beyond the end of the project. The following paragraphs describe the local partner involvement in the project. Chapter 6 presents our recommendation for the on-going operation and maintenance of the database and model.

2.5 Throughout the project a distinction has been maintained in each country between the recipient organisation and the local partner.

2.6 The recipient organisation (or 'local operator') in each country is the official beneficiary of the TRACECA project and comprises a Government Ministry or Cabinet. This beneficiary is effectively the owner of the database and modelling software and hardware provided in each of the eight TRACECA countries as a project deliverable. The recipient organisation in each country is as follows:

Armenia	-	Ministry of Transport
Azerbaijan	-	Ministry of Economy
Georgia	-	Ministry of Transport
Kazakhstan	-	Ministry of Transport
Kygyzstan	-	Ministry of Transport
Tajikistan	-	Ministry of Economy
Turkmenistan	-	Cabinet of Ministers
Uzbekistan	-	Cabinet of Ministers

2.7 As has been the case during the project the recipient organisation is responsible for appointing an appropriate technical organisation to undertake the database and model operations as required both by the recipient organisations and external (third party) users of data and forecasts (including international funding agencies).

2.8 As has been indicated in earlier progress reports, the nomination of local technical partner organisations has varied from country to country. At the outset, we sought to establish agreement with local partners nominated by the recipient Governments. However, in practice, certain recipients preferred not to make a firm commitment to technical partners but instead to maintain a more flexible approach by participating in the technical work themselves and/or by involving technical organisations in specific aspects of the work only. In addition, the assignment of local partners to the project in one or two countries has been changed at a Ministerial level.

2.9 The selection of local partners was finalised in the course of the TRACECA project. The position in each country is summarised in Annex A.

WORK STAGES AND PROGRAMME

2.10 The project commenced in January 1996 with a contract end date (to coincide with the production of the draft Final Report) of end June 1997. A three month extension to the project duration was agreed in April 1997 with a revised contract end date of 20 September 1997.

2.11 As summarised in the projects synopsis the work was structured as three phases following an Inception phase with the first phase sub-divided into two sub-phases. The programme of work as planned at the Inception stage is shown in Annex B. In practice, a number of key tasks extended into subsequent phases reflecting both the delays experienced in collating and processing data sets and the interactions between task and phases concerned with the development and training, the use of the database and modelling tasks. Figure 2.1 shows the programme of work as actually implemented. Figures 2.2 and 2.3 present a project completion report and output performance summary respectively.

2.12 Phase 1A necessarily extended through to the final month of the project in order to include 1996 as well as 1995 trade data in the database. In accordance with the long-term objectives and sustainability of the project, data collection has been treated as a continuous exercise.

2.13 Phase 1B was also extended reflecting the continuous nature of data collection and its input to the database and model development. Calibration and validation of the model in particular, required careful treatment of apparent inconsistencies in data sets.

2.14 Phase 2 work on scenario definitions, development of economic forecasts and case study definitions was undertaken over months 13 to 18 reflecting the extended duration of the earlier Phase 1 work. Hence, a 'slippage' of approximately three months was identified at this stage and a contract extension agreed with Tacis. The remainder of the Phase 2 work on testing the forecasting model runs as inputs to case study tests was undertaken in parallel with, and as an integral part of, the Phase 3 work.

2.15 The Phase 3 work was also implemented over an extended period with the database and model manuals preparation starting as originally scheduled but with the handover missions and case study tests benefiting from the project programme extension period. Handover and support missions were integrated with training in the application of the model for case study analyses and use of the database for storing updated 1996 trade data. The initial handover missions started in month 18 and continued through to month 21.

2.16 Seminars and workshops were held as follows:

June 16-10	Ashgabad for all Central Asian partners;
June 23-27	Tblisi for all Caucasian partners;
July 16-18	Tashkent for Uzbekistan partner;
July 21-25	Bishkek for all Central Asian partners;
July 28	Baku for Azerbaijan partner;

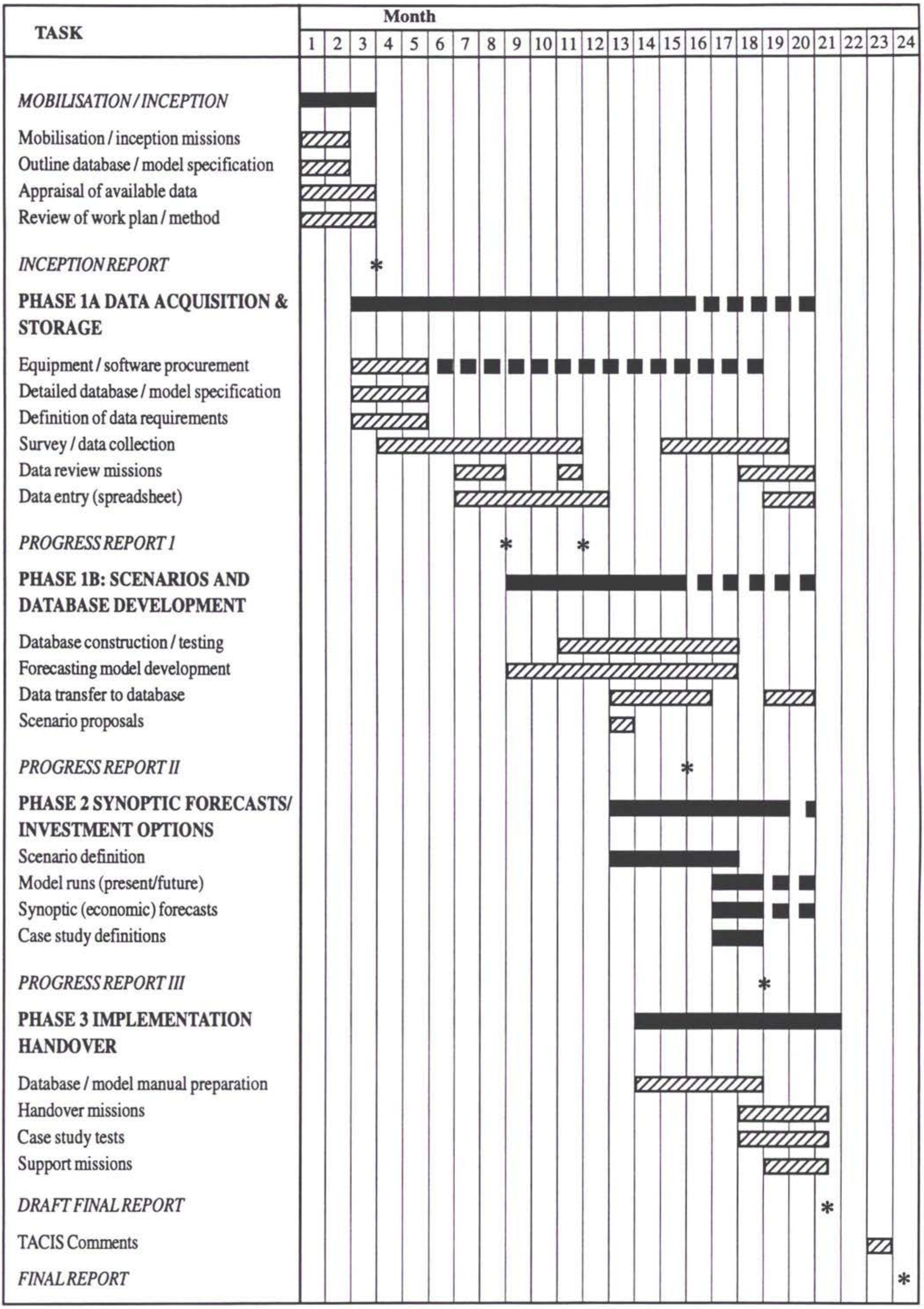

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FIGURE 2.1: Project Programme as Implemented

Figure 2.2 - Project Completion Report

Project title : TRACECA: Regional Traffic Database and Forecasting Model	Project nr : WW 93.05/05.01/B008	Country : All 8 TRACECA States	Page :
Reporting period : Up to August 1997	Prepared on :	EC Consultant : WS Atkins International Limited Woodcote Grove, Ashley Road, Epsom, Surrey, KT18 5BW Tel: +44 1372 726140 Fax: +44 1372 740055	

REPORTING PERIOD	MAIN ACTIVITIES UNDERTAKEN	INPUTS UTILISED			
		EC CONSULTANT MAN MONTHS	LOCAL PARTNERS MAN MONTHS	MATERIALS AND EQUIPMENT	OTHER
1/96 - 4/96 **Mobilisation Inception**	Mobilisation and Inception	5½	2½		
3/96 - 8/97 **Data Acquisition and Storage (Phase 1A)**	Database and Model Specifications Data Collection Data Entry	2½ 4 3	 21 17		
10/96 - 8/97 **Scenarios and Database Development (Phase 1B)**	Database Construction Model Construction	1½ 2½	13½ 12		
1/97 - 7/97 **Synoptic Forecasts/Investment Options (Phase 2)**	Scenario Definitions Economic Forecasts Case Study Definitions	1 2½ 1½	4 10 5		
2/97 - 9/97 **Implementation/Handover (Phase 3)**	Database/Model Manual Preparation Case Study Tests Handover and Support Missions	1 2 2½	1 3 8		 TRACECA Database Manual (x 8) TRACECA Forcasting Model & Manual (x 8)
9/97 Final Report	Draft	½	1		
	TOTAL	30	98		

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Figure 2.3 - Output Performance Summary

Project title : TRACECA: Regional Traffic Database and Forecasting Model	Project nr : WW 93.05/05.01/B008	Country : All 8 TRACECA States	Page :
Prepared on : September 1997		EC Consultant : WS Atkins International Limited Woodcote Grove, Ashley Road, Epsom, Surrey, KT18 5BW Tel: +44 1372 726140 Fax: +44 1372 740055	

Output results	Deviation original plan (+ or - months for submission of deliverable)	Reason for deviation	Comment on constraints & assumptions
Inception Report	+1 month	• Lack of preparedness amongst local official organisations • Access to available data	• Flexibility required in achieving input from local partners and specialists.
Progress Report I	+3 months (for revised report)	• Data collation and data reliability difficulties	• Specific data sets were required - necessitating approval procedures at ministerial levels and investment of more than one local institute in some cases.
Progress Report II	+2 months	• Model calibration complications	• Determing appropriate tariff levels and model parameters constrained by availability of reliable data sources and transitionary nature of economics.
Progress Report III	+3 months	• Achieving agreement on economic forecasting and scenarios definitions	• Considerable uncertainty regarding future scenarios. Hence, need to keep assumptions transparent and to consider a range of forecasts.
Database and Manual	+3 months		
Model and Manual	+3 months		
Draft Final Report	+3 months		

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July 21 - August 1	Tblisi for all Caucasian partners;
September 2 - 5	Almaty for all Central Asian partners;
September 8 - 9	Baku for Azerbiajan partner;
September 17 - 20	Yerevan for Armenian and Georgian partners.

PROJECT PROGRESS IN FINAL REPORTING PERIOD

2.17 Since submission of the Progress Report II (June 1997) the main focus of the work has been on the application of the model for case study testing and the handover/training in the use of the database and model. Preparation of this draft final report has also been undertaken in this period. Annex C contains the Project Performance Tables for this period.

REPORTING

2.18 In the course of the study four progress reports have been produced at the end of each of the key stages of the study:

- Inception Report (April 1996);
- Progress Report I (September 1996) (Revised December 1996);
- Progress Report II (March 1997);
- Progress Report III (June 1997).

2.19 In addition three key technical reports have been produced:

- Database Manual (May 1997);
- Traffic Model Development Report (August 1997) (earlier draft issued as a seminar paper in June 1997);
- SATURN Manual (Russian Translation) (May 1997).

2.20 This Draft Final Report will be followed by a Final Report following receipt of comments from Tacis and recipients.

3. TRACECA DATABASE

3.1 A TRACECA database has been constructed and a Database Manual (May 1997) prepared. The Manual describes the scope of the data held in the database together with the structure and use of the database for storing and reviewing data. The database is stored in MS ACCESS software.

STRUCTURE OF THE DATABASE

3.2 The data sets are accessible in tables within MS ACCESS such that relationships are created between these tables by establishing links to common fields (which contain common data) within other tables. This structure is termed a 'schema' and Figure 3.1 illustrates the database schema used for the TRACECA database. The database enables a wide variety of information to be retained in a form that makes use of the linkage between databases. Annex D summarises the database tables.

3.3 The structure of the database is founded on three types of spatial unit consistent with the transport model definition:

- zones : representing the spatial units for representing freight movements between different parts of the TRACECA region;
- nodes:representing road junctions, rail termini, rail junctions and ports and points at which significant changes in the standard of the transport supply varies;
- links: representing the roads, rail and sea strategic transport route network as a series of discrete sections of the transport infrastructure or service lines connecting nodes.

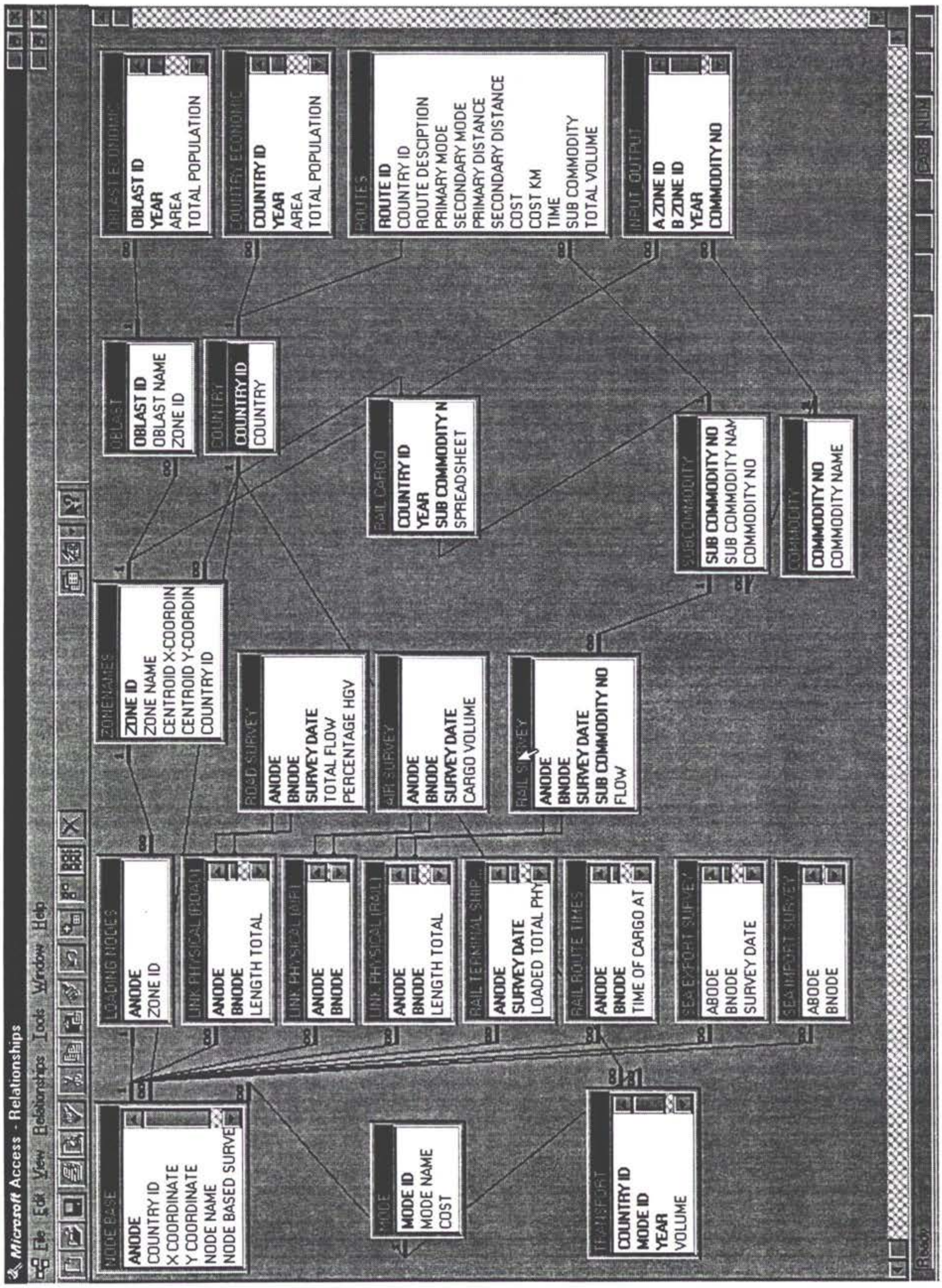

Figure 3.1 - Database Schema

ZONES

3.4 The zoning system comprises 33 zones internal to the TRACECA region and 23 external zones. Figure 3.2 shows the zoning system.

3.5 Internal zones comprise whole countries or groups of administrative areas (Oblasts) within a country. External zones represent geographic regions for the rest of the world taking account of trading routes.

3.6 Annex E provides a complete list of zones.

NODES AND LINKS

3.7 The road, rail and maritime networks in the TRACECA region and represented as a series of nodes connected by links representing the main modal routes.

3.8 These nodes and links provide the means to store attributes describing the transport supply and the volume of traffic using different parts of the network.

3.9 Each node has a unique reference number and map co-ordinates in order to reference its precise geographical location. Links are defined as a connection between two nodes (a node, b node). Nodes stored in a file within both the database and within the traffic forecast model software SATURN. Plots of the road and rail and maritime networks produced using SATURN graphics are presented in Annex F.

COMMODITIES

3.10 For certain data sets trade and transport flows are given by commodity groups. The import/export trade data is provided for 21 categories of commodity. Rail flows are sub-divided into 9 different categories. Annex G contains a table of the main commodity groups used in the zone based import and export data and shows their relationship to the sub-commodities which are used by the rail authorities.

MODES

3.11 In certain tables transport modes are given classification numbers. A list of these is also provided in Annex E.

FIGURE 3.2
Zone Plan

SCOPE OF DATA

3.12 The data contained within the database comprises six broad types of information. Figure 3.3 summarises these data sets and the Table numbers used in the initial collation and processing of data.

3.13 In addition to these six groups of data, further information has been obtained from a variety of sources on transport tariffs. This information has been used as the basis for calculating costs for input to the transport model. Annex H provides an explanation of the data sources and cost calculations.

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	TABLES I **Socio-economics & Import/Export Data**	*TABLES II* **Road Network Data**	*TABLES III* **Rail Network Data**	*TABLES IV* **Sea Ports**	*TABLES V* **Airports**	*TABLES VI* **Routing Data**
ZONE ** by country only*	• GDP* • Area • Population by administrative area *(Table I.1)* • Tons transported by mode & commodity* *(Table I.2)* • Tons imported by mode & commodity *(Table I.3)* • Tons exported by mode & commodity *(Table I.4)* • Origin destination matrices by commodity *(Table I.5)*		• Tons transported between internal (to country) oblast and between internal oblast and junction point by commodity groups *(Table III.2)*			
NODE			• Number and weight of containers loaded and unloaded *(Table III.4)*	• Depth • Area • Length • Capacity by post facility *(Table IV.1)* • Port tariffs by service *(Table IV.2)* • Cargo handling (unloading/loading) -tons by commodity imported/exported *(Table IV.3)* Vessel movements by: • Vessel type • Imported/exported • Commodity type & weight • Port of origin/destination • Unloading time *(Tables IV.4 & IV.5)*	• Type of aircraft landing and based at airport • Runway dimensions • Availability of facilities for loading/unloading • Goods dispatched (tons) by internal, neighbouring country and international air route • Turnover (billion ton kms) • Tariffs by type of route • Unloading time *(Tables V.1 & V.2)* • Cargo (tons) by: - origin/destination airport - tariff distance *(Table V.3)*	• Trucks per month crossing at border point *(Table VI.2)*
LINK		• Length (km) • Width (m) • Pavement type • Pavement condition *(Table II.1)* • Vehicles per day • % trucks *(Table II.2)*	• Length (km) • Signalling & control • Systems • Gradient • Normal train weight *(Table III.1)* • Tons transported by commodity *(Table III.3)* • Transit times *(Table III.5)*			For a given route: • Mode choice • Transit type • Transport times • Distance *(Table VI.2)*

FIGURE 3.3

4. THE TRACECA TRAFFIC FORECASTING MODEL

4.1 A TRACECA regional traffic model has been constructed and a Model Development report prepared (first draft issued June 1997 subsequent report issued August 1997). The traffic forecasting model was developed using the current SATURN suite of modelling programs. A Russian version of the SATURN software manual tailored to the TRACECA model has also been prepared.

MODEL STRUCTURE

4.2 The model is built from data stored in the database. The transport system is represented by a multi-modal network (links and nodes) and strategic movements of freight by commodity are represented as matrices of tonnes moved between zones. Figure 3.2 shows the zone system and Annex E lists the zones.

4.3 The model comprises a multi-modal network including all major roads, rail and sea routes within each of the eight TRACECA countries together with many secondary links in order to ensure all significant freight routes through the TRACECA countries are represented. Strategic links between the TRACECA region and external areas are also represented. This network is shown in Annex F.

NETWORK DESCRIPTION

4.4 Each model in the network is represented by a set of uniquely defined links each with a distance, speed and delay and other physical attributes coded. In order to reflect the multi-modal nature of the transport system, interchange links are also represented. These facilitate modelling of the transfer of freight between modes (intermodality). Short links located at the border of each country have also been included in both the road and rail networks, to represent border delays, interchange penalties and border charges. Network calibration was undertaken to ensure modelled delays and routes accord with those observed.

TARIFFS

4.5 Throughout Central Asia and the Caucasus Regions tariffs vary by mode, region and commodity. Shipment costs per tonne by commodity have been calculated for different types of link reflecting mode and region. (Annex H summarised these calculations).

FREIGHT MOVEMENT MATRICES

4.6 Zone to zone movements of freight in tonnes per annum by 21 commodity groups were assembled from import and export data collated from field visits in each country and stored in the database. The 21 commodity groups were aggregated to produce 8 aggregated commodity groups for use at the model assigned stage as shown in Annex G.

ROUTE ASSIGNMENT

4.7 The allocation of strategic trade flows to routes through the TRACECA region is represented in the model by assigning the freight matrices to the multi-model network. Mode choice and route choice are, therefore, modelled simultaneously based on the generalised costs (transit times, interchange times, delays and tariffs) associated with each route. Value of time by commodity group are shown in Annex G. The assignment procedures are based on freight forwarders and operators perceiving the attractiveness of routes differently and, hence, freight is spread between competing routes.

4.8 The assignment calibration has been confined to looking at the strategic freight movements between the TRACECA countries. The freight matrices have been built from customs data, and therefore, represent international movements only. Direct comparison between assigned flows and observed flows has therefore, been confined to key ports and border crossings. In all countries it is clear that there are high levels of domestic traffic, which are included in the observed data, and hence, the observed flows should, and are, significantly higher than the assigned international movements on links within countries. In calculating total flows relative to link capacities it will be necessary to take account of this domestic traffic and this has been included in the model network as a fixed flow on links. In addition to this there are several other factors which prevent a direct comparison between observed flows of freight on links and assigned flows from the modelling process:

- road flow data in number of trucks per day has been converted to estimate annual tonne flows using a weighted average tonnage per truck;

- history shows that there has been a significant volatility in trade movements over recent years resulting from economic conditions, trade barriers and the closure of border crossing points;

- traffic information collected to date has mainly comprised a mix of 1993, 1994 and 1995 flow data, whereas the import/export data received represents trade in 1995.

4.9 A satisfactory calibration of the model has been achieved to ensure its robustness as a tool in forecasting future year traffic conditions to assist strategic planning of the freight network, and assess the impacts of proposed investments in the region.

4.10 The assignment calibration and validation has been based on a comparison between assigned and observed flows:

- on sea links between Baku and Turkmenistan;
- through the Black Sea Ports of Poti and Batumi;
- on eight road and rail screenlines across the region.

BASE YEAR FREIGHT TRAFFIC FLOWS

4.11 As shown in Annex J, the proportion of the total estimated flow representing strategic (international) movements varies considerably between screenlines and to a lesser extent between links within screenlines. This reflects the location of screenlines relative to country borders and the differing role played by rail relative to road and by different road and rail routes in carrying strategic freight. The pattern of movements as modelled accords well with reported road traffic and the most attractive existing routes as reported by freight forwarders operating in the region.

4.12 Annex I also shows the modelled strategic flow disaggregated by commodity group across the screenline as a whole. This demonstrates the importance of:

- oil, petroleum and minerals freight across the region as a whole;

- grain and cereal freight imported through the Black Sea ports and through Turkmenistan. It should be noted that this comprises largely of food aid delivered from the west and is likely to decline in the future;

- ores, metals and stones in the east of the TRACECA region.

4.13 Table 4.1 summarises the estimated total flows by road and rail on key sections of the TRACECA corridor in each of the eight countries. Mode shares and the strategic assigned flow are also shown. Figures 4.1 (a and b) show the location of these key sections (referenced by the Section ID) for road and rail respectively.

4.14 The figures in the Table 4.1 also show the dominance of rail in the movement of freight on the primary TRACECA routes within Central Asia, with an approximate mode share exceeding 70%. A similar mode share is shown for other countries including Kazakhstan, Turkmenistan and Uzbekistan. Kyrgyzstan and Tadjikistan are the exceptions where, given the lack of existing rail infrastructure due to the severe mountainous conditions, road haulage caters for over 80% and 90% of the estimated total freight traffic on the main TRACECA routes respectively.

4.15 Within the Caucasus region the model shows overall an approximate balance between road and rail freight movement.

FORECASTING

4.16 The primary purpose of the TRACECA model is to provide a means of forecasting strategic freight flows through the region by mode and commodity group.

4.17 There are two distinct components of the forecasting process:

- development of scenarios - representing future trade patterns (matrices of freight movements) reflecting two different levels of economic growth (low and high);

- testing of case studies - representing changes to the transport network including infrastructure investments and tariff changes.

Table 4.1 - Modelled Strategic and Estimated Total Tonnage Flows on Selected Sections of the TRACECA Route, 1995

Country	Section ID	ROAD Section		Modelled Strategic 2 Way Flow (000 Tonnes p a)	Estimated Total 2 Way Flow (000 Tonnes p a)	Mode Share (%)	RAIL Section		Modelled Strategic 2 Way Flow (000 Tonnes p a)	Estimated Total 2 Way Flow (000 Tonnes p a)	Mode Share (%)
Kazakhstan	1	Bejneu	Aktau	47	1339	39%	Bejneu	Aktau	906	2100	61%
	2	Kulsary	Bejneu	13	1238	8%	Kulsary	Bejneu	1708	13900	92%
	3	Makat	Nr. Oktjabr'sk	56	1310	11%	Makat	Nr. Oktjabr'sk	2480	10599	89%
	4	Karabutak	Aral'sk	450	1642	10%	Karabutak	Aral'sk	6172	14900	90%
	5	Kzyl	Orda	1098	2866	15%	Kzyl	Orda	6138	16500	85%
	6	Djumbul	Ojtal	1363	3773	15%	Djumbul	Ojtal	4761	21200	85%
	7	Almaty	Cilik	1232	3492	23%	Almaty	Cilik	340	11600	77%
Kyrgyzstan	8	Kara Balta	Bishkek	704	13097	77%	Kara Balta	Bishkek	3746	3960	23%
	9	Bishkek	Tokmak	886	4066	100%					
Uzbekistan	11	Jangijul	Tashkent	4285	7089	30%	Jangijul	Tashkent	701	16200	70%
	12	Dzizak	Bekabad	268	671	2%	Dzizak	Bekabad	42	30052	98%
	13	Katta Kurgan	Samarakand	2565	4023	93%	Bokhara	Samarakand	29	295	7%
	14	Nr Bokhara	Navoi	2677	4168	49%	Nr Bokhara	Navoi	439	4385	51%
	15	Termez	Dsarkurgan	348	870	100%					
Turkmenstan	16	Nr Mary	Chardzhou	1606	1296	18%	Nr Mary	Chardzhou	577	5760	82%
	17	Kizyl Arvat	Ashgabat	536	2441	33%	Kizyl Arvat	Ashgabat	1238	5040	67%
	18	Turkmenbashi	Nebit-Dag	796	1570	74%	Turkmenbashi	Nebit-Dag	1252	540	26%
Tadjikistan	19	Denau	Dushbanbe	348	3694	100%					
Azerbaijan	20	Baku	Tbilisi	914	1306	22%	Baku	Tbilisi	1705	4680	78%
Georgia	21	Tbilisi	Black Sea	1635	6480	65%	Tbilisi	Black Sea	2134	3551	35%

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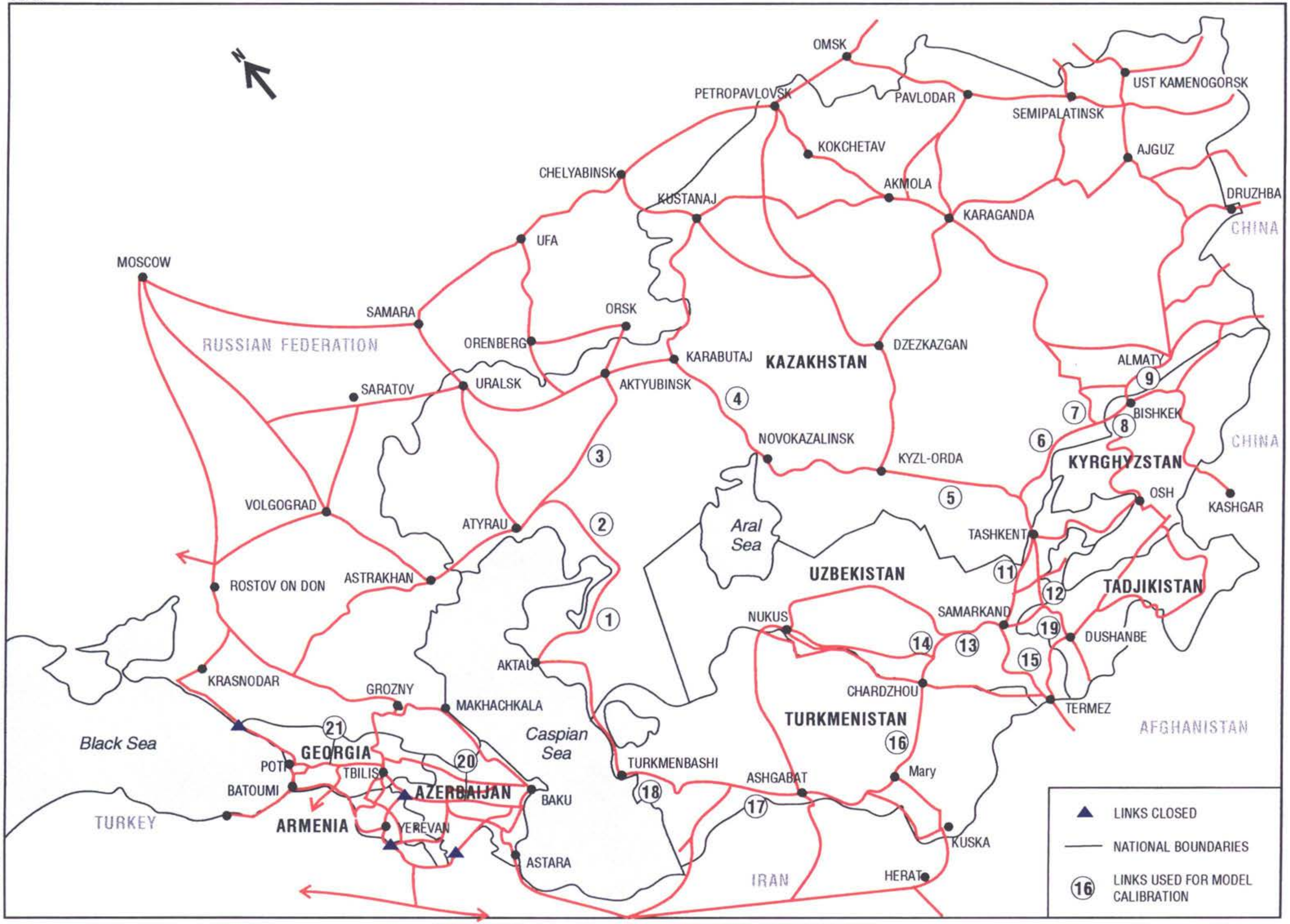

Figure 4.1(a)
Location of Links used for Model Calibration, Road Network

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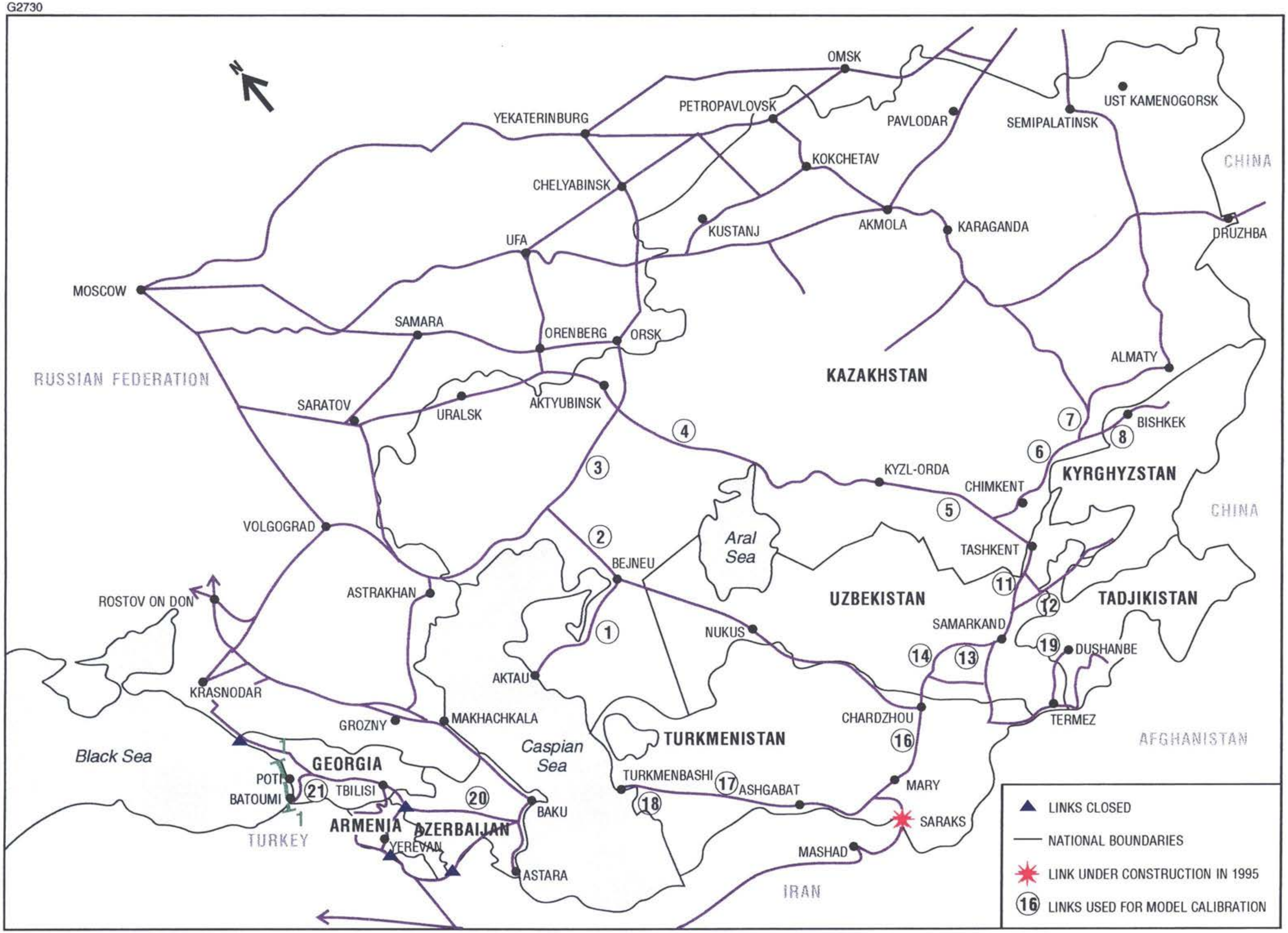

Figure 4.1(b)
Location of Links used for Model Calibration, Rail Network

4.18 The testing of case studies is summarised in Chapter 5 and the results presented in Annex K. Annex J, summarises the forecasting of economic and trade growth underpinning the future year trade patterns based on a review of international sources and sector specific analyses.

5. CASE STUDY TESTS

5.1 The following Case Studies have been investigated using the freight traffic Model to prepare forecasts of traffic for 2001 and 2011. The Case Studies and the results of the tests are described in Appendix K. All case studies have been assessed with increased tariffs as shown in Table 5.1. Details of the analysis of tariff increases are given in Appendix K. Results of all the Case Studies are summarised in Table 5.2

Table 5.1 - "Real" Tariff Increases Assumed in the Case Study Traffic Forecasts

Average Tariff increases considered in Forecasts		
Countries	**Rail Tariff**	**Road Tariff**
Kazakstan	20%	25%
Uzbekistan, Kyrgyzstan, Tadjikistan and all Caucuses countries	27.5%	25%
Turkmenistan	40%	25%

Case Studies In Armenia

5.2 Forecasts have been prepared with the model for three road rehabilitation projects, one railway rehabilitation project and one major new railway extension between Armenia and Iran.

Road and Railway Rehabilitation Projects

5.3 The road rehabilitation projects have been the subject of preparation under the Traceca programme. The location of the schemes is shown in Appendix K, brief details are as follows:

- Scheme Ar1, Yerevan - Gumri - Georgian border. The project involves improvement to the existing road up to the existing Georgian border including repaving the road and improving the geometry of a few sections. Traffic speeds would increase and safety would be improved. Road capacity would not materially change;

- Scheme Ar2, Yerevan - Sevan - Georgian border. The project involves repavement and improvement of the existing road up to the Georgian border Road capacity would not materially change. The above two rehabilitation projects are to some extent competing for the same international traffic;

- Scheme Ar3, Yerevan - Meghri - Iran border. The project involves creating a substantially new trunk highway route over some 240 kilometres by repaving and improving the geometry of existing road sections and building several new linking road sections to create a new trunk route connecting Yerevan with the Iran border at Meghri. The overall route distance would be shortened by comparison with the existing rather tortuous route, traffic speeds would increase substantially and the journey time to the border would be significantly reduced. The overall capacity of the route would be improved. The traffic forecast for the road in the maximum loaded section Ararat-Sisian is 2.2 million tonnes per year in 2001 and 2.6 million tonnes per year in 2011;

- Scheme Ar4, rehabilitation of the rail line from Yerevan to Tibilisi and operation of a "Pilot Train" block train in the section Tibilisi - Yerevan. This could be co-ordinated with the Baku - Poti pilot train;

Railway Extension Project

5.4 Scheme Ar5, a new railway line to Meghri on the border with Iran and continuing within Iran to link with the existing Iran - Turkey railway at Murand, approximately 70 kilometres from the Armenian border and about an equal distance from Tabriz. The project location is shown in Appendix K. The new link attracts some 750,000 tonnes of freight per year in 2001 rising to 960,000 tonnes per year in 2011.

Case Studies In Azerbaijan

5.5 Case studies considered in Azerbaijan are as follows. The locations are shown in Appendix K. Results of the tests are summarised in Table 5.2.

- Az1, railway rehabilitation to restore the Azeri main line to a maximum operating speed of 80 KPH for freight, and improvement of Pilot Train transit time in the Azerbaijan sections;

- Az2, road rehabilitation to achieve effective average running speed for freight vehicles of about 40 KPH;

- Az3, reconstruction of facilities at the port of Baku to achieve faster loading/ unloading of the Caspian Sea Ferry (CSF) vessels (Baku - Turkmenbashi) and better facilities for other shipping linkages;

- Az4, a new rail link from Astara on the Azerbaijan/Iran border to join up with the Iranian railway network near Qasvin.

- Az5, increased frequency of the Caspian Sea Ferry by 50% (i.e. to sailing approximately six times per week instead of the three per week frequency prevalent in 1995.

Case Studies In Georgia

5.6 Case studies in Georgia have been considered as follows (the schemes are shown in Appendix K). Results of the tests are summarised in Table 5.2.

- Ge1, Trans-caucuses rail line rehabilitation;

- Ge2, road rehabilitation and pavement management systems for the Trans caucuses main road network;

- Ge3, rehabilitation, improvement and extension of facilities at the ports of Poti and Batoumi to increase berth capacity and reduce ship berthing difficulties, loading/unloading delays and consequent demurrage charges, and to thereby improve the ports' throughput;

- Ge4, possible implementation of a ro-ro rail wagon ferry on the Black Sea between Poti and Illechevsk (Odessa), also other ro-ro operations between Poti and Bulgarian ports. Co-ordination of the schedules of the Ro-Ro rail wagon ferry with the Trans-Caucuses block train to optimise transit time for cargoes;

- Ge5, Ge6 and Ge7, improvements to capacity and reduction in delay at existing road border crossings with Turkey, Azerbaijan and with Southern Russia.

Case Studies In Kazakstan

5.7 Forecasts of future traffic have been prepared with the model for case studies in Kazakstan as follows (the schemes are shown in Appendix K):

- Ka1, a new rail link from Arkalyk to Kyzil-Orda passing through Dzenkagzan. This will provide a direct link between southern regions of Kazakstan and northern Kazakstan and with the new capital at Akmola;

- Ka2, Aktau - Bejneu rail line rehabilitation and improvement. This is a key link in the northern branch of the Traceca corridor;

- Ka3, improvements at Aktau port facilities for Aktau - Baku shipping including possibly restarting the ferry;

- Ka4, a new Aktau - Turkmenbashi rail line. This is an international project involving a new rail border crossing between Kazakstan and Turkmenistan. The proposed rail line would carry traffic between north-western Kazakstan as well as the Russian industrial areas around Yekaterinberg, Ufa and Orsk, and

Iran and Turkmenistan. This project would be in direct competition with a possible Caspian Sea north - south shipping line;

- Ka5, a new road link between Almaty (Azunagac) and Buvaldai to provide a more direct connection between Almaty and Bishkek and to the road south to Kashgar;
- Ka6, rehabilitation and improvement to the Almaty - Akmola - Kotchetav road.

Case Studies In Kyrgyzstan

5.8 The following Case Studies in Kyrgyzstan have been considered. (The schemes are shown in Appendix K):

- Ky1, new rail link between Balkashi (Issyk-Kul) and Djalalabad (to link to the present Djalalabad - Osh rail spur);
- Ky2, new rail link between the Djalalabad - Osh rail spur (off the Uzbek Fergana valley rail line) and Kashgar in Western China. Two possible routes for this rail connection have been studied;
- Ky3, improvement of the Bishkek - Kashgar road up to the Torugart pass;
- Ky4, creation of a new strategic level road connection between Djalalabad and the Torugart pass through a substantial upgrading of existing village roads in this region of Kyrgyzstan.

Case Studies In Tadjikistan

5.9 The following Case Studies in Tadjikistan have been considered (the schemes are shown in Appendix K):

- Ta1, the Gissarski mountain tunnel project on the Dushanbe - Ura-Tube road to avoid the highest road sections of the Anzob and Shakristan passes (3378 metres) by means of tunnels;

- Ta2, a new road connection from eastern Tadjikistan near Murgab, to join the Karakorum Highway in western China between Kashgar and Taxkorgan. This project would provide direct linkages for Tadjiskistan to China, without the need for Tadjik traffic to transit Kyrgyzstan, and to Pakistan and southern ports without the need to transit Afghanistan and Iran.

- Ta3, a new road to join Kulaab with Kalajchum via Zigar. This scheme would serve predominantly national traffic. The scheme is not therefore suitable for assessment with the model.

Case Studies In Turkmenistan

5.10 The following Case Studies have been considered in Turkmenistan (the schemes are shown in Appendix K):

- Tu1, reconstruction of the Rail and road bridges over the Amu-Darya river at Chardzhou;

- Provision of a new international rail line between Turkmenbashi and Aktau. This scheme has already been described under the list of schemes in Kazakstan, as scheme reference Ka4;

- Tu2, provision of a new rail line from Kazanzik, on the Turkmenbashi - Ashgabad main line, to a gauge change facility at the border with Iran near Kizyl Atrek and link up to the existing Iranian railway line at Bandar Torkeman on the Caspian Sea. This scheme (Tu2) together with the Aktau - Turkmenbashi rail line scheme (Ka4) would provide a new north - south rail link within the Traceca countries and facilitating traffic between the Russian industrial areas around Yekaterinberg, Ufa and Orsk/ Orenberg, and Iran and the Iranian Gulf ports;

- Tu3, improvements to the Port of Turkmenbashi to increase capacity and reduce loading times for the Caspian Sea Ferry;

- Tu4, road improvements in the sections Turkmenbashi - Ashgabad - Chadzhou up to first category standard depending on traffic.

Case Studies In Uzbekistan

5.11 No Case Studies for international traffic in Uzbekistan were put forward for examination with the model.

COMPREHENSIVE INTERNATIONAL CORRIDOR IMPROVEMENTS

Case C1, The North - South Rail link, (Combined case Tu2 and Ka4)

5.12 The combined case of the two North - South schemes taken together attracts additional traffic than either of the schemes individually. The scheme location is shown in Figure 5.1.

Case C2, The Traceca corridor Illechevsk - Poti - Baku - Turkmenistan - Kazakstan

5.13 The analyses of the separate schemes described above has identified the traffic attractiveness and routeing effects of individual schemes. In this section we have carried out a tests on networks including comprehensive improvements in the whole of the Traceca corridor. The network in this test included the following improvements:

- Ro- Ro wagon ferry across the Black Sea to Poti;
- improvements at Poti to speed up ship berthing and cargo loading/unloading;
- co-ordination of the schedules of the ro-ro ferry with the arrival/departure of the Trans-caucuses "Pilot Train" to achieve an effective time of 12 hours from ferry arrival to train departure at Poti and vice-versa;
- operation of the Pilot Train (Poti - Baku) with improved operating speed as a result of railway rehabilitation in Georgia and Azerbaijan;
- improvements in the port of Baku to achieve faster turnaround time for shipping;
- regular daily scheduled departures of the Caspian Sea Ferry to Turkmenbashi;

- improved frequency of sailing Baku - Aktau;

- improvements at the ports of Turkmenbashi and Aktau to achieve faster turnaround time for shipping;

- rehabilitation of the Aktau - Bejneu railway line;

- reconstruction of the Chardzhou bridges for railway and road traffic.

5.14 The locations of the above network improvements are shown on Figure 5.2

Case C3, North- south Shipping links on the Caspian Sea, Russia/Kazakstan - Iran

5.15 This scheme is shown on Figure 5.3. The scheme would include the following through shipping links, Atrau-Astrakhan-Baku-Anzali with a rail connection from Anzali to the Iranian railway network.

5.16 The results of the Case Studies are described in detail in Appendix K. They are summarised in Table 5.2.

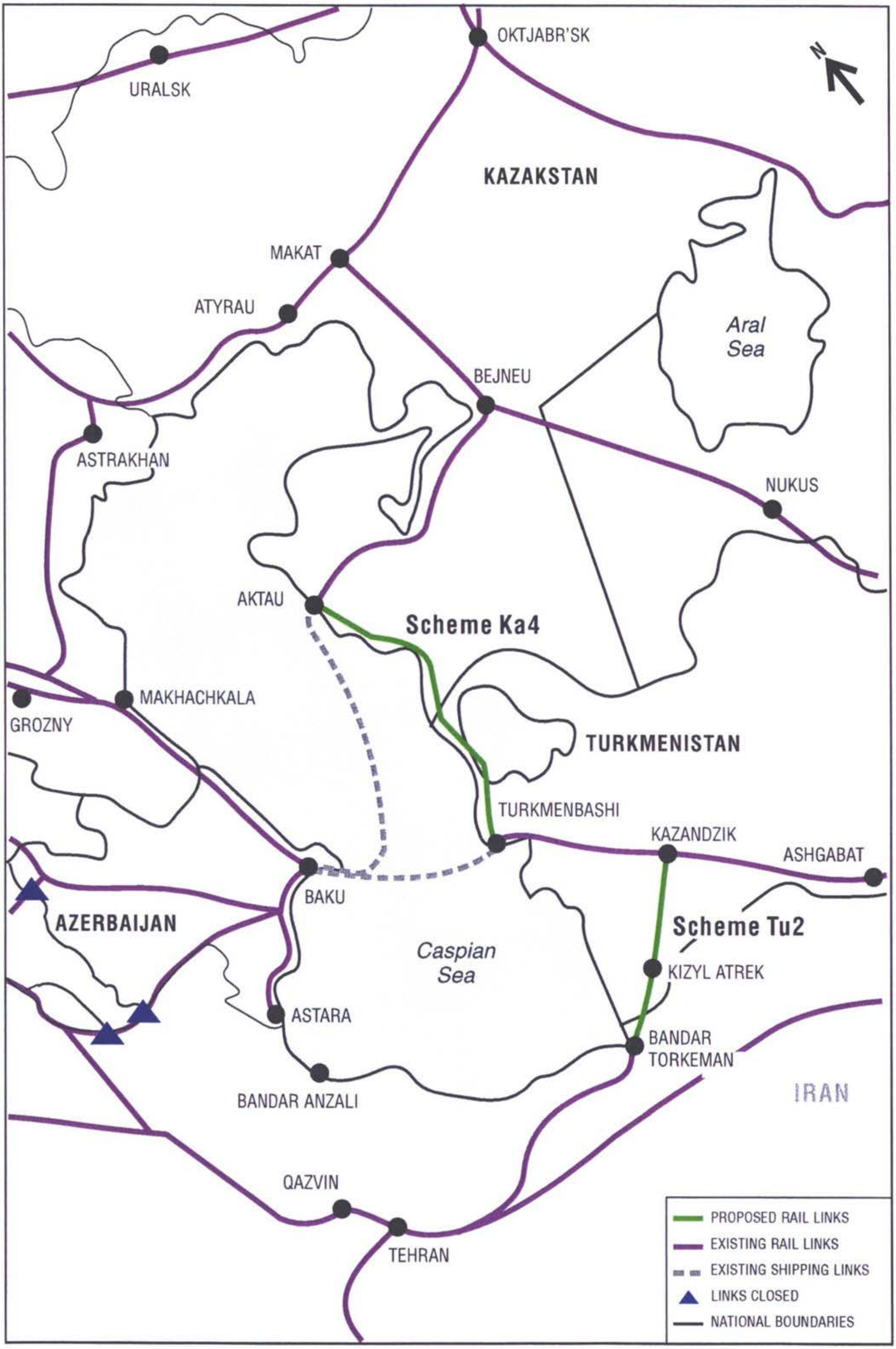

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Figure 5.1
Case C1, The North - South Rail Link (Combined Case Tu2 and Ka4)

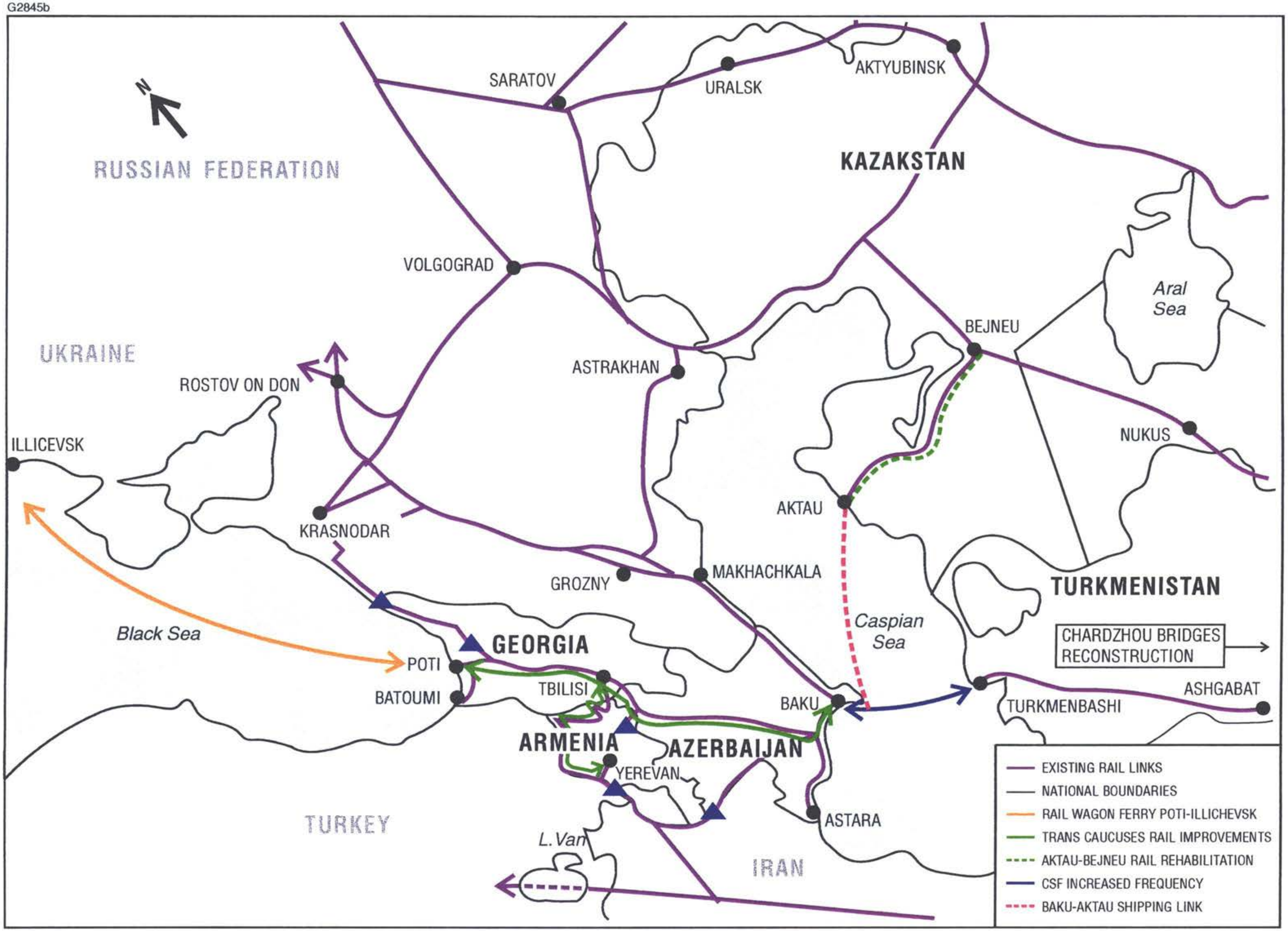

Figure 5.2
Case C2 ComprehensiveTRACECA Corridor Improvement Scheme

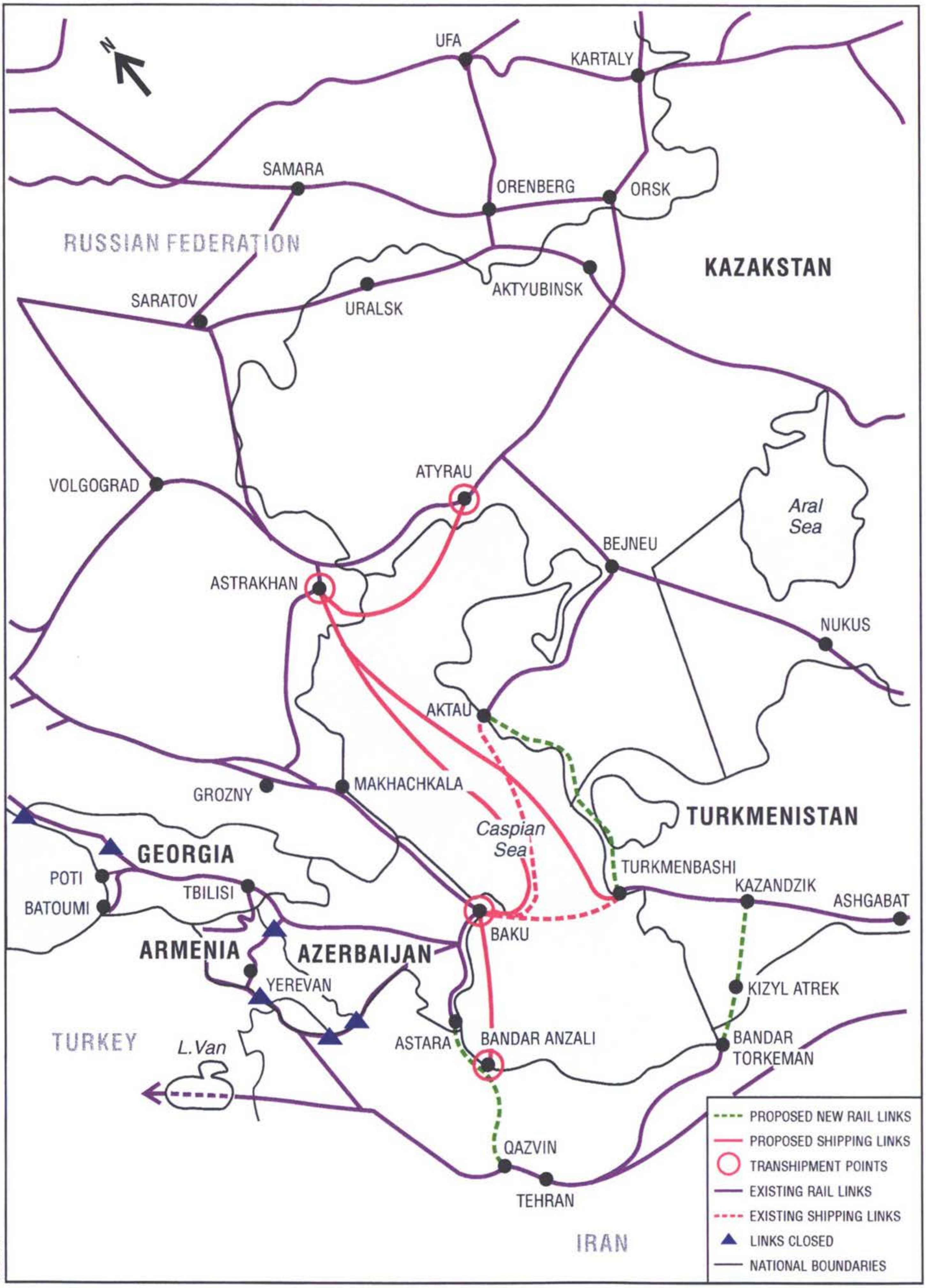

Figure 5.3
Case C3, North-South Shipping andCompeting North-South Connections in the Caspian Basin

Table 5.2 - Summary of Results of the Case Studies
(traffic load in 000 tonnes per year two way on the maximum loaded section)

Case	2001			2011		
	Freight Volumes			Freight Volumes		
	Domestic	Internation'l	Total	Domestic	Internation'l	Total
Ar 1	1080	220	1300	1720	360	2080
Ar 2	5640	140	5780	9010	360	9370
Ar 3	1670	500	2170	1990	610	2600
Ar 4	660	85	745	1050	170	1220
Ar 5	-	750	750	-	960	960
Az 1	2500	2200	4700	5900	4500	10400
Az 2	5600	3800	9400	12800	7050	19850
Az 3	0	1880	1880	-	-	-
Az 4	1750	1200	2950	4020	1700	5720
Az 5	120	1200	1320	230	1800	2030
Ge1	2110	2100	4210	3750	4230	7980
Ge 2	10300	1490	11790	18500	2280	20780
Ge 3	0	2800	2800	0	-	-
Ge 4	0	200	200	0	310	310
Ge 5	0	1400	1400	0	2440	2440
Ge 6	0	5000	5000	0	9300	9300
Ge 7	0	800	800	0	1070	1070
Ka 1	4400	1300	5700	9240	-	-
Ka 2	1190	570	1760	2500	2380	4880
Ka 3	0	570	570	0	2380	2380
Ka 4	-	1800	-	-	4410	-
Ka 5	-	530	-	-	900	-
Ka 6	3320	830	4150	6090	1520	7610
Ky 1	1400	2300	3700	-	-	-
Ky 2	-	1300	1300	-	2300	2300
Ky 2(b)	-	150	150	-	270	270
Ky 2(c)	-	220	220	-	410	410
Ky 3	310	340	650	560	530	1090
Ky 4	200	220	420	360	340	700
Ta 1	1650	860	2510	2300	1330	3630

Case	2001			2011		
	Freight Volumes			Freight Volumes		
	Domestic	**Internation'l**	**Total**	**Domestic**	**Internation'l**	**Total**
Ta 2	0	60	60	0	100	100
Tu 1	7710	1770	9480	10800	2880	13680
Tu 2	-	2400	2400	-	3600	3600
Tu 3	-	1480	1480	-	2220	2220
Tu 4	2800	490	3290	3930	740	4670
C 1	-	2300	2300	-	5200	5200
C 2	2650	3200	5850	-	-	-
C 2 (t)	2650	5100	7750	-	-	-
C 3	0	3400	3400	-	-	-

Note: - indicates flow not available
Ky2(b) is the longest of the three rail options Djelalabad-Kashgar
Ky2(c) is the combined Djelalabad-Bishkek-Kashgar options
(flows on the international section)

CONCLUSION

5.17 The model has been used in these Case Studies to test a wide variety of future possible developments in transport in most of the Traceca Countries. These tests have included tariff changes for all of the modes represented in the model involving 6 tests, 16 test of improvements in network performance through rehabilitation and reconstruction measures and 14 tests of possible new links in the network. Four tests of operational changes have been assessed. The transport system developments have been considered individually and in 3 combination tests. A total of 46 case studies in all have been assessed.

5.18 The survey of importers and exporters and freight forwarders carried out as part of the study data collection showed that the cost and time of transit are the two most important factors in route choice, in that order. The model has performed logically and shows through the tests completed so far that freight transport route choice reacts to changes in the tariffs and to time savings. Many individual schemes in the Traceca corridor are not sufficient on their own to have any impact on overall traffic routeing between Europe and the Caucuses or Central Asia due to the relatively small time savings provided by individual schemes. Only when the corridor as a whole is improved through a combination of schemes does this result in substantial extra traffic.

5.19 The data base should be maintained up to date. In particular the matrix of international commodity movement should be kept up to date as a basis for updating the forecasts of future traffic.

FURTHER INVESTIGATIONS POSSIBLE IN THE FUTURE

5.20 From the results of the tests carried out and the Case Studies analysed with the model in the present work the following case studies appear worth further investigation with the model in due course:

- It appears that a co-ordinated corridor wide tariff restructuring project would be worthy of consideration, especially on the railways, on the Caspian Sea Ferry and possibly other shipping routes on the Caspian Sea (e.g. North-south route) and for the proposed Ro-Ro wagon Ferry on the Black Sea;

- Border crossing charges, especially for the external borders of the Traceca countries;

- the relative merits and economic benefits of the north-south rail route Kazakstan -Turkmenistan - Iran compared to parallel shipping services on the Caspian Sea;

- further co-ordination possibilities in the Tracea corridor generally and particularly in the Trans-Cauccuses corridor and it's interaction with the traffic at the border crossings to Southern Russia;

- the new rail linkages proposed in Kazakstan and their re routing effects;

- the Andizan/Osh - Kashgar rail options;

5.21 In addition the extension of the model in each of the countries to include more detailed consideration of National Traffic flows will be advisable in the future, for the full potential of the model as an essential project appraisal tool to be fully realised.

6. ON-GOING OPERATION AND MAINTENANCE OF THE TRACECA DATABASE AND FORECASTING MODEL

6.1 The value of the database and forecasting model to the TRACECA countries and other organisations with an interest in transport investment in the region is dependent on the extent to which these tools can be operated and maintained within the region beyond the termination of the current contract.

6.2 Indeed the sustainability of the database and model will be dependent on the extent to which local entities are capable and committed to operating and maintaining these tools. The handover phase of the project has focused on creating a greater self-sufficiency in the data collection, analysis and forecasting work.

6.3 In determining the means by which this self-sufficiency can best be achieved we have to considered:

- the different roles and responsibilities of local entities;
- the relationship between local partners and recipients;
- the division of functions between local partners and a regional centre;
- funding and financing arrangements.

6.4 A draft discussion paper on these issues was circulated in July 1997 a basis for seeking the views of others involved in the TRACECA programme. Comments received have been taken on board in developing our recommendations.

6.5 In summary, the local partners in all countries are appropriate for undertaking certain aspects of the work but do not necessarily have sufficient breadth of experience to competently undertake the full range of data collection and analysis across all modes of transport economics, forecasting, database operations **and** modelling. It is important, therefore, that the local partners strengthen their capabilities through seconding or appointing specialists and/or forming specialist multi-modal groups with representatives from other specialist institutes or universities.

THE DIFFERENT ROLES AND RESPONSIBILITIES OF LOCAL ENTITIES

6.6 The recipient organisations are listed in Chapter 2 and the involvement in local partners in undertaking the project is described in Annex A.

6.7 In the database and model development phases a blurring of the boundaries between recipient organisations and local technical partners has been inevitable and, indeed, necessary in certain instances to enable the relevant data inputs and co-operation to be provided.

6.8 It is important, however, that, for on-going application, a clearly defined remit is provided to local partners responsible for applying and updating the database and model in behalf of the recipient. The extent to which the local partner should be a separate entity from the recipient is less clear and discussions with Tacis and TRACECA representatives have identified alternative views on this issue.

6.9 On the one hand, there are advantages in the local partner being independent of the recipient organisation with a clear contractual obligation to provide database and modelling services on behalf of the recipient. This will enable the partner to employ appropriate technical specialists and to develop as a centre for data analysis and forecasting and not be constrained by the recipients organisational structure and lack of research experience.

6.10 On the other hand, it is important that the recipient organisation has sufficient control over the use of the database and model, particularly as in some countries certain data sets are considered 'secret' and have restricted access.

RELATIONSHIP BETWEEN LOCAL PARTNERS AND RECIPIENTS

6.11 Whilst the flexibility afforded to date in the allocation of responsibilities between recipient and technical partners during the course of the project has been necessary in order to secure the participation of both, we recommend that each recipient is encouraged to move to a situation whereby a modelling and database agency in each country is appointed with clearly defined responsibilities. The local partners already nominated and individuals from recipient organisations should provide the core staff of these agencies and through the training and handover missions have acquired a technical competency sufficient to undertake this role. Their is also a need, however, for Tacis to secure a commitment at the Ministerial level of recipient organisations to the creation, recognition and support of a database and modelling agency. This is particularly important in ensuring that these agencies provide a service to cover data collection and analysis for all modes of transport and multi-modal modelling and forecasting.

6.12 The stated commitment and support for the project and its sustainability the future expressed by recipients needs to be backed by formulation of the organisational framework necessary to continue the technical work and to provide a data and modelling service to customers (including the recipients).

6.13 We suggest that this requires clear contractual obligations between the proposed agencies and recipient Governments regarding:

- ownership of the database and model software and hardware;
- the service to be provided by agencies;
- access to data held by other Government Ministries and agencies necessary for updating the databases and model;
- granting of a licence by the recipient to the agency for using the software and hardware;
- the ability for agencies to liaise with and participate in data exchange and technical activities with other agencies (local partners at regional level i.e. in other countries).

DIVISION OF FUNCTIONS BETWEEN LOCAL PARTNERS AND A REGIONAL CENTRE

6.14 The traffic forecasting model has been developed essentially as a regional forecasting tool focusing on strategic routes (of which the TRACECA corridor is one) and strategic freight movements across the region as a whole. Similarly, the database contains data not only specific to particular countries but also information for the region as a whole (trade movements). It is essential, therefore, that any arrangements for the on-going operation and maintenance of the model and the database facilitates the application of these tools at a regional as well as national level and facilitates co-ordination between local partners.

6.15 Equally, the complexities of data acquisition and the fact that required applications of the database and model will vary from country to country necessitates that local partners are able to apply the tools and collate the data necessary for updating the tools in each country. Removal of local involvement is also likely to be unacceptable to recipient organisations given the sensitivities regarding data sets.

6.16 For this reason we recommend that a balance needs to be maintained between the tasks undertaken by local partners in each country and the tasks undertaken by regional centre(s). Figure 6.1 summarises the different role to be fulfilled.

6.17 Figure 6.2 proposes a more detailed division of responsibilities such that the data collection, data entry and database and model applications are undertaken by the local partners. The devolving of technical responsibilities for application of the database and model to the local partners is recommended. This provides the most promising means of encouraging the recipient and technical partners to become self-sufficient in both the technical skills and financing of the database and model operation and, hence, sustaining transport forecasting capabilities in the region in the longer term. We propose that the regional centre role is essentially one of co-ordination and control of the database and model versions to ensure consistency in data usage and forecasting across the region. There may, however, be certain strategic applications of the model and database possibly best undertaken by the regional centre.

6.18 We recommend that this co-ordination role includes organisation of regular user groups, formation of a specialist economic forecasting group to update the economic forecasts and other specialist groups to address specific issues as they arise. Control and issuing of new versions of the software should also be a function of the regional centre.

REGIONAL CENTRE(S)

6.19 During the handover missions we have explained the importance of co-ordination between local partners across the region and have encouraged local partners to seek to find a consensus view as to the most appropriate form and location of a regional centre.

6.20 A clear distinction exists between the Caucasus countries and Central Asian countries which has been reflected in the handover and training missions (as well as the TRACECA co-ordination organisational structure). We believe, therefore, that it

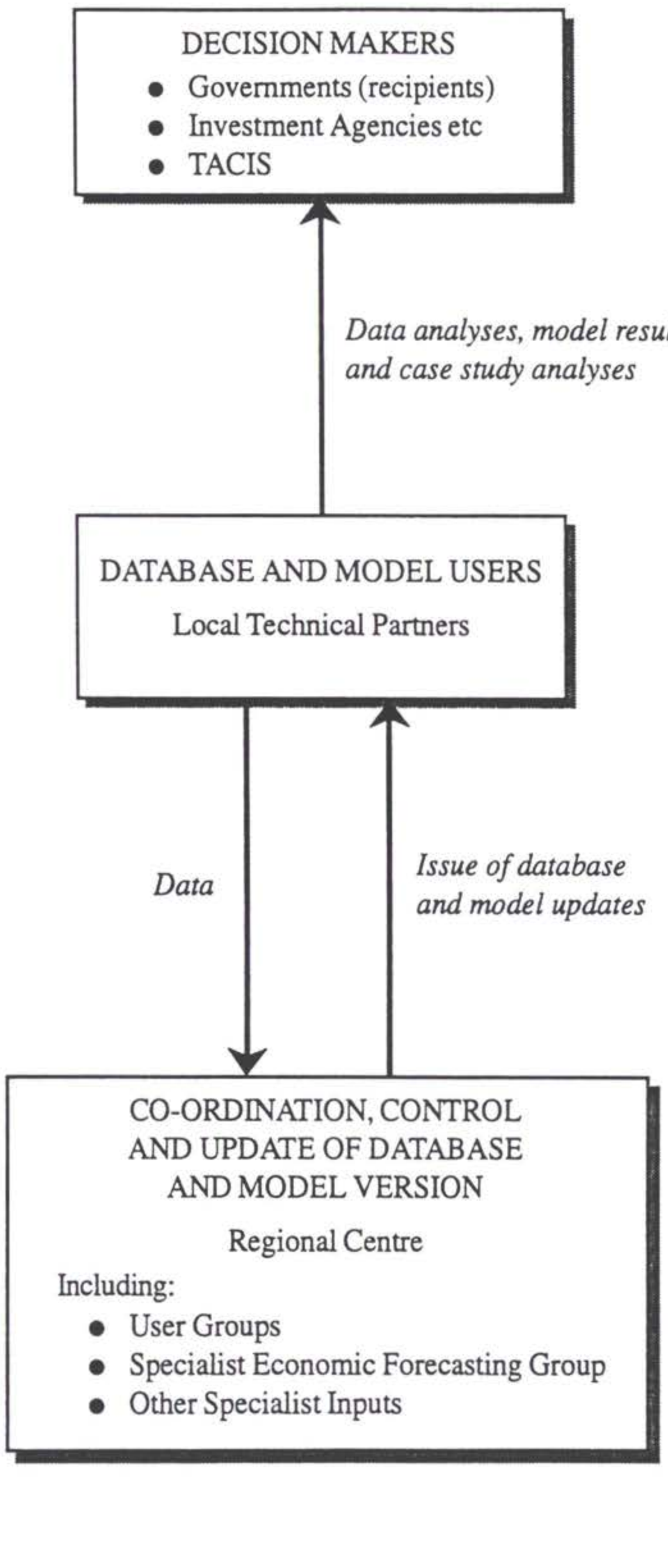

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FIGURE 6.1 Operating Structure

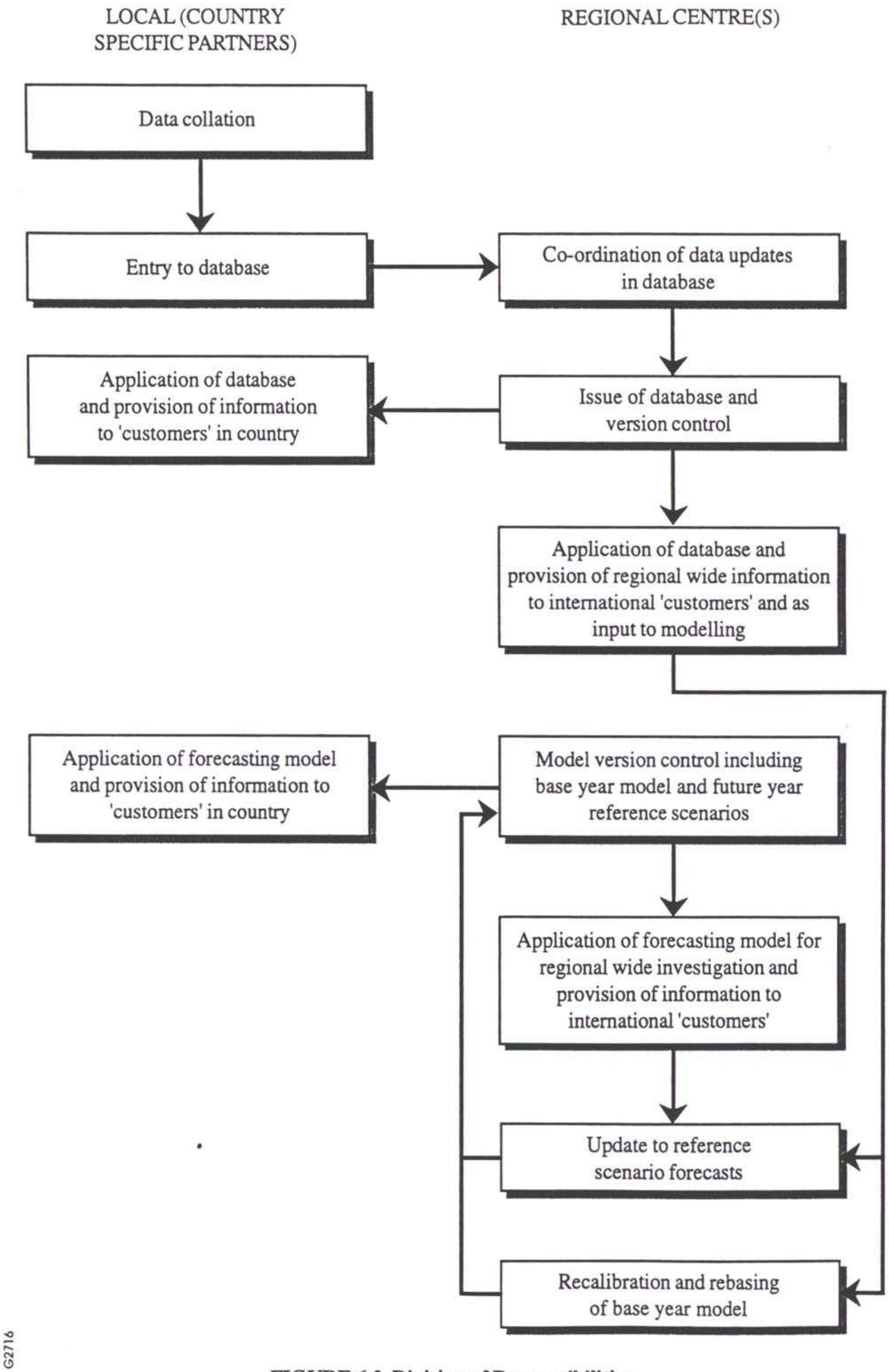

FIGURE 6.2 Division of Responsibilities

would be sensible to operate two regional centres, one in each area, but with an exchange of data inputs and an agreed programme of work and division of responsibilities for updating both the database and model such that both regional centres issue and operate the same version. This approach has some risks and should perhaps be implemented on a trial basis. Also, variant options include one regional centre co-ordinating the database and another co-ordinating the model. Ultimately, the consensus views of the local partners and recipients together with the appropriate capabilities being available must be determining factors.

6.21 Within the Caucasus we believe that there a consensus view in support of the Georgian Ministry of Transport providing the regional co-ordinating role. This is clearly the most acceptable choice for political reasons.

6.22 Within Central Asia, the Uzbekistan local partner has also expressed a strong desire to undertake the regional co-ordinating role. This is supported by the Monitoring and Evaluation consultants and has obvious merits given the central role of Uzbekistan on the TRACECA corridor and the Co-ordination Team being located in Tashkent. We conclude that the Uzbek partner has sufficient technical capability to maintain and co-ordinate the database but is likely to need technical assistance with the model co-ordination. This could be provided by the Kazahkstan local partner who has the greatest level of proficiency in modelling at the current point in time.

FUNDING AND FINANCING ARRANGEMENTS

6.23 The sustainability of the database and model requires the local partners as users, the regional centre(s) as co-ordinators and the recipient organisations as customers and owners of the tools to be self-sufficient in their ability to execute these functions not only in terms of technical ability but also in terms of funding.

6.24 In the longer-term it is anticipated that the local partners activities can be funded through their charging the recipient organisations and third party users for providing data and forecasting services. It is normal in this situation for the recipient and a separate set of (higher) rates for services for third party customers including investment agencies and contractors working on behalf of international funding bodies. The recipient may wish to agree with the local partner how revenues are distributed, however, the intention must be to set rates such that the local partners activities are fully financed. Protocols will also be required to ensure that different local partners do not undercut each other in competing for project work outside their country.

6.25 The extent to which this can be achieved in the short-term depends on the ability to which recipients are able to fund the local partners and the extent to which the local partners will be able to undertake fee earning work for third parties. Discussions with recipients and local partners lead us to conclude that both will be seeking additional external funding. Local partners have expressed concerns about the potential lack of funding beyond the end of the Atkins contract and we recommend that Tacis clarify this situation with local partners urgently in order to ensure continuity and to maintain the momentum established in the handover and training phases of the project.

6.26 Funding the regional centre(s) is potentially more complicated given that their role will be largely one of co-ordination and software version control. A potential source of funding in the longer-term would be through the regional centre charging a licence and annual maintenance fee to local partners. Local partners would then need to recover this cost through charges to recipients and third parties. We are conscious that any arrangement that involves payment by local partners or recipients to one or more regional centres will involve the transfer of money across national borders and this may cause further complications as to the practical feasibility of this approach in the short-term at least.

6.27 We are also conscious in the short-term the regional centre will need to lead by example and may take responsibility for certain database and model applications. Lack of funding could be a potential barrier to this taking place and external funding possibly supported by technical assistance would ensure that the regional centres(s) and its link to the local partners is properly established. One options raised by the Monitoring and Evaluation Team if for Tacis to continue to finance the project as a component of the TRACECA Co-ordination Team and this would appear to be the best way to proceed in order to secure a continued momentum in the application of databases and forecasting tools in the region.

ANNEX A

Local Partners

A. LOCAL PARTNERS

A.1 **Armenia:** data collection undertaken by the recipient organisation. Initially we had proposed to adopt the Engineering University as technical partner but the recipient organisation preferred to retain responsibility for the work with a view to creating a specialist TRECECA team with experts seconded from various specialist institutions. The creation of this team has not materialised to date. The database and model training has been undertaken by representatives of the Ministry of Transport who have computing skills.

A.2 **Azerbaijan**: data collection and validation together with training in the use of the database and model was undertaken by the Railways computer centre. The recipient provided an input to the economic forecasting.

A.3 **Georgia:** data collection and validation undertaken by the Centre for Government Statistics in co-operation with the Institute of Economy and Marketing. This Institute of Economy was nominated as our local technical partner for much of the project and has undertook economic forecasting work. However, since the project started a Ministry of Transport has been created and decided during the course of the study to appoint its own staff to take a lead role in the database and model training. Mr Kgirtskaya, Head of Division of Information, was assigned to the position of operating the database and model (combining his analytical and computer skills with his experience of the transport sector).

A.4 **Kazakhstan:** data collection, data processing and validation was undertaken by our local partner the Research Institute for Transport (AO-NIAT). Surveys to establish freight costs and economic forecasting were also undertaken. This partner was appointed with the approval of the recipient at the outset of the project. The capabilities of this institute have enabled us to involve technical staff in the co-ordination and processing of data sets for all countries. Moreover, during the course of the work, staff contributed to the base year model development work including the translation of a modified software manual tailored to the TRACECA model. In addition the University participated in economic forecasting work.

A.5 **Kyrgystan:** data collection and validation undertaken by the local technical partner the State Institute of Road Design (Kyrghzdortransproekt). This partner was selected following discussions with the Ministry of Transport and, whilst it has little experience in multi-modal forecasting, has demonstrated a high level of motivation (which is also reflected through its success in winning contracts in international tenders). The Institute nominated staff for participating in the database and model training.

A.6 **Tadjikistan**: at the outset of the project the State Project and Research Institute "Tajikgipro-transstroy" was designated the recipient as our local technical partner. The Institute has undertaken data collection and validation and participated in the database and model training sessions.

A.7 **Turkmenistan:** initially the Turkmen Institute for Transport and Communications was considered to be an appropriate technical partner. However, the recipient organisation took direct responsibility for data collection and nominated the Institute of Economy to participate in the project. This Institute reviewed the economic forecasts and has participated in the database and model training. Representatives of the railways also participated in the training and handover sessions.

A.8 **Uzbekistan:** data collection was undertaken by a range of organisations including the University and the Institute of Economy with assistance from the Cabinet of Ministers. After protracted discussions with the recipient, our official local technical partner, Uzavinformtransystema, was appointed to the project in December 1996. This partner undertook work on comparative freight costs and participated in the database and model training. In addition Professor Ujabiev from the University and Institute of Economy participated in training seminars and workshops. The local technical partner is proficient in database operations but beyond the project may require improved access to trade and rail data. This could possibly be achieved by seconding or appointing appropriate specialists from other institutions to work on the project.

A.9 All partners in seminars and workshops designed to train them in the application of the database and model.

ANNEX B

Original Project Programme

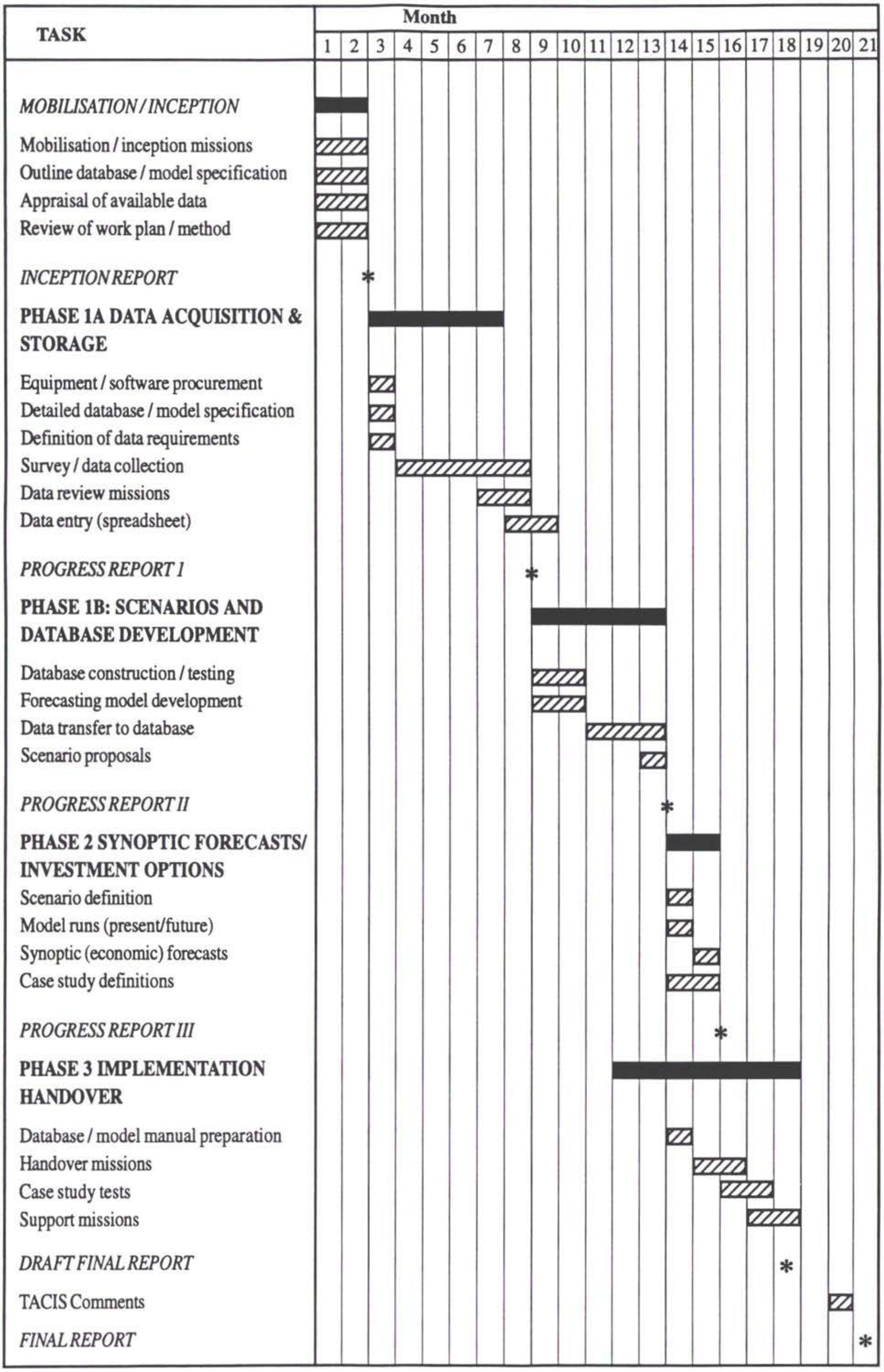

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FIGURE B.1: Original Project Programme

ANNEX C

Project Peformance Tables for

for Reporting Period

TABLE C.1 PROJECT PROGRESS REPORT: LAST PERIOD

Project title: Regional Traffic Database and Forecasting Model							Country: TRACECA States									
Planning period: January 1996 - September 1997							Prepared: September 1997									
Project objectives: development and implementation of a traffic database and forecasting model																
NO.	MAIN ACTIVITIES	TIME FRAME					INPUTS									
		1997					PERSONNEL				FLIGHTS				PERDIEM	
		JUN	JUL	AUG	SEPT	OCT	EU Experts (weeks)		Local Experts (weeks)		Long Haul (flights)		Local (flights)		(days)	
							Pln'd	Act'l	Pln'd	Act'l	Pln'd	Act'l	Pln'd	Act'l	Pln'd	Act'l
3	SCENARIOS/DATABASE DEVELOPMENT															
3.3	Further data collection/entry	XXXX	XXXX	XXXX			1		20							
4	SYNOPTIC FORECASTS															
4.1	Scenario definition	XXXX					1		4		1		1		10	
4.2	Zonal economic forecasts						1		4							
4.3	Case study definitions	XX					1		4		1		1		10	
5	IMPLEMENTATION/HANDOVER															
5.2	Handover/training missions	XX	XX				10		30		4		11		100	
5.3	Case studies		XX	XXXX			8		30		4		11		48	
5.4	Support mission		XX	XX			4		16		4		11		40	
5.5	Draft Final Report				XXXX		2		5							
							28	0	113	0	14	0	35	0	208	0

TABLE C.2 RESOURCE UTILISATION REPORT

Project title: Regional Traffic Database and Forecasting Model			Country: TRACECA States		
Planning period: January 1996 - September 1997		Prepared: September 1997	EU Lead Consultant: WS Atkins International Ltd.		
Project objectives: development and implementation of a traffic database and forecasting model					
RESOURCES/INPUTS	TOTAL PLANNED	PERIOD PLANNED	PERIOD REALISED	TOTAL REALISED	AVAILABLE
PERSONNEL (Weeks)					
EU Experts	128	28			
Local Experts	144	113			
FLIGHTS (Tickets)					
Long haul	25	14			
Local	90	29			
PER DIEM					
Days	600	208			

TABLE C.3 OUTPUT PERFORMANCE REPORT

Project title: Regional Traffic Database and Forecasting Model		Country: TRACECA States	
Planning period: June 1997 - September 1997		Prepared: September 1997	
Project objectives: development and implementation of a traffic database and forecasting model			
Output results	Derivation from original plan (plus ...... - months for submission of deliverable)	Derivation from revised plan	Comment on constraints and assumptions
Database and Manual	+ 3 months	0	Handover to local partners necessitated full co-operation and participation during holiday period (August). Achieved, although some difficulties with co-operation between TRACECA countries.
Model and Manual	+ 3 months	0	
Handover/Training/ Support Missions	+ 3 months	0	
Cast Study Tests	+ 3 months	0	
Draft Final Report	+ 3 months	0	

ANNEX D

Database Tables

TRACECA Database Tables and Their Contents

MS ACCESS Table	Fields within the table	Comments
CATAGORY	**CATEGORY ID**	
	CATEGORY DESCRIPTION	
	CAPACITY	
COMMODITY	**COMMODITY NO**	The main 21 categories of cargo and their associated code.
	COMMODITY NAME	
COUNTRY	**COUNTY ID**	The 8 countries and their codes used in the database. Note 9 = outside model area
	COUNTRY NAME	
COUNTRY ECONOMIC	**COUNTRY ID**	Contains aggregated Oblast socio-economic data for the 8 countries in the TRACECA area.
	YEAR	
	AREA	
	TOTAL POPULATION	
	CITY POPULATION	
	GNP PER CAPITA	
	GDP PER CAPITA	
	EMPLOYMENT RATE	
	CAR OWNERSHIP RATE	
OBLAST ECONOMIC	**OBLAST ID**	Contains socio-economic data for the 82 Oblasts in the TRACECA area.
	YEAR	
	AREA	
	TOTAL POPULATION	
	CITY POPULATION	
	GNP PER CAPITA	
	GDP PER CAPITA	
	EMPLOYMENT RATE	
	CAR OWNERSHIP RATE	
	IMPORT EXPORT SPREADSHEET	

MS ACCESS Table	Fields within the table	Comments
INPUT_OUTPUT	**A ZONE ID** **B ZONE ID** **YEAR** **COMMODITY NO** IMPORT EXPORT FLOW	This table contains the bulk of the TRACECA data. It contains a flow of commodity between all zones. Note: This data has been pre-processed so that the reported total imports and total reported exports between zones balance.
LINK PHYSICAL (RAIL)	• **ANODE** • **BNODE** • LENGTH TOTAL • LENGTH 2 WAY • LENGTH 1 WAY • DISPATCH BOARD • AUTOMATIC BLOCKING • SEMIAUTOMATIC BLOCKING • OTHERS • TRACTION TYPE • LENGTH ENTRANCE WAYS • LEADING GRADIENT (A TO B) • LEADING GRADIENT (B TO A) • FREIGHT (A TO B) • FREIGHT (B TO A) • PASSENGER (A TO B) • PASSENGER (B TO A)	This table contains the physical attributes of rail links within the model.
LINK PHYSICAL (ROAD)	• **ANODE** • **BNODE** • LENGTH TOTAL • LENGTH MOUNTAIN • WIDTH ROADBED • WIDTH PAVEMENT	This table contains the physical attributes of road links within the model.

MS ACCESS Table	Fields within the table	Comments
	• LENGTH CAPITAL PAVEMENT • LENGTH FACILITATED PAVEMENT • LENGTH OTHER PAVEMENT • LENGTH GOOD PAVEMENT PLANE • LENGTH SATISFACTORY PAVEMENT PLANE • LENGTH UNSATISFACTORY PAVEMENT PLANE	
LOADING NODES	• **ANODE** • ZONE ID	Contains the loading points from the zones on to the network.
MODE	• **MODE ID** • MODE NAME • COST	This table contains the mode and associated mode code used with the database.
NODE BASE	• **ANODE** • X CO-ORDINATE • Y CO-ORDINATE • NODE NAME • NODE BASED SURVEY INFORMATION • MODE ID	This table is the one of the most important tables in the database. It hold and exhaustive list of all nodes within the model along with the nodes attributes. Some of the nodes contain a reference in the NODE BASED SURVEY INFORMATION field. This reference is stored an embedded EXCEL spreadsheet which contains node specific information e.g. the capacity of a seaport.
OBLAST	• **OBLAST ID** • OBLAST NAME • ZONE ID	Contains the names and codes of the Oblasts and their association with the model zones.
RAIL CARGO	• **COUNTRY ID** • **YEAR** • **SUB COMMODITY NO** • SPREADSHEET	This table contains embedded EXCEL spreadsheets which hold external/internal oblast/zone commodity flows.
RAIL ROUTE TIMES	• **ANODE** • **BNODE** • TIME OF CARGO AT END OF SECTION	

MS ACCESS Table	Fields within the table	Comments
	• TIME OF CARGO AT START OF SECTION • TIME OF PASSENGER AT END OF SECTION • TIME OF PASSENGER AT START OF SECTION • RESERVE CARRYING CAPACITY	
RAIL SURVEY	• **ANODE** • **BNODE** • **SURVEY DATE** • **SUB COMMODITY NO** • FLOW	**One way** import and export flows of sub-commodity on links along the railway network for survey years.
RAIL TERMINAL SHIPMENTS	• ANODE • SURVEY DATE • LOADED TOTAL PHYSICAL UNITS • LOADED TOTAL AVERAGE WEIGHT • LOADED LARGE PHYSICAL UNITS • LOADED LARGE AVERAGE WEIGHT • LOADED MEDIUM PHYSICAL UNITS • LOADED MEDIUM AVERAGE WEIGHT • LOADED SPECIAL PHYSICAL UNITS • LOADED SPECIAL AVERAGE WEIGHT • UNLOADED TOTAL PHYSICAL UNITS • UNLOADED TOTAL AVERAGE WEIGHT • UNLOADED LARGE PHYSICAL UNITS • UNLOADED LARGE AVERAGE WEIGHT • UNLOADED MEDIUM PHYSICAL UNITS • UNLOADED MEDIUM AVERAGE WEIGHT • UNLOADED SPECIAL PHYSICAL UNITS • UNLOADED SPECIAL AVERAGE WEIGHT	This table contains loading and unloading data for the rail terminal
ROAD SURVEY	• **ANODE** • **BNODE**	**Two way** total and HGV flows on links along the railway network for survey years.

MS ACCESS Table	Fields within the table	Comments
	• **SURVEY DATE** • TOTAL FLOW • PERCENTAGE HGV	
ROUTES	• **ROUTE ID** • COUNTRY ID • ROUTE DESCRIPTION • PRIMARY MODE • SECONDARY MODE • PRIMARY DISTANCE • SECONDARY DISTANCE • COST • COST KM • TIME • SUB COMMODITY • TOTAL VOLUME	ROUTE ID is a unique reference assigned to different routes which are made of combinations of links
SEA EXPORT SURVEY	• ANODE • BNODE • VESSEL • VESSEL TYPE • SUB COMMODITY ID • WEIGHT • CONTAINERS • WAITING TIME	Export flows by sub commodity between seaports for survey years.
SEA IMPORT SURVEY	• ANODE • BNODE • VESSEL • VESSEL TYPE • SUB COMMODITY ID • WEIGHT	Export flows by sub commodity between seaports for survey years.

MS ACCESS Table	Fields within the table	Comments
	• CONTAINERS • WAITING TIME	
SUB COMMODITY	• **SUB COMMODITY ID** • SUB COMMODITY NAME	Commodities used in the rail data. These form subsets of the main 21 categories.
TRANSPORT	• **COUNTRY ID** • **MODE ID** • **YEAR** • VOLUME • TURNOVER	This table contains the volume and turnover for the 4 transport modes by country.
ZONENAMES	• **ZONE ID** • ZONE NAME • CENTROID X-COORDINATE • CENTROID Y-COORDINATE • COUNTRY ID	An exhaustive list of the 56 zones used in the TRACECA model along with the model centroid co-ordinates and country associations.

ANNEX E

Zone System

Table E.1 - TRACECA Internal Zoning System

Country	Country Id	Zone Name	Zone Id	Oblast Name (Administrative Area)	Oblast Id
ARMENIA	1	Armenia	22	Shirak	8
				Erevan	1
				Tavush	11
				Syunik	9
				Kotaik	7
				Lori	6
				Geharkunik	5
				Armavir	4
				Ararat	3
				Aragacotn	2
				Vaiocdzor	10
AZERBAIJAN	2	Azerbaijan	23	Sheki	20
				Ali-Bairamly	17
				Naftalan	21
				Lenkoran	19
				Evlah	18
				Sumgait	15
				Gyanja	14
				Nahichevanskaya A. R.	12
				Baku	13
				Minchegaur	16
GEORGIA	3	Georgia	21	Racha-Letchumi	28
				Tbilisi	34
				Abchazeti	33
				Achara	32
				Svaneti	31
				Kaheti	22
				Samegrelo	29

Country	Country Id	Zone Name	Zone Id	Oblast Name (Administrative Area)	Oblast Id
				Imereti	27
				Samtche-Djavachetey	26
				Mtianeti	25
				Kvemo Kartley	24
				Shuda Kartley	23
				Guriya	30
KAZAKHSTAN	4	Zapadno-Kazakchstanskaya	151	Zapadno-Kazakchstanskaya	42
		Atyrausskaya	152	Atyrausskaya oblast	38
		Mangistausskaya	153	Mangistausskaya oblast	47
		Kustanaiskaya	161	Kustanaiskaya oblast	46
		Turgaiskaya	162	Turgaiskaya oblast	52
		Aktyubinskaya	163	Aktyubinskaya oblast	36
		Severo-Kazakchtanskaya	171	Severo-Kazakchtanskaya	49
		Kokchetavskaya	172	Kokchetavskaya oblast	45
		Pavlodarskaya	173	Pavlodarskaya oblast	48
		Akmolinskaya	181	Akmolinskaya oblast	35
		Karagandinskaya	182	Karagandinskaya oblast	43
		Djezkazganskaya	183	Djezkazganskaya oblast	41
		Semipalatinskaya	184	Semipalatinskaya oblast	50
		Vostochno-Kazakchstanskaya	185	Vostochno-Kazakchstanskaya	39
		Taldy-Kurganskaya	191	Taldy-Kurganskaya oblast	51
		Almatinskaya	192	Almatinskaya oblast	37
		Kzyl-Ordinskaya	201	Kzyl-Ordinskaya oblast	44
		Yujno-Kazakchstanskaya	202	Yujno-Kazakchstanskaya	53
		Djambul'skaya	203	Djambul'skaya oblast	40

Country	Country Id	Zone Name	Zone Id	Oblast Name (Administrative Area)	Oblast Id
KYRGHYZSTAN	5	Kyrghyzstan	4	Djelal-Abadskaya oblast	54
				Issyk-Kulskaya oblast	55
				Narynskaya oblast	56
				Oshskaya oblast	57
				Talasskaya oblast	58
				Chuiskaya oblast	59
				Bishkek	60
TADJIKISTAN	6	Leninabadskaya and Districts of Republican Submission	1	Districts of republican submission and Dushanbe	61
				Leninabadskaia oblast	62
		Hatlonskaya	2	Hatlonskaia oblast	63
		Gorno-Badahshanskaia	3	Gorno-Badahshanskaia autonomous oblast	64
TURKMENISTAN	7	Cardjouskaya and Maryiskaya	12	Chardjouskaya oblast	65
				Maryiskaya oblast	66
		Tashanakaya and Ashgabadskaya	13	Tashanskaya oblast	67
				Ashgabadskaya oblast	68
		Krasnovodskaya	14	Krasnovodskaya oblast	69
UZBEKISTAN	8	Andijanskay, Namanganskaya and Ferganskaya	7	Ferganskaya oblast	80
				Andijanskaya oblast	70
				Namanganskaya oblast	75
		Djizakskaya, Syrdarinskaya and Tashkentskaya	8	Tashkentskaya oblast	79
				Djizakskaya oblast	72
				Syrdar'inskaya oblast	78
		Bucharskaya (part of), Chorezmskaya and Rep. of Karakalpakstan	9	Navoiiskaya oblast	74
				Republic of Karakalpakstan	82

Country	Country Id	Zone Name	Zone Id	Oblast Name (Administrative Area)	Oblast Id
				Chorezmskaya oblast	81
		Bucharskaya (part of) and Samarkandskaya	10	Samarkandskaya oblast	76
				Bucharskaya oblast	71
		Kashkadar'inskaya and Surchandar'inskaya	11	Kashkadar'inskaya oblast	73
				Surchandar'inskaya oblast	77

Table E.2 - TRACECA External Zoning System

Country	Country Id	Zone Name	Zone Id
EXTERNAL	9	South Russia	24
		North Russia	26
		North Russia	27
		North Russia	28
		Ukrane	29
		China	30
		Indian Sub Cont.	31
		Iran, Gulf	32
		Turkey	33
		N-Western Europe	34
		Southern Europe	35
		Central Europe	36
		Baltic States	37
		N-Central Europe	38
		Northern Europe	39
		Middle East	40
		East Africa	41
		West Africa	42

Country	Country Id	Zone Name	Zone Id
		East Asia Developing	43
		East Asia Industrial	44
		East Coast America	45
		West Coast America & Pacific	46

ANNEX F

TRACECA Network Plans

G2730

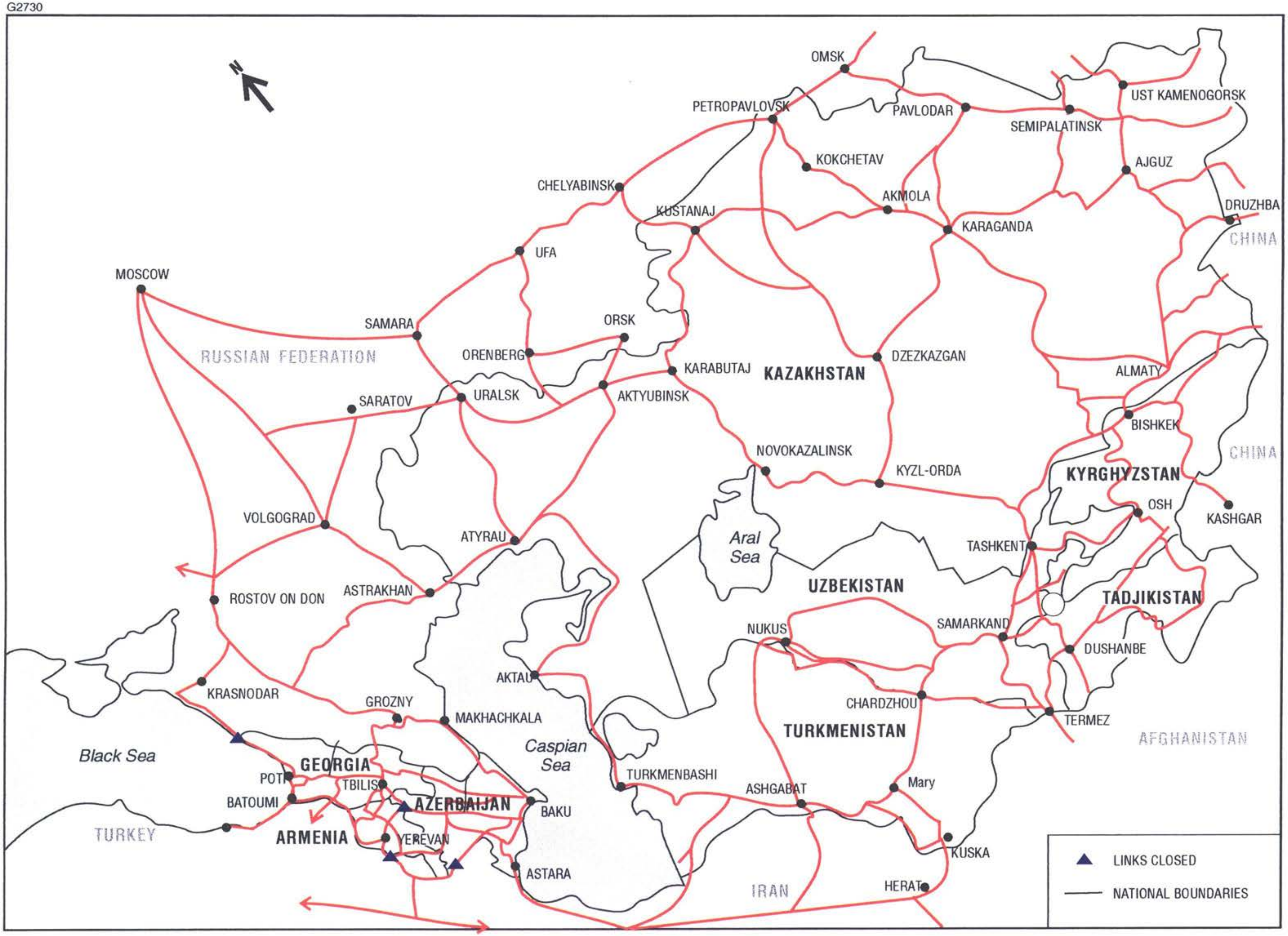

Figure F1
Extent of Modelled Road Network

G2730

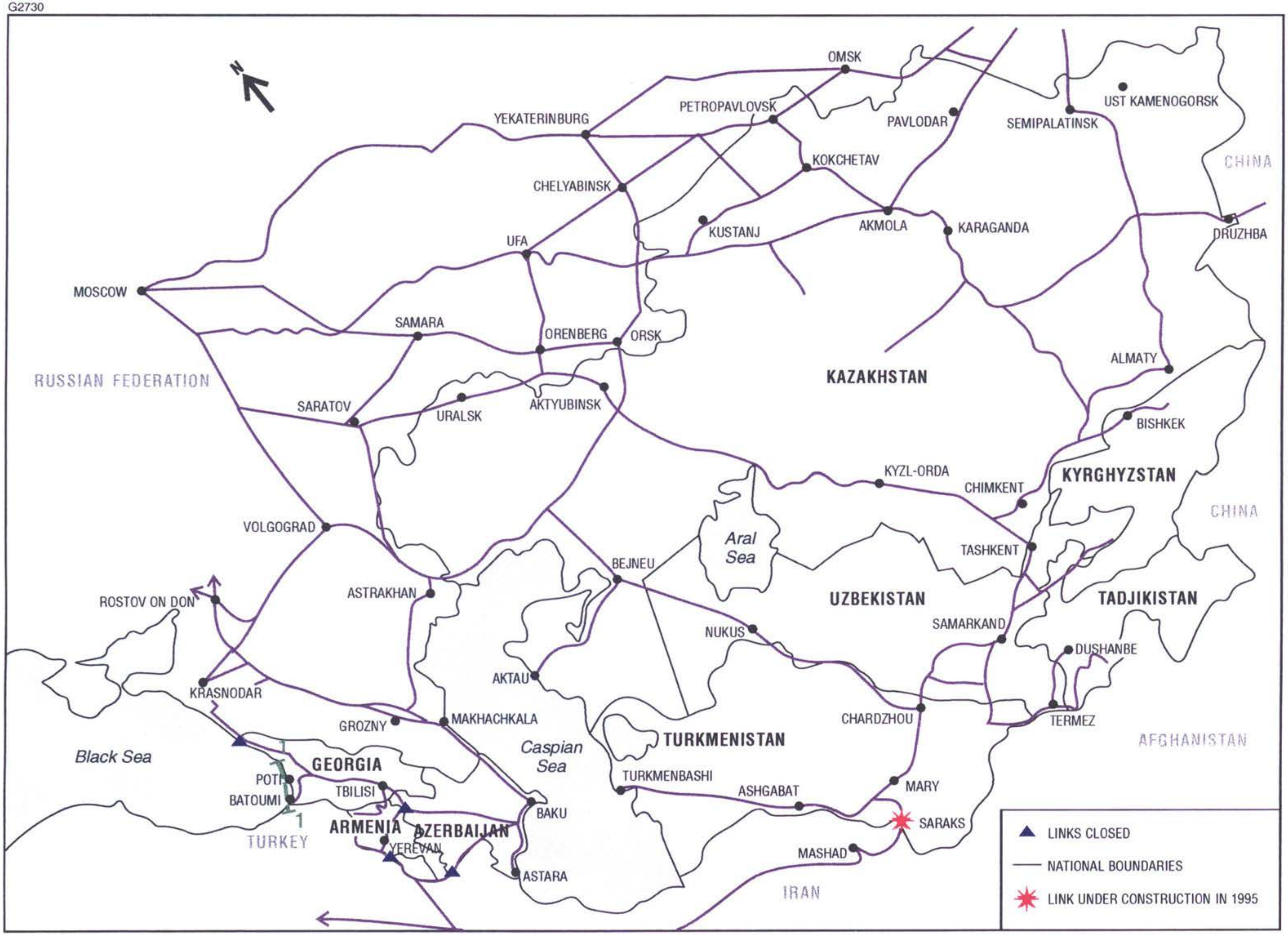

Figure F2
Extent of Modelled Rail Network

ANNEX G

Commodity Groups and Mode Classifications

Table G1 - Commodity and Sub-Commodity Relationship

COMMODITY NO	COMMODITY NAME	SUB COMMODITY NO	SUB COMMODITY NAME
1	CATTLE AND PRODUCTS OF ANIMAL ORIGIN	-	-
2	PRODUCTS OF VEGETABLE ORIGIN	780	VEGETABLE OIL
		850	BARLEY
		860	BORIT
		880	CIGARETTES
		940	GRAIN
		950	LAUREL LEAF
		1090	TOBACCO
3	FAT AND OIL OF ANIMAL OR VEGETABLE ORIGIN	-	-
4	FINISHED FOOD STUFFS	190	CEREALS AND GRAIN
		500	ALCOHOLIC DRINKS
		630	FLOUR
		640	FOOD-STUFF
		960	MIN. WATER
		1000	PACKING FLOUR
		1070	SUGAR
		1080	TEA, MIN. WATER
5	MINERAL PRODUCTS	110	COAL
		120	COKE
		130	OIL
		140	ORE
		690	OIL PRODUCTS
		910	DIESEL FUEL
		920	GASOLINE
		1010	PETROLEUM
		1020	PETROLEUM PROD.
		1040	SALT
		1120	WATER
6	PRODUCTS OF CHEMICAL INDUSTRY	180	CHEMICAL FERTILIZER
		550	CATHODE CU
		560	CHEMICAL
		580	CR OXIDE
		600	ELECTROLYTE
		620	EXPLOSIVE
		670	LIQUID CL
		720	SHAMPOO
		790	VINEGAR ACID
		820	YELLOW P

		830	ZINC
		840	ZINC OXIDE
7	PLASTICS AND RUBBER, AND THEIR WARES	760	TYRES
8	WOOD AND ITS WARES	-	-
9	WOOD AND ITS WARES	160	TIMBER
10	PAPER AND ITS WARES	800	WALL-PAPER
11	TEXTILE AND ITS WARES	220	COTTON
		530	CARPET-COVER
		540	CARPETS
		660	KNITTED WEAR
		710	SACKS
12	SHOES, HEAD DRESSES, UMBRELLAS, WALKING STICKS ETC.	-	-
13	WARES FROM STONE, GYPSUM AND CEMENT	200	CEMENT
		510	ASBESTOS
		520	BRICKS
		590	DISHES
		970	MINING BULK
14	PRECIOUS AND SEMI-PRECIOUS STONES AND METALS, AND THEIR WARES	740	TITANIUM (POROUS?)
		750	TITANIUM SLAG
15	NON-PRECIOUS METAL AND ITS WARES	150	METAL
		650	IRON-ORE PELLETS
		680	METAL
		1030	ROAD - METAL
16	MACHINERY, EQUIPMENT AND MECHANISMS	900	CONTAINERS
		1050	SCRAP-METAL
		1060	SPARE PARTS
17	ROAD, RAIL AND WATER VEHICLES	990	MOTOR EQUIP.
		1100	VEHICLES
18	DEVICES (APPARATUS) AND APPLIANCES	610	EQUIPMENT FOR CHEMICAL LABS
		730	STILL
		810	WATER-HEATER
19	ARMS AND AMMUNITION, THEIR SPARE PARTS AND ACCESSORIES	870	CARS, TANKS
20	DIFFERENT MANUFACTURED GOODS	170	CONSTRUCTION
		210	OTHER
		700	PIPES
		770	UNKNOWN
		930	GENERAL CARGO
		980	MISCELLANEOUS
		1110	VESSELS
21	ART PRODUCTS	-	-

Table G.2 - Grouped Commodities and Values of Time for Freight

Aggregated Commodity Group	Commodity codes (from the 21 grouped commodities)	Description	Estimated value of time of commodity in $ per day
1	2	All grains, cereals etc.	10.08
2	11	Cotton and Textiles	1.44
3	13,14,15	Ores, Metals and Stone	1.44
4	5,6,7	Oil, petroleum & minerals	1.44
5	9,16,18,19	Wood, Construction plant, Equipment and machinery	4.32
6	8,10	Dry bulk (include. paper)	1.44
7	17	Vehicles	1.44
8	1,3,4,12,20,21	Other consumer goods	1.44

Table G.3. - Mode Classification

MODE ID	MODE NAME
10	SEA
20	RAIL
30	ROAD
35	PUBLIC TRANSPORT (used in TRANSPORT table only)
40	AIR
45	OTHER

ANNEX H

Tariff Calculations

H. TARIFF CALCULATIONS

H.1 In order to validate the model it is necessary to be able to compare the costs of transporting different categories of commodities over different routes by different modes of transport. The decision of a transporter on the mode of transport for sending his consignment will depend on many factors but can be generalised as a cost function usually made up of three elements:

- unit cost to cover elements independent of the distance transported (loading, unloading, transfers between modes or railway gauges, customs and other duties and taxes levied by authorities on each assignment) -expressed as cost per ton
- costs directly related to the distance travelled on each mode of transport (to cover fuel, staff wages, maintenance etc.) expressed as cost per ton.km
- perceived cost of time taken to deliver goods to their destination, to reflect the transport's preference for modes that reduce the time spent in transit

H.2 Since freight rates are not quoted in this format, it is necessary to deduce the parameters necessary for the model from any available data. It is frequently difficult to obtain detailed or accurate freight rates for reasons of commercial sensitivity, but figures have been obtained from freight forwarders, railway companies and transporters. These have been analysed to develop estimated parameters for the transport factors above.

SOURCES

H.3 Three main sources of data have been used:

- Russian railway rates for containers travelling from the European borders to the capitals of the TRACECA countries

- Sample rates obtained for imports and exports to Kazakhstan, mainly for rail but with some road consignments, together with individual rates quoted as examples in interviews with officials etc.

- figures quoted in other TACIS reports:

  (i) "Forwarding - Multi-modal transport systems"

  (ii) "Transportation of Uzbekistan cotton"

H.4 The results of the analysis of this data is presented below. It should be emphasised that:

- the data sample was rather limited and only covered one or two commodities within a specific grouping

- rates were quoted on both an individual consignment basis (e.g. 15 ton load) and on a period contract basis (e.g. 15000 -20000 ton annual contracts)

- rates are a mixture of direct market rates and indicative reference tariffs. Extra discounts or surcharges may be applied depending on prevailing commercial circumstances.

H.5 The results by mode are given below - all rates are expressed in US dollars.

SUMMARY

Mode	Route/Area/Commodity	Rate $ Per Ton
Road	Traceca	10 + 0.06 per km
	Russia	30 + 0.06 per km
	Bandar Abbas	20 + 0.035 per km
Caspian	salt	2.5
	wheat	5
	general cargo	12
	container goods	28
Sea	Baltic : Europe	40 to 85
	Asia	50 to 90
	Bandar Abbas	150 to 200
	Black Sea	120 to 250

H.6

ANNEX I

Base Year Freight Flows

Table I.1 - Modelled and Estimated Flows Across Major Screenlines

			Eastbound Direction		Westbound Direction	
			Modelled Strategic Flow (000 Tonnes per annum)	Estimated Total Flow (000 Tonnes per annum)	Modelled Strategic Flow (000 Tonnes per annum)	Estimated Total Flow (000 Tonnes per annum)
Screenline 1	Georgia - Black Sea	Road	1344 (62%)	1494 (62%)	499 (27%)	582 (28%)
		Rail	814 (38%)	905 (38%)	1320 (73%)	1466 (72%)
		Total	2159	2398	1819	2049
Screenline 2	Georgia - Azerbaijan/Armenia	Road	641 (43%)	2363 (63%)	740 (34%)	1755 (47%)
		Rail	838 (57%)	1393 (37%)	1460 (66%)	2008 (53%)
		Total	1478	3756	2200	3762
Screenline 3	Azerbaijan - Caspian Sea	Road	1226 (52%)	2143 (51%)	2113 (53%)	3592 (35%)
		Rail	1134 (48%)	2073 (49%)	1868 (47%)	6814 (65%)
		Total	2361	4215	3981	10407
Screenline 4	Caspian Sea - Central Asia	Road	439 (9%)	1277 (10%)	815 (16%)	6669 (31%)
		Rail	4528 (91%)	11284 (90%)	4392 (84%)	14646 (69%)
		Total	4967	12561	5208	21315
Screenline 5	Central Asia (Turkmenistan)	Road	1088 (58%)	3198 (49%)	418 (46%)	1224 (26%)
		Rail	772 (42%)	3376 (51%)	494 (54%)	3572 (74%)
		Total	1859	6573	912	4796
Screenline 6	Central Asia (Uzbekistan)	Road	233 (6%)	1193 (10%)	286 (9%)	1557 (22%)
		Rail	3584 (94%)	11175 (90%)	2779 (91%)	5632 (78%)
		Total	3816	12368	3065	7189
Screenline 7	Central Asia (Kazakhstan)	Road	2940 (92%)	16698 (84%)	6174 (89%)	21036 (88%)
		Rail	253 (8%)	3294 (16%)	756 (11%)	2996 (12%)
		Total	3193	19992	6930	24032
Screenline 8	East Kazakhstan - China	Road	1504 (77%)	2072 (73%)	181 (61%)	396 (68%)
		Rail	467 (24%)	800 (28%)	134 (43%)	200 (34%)
		Total	1970	2872	315	596

Table I.2 - Modelled Strategic Flow by Commodity Across Screenlines

Commodity Type	Screenline 1 Georgia - Black Sea		Screenline 2 Georgia-Azerbaijan/Armenia		Screenline 3 Azerbaijan - Caspain Sea		Screenline 4 Caspian Sea-Central Asia		Screenline 5 Central Asia (Turkmenistan)		Screenline 6 Central Asia (Uzbekistan)		Screenline 7 Central Asia (Kazakhstan)		Screenline 8 East Kazakhstan-China	
	000 Tonnes per Annum	%	000 Tonnes per Annum	%	000 Tonnes per Annum	%	000 Tonnes per Annum	%	000 Tonnes per Annum	%	000 Tonnes per Annum	%	000 Tonnes per Annum	%	000 Tonnes per Annum	%
Grains and cereals	1008	25.3%	443	12.0%	623	9.8%	1440	14.1%	874	31.5%	1414	20.5%	748	7.5%	143	6.2%
Cotton and textiles	269	6.8%	345	9.4%	439	6.9%	757	7.4%	575	20.7%	593	8.6%	14	0.1%	210	9.2%
Ores, metals and stone	558	14.0%	562	15.3%	978	15.4%	1838	18.1%	458	16.5%	1292	18.8%	1913	19.1%	875	38.3%
Oil, petroleum and minerals	1675	42.1%	1828	49.7%	3533	55.7%	4267	41.9%	486	17.5%	2297	33.4%	6746	67.4%	904	39.5%
Timber construct. equipment	26	0.6%	41	1.1%	100	1.6%	220	2.2%	19	0.7%	198	2.9%	365	3.6%	78	3.4%
Dry bulk	50	1.2%	57	1.6%	46	0.7%	55	0.5%	5	0.2%	54	0.8%	18	0.2%	39	1.7%
Vehicles	10	0.3%	11	0.3%	44	0.7%	82	0.8%	21	0.7%	58	0.8%	47	0.5%	7	0.3%
Other Consumer goods	383	9.6%	392	10.6%	580	9.1%	1515	14.9%	334	12.0%	976	14.2%	154	1.5%	31	1.3%
Total	3978	100%	3679	100%	6343	100%	10174	100%	2772	100%	6881	100%	10004	100%	2286	100%

G2730

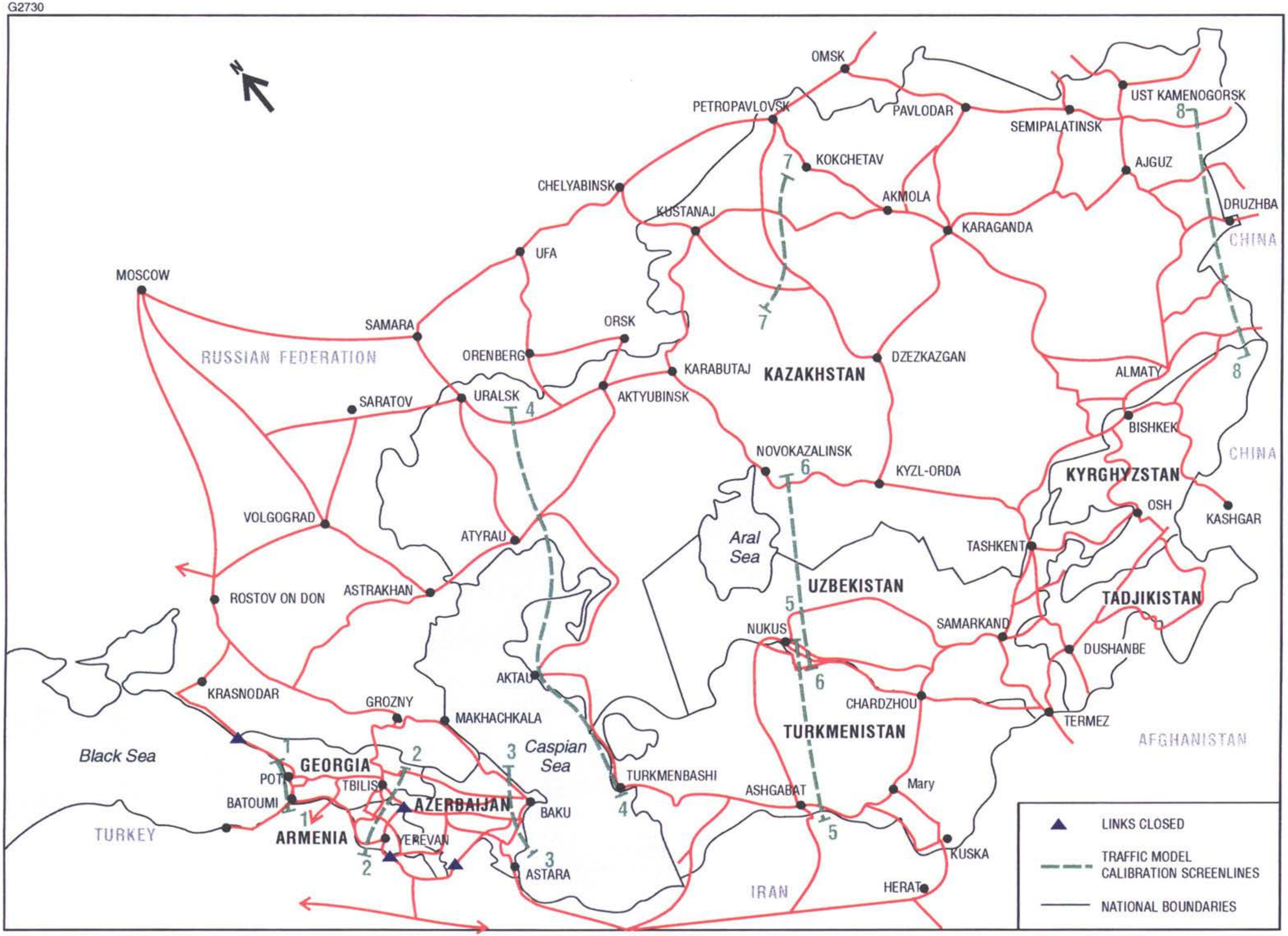

Figure I1
Location of Traffic Model Calibration Screenlines, Road Network

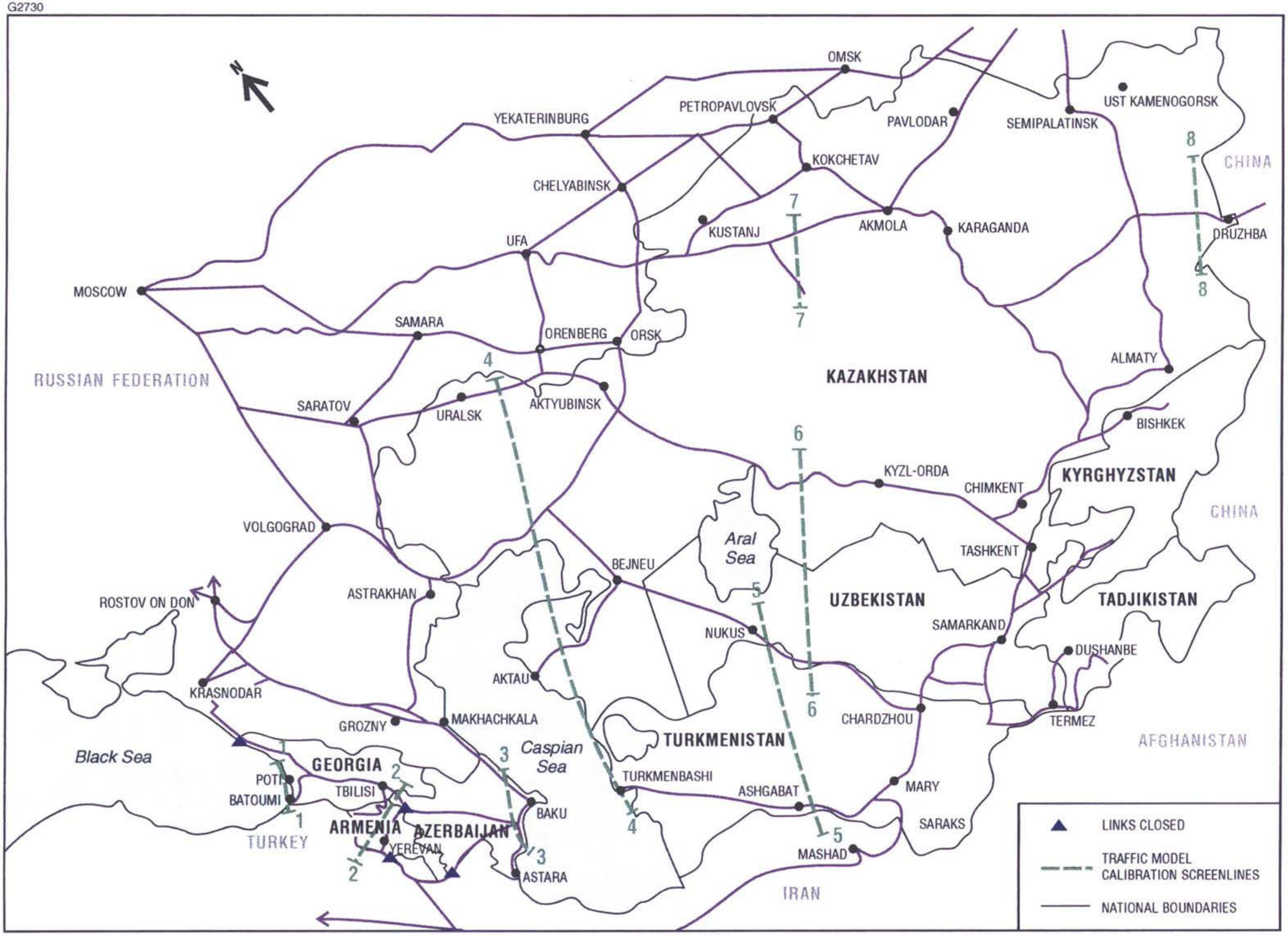

Figure 12
Location of Traffic Model Calibration Screenlines, Rail Network

ANNEX J

Economic and Trade Forecasts

J. ECONOMIC AND TRADE FORECASTS

J.1 This analysis of the current factors influencing economic growth and the likely future prospects in each country was built upon our previous SWOT analysis and lead to the tentative conclusion on ranges of economic growth of GDP as shown in Table J.1 which gives forecast rates for high economic growth, "Central" or most likely and low economic growth.

J.2 In forecasting freight traffic flows and appraising infrastructure investments it is appropriate to consider a range of economic growth expectations with reasonable probability of occurrence. This means that it is not appropriate to forecast the highest possibilities for growth which may not have more than a 1% probability of occurrence. Infrastructure designed to accommodate such a high level of demand would generally be an excessive use of scarce capital resources that could be more beneficially be invested in other projects with greater benefit. In many cases designing in the first place for the highest foreseeable level of demand could result in a completely unaffordable project.

J.3 The appropriate basis of such forecasts is that there is about a 70% probability of the eventual outturn being somewhere between the selected high growth and the selected low growth. There will be a chance (+/-15%) of the outturn being higher or lower than the forecast range. This is unavoidable in the method and periods of peak traffic demand can be accepted as they are anyway short. In the case of freight if the growth rate proves to be consistently faster than forecast then infrastructure strengthening or additional facilities can be planned before the demands seriously swamp the capacity. This one of the main reasons for continuously monitoring the demand year on year.

J.4 Forecasting freight demand on a complex network of routes also combining rail, road and maritime modes has to take account of the inherent suitability of some modes for certain types of freight (commodities) and also transit time, security and tariff issues which are of different relative importance for different commodities. The model has therefore differentiated 8 groups of commodities for forecasting as follows:

- Grains and cereals;
- Cotton and textiles
- Ores, metals and stone
- Oil, petroleum and minerals
- Wood, construction plant equipment etc.
- Dry bulk
- Vehicles
- Other Consumer Goods

J.5 Growth in freight is a function of GDP growth for many commodities. On a World average each 1% of GDP growth produces between 1.2% - 1.5% increases in trade flows by volume.

J.6 Additional relevant factors are the relative cost of labour and capital in the country of forecast. Where labour costs are low trade based on import and export develops more rapidly. Such trade flows are already developing in several of the Traceca countries (Armenia and Uzbekistan). Therefore this factor has been taken into account as 1.5% for 5 years declining to 1.29% in later years. This gives the forecast ranges of growth rates applicable to general trade commodities as shown in Table J.2 and total prospective growth in Table J.3.

J.7 Table H4 summarises the growth rates across the region as a whole for each commodity group.

Table J.1 - Economic Growth Forecast Ranges for the TRACECA Countries % Per Annum

Country	Years Forecast	1996	1997	1998	1999	2000	2001	2002-2006	2007-2011
Armenia	High	6.5	7.5	7.5	7.5	7.5	7.5	6.0	5.0
	Central	6.5	7.0	7.0	6.0	6.0	6.0	5.0	4.0
	Low	6.5	6.5	6.0	5.0	5.0	5.0	5.0	4.0
Azerbaijan	High	-4.4	4.5	5.5	6.0	7.0	9.0	10.0	9.0
	Central	-4.4	4.4	5.0	5.5	7.0	9.0	9.0	8.0
	Low	-4.4	3.5	4.0	5.0	6.0	6.0	7.0	7.0
Georgia	High	8.0	10.0	10.0	9.0	9.0	9.0	8.0	6.0
	Central	8.0	10.0	10.0	7.0	7.0	7.0	5.5	5.0
	Low	8.0	8.0	8.0	6.0	6.0	6.0	5.0	4.0
Kazakstan	High	0.4	1.5	3.5	5.0	5.0	6.0	8.0	8.0
	Central	0.4	1.1	3.0	5.0	5.0	5.5	7.5	7.0
	Low	0.4	1.0	2.5	4.0	4.0	4.0	6.0	5.0
Kyrgyzstan	High	2.4	6.0	6.0	6.0	6.0	6.0	6.0	5.0
	Central	2.4	5.3	5.4	5.5	5.6	5.6	6.0	4.0
	Low	2.4	5.0	5.0	5.0	5.0	5.0	5.0	4.0
Tadjikistan	High	-7.0	1.0	3.6	5.0	5.0	5.0	4.0	4.0
	Central	-7.0	0.3	3.6	4.1	4.1	4.1	3.0	3.0
	Low	-7.0	0.0	2.5	3.0	3.0	3.0	3.0	3.0
Turkmenistan	High	3.7	3.5	3.5	3.5	3.5	3.5	3.5	3.5
	Central	3.7	2.0	2.0	2.0	2.0	2.0	3.5	3.5
	Low	3.7	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Uzbekistan	High	-1.0	1.0	3.0	5.0	5.0	5.0	5.0	5.0
	Central	-1.0	0.5	2.5	4.0	5.0	5.0	3.5	3.0
	Low	-1.0	0.5	1.5	3.0	3.5	3.5	3.5	3.0

Table J.2 - Trade Growth Forecast Ranges for the Traceca Countries % Per Annum

Country	Years Forecast	1996	1997	1998	1999	2000	2001	2002-2006	2007-2011
Armenia	High	9.69	11.18	11.18	11.18	11.18	11.18	7.74	6.45
	Central	9.69	10.43	10.43	8.94	8.94	8.94	6.45	5.16
	Low	9.69	9.69	8.94	7.45	7.45	7.45	6.45	5.16
Azerbaijan	High	6.56	6.71	8.20	8.94	10.43	13.41	12.90	11.61
	Central	6.56	6.56	7.45	8.20	10.43	13.41	11.61	10.32
	Low	6.56	5.22	5.96	7.45	8.94	8.94	9.03	9.03
Georgia	High	11.92	14.90	14.90	13.41	13.41	13.41	10.32	7.74
	Central	11.92	14.90	14.90	10.43	10.43	10.43	7.10	6.45
	Low	11.92	11.92	11.92	8.94	8.94	8.94	6.45	5.16
Kazakstan	High	0.60	2.24	5.22	7.45	7.45	8.94	10.32	10.32
	Central	0.60	1.64	4.47	7.45	7.45	8.20	9.68	9.03
	Low	0.60	1.49	3.73	5.96	5.96	5.96	7.74	6.45
Kyrgyzstan	High	3.58	8.94	8.94	8.94	8.94	8.94	7.74	6.45
	Central	3.58	7.90	8.05	8.20	8.34	8.34	7.74	5.16
	Low	3.58	7.45	7.45	7.45	7.45	7.45	6.45	5.16
Tadjikistan	High	10.43	1.49	5.36	7.45	7.45	7.45	5.16	5.16
	Central	10.43	0.45	5.36	6.11	6.11	6.11	3.87	3.87
	Low	10.43	-	3.73	4.47	4.47	4.47	3.87	3.87
Turkmenistan	High	5.51	5.22	5.22	5.22	5.22	5.22	4.52	4.52
	Central	5.51	2.98	2.98	2.98	2.98	2.98	4.52	4.52
	Low	5.51	2.98	2.98	2.98	2.98	2.98	2.58	2.58
Uzbekistan	High	1.49	1.49	4.47	7.45	7.45	7.45	6.45	6.45
	Central	1.49	0.75	3.73	5.96	7.45	7.45	4.52	3.87
	Low	1.49	0.75	2.24	4.47	5.22	5.22	4.52	3.87

Table J.4 - Percentage Growth In Freight Movements By Commodity Group.

Commodity Group	1995 - 2001		1995 - 2011	
	Low	High	Low	High
1 [1 2]	- 10%		- 5%	
2 [2]	+ 3%		+ 11%	
3	+ 23%	+ 34%	+ 130%	+ 244%
4	+ 35%	+ 59%	+ 89%	+ 142%
5	+ 31%	+ 67%	+ 156%	+ 266%
6	+ 27%	+ 46%	+ 121%	+ 226%
7	+ 38%	+ 53%	+ 109%	+ 213%
8	+ 27%	+ 37%	+ 116%	+ 195%

Notes:

1. Grains and cereal (commodity group 1) movement is expected to decline due to increased national self efficiency of production and reduced reliance on aid following restoration of civil order.

2. Only one growth scenario was adopted for grains and cereal and for cotton (commodity groups 1 and 2 respectively) because the low/high growth range was very narrow in these cases.

Table J.3 - Trade Growth Forecast Ranges for the Traceca Countries
% Growth Over 1995 (based on GDP growth forecasts)

Country	Years Forecast	1995	1996	2001	2006	2011
Armenia	High	100.00	109.69	186.29	270.44	369.65
	Low	100.00	109.69	162.59	222.24	285.81
Azerbaijan	High	100.00	93.44	147.19	269.98	467.58
	Low	100.00	93.44	132.85	204.68	315.36
Georgia	High	100.00	111.92	215.53	352.19	511.28
	Low	100.00	111.92	181.25	247.75	318.62
Kazakstan	High	100.00	100.60	136.10	222.40	363.41
	Low	100.00	100.60	125.98	182.89	249.99
Kyrgyzstan	High	100.00	103.58	158.93	230.72	315.36
	Low	100.00	103.58	148.35	202.78	260.78
Tadjikistan	High	100.00	98.57	118.82	152.81	196.52
	Low	100.00	98.57	105.93	128.08	154.85
Turkmenistan	High	100.00	105.51	136.05	169.66	211.58
	Low	100.00	105.51	122.20	138.80	157.65
Uzbekistan	High	100.00	98.51	129.57	177.11	242.09
	Low	100.00	98.51	117.34	146.33	176.93

ANNEX K

Forecasts of Future Freight Traffic on the Case Studies Developed Using the Model

K. FORECASTS OF FUTURE FREIGHT TRAFFIC ON THE CASE STUDIES DEVELOPED USING THE MODEL

INTRODUCTION

K.1 The future volumes of freight traffic and the modes used for transportation in future will be influenced by many factors, amongst which the most significant will be, future levels of economic activity and GDP, trade volume relative to GDP growth, changes in total transportation costs influenced by changes in tariffs relative to general price inflation in the various countries, network availability, service speed and any delays and other service quality factors.

K.2 The study has considered a range of forecasts of GDP and trade growth as reported in Progress Report No 3 (June 1997). Import/export trade growth factors were derived in this work as reported in the Progress Report. Improvements and additions to the networks and services for testing as "Case Studies" were also identified in Progress Report No 3. This Appendix reports on the results of these Case Studies.

K.3 To provide an appropriate context for the Case Studies the possible changes in future tariff levels are discussed and considered in the following paragraphs concluding with a uniform future tariff level for use in the Case Study tests.

TRAFFIC DENSITIES, REVENUES AND FUTURE TARIFF LEVEL REQUIREMENTS

Future Rail Tariffs

K.4 Throughout the TRACECA countries the present domestic railway freight tariffs are very low by comparison with other countries in Europe. To a slightly lesser extent the international tariffs are also low. A consequence of this policy is that railway revenues do not cover the full operating costs. The principal physical evidence for this is the evident deferral of maintenance over recent years. This has been not simply below the formerly prescribed soviet levels, which were largely time related, but even below the

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essentials needed for continuing the systems in efficient operation. This deferred maintenance is affecting both permanent way and rolling stock. Thus in the Caucuses there are now long stretches of severely speed restricted track including main line. In most of the railways there are locomotives no longer operational for want of spares and maintenance, and some that have been cannibalised to provide parts to keep a core requirement of locomotives in service. This core of operational rolling stock has been gradually dwindling over recent years.

K.5 In most of the countries domestic tariff increases have substantially lagged behind the general levels of cost inflation experienced during the recent economic transition. This has resulted in the rail operating revenues falling below the full costs of operation and financing of the railways at present prices.

K.6 To bring the railway system back to a sustainable level of technical performance will require substantial investment. This is confirmed by several other Traceca corridor technical studies (e.g. Traceca Rail Maintenance Central Asia, DE-Consult; Traceca Infrastructure Maintenance 1 Trans Caucasian Railway, TEWET/DE-Consult.)

K.7 Studies of the organisation and financing of the various newly formed CIS national railways currently underway or recently completed are recommending various restructuring proposals aimed at reducing operating costs and improving efficiency. These studies have shown that a number of efficiency enhancing measures could be taken and that the overall operating cost per train kilometre could be reduced. However for the railways to cover their costs in the future, and to be able to afford a programme of investment to remedy the current deterioration, it will be necessary to raise tariffs.

K.8 The size of the tariff increase needed depends substantially on the present density of traffic relative to the train paths available (a measure of signalling system sophistication and the extent of double tracking), and the possibilities for thorough management restructuring, raising of operational efficiency and cost saving. A further important factor is the nature of the rail traffic, the economics of it's market value and the consequent competitive and market pressures on the tariffs.

K.9 The CIS rail system as a whole has experienced a steep decline in traffic volumes over the last 5 years. This has been due to the rapid economic collapse following the break up of the former Soviet Union and the subsequent process of rationalisation of production and transportation activities. Thus rail traffic levels on parts of the network in northern Kazakstan have dwindled almost to extinction as the former level of Trans-Siberian traffic has fallen to the point where there is no longer the need for these bypass or relief lines.

K.10 Nevertheless Kazakstan still has the highest density of rail traffic within the Traceca. Indeed rail traffic density in Kazakstan is still amongst the highest in the world despite these heavy falls in traffic levels over recent years.

K.11 The Kazakstan railways have been the subject of a restructuring and financial study the results of which are already in the process of implementation to achieve substantial cost savings and to improve efficiency levels. From this financial analysis it is estimated that a tariff increase averaging about 15% - 20% will be needed to finance remedial actions and a sustainable future investment programme.

K.12 All of the other national railways in the Traceca region have substantially lower traffic densities than Kazakstan. However in most cases the other railways need at least comparable levels of investment when expressed on a per route kilometre basis. They are therefore very likely to need higher tariff increases if the systems are to survive in viable form.

K.13 The Turkmenistan railway would appear to be in the most fragile state. The traffic density is relatively low and tariff levels have not been increased to compensate for cost inflation in the economy. Consequently revenue is weak and current costs have had to be pared. The impact of lack of spare parts for rolling stock and consequent deferred maintenance has reduced the availability of locomotives to critical levels. There appears to be a strong likelihood that a large tariff increase will shortly be necessary.

K.14 Taking account of the above factors, the range of possible "real" increases in rail freight tariffs that have been considered in the study over and above the future general level of price inflation are set out in Table K.1. These increases in tariff have been considered as one-off increases taking place before 2001.

Table K.1 - Average Freight Tariff Increases Considered (in "constant prices" above the 1997 price level)

Country	Low rail tariff increase	High rail tariff increase
Armenia, Azerbaijan, Georgia	25%	30%
Kazakstan	20%	20%
Kyrgyzstan, Tadjikistan, Uzbekistan	25%	30%
Turkmenistan	30%	50%

Road Transport

K.15 Existing road freight tariffs are also very low by international standards. This is principally because existing road user taxes and charges are very low, labour costs are low (resulting in low crew costs and maintenance labour costs) and fuel costs are low because of the low tax rate. This situation is very likely to change in the medium term future for two principal reasons:

- the need to replace the freight vehicle fleets increasingly with more fuel efficient diesel trucks and larger trucks that meet international transit freight and environmental standards;
- likelihood of increases in fuel taxes and duties on larger vehicles to recover the full costs of road use and enable governments to fund the proper maintenance of the road network.

K.16 Although the larger vehicles may enable staff economies to be made as well as improved fuel economy derived from more up to date vehicles and in particular increased use of diesel vehicles, since the labour component of operating costs at present is so small and the higher taxes on fuel would offset the improvements in fuel economy, the costs of re-equipment in terms of increased depreciation and interest charges are likely to result in tariffs having to rise. The extent of the road freight tariff increase considered in the study has been judged the same for all countries as follows:

- low increase level +20% in constant prices above 1997 levels
- high increase level +30% "

Maritime Transport

K.17 Existing Maritime tariffs applicable on the Caspian and Black Sea services are generally rather high and much higher than other comparable "short sea routes". This situation appears to have arisen due to low demand hitherto and a lack of competition on these routes, resulting in shipping lines treating them as feeder routes. There does not appear to be a case for assuming that there will be cost pressure to increase tariffs, rather the reverse. This is discussed separately later in this Appendix.

Sensitivity Tests Carries Out on Tariff Levels

K.18 The above assumed rates of increase in rail and road freight tariffs have been combined together in a series of sensitivity tests using the model to asses the possible changes in routeings and modal shifts that may occur. There were therefore four sensitivity tests:

- High rail tariff with high road freight tariff increases;
- High rail tariff with low road tariff increases;
- Low rail tariff with low road tariff increases;
- Low rail tariff with high road tariff increases.

Results of the Tariff Sensitivity Tests

K.19 The results of the four tariff sensitivity tests are shown in Table K2. Generally the effects of high levels of rail tariff increases are that the railway systems lose international traffic to road transport. The loss of rail traffic is reduced or eliminated if road transport tariffs also rise at the higher rate. In the cases of the high road transport tariff increases considered road freight volumes are reduced, most markedly when the rail tariff increase is kept low. These trends are illustrated by reference to the volumes on the trans-caucuses rail and road routes shown in Table K2.

K.20 The effects on the international rail traffic are also well illustrated by examination of the traffic using the main rail line accessing the region through Kyzil-Orda in Kazakstan. The way in which this traffic responds to the tariff increases is summarised in Table K3.

Table K2 RESULTS OF THE TARIFF SENSITIVITY TESTS (effects on international traffic)
All flows in 000 tonnes per year at 2001 forecast international traffic levels

		Tariff increases											
Tariff Regime		**Hi Rail Tariff/Hi Road Tariff**			**Hi Rail Tariff/Lo Road Tariff**			**Lo Rail Tariff/Hi Road Tariff**			**Lo Rail Tariff/Lo Road Tariff**		
KEY LINKS	**Reference flows**	**Test Flows**	**Diff from Ref flow**	**% diff fm Ref.**	**Test Flows**	**Diff from Ref flow**	**% diff fm Ref.**	**Test Flows**	**Diff from Ref flow**	**% diff fm Ref.**	**Test Flows**	**Diff from Ref flow**	**% diff fm Ref.**
CSF E'bd	435	352	-83	-19%	350	-85	-20%	392	-43	-10%	390	-45	-10%
CSF W'bd	487	316	-171	-35%	314	-173	-36%	412	-75	-15%	385	-102	-21%
CSF tot	922	668	-254	-28%	664	-258	-28%	804	-118	-13%	775	-147	-16%
Tr-Cau **Rly** E'bd	245	313	68	**28%**	283	38	**16%**	302	57	**23%**	281	36	**15%**
Tr-Cau **Rly** W'bd	927	1050	123	**13%**	803	-124	**-13%**	1311	384	**41%**	923	-4	**0%**
Sub Total **Rly**	1172	1363	191	**16%**	1086	-86	**-7%**	1613	441	**38%**	1204	32	**3%**
Tr-Cau Rd E'bd	329	250	-79	-24%	302	-27	-8%	249	-80	-24%	290	-39	-12%
Tr-Cau Rd W'bd	1294	1072	-222	-17%	1290	-4	0%	925	-369	-29%	1184	-110	-9%
Sub Total **Road**	1623	1322	-301	-19%	1592	-31	-2%	1174	-449	-28%	1474	-149	-9%
Tr-Cau tot	3967	4048	81	2%	3764	-203	-5%	4400	433	11%	3882	-85	-2%
Ir/Tu **Rly** E'bd	1815	1597	-218	**-12%**	1637	-178	**-10%**	1622	-193	**-11%**	1651	-164	**-9%**
Ir/Tu **Rly** W'bd	2208	1819	-389	**-18%**	1878	-330	**-15%**	1921	-287	**-13%**	1957	-251	**-11%**
Iran Rail Tot	4023	3416	-607	-15%	3515	-508	-13%	3543	-480	-12%	3608	-415	-10%
Ir/Tu Rd E'bd	190	367	177	**93%**	353	163	**86%**	366	176	**93%**	342	152	**80%**
Ir/Tu Rd W'bd	111	114	3	**3%**	114	3	**3%**	114	3	**3%**	114	3	**3%**
Iran Rd tot	301	481	180	60%	467	166	55%	480	179	59%	456	155	51%

Table K2 (Continued)

		Traffic increases											
Tariff Regime		**Hi Rail Tariff/Hi Road Tariff**			**Hi Rail Tariff/Lo Road Tariff**			**Lo Rail Tariff/Hi Road Tariff**			**Lo Rail Tariff/Lo Road Tariff**		
KEY LINKS	**Reference flows**	**Test Flows**	**Diff from Ref flow**	**% diff fm Ref.**	**Test Flows**	**Diff from Ref flow**	**% diff fm Ref.**	**Test Flows**	**Diff from Ref flow**	**% diff fm Ref.**	**Test Flows**	**Diff from Ref flow**	**% diff fm Ref.**
Amu-Darya E'bd	17	43	26	**153%**	39	22	**129%**	42	25	**147%**	41	24	**141%**
Amu-Darya W'bd	258	282	24	**9%**	299	41	**16%**	280	22	**9%**	302	44	**17%**
Amu-Darya	275	325	50	18%	338	63	23%	322	47	17%	343	68	25%
Termez W E'bd	573	915	342	**60%**	902	329	**57%**	895	322	**56%**	880	307	**54%**
Termez W W'bd	26	62	36	**138%**	52	26	**100%**	56	30	**115%**	53	27	**104%**
Termez W	599	977	378	63%	954	355	59%	951	352	59%	933	334	56%
Sub tot	874	1302	428	49%	1292	418	48%	1273	399	46%	1276	402	46%
Kyzl-Orda Rd E'bd	1010	871	-139	-14%	943	-67	-7%	842	-168	-17%	889	-121	-12%
Kyzl-Orda Rd W'bd	357	254	-103	-29%	307	-50	-14%	226	-131	-37%	291	-66	-18%
Kyzl-Orda **Rly** E'bd	6295	5622	-673	**-11%**	5441	-854	**-14%**	5648	-647	**-10%**	5494	-801	**-13%**
Kyzl-Orda **Rly** W'bd	2051	1853	-198	**-10%**	1773	-278	**-14%**	1796	-255	**-12%**	1731	-320	**-16%**
Kyzl-Orda Railway Sub total	8346	7475	-871	**-10.4%**	7214	-1132	**-13.6%**	7444	-902	**-10.8%**	7225	-1121	**-13.4%**

Table K.3 - Effects of Tariff increases on Freight Traffic on the Kyzil-Orda Main Line

	Possible Future Tariff Regimes Tested			
2001 International	Lo Rail/Lo Road	Lo Rail/Hi Road	Hi Rail/Lo Road	Hi Rail/ Hi Road
Reference Freight Annual Traffic volume	% diff. From Reference vol.	% diff. From Reference vol.	%diff. From Reference vol.	% diff. From Reference vol.
8.3M	-13.4%	-10.8%	-13.6%	-10.4%

K.21 From the tests carried out the most striking and consistent result of increases in tariffs for either rail freight or road freight in the Traceca countries generally is to reduce freight flows using routes within the region and to increase the volumes of freight passing through Iran and Afghanistan on the road system to bypass the region. Thus the volumes on the border crossings into Turkmenistan at Kushka/ Saraks and into Uzbekistan at Termez are shown to increase with respect to the base case by about 20% and 50% respectively as can be seen in Table K2. If tariffs are raised within the region to stem railway operating losses and to pay for maintenance and new investment programmes it will be advisable to raise border charges levied on foreign trucks correspondingly. However to avoid excessive consumer price inflation the amount of such charges needs to be moderate and sufficient only to restore a balance in the transport system. This is a matter that could be explored further through road charging analysis and with the model.

K.22 Information available from the TRACECA Project Study of the Cost and Financing of Road Usage and from the EBRD appears to indicate that some tariff and user charge increases will be essential. However the extent of such increases is not known at the present. We have therefore carried out all tests of infrastructure projects using the model with average levels of tariff increase as given in Table K4.

Table K.4 - "Real" Tariff Increases Assumed in the Case Study Traffic Forecasts

	Average Tariff increases considered in Forecasts	
Countries	Rail Tariff	Road Tariff
Kazakstan	20%	25%
Uzbekistan, Kyrgyzstan, Tadjikistan and all Caucuses countries	27.5%	25%
Turkmenistan	40%	25%

GROWTH OF DOMESTIC FREIGHT TRAFFIC DEMAND

K.23 A research project[1] carried out by the World Bank provides a simple method of forecasting the development of national freight traffic in total tonne kilometre terms. The research considered market economies, socialist planned economies, developing country economies and combinations of these three data sets. This was discussed in Progress Report No 2 and the method was used to prepare forecasts presented in the report.

K.24 Forecasts developed on the basis of the equations derived for a combination of market economies and socialist planned economies in the research suggest that most of the Traceca countries are likely to experience further decline in domestic freight demand at least over the near term future as the transition to market economies continues. We have assumed that the situation will stabilise in most countries between the present time and 2001, and that levels of domestic freight movement in 2001 will be similar to the 1995 recorded volumes. The possible exception to this scenario is in Kazakstan where the recorded volume of domestic freight was very high in relation to world trends and more than half of the traffic was accounted for by coal, grain and oil which are significantly threatened by foreseeable economic developments. The coal traffic is under threat on account of adverse market economics of large scale long haul

[1] Policy Research Working Paper "What Determines Demand for Freight Transport?" Esra Bennathan, Julie Fraser and Louis S Thompson, The World Bank. 1992

shipments and energy substitution policies. The traffic of oil tanker wagons will experience short term rapid growth but will be substituted by pipelines in the fairly near future. Other segments of the freight traffic may grow in line with the expected turnaround of the domestic economy but at best the overall domestic freight in 2001 may be the same as in 1995, whilst a low scenario may realistically be assumed as 70% of the 1995 level.

K.25 The forecast growth factors applicable to domestic freight derived from the research discussed above and the considerations in respect of domestic coal, oil and grain traffic mentioned above, are set out in Table K5.

Table K.5 - Growth in Domestic Freight Demand in the Traceca Countries (by comparison with 1995 freight traffic levels)

Country	2001		2010/11	
	Low	High	Low	High
Armenia	1.00	1.00	1.4	1.6
Azerbaijan	1.00	1.00	1.9	2.3
Georgia	1.00	1.00	1.6	1.8
Kazakstan	0.70	1.00	1.3	2.1
Kyrgyzstan	1.00	1.00	1.6	1.8
Tadjikistan	1.00	1.00	1.2	1.4
Turkmenistan	1.00	1.00	1.2	1.4
Uzbekistan	1.00	1.00	1.2	1.4

K.26 The growth factors set out in Table K5 above have been used with the estimated domestic freight traffic on each link in the network to provide forecasts of future domestic freight flows. These have been combined with the forecast international freight flows to give total future freight flows in the high and low growth scenarios for 2001 and 2010/11.

REFERENCE CASE ASSIGNMENT

K.27 A test was prepared as a base against which to assess the effects and implications of all the other case studies. The reference tests were prepared using a 1997 base network including the 1995 calibration networks plus additional links that have been completed and opened to traffic between 1995 and mid 1997. This network therefore included the Turkmenistan - Iran railway connection at Saraks and the Sary-Tash to Kashgar road. The reference case rail network is shown in Figure K1(a) and the road network in Figure K1(b). The results of this test for 2001 are referred to throughout the assessment of the results of the various case studies. Sections of the Reference Case assignment are reproduced in figures as required throughout this appendix.

K.28 The possibilities for development of multi-modal containerised transport service in the Traceca corridor has been analysed and developed in the Study of Forwarding - Multi-modal Transport Systems. The concept developed in that study has been adopted in the Reference Case and in all Case Study Tests including the development of the container handling and transhipment stations identified as "high priority" or "priority" in the Multi-modal study. The network and locations of assumed transhipment stations is shown on figure K2.

K.29 Each of the Case Studies has first been assessed as to the future traffic demands and the extent of freight volume attracted separately against the reference. Following this first assessment process the case studies have been combined into more extensive corridor improvement projects and again assessed against the reference case.

CASE STUDIES IN ARMENIA

K.30 Forecasts have been prepared with the model for three road rehabilitation projects, one railway rehabilitation project and one major new railway extension in Armenia.

Road and Railway Rehabilitation Projects

K.31 The road rehabilitation projects have been the subject of preparation under the Traceca programme. The location of the schemes is shown on Figure K3, brief details are as follows:

- Scheme Ar1, Yerevan - Gumri - Georgian border. The project involves improvement to the existing road up to the existing Georgian border including repaving the existing road and improving the geometry of a few sections. Traffic speeds would increase and safety would be improved. Road capacity would not materially change;

- Scheme Ar2, Yerevan - Sevan - Georgian border. The project involves improvement to the existing road up to the Georgian border including repaving the existing road and improving the geometry. Traffic speeds would increase and safety would be improved. Road capacity would not materially change;

- Scheme Ar3, Yerevan - Meghri - Iran border. The project involves creating a substantially new trunk highway route over some 240 kilometres by repaving and improving the geometry of existing road sections and building several new sections of road to link up the existing roads and create a new trunk route connecting Yerevan with the Iran border at Meghri. The overall route distance would be shortened by comparison with the existing, traffic speeds would increase substantially and the journey time to the border would be significantly reduced. Road safety would be improved. The overall capacity of the route would be improved.

- Scheme Ar4, rehabilitation of the rail line from Yerevan to Tibilisi and operation of a "Pilot Train" block train in the section Tibilisi - Yerevan co-ordinated with the Baku - Poti pilot train;

K.32 The reference case flows over the rail and road networks in the Caucuses are shown in Figures K4 and K5 respectively for 2001.

Cases Ar1 and Ar2 Road Rehabilitation up to the Georgian Border

K.33 The changes in traffic speed over the lengths of road involved up to the Georgian border in both Ar1 and Ar2 achieve total journey time savings of only between 2 and 3 hours in either case. This is not sufficient to cause any change of routeing of the international traffic. Therefore the traffic flows are the same as in the Reference case. Forecast traffic growth to 2011 on both of these routes is shown in Table K6.

Table K.6 - Freight Tonnage Forecast for the Roads from Yerevan to the Georgian Border (all volumes in 000 Tonnes per year)

Road Link Flows (two way)	2001		2011	
	International	Domestic	International	Domestic
Yerevan-Gumri	210	320	340	510
Gumri-Georgia	220	1080	360	1720
Yerevan-Sevan	140	5640	280	9010
Sevan-Georgia	140	1160	290	1860

Case Ar3, Yerevan - Meghri Road Rehabilitation

K.34 The improvement of the roads to the Iranian border (Case Ar3) will save approximately 4 hours in journey time for road freight and this produces a slight change in 2001 traffic routeing as shown in Figure K6. In this Case some 30,000 tonnes per year is attracted away from other roads in the Caucuses by comparison with the Reference Case. This traffic is equally split between Armenia - Iran and transit traffic Iran - Russia. The forecast growth in traffic to 2011 in this Case is shown in Table K7.

Table K.7 - Freight Tonnage Forecast for the Road from Yerevan to the Iranian Border at Meghri (all volumes in 000 Tonnes per year)

Road Link Flows (two way)	2001		2011	
	International	Domestic	International	Domestic
Yerevan-Ararat	460	390	610	620
Ararat - Sisian	500	1670	610	1990
Sisian - Meghri	500	1300	640	2470

Case Ar4, Rehabilitation of the Railway Line Yerevan - Tibilisi

K.35 The rehabilitation of the railway line (Case Ar4) to achieve an improvement of speed over the circuitous route of approximately 320 kilometres from Yerevan via Gumri to the Georgian border, and introduction of a "Pilot Train" from Tibilisi to Yerevan achieves a small transfer of freight to the rail line. This is shown in Table K8. However the test indicates that at standard tariffs this is only likely to be of the order of 85,000 tonnes per year of international traffic by 2001. All this attracted traffic goes out via the Caucuses main line to the east.

Table K.8 - Freight Tonnage Forecast for the Armenian (Yerevan- Tiblisi) Railway (all volumes in 000 Tonnes per year)

Rail Link Flows (two way)	2001		2011	
	International	Domestic in Armenia	International	Domestic in Armenia
Tibilisi- Yerevan	85	450	161	670

Case Ar5, Armenian Railway Extension Project

K.36 The project is for a new railway line to Meghri on the border with Iran and continuing within Iran to link with the existing Iranian railway near Murand, approximately 70 kilometres from the border and about an equal distance from Tabriz. The project location is shown in Figure K7.

K.37 In terms of 2001 demands the new railway would attract approximately 750,000 tonnes of freight as shown in Figure K8. Some 450,000 tonnes of this total flow is traffic with Iran and other eastern countries and 110,000 tonnes is coming from the west (Turkish direction). About 400,000 tonnes (in 2001) would be attracted to the railway from the Armenia - Iran road, and 90,000 tonnes from the Azerbiajan - Iran road, whilst some 250,000 tonnes will be re-routed from the existing Armenia-Georgia road connections. A further 30,000 tonnes of freight per year would be transit traffic between Iran and Georgia attracted to the new rail linkage.

K.38 The new link increases the international freight traffic demand on the eastern Turkish railway marginally to 830,000 tonnes per year in 2001 with 425,000 tonnes in the maximum direction. This is equivalent to approximately 24 fully loaded wagons per day. Depending on the volume of domestic Turkish demand this should be within the capacity of the existing Lake Van wagon ferry.

K.39 International traffic demand on the new rail link Armenia - Iran is forecast to rise to 960,000 tonnes in 2011. The pattern of traffic remains the same as that described above for 2001.

CASE STUDIES IN AZERBAIJAN

K.40 Forecasts of future traffic have been prepared with the model for case studies in Azerbaijan as follows:

- Az1, railway rehabilitation to restore the Azeri main line to a maximum operating speed of 80 KPH for freight, and improvement of Pilot Train transit time in the Azerbaijan sections;

- Az2, road rehabilitation to achieve effective average running speed for freight vehicles of about 40 KPH;

- Az3, reconstruction of facilities at the port of Baku to achieve faster loading/ unloading of the Caspian Sea Ferry (CSF) vessels (Baku - Turkmenbashi) and better facilities for other shipping linkages;

- Az4, a new rail link from Astara on the Azerbaijan/Iran border to join up with the Iranian railway network near Qasvin.

- Az5, increased frequency of the Caspian Sea Ferry by 50% (i.e. to sailing approximately six times per week instead of the three per week frequency of 1995.

K.41 The location of these projects in Azerbaijan are shown on Figure K9 (Trans Caucuses rail and road projects and related maritime projects) and on Figure K7 (rail link Astara - Iran). The context of the Azerbaijan trans-caucuses projects as parts of a larger strategic project for the TRACECA corridor as a whole is apparent from Figure K9. This is discussed later in this appendix under comprehensive international multi-modal Case Studies.

K.42 The reference case flows over the rail and road networks in the Caucuses are shown in Figures K4 and K5 respectively for 2001.

Case Az1, Rehabilitation of the Main Trans-Caucuses Railway in Azerbaijan

K.43 The freight flows in 2001 after rail rehabilitation (Case Az1) are shown in Table K9. The improvement in average speed results in a saving of transit time of about 6 hours. This relatively small improvement in transit time is because of the need for freight trains to change crew and locomotive at rather frequent intervals. This test results in an increase in international freight of about 130,000 tonnes per year on the railway. Almost all of this increase is in freight between Russia and Georgia/ Azerbaijan which in the Reference Case was using road transport through the Caucuses on the North-South Russian-Georgian route through the Kezbegi crossing.

Table K.9 - Freight Tonnage Forecast for the Trans - Caucuses Railway in Azerbaijan and Changes over the Reference Case (all volumes in 000 Tonnes per year)

Rail/Road Link Flows	2001		2011	
(two-way)	International	Domestic	International	Domestic
Baku - Buyu-Kasik rail	2200	2500	4500	5900
Derbend - Baku rail	2900	3400	6400	7200
Buyu-Kasik - Tibilisi rail	2200	2100	4500	4300
Kasbegi - Tibilisi road	650	1900	740	3500

Case Az2, Trans-Caucuses Road Rehabilitation in Azerbaijan

K.44 The traffic effects on freight demand in 2001 of the road rehabilitation project (Az2) are shown on Figure K10 (road flows). The effect is to increase the flows on the main Trans-Caucuses road by between 240,000 and 480,000 tonnes per year. About 20,000 tonnes per year of this increase transfers from the railway and between 120,000 and 440,000 tonnes of the increase arises from concentration of road freight on the improved route and away from the minor mountain road and the border crossing with Georgia at Belokani/Lagodechi. Table K10 shows the forecast growth in freight traffic to 2011 on the main road sections in this case.

Table K.10 - Freight Tonnage Forecast for the Trans - Caucuses Road Rehabilitation Case in Azerbaijan, and Changes over the Reference Case (all volumes in 000 Tonnes per year)

Road Link Flows	2001		2011	
(two-way)	International	Domestic	International	Domestic
Baku - Aljat	3800	5600	7050	12800
Aljat - Jevlach	1650	590	3050	900
Jevlach - Georgia	2030	390	3490	900

Case Az3, Reconstruction and Improvement of Baku Port Facilities

K.45 The traffic effects of the Baku port improvement project (Case Az3) on freight flows on the Caspian shipping routes using Baku are discussed below. This test shows that the proposed improvements to Baku port, by reducing loading time substantially would have about a 10% effect on the freight volumes crossing the Caspian Sea Ferry (CSF). The volumes using the CSF in 2001 increase from 840,000 tonnes per year in the reference case to 910,000 tonnes per year with the case of the improved port.

Case Az4, Astara - Iran Railway Link

K.46 The effect of the Astara - Iran railway link (Case Az4) is shown in Figure K11 for the rail flows and Figure K12 for the road flows. The rail link attracts 1.2 million tonnes of international freight per year, mainly from the existing Astara - Iran road but also some transit traffic from Russia and northern Kazakstan which is presently using a number of routes to cross Kazakstan, Uzbekistan and Turkmenistan to reach Iran or

Afghanistan. The traffic on this new rail connection is forecast to grow to 1.7 million tonnes per year by 2011.

Case Az5, Caspian Sea Ferry (CSF) Frequency Increase

K.47 The improvement in the CSF frequency from intermittent sailings of approximately three per week in 1995 to an assumed frequency of about six sailings per week halves delays at the ferry and on its own causes a 55% increase in the attraction of traffic in the ferry route's corridor of influence. Freight flows on the more frequent CSF service increase to 1.3 million tonnes per year in 2001. This traffic would grow to 2 Million tonnes per year by 2011.

K.48 A reduction in the tariff by 25% is shown by the model also to have a substantial effect. A combined increase in frequency and 25% reduction in tariff attract about an additional 670,000 tonnes per year to the CSF in 2001, an 80% increase in it's freight traffic above reference case flows. The effect should be very likely to increase revenues despite the tariff reduction. This effect on 2001 forecast traffic is shown in Figure K13 for the rail flows and Figure K14 for the road flows. In this case significant volumes of additional international freight traffic are also attracted to the railway networks both in Azerbaijan (24% increase) and in Turkmenistan (37% increase). About half of this traffic increase is attracted from Southern Russia and half is attracted away from the Iranian rail and road connections.

CASE STUDIES IN GEORGIA

K.49 Forecasts of future traffic have been prepared with the model for case studies in Georgia as follows (the schemes are shown on Figure K9):

- Ge1, Trans-caucuses rail line rehabilitation and improvement projects to restore the main line to an average operating speed of 80 KPH;
- Ge2, road rehabilitation and pavement management systems for the Trans caucuses main road network to restore traffic operations to normal speeds for freight traffic;

- Ge3, rehabilitation, improvement and extension of facilities at the ports of Poti and Batoumi to reduce ship berthing difficulties, loading/unloading delays and consequent demurrage charges, and to thereby improve the ports throughput;

- Ge4, possible implementation of a ro-ro rail wagon ferry on the Black Sea between Poti and Illechevsk (Odessa), also other ro-ro operations between Poti and Bulgarian ports. Co-ordination of the schedules of the Ro-Ro rail wagon ferry with the Trans-Caucuses block train to achieve a minimum loading/unloading delay at the port;

- Ge5, improvements to capacity and reduction in delay at existing road border crossings with Turkey;

- Ge6, improvements to capacity and reduction in delay at the border crossing with Azerbaijan at Red Bridge (Krasni Most);

- Ge7, improvements to capacity and reduction in delay at existing road border crossings with Southern Russia.

RESULTS OF THE CASE STUDY TESTS FOR GEORGIA

Case Ge1 Trans Caucuses Rail Rehabilitation

K.50 The results of the test of the Trans-caucuses rail line rehabilitation is summarised in Table K11. Overall there is no change from the reference case as the change in journey time arising from the improvement in Georgia alone is not sufficient to attract additional traffic to the route.

Table K.11 - Freight Tonnage Forecast for the Trans - Caucuses Railway in Georgia (all volumes in 000 Tonnes per year)

Rail Link Flows	2001		2011	
(two-way)	International	Domestic	International	Domestic
Tibilisi - Samtredia	2300	1110	4140	1990
Samtredia - Poti	1400	440	2400	800
Samtredia - Batoumi	920	530	1740	950
Tibilisi - Bujuk-Kasik	2100	2110	4230	3750

Case Ge2 Trans Caucuses Road Rehabilitation

K.51 The results of this test are given in Table K12. The road from Tibilisi to Poti would carry an additional 30,000 - 90,000 tonnes of freight per year. The maximum level of two-way traffic on the first section from Tibilisi to Mtskheta is forecast at 11.7 million tonnes per year in 2001 (combined international and domestic traffic). The 2001 2 way flow at Samtredia would be 4.6 million tonnes per year.

Table K.12 - Freight Tonnage Forecast for the Trans - Caucuses Roads in Georgia (all volumes in 000 Tonnes per year, two-way)

Road Link Flows	2001		2011	
	International	Domestic	International	Domestic
Tibilisi - Mtskheta	1490	10300	2280	18500
Mtskheta - Gori	1350	6640	2010	11950
Gori - Khashuri	1550	4840	2030	8720
Khashuri - Samtredia	710	3890	720	7000
Samtredia -Poti	100	3220	110	5800
Poti - Batoumi	240	760	340	1200
Sarpi	537	30	990	50
Khashuri - Akhaltsikhe	850	120	1330	220
Mtskheta - Russia	684	940	800	1350
Gori - Russia	146	2560	270	5670
Tibilisi - Armenia	1120	130	1880	230
Tibilisi - Azerbaijan	1760	310	2990	550

Case Ge3, Improvements to the Ports of Poti and Batoumi

K.52 Improvements to the ports of Poti and Batoumi have been considered on the basis of the information in the feasibility reports. The improvements have been represented in the model as reducing the ship loading/discharging times by less than half a day. Whilst of substantial benefit to shipping this improvement in freight transit time is not a sufficient improvement in transit on it's own to result in any additional traffic being attracted to the corridor. The freight volumes forecast for 2001 remain as in the reference case, 1.9 million tonnes at Poti and 0.9 million tonnes per year at Batoumi.

Case Ge4, Establishment of a Ro-Ro Rail Wagon Ferry between Poti and Illechevsk

K.53 The establishment of a wagon ferry operation on the Black Sea with ship loading by means of a "link span" lifting bridge between the vessel and the shore represents a substantial saving of time on both the passage (reduction from 55 hours to 40 hours) and on the loading /unloading time for a complete train of 50 - 60 wagons. This development is assumed to reduce average loading/ unloading from 28 hours to 12 hours. These savings in transit time and loading delay totalling 31 hours are sufficient to attract extra traffic.

K.54 The effects of this case are summarised in Table K13. The wagon ferry with its improved loading and unloading time and superior transit time would attract an additional 200,000 tonnes of freight in 2001. Some 140,000 tonnes of this would be in the eastbound direction. On the basis of one sailing per week this would imply 2700 tonnes per eastbound passage. This would be equivalent to about 90 wagons with 40ft laden containers. Alternatively 55 wagons fully laden with baled or other non-containerised goods. The westbound loads would be about 43% of the eastbound with the possible addition of empty containers if returned. The forecast development of this traffic to 2011 is also shown in Table K13.

K.55 The traffic attracted to the wagon ferry in the test is attracted equally from other shipping routes via Batoumi or Poti and from the road route from Georgia through Turkey.

K.56 The test shows that in 2001 there would continue to be some 1.65 million tonnes of other freight traffic passing through Poti bound for other Black Sea Ports. It is possible that the wagon ferry service could win some of this traffic also as the model in its present strategic corridor level of detail, is not able to differentiate the normal loading time for the other traffic from the improved loading time for the wagon ferry.

Table K.13 - Forecast Freight Traffic Using the Ro-Ro Wagon Ferry on the Black Sea Without Corridor Service Co-ordination (all traffic in 000 tonnes per year)

Port of Poti	2001	2011
Wagon Ferry	200	310
Other traffic	1650	3000

Case Ge5. Border crossing improvements with Turkey

K.57 The demand freight volumes forecast for the border crossings with Turkey are shown in Table K14.

Table K.14 - Forecast Freight Volumes for the Border Crossings Georgia - Turkey (all flows are International Traffic only in 000 tonnes per year)

Border Crossing	2001	2011
Sarpi	500	950
Ackalciche	900	1490

Case Ge6, Border Crossing Improvements with Azerbiajan and new bridge at Red Bridge

K.58 Demand freight volumes forecast for the road and rail border crossings with Azerbaijan are shown in Table K15.

Table K.15 - Forecast Freight Volumes for the Border Crossings Georgia - Azerbaijan (all volumes are international traffic only in 000 tonnes per year)

Border Crossing	2001	2011
Road, Red Bridge	1700	2900
Road, Belokani/Lagodechi	1200	2200
Rail, Bujuk-Kasik	2100	4200

Case Ge7, Border Crossing improvements with Russia

K.59 Demand freight volumes forecast for the road the border crossings with Russia are shown in Table K16.

Table K.16 - Forecast Freight Volumes for the Border Crossings Georgia - Russia (all volumes are international traffic only in 000 tonnes per year)

Border Crossing	2001	2011
Kazbegi	640	800
Matusonskij	160	270
Abkhazia	NA	NA

CASE STUDIES IN KAZAKSTAN

K.60 Forecasts of future traffic have been prepared with the model for case studies in Kazakstan as follows (the schemes are shown on Figure K15, Figure K16 and K17):

- Ka1, a new rail link from Arkalyk to Kyzil-Orda passing through Dzenkagzan. This will provide a direct link between Jesil and Kyzil-Orda (940 km) thus linking southern regions of Kazakstan with northern Kazakstan and with the new capital at Akmola and avoiding the need for the 2300 kilometre deviation via Chimkent and Tchu (one of the busiest sections of the Kazak railway) or for passing through the Russian railway system at Orsk (1850 km);

- Ka2, Aktau - Bejneu rail line rehabilitation and improvement (shown in Figure K9). This is a key link in the northern branch of the Traceca corridor, linking the oil fields of western Kazakstan with the Caspian Shipping link to Baku and the Trans-caucuses rail and road links;

- Ka3, improvements at Aktau port facilities for Aktau - Baku shipping including possibly restarting the ferry;

- Ka4, a new Aktau - Turkmenbashi rail line, shown in Figure K16. This is an international project involving a new rail border crossing between Kazakstan and Turkmenistan. The proposed rail line would carry traffic between north-western Kazakstan as well as the Russian industrial areas around Yekaterinberg, Ufa and Orsk, and Iran and Turkmenistan. The new rail route would avoid the need for the north south traffic to transit Uzbekistan twice on the existing Bejneu - Chardzhou line. This project would be in direct competition with a possible Caspian Sea north - south shipping line;

- Ka5, a new road link between Almaty (Azunagac) and Buvaldai shown on Figure K17. This would be a more direct connection between Almaty and Bishkek and would also shorten the route Almaty-Kashgar (China);

- Ka6, rehabilitation and improvement to the road Almaty - Akmola - Kotchetav in Kazakstan.

K.61 The Reference case 2001 assignment results for Kazakstan are shown in Figure K18 (rail traffic) and Figure K19 (road traffic).

RESULTS OF THE KAZAKSTAN CASE STUDY TESTS

Case Ka1, rail link from Arkalyk to Kyzil-Orda

K.62 The 2001 annual freight volumes as a result of the new rail line are shown in Figure K20 for the railway network. The proposed new rail line would attract freight volumes of about 5 million tonnes per year including 1.1 million tonnes per year of international freight in the section Arkalyk - Dzezkazgan, and about 5.7 million tonnes including 1.3 million tonnes of international traffic in the section Dzezkazgan - Kyzil-Orda. The scheme would connect with the existing rail branch to Dzezkazgan from

Karaganda and would result in an additional 400,000 tonnes per year using this branch.

K.63 The scheme would reduce loadings on the Russian railway through Orsk and Kartali by 1.7 million tonnes per year. The scheme would reduce loadings on the sections Kyzil-Orda - Tchimkent, Tchimkent - Tchu, and Tchu - Karaganda by 270,000 tonnes, 620,000 tonnes and 1.3 million tonnes per year respectively. By shortening the route between Eastern Kazakstan and West Kazakstan / Southern Russia, the new connections place an additional load of some 660,000 tonnes per year of international traffic on the Aktyubinsk - Aralsk - Kyzil-Orda sections of this main line within Kazakstan. The international traffic on this section would therefore rise to some 9 million tonnes per year (25,000 tonnes per day), and total traffic to 17.8 million tonnes per year, in 2001.

K.64 The scheme would also enable freight traffic to use a number of routeing combinations for connections east-west. For the rail line Tobol - Jesil - Akmola the model indicates an overall increased of some 1.3 million tonnes per year between Tobol and Jesil and an increase of 1.4 million tonne between Jesil and Akmola.

Case Ka2, rehabilitation of the rail line from Aktau to Bejneu

K.65 The rehabilitation of this 404 kilometre section of the railway network would reduce journey times by just under 4 hours, from the 1995 level of about 8 hours to about 4.25 hours. The results of the test of this Case on it's own shows that there would be no improvement in freight loading on account of the shortened journey time but the forecast is for a substantial traffic growth by 2011 on account of underlying economic growth in this region of Kazakstan. The forecast freight traffic is shown in Table K17

Table K.17 - Freight Tonnage Forecast for the Aktau - Bejneu line (all volumes in 000 Tonnes per year)

Rail Link Flows	2001		2011	
	International	Domestic	International	Domestic
Aktau - Bejneu	570	1190	2380	2500

Case Ka3, Port improvements at Aktau

K.66 The case of improvement of Aktau port facilities as an individual free standing project results in an attraction of an additional 100,000 tonnes per year of international freight to the Baku - Aktau - Bejneu - Aktyubinsk corridor. The majority of this diverted traffic is between southern Russia and Azerbaijan to and from the western region of Kazakstan.

K.67 The additional traffic would grow by a further 420,000 tonnes by 2011 resulting in a total freight volume of 2.5 million tonnes per year by 2011 due to the developments and economic growth expected in the western regions of Kazakstan.

K.68 The forecasts for this case study must be dependant on any possible improvements of the Russian railway network through Astrakhan which would compete with the Baku - Aktau - Bejneu corridor of this additional traffic.

Case Ka4, new rail line between Aktau and Turkmenbashi in Turkmenistan.

K.69 The results of the test are shown in Figure K21 (rail traffic flows) and Figure K22 (road traffic flows). The proposed new railway line would attract international freight of about 1.8 million tonnes per year in 2001. Since the existing road in this corridor is very circuitous, in a poor condition and slow, the availability of a rail connection would eliminate the road freight traffic in the corridor. The more widespread effects of the scheme are indicated as differences from the reference case in Table K18. Since the link is an international connection it will not effect the domestic traffic volumes.

Table K.18 - Freight Tonnage Forecast for the Aktau - Turkmenbashi Rail Link Scheme (all volumes in 000 Tonnes per year, two way)

Rail / Road Link Flows	2001[1]	2011[2]
Rail Aktau - Turkmenbashi	1,800	+4410
Rail Bejneu - Aktau	+ 1,500	+3600
Rail T'menbashi- Ashgabad	+ 830	+1970
Rail Bejneu - Nukus	- 550	+10
Rail Atyrau - Makat	+ 440	+2100
Rail Makat - Oktjabrsk	+ 550	+4500
Road Kizyl-Arvat - Iran	- 170	+320
Road Aktau - T'bashi	- 230	0
Road T'bashi - Kizyl-Arvat	- 150	+100
Road Kizyl-Arvat - Ashgabad	- 50	+160
Road Astara - Iran	- 110	+960

1 Changes in international freight volumes compared to the Reference Case.
2 Growth from 2001

K.70 By strengthening the railway network the scheme achieves transfer of road freight to rail in several corridors (e.g. Bejneu - Aktau and Astrakhan - Makat). The scheme results in a transfer of traffic from the rail links on the western side of the Caspian Sea and using the Caspian Sea Ferry to reach Turkmenistan to the eastern side of the Caspian Sea using the new link to access Turkmenistan.

Case Ka5, New Road connecting Almaty to Buvaldai

K.71 This scheme, which is shown in Figure K17, would achieve a more direct connection between Almaty and Bishkek than the existing road. The new road would also shorten the route by road from Almaty to Kashgar in China. The traffic demand is summarised in Table K19. The new road would attract about one third of the traffic between the two capital regions.

Table K.19 - Freight Tonnage Forecast for the Almaty-Buvaldai-Bishkek Road (all volumes in 000 Tonnes per year)

Road Link Flows	2001		2011	
	International	Domestic	International	Domestic
Almaty - Uzunagac	920	500	1500	1050
Uzunzgac - Buvaldai	530	0	900	0
Buvaldai - Bishkek	650	1100	890	1600
Almaty - Bishkek (old road)	400	500	620	1040

Case Ka6, Road improvements Almaty - Akmola - Kotchetav

K.72 This Case Study involves the improvement of 1500 kilometres of roads connecting the Northern and Southern regions of Kazakstan with the new capital at Akmola. The improvement is forecast to result in changes in freight traffic volumes in 2001 as shown on Figure K23 for the road traffic and Figure K24 for the forecast consequent impact on rail freight traffic. The pattern of road traffic forecast for 2011 is shown in Figure K25. The scheme attracts traffic onto the improved roads and also onto connecting roads from Djambul - Tchu in the Southern region, to Petropavlovsk - Kotchetav in the North. The scheme would attract traffic away from the railway sections Almaty - Kotchetav - (1.7m tonnes per year) and from the competing roads via Tchimkent, Kyzil-Orda, Djezgazan and Arkalyk.

CASE STUDIES IN KYRGYZSTAN

K.73 Forecasts of future traffic have been prepared with the model for case studies in Kyrgyzstan. The schemes are shown on Figure K26 (rail schemes) and K27 (road schemes):

- Ky1, new rail link between Balkashi (Issyk-Kul) and Djalalabad (to link to the present Djalalabad - Osh rail spur) shown on Figure K26;

- Ky2, new rail link between the Djalalabad - Osh rail spur (off the Uzbek Fergana valley rail line) and Kashgar in Western China. Three possible routes for this rail connection have been studied as shown on Figure K26;

- Ky3, improvement of the Bishkek - Kashgar road up to the Torugart pass shown on Figure K27;

- Ky4, creation of a new strategic level road connection between Djalalabad and the Torugart pass crossing into China through a substantial upgrading of existing village roads in this area of Kyrgyzstan, shown on Figure K27;

- Ky5, possible new road link between Buvaldai and Almaty (see Ka5, and figure K22).

K.74 The Reference Case traffic flows are shown on Figure K28 for rail freight flows and Figure K29 for road freight flows. These Figures also show the Tadjikistan network.

RESULTS OF THE CASE STUDIES IN KYRGYZSTAN

Case Ky1 New Rail Link Balkashi - Djelalabad - Osh

K.75 Figures K30 (rail traffic) and K31 (road traffic) show the 2001 traffic forecasts for this case. The new rail line attracts 3.7 million tonnes per year in 2001. Some 970,000 tonnes per year comes from the Bishkek - Djelalabad - Osh road. Some 1 million tonnes per year of international traffic between Osh or Andizan (the Fergana valley in Uzbekistan) and Northern Kazakstan/Russia is re-routed from Tashkent and the Kokand corridor route to access the Fergana valley via the new rail line. Also about 400,000 tonnes to/from Samarkand is routed via the new connection through the Fergana Valley. Thus the rail traffic on the Kokand corridor route falls from 4.21 million tonnes per year to 3.3 million tonnes per year.

Case Ky2 New Rail Link between Osh/Djelalabad and Kashgar (China)

K.76 Three routes are currently the subject of a technical and economic feasibility study for this new rail connection. These are shown on Figure K26. The model has been used to test the attractiveness of two of the options under study.

K.77 The options selected for test were the shortest route to Kashgar and the longest route. Figures K32 (rail traffic) and K33 (road traffic) show the volumes of freight attracted. The shortest rail route to Kashgar (option 2 shown on Figure K26) attracts about 1.3 million tonnes of international traffic per year in 2001 and relieves the Sary-Tash - Kashgar road of 300,000 tonnes and the Bishkek - Kashgar road of 160,000 tonnes per year. The international traffic demand on this rail option is forecast to increase to 2.3 million tonnes per year by 2011.

K.78 In the case of the longest rail route via Djelalabad, (option 3 on Figure K26) the scheme is much less attractive to the traffic and only some 150,000 tonnes per year are attracted to this route. The route is circuitous and insufficiently attractive to achieve any significant re-routeing of freight traffic away from the existing border crossing at Druzhba. Neither does the route appear to attract freight away from the Sary-Tash - Kashgar road or the Bishkek - Kashgar road to any degree despite the assumption that the railway line would operate at a higher speed than the road freight average speed attained.

Combined Rail Links Bishkek - Djelalabad - Osh and Djelalabad - Kashgar (Option 3)

K.79 The results of this combined test are shown in Figures K34 (rail links) and K35 (road links). The traffic effects of this combined scheme are summarised in Table K20. The new rail linkage relieves the Bishkek - Kashgar road of a significant proportion of the international freight traffic as well as the Bishkek - Osh road.

Table K.20 - Freight Tonnage Forecast for the Combined Rail Links Osh - Kashgar, Bishkek - Kashgar Scheme (all volumes in 000 Tonnes per year)

Rail / Road Link Flows	2001 International	2011 (Growth from 2001) International
Rail Djelalabad - Kazarman	+3480	+2490
Rail Kazarman - Balkashi	+3550	+2420
Rail Kazarman - Kashgar	+220	+90
Rail Kokand - Andizan	-825	+1880
Rail Lugovoj - Bishkek	+3150	+4380
Rail Tashkent - Kokand	-825	+1880
Road Sary-Tash - Kashgar	-5	+535
Road Bishkek - Kashgar	-140	+150
Road Bishkek - Osh	-1300	-30

Ky3, Improvement of the Bishkek - Kashgar road

K.80 This scheme would improve the surface condition, geometry and capacity of the Bishkek - Kashgar road within Kyrgyzstan and has been assumed to improve the average speed for road freight vehicles from the existing 26 KPH by about 10% up to 29 KPH. The distance is about 320 Kilometres and therefore the time saving will be less than 2 hours. This small saving will not have any effect on the routeing of traffic. Therefore the basic traffic forecast for the scheme is shown in the "reference case" assignment. The forecast freight flows are as shown in Table K21.

Table K.21 - Freight Tonnage Forecast for the Bishkek - Kashgar Road (all volumes in 000 Tonnes per year)

Link Flows	2001		2011	
	International	Domestic	International	Domestic
Bishkek - Kashgar	340	310	530	560

Ky4, New Strategic Road Djelalabad - Torugart

K.81 The results of the test of this scheme are shown in Figure K36. The proposed new road attracts about 220,000 tonnes per year in 2001 (52% of the Osh - Kashgar traffic) off the Sary-Tash - Kashgar road and on to this alternative route over the Torugart pass. The remainder of the traffic remains on the Kashgar - Sary-Tash road. There are no other significant effects.

CASE STUDIES IN TADJIKISTAN

K.82 Forecasts of future traffic have been prepared with the model for case studies in Tadjikistan as follows (the schemes are shown on Figure K37):

- Ta1, the Anzob and Shakristan mountain tunnels project on the Dushanbe - Ura-Tube road. This project involves repaving the road and provision of tunnels to avoid the highest road section of the Anzob/ Shakristan passes (3378 metres) by means of tunnels approximately 200 metres below each pass. It is understood that this scheme would enable the road to remain open to traffic for 2 to 3 months longer each year than the 7 months of summer opening at present;

- Ta2, a new road connection from eastern Tadjikistan near Murgab, to join the Karakorum Highway in western China between Kashgar and Taxkorgan. This project would provide direct linkage to China without the need for Tadjik traffic to transit Kyrgyzstan, and to Pakistan and southern ports without the need to transit Afghanistan and Iran.

- Ta3, a new road to join Kulaab with Kalajchum via Zigar. This scheme would serve predominantly national traffic. In terms of the traffic model the scheme lies entirely within one zone and does not materially facilitate traffic movement on the international network. The scheme is not therefore suitable for assessment with the model.

K.83 The Reference network assignment for Tadjikistan with 2001 traffic is shown along with the Kyrgyzstan network in Figure K28 for rail flows and K29 for road traffic.

RESULTS OF THE CASE STUDIES IN TADJIKISTAN

Case Ta1, The Anzob and Shakristan mountain tunnels

K.84 The reconstructed route with tunnels would be about 30 kilometres shorter than the existing road (a time saving of about 1.5 hours). A large part of the route would be repaved and regraded as well as provision of the tunnels. It is expected that the improved road could be kept open to traffic for at least 10 months of the year (compared to the present 7 months of availability of the route) and, with improved snow clearing on the paved road it may be possible to keep it open for 12 months. The forecast freight traffic flows in 2001 and 2011 for the tunnel case are shown in Table K22. The table also shows the flow changes on the alternative route via Samarkand. The detour involved when the existing mountain passes are closed by snow and bad weather, is so large that only the most essential trips are made at the present time. About 10,000 tonnes freight per month may divert to the Samarkand - Ura-Tube road via Bekabad.

Table K.22 - Freight Tonnage Forecast for the Gissarski mountain tunnel Road (all volumes in 000 Tonnes per year, two way with Tunnels Open)

Link Flows	2001			2011	
	International	Domestic	Changes in International traffic from Reference Case	International	Domestic
Gissarski mountain tunnel route	890	1650	+100	1380	2300
Dushanbe - Samarkand	910	830	+50	1310	1160
Dushanbe - Termez	540	500	-40	780	700
Samarkand - north Tadjikistan	50	400	-30	70	560

Case Ta2, Murgab - Karakorum Road

K.85 The results of the Murgab - Karakorum highway connection are shown in Figure K38. This scheme affects the distribution of road traffic only, there are no effects on the railway network. The traffic attracted to the scheme in 2001 would be 60,000 tonnes per year. This traffic would mainly be diverted from the Termez border crossing and from the Sary-Tash road border crossing. The traffic forecast for 2011 is 95,000 tonnes per year.

CASE STUDIES IN TURKMENISTAN

K.86 Forecasts of future traffic have been prepared with the model for case studies in Turkmenistan as follows (the schemes are shown on Figure K39):

- Tu1, reconstruction of the Rail and road bridges over the Amu-Darya river at Chardzhou;
- Provision of a new international rail line between Turkmenbashi and Aktau. This scheme has already been described under the list of schemes in Kazakstan, as scheme reference Ka4;
- Tu2, provision of a new rail line from Kazanzik, on the Turkmenbashi - Ashgabad main line, to cross the border with Iran near Kizyl Atrek and link up to the existing Iranian line at Bandar Torkeman on the Caspian Sea. This

facilitating traffic between the Russian industrial areas around Yekaterinberg, Ufa and Orsk/ Orenberg, and Iran and the Iranian Gulf ports.

- Tu3, improvements to the Port of Turkmenbashi to increase capacity and reduce loading times for the Caspian Sea Ferry;

- Tu4, road improvement in the sections Turkmenbashi - Ashgabad - Chadzhou up to first category standard depending on traffic.

K.87 We are aware of a number of other long term schemes for the development of the Turkmenistan railway system such as Ashgabad - Chodjeli - Kizylgaia and Kerki - Saraks direct. The locations of these schemes are also shown on Figure K39 but tests of these schemes have not been included in the present Case Studies for testing as discussed and agreed with the Co-ordinating Consultants and the Local Technical Partners.

K.88 The results of the Reference Case assignment of 2001 traffic in Turkmenistan are shown on Figure K40 for rail flows and A41 for road traffic.

RESULTS OF THE TURKMENISTAN CASE STUDIES

Case Tu1 Chardzhou Bridges

K.89 The traffic flows forecast for the Chardzhou bridges are set out in Table K23.

Table K.23 - Freight Tonnages Forecast for the Chardzhou Bridge (000 tonnes per year, two way flows)

	2001		2011	
Rail / Road Freight	International	Domestic	International	Domestic
Rail Eastbound	370	940	580	1320
Rail Westbound	750	3000	1380	4210
Road Eastbound	290	2370	400	3310
Road Westbound	360	1400	520	1960

Case Tu2, Kazanzik - Kizyl Atrek - Bandar Torkeman Rail Line

K.90 The traffic demand for this link is forecast at 2.4 million tonnes per year (6,700 tonnes per day) in 2001 as shown in Figure K42. Of this traffic 67% is in the direction north to south with 33% in the reverse direction. Some 270,000 tonnes per year transfers from the existing road border crossing at Gudriolym near Kizyl-Atrek whilst a further 111,000 tonnes per year transfers from the Ashgabad - Bajgiram road border crossing. Some 600,000 tonnes per year is attracted to the new line from the eastern direction and about 700,000 tonnes from the west. The scheme reduces freight traffic on the Turkmenbashi - Kazandzik - Kizyl-Arvat road between 150,00 and 250,000 tonnes per year (400 - 700 tonnes per day). Freight traffic on the Bejneu-Nukus railway line reduces by 100,000 tonnes per year. The effect on the railway border crossing at Saraks is a reduction of 1,020,000 tonnes per year.

K.91 Traffic on the link is forecast to increase to 3.6 million tonnes per year in 2011.

Case Study Tu3. Reduced loading delay at Turkmenbashi Port.

K.92 This scheme affects international traffic only. The effects of the improvements to the port of Turkmenbashi on forecast international freight volumes are shown in Figures K43 and K44. The scheme has been assumed to halve the loading and unloading times. The result is an increase of 20,000 tonnes per year on the CSF. Because the port improvements would effectively benefit the rail loading/unloading times most the improvements result in an increase in rail freight of 90,000 tonnes per year on the Turkmenbashi - Nebit-Dag line and a small reduction in road freight on the parallel road from Turkmenbashi to Nebit-Dag.

K.93 There is also an increase of road freight of 70,000 tonnes per year on the Turkmenbashi - Aktau road as the Turkmenbashi port improvements attract traffic away from the direct Baku - Aktau shipping lane. However this result may indicate that the slower loading direct shipping route becomes very similar in "generalised cost" to the Baku - Turkmenbashi - Aktau alternative in this case and arise from the model's multiple routeing technique.

K.94 On the western side of the Caspian the scheme is forecast to very marginally increase freight loadings on the Trans-Caucuses railway by 20,000 tonnes per year. This traffic gain all comes from the Iran-Turkey rail link.

Case Tu4, Turkmenbashi-Ashgabad-Mary-Chardzhou Road Improvement

K.95 This scheme is to improve the road to first category standard in the former Soviet system of road categorisation. The need and timing of this will depend on the traffic growth. The road traffic demands from the Reference case assignment for 2001 and 2011 are shown in Table K24. The forecast freight volumes in 2001 imply a road traffic flow in the range 450-700 trucks per day in the heaviest section from Ashgabad to Mary.

Table K.24 - Freight Tonnages Forecast for the Turkmenbashi - Chardzhou Road (000 tonnes per year, two way flows)

	2001			2011	
Key Road Sections	International	Domestic	Change from Reference Case	International	Domestic
Turkmenbashi - Nebit Dag	350	770	+20	470	1080
Nebit Dag - Kazandzik	1050	260	+25	1290	350
Kazandzik - Ashgabad	250	1080	+15	410	1510
Ashgabad - Mary	490	2800	+50	740	3930
Mary - Chardzhou	660	0	+100	880	0

CASE STUDIES IN UZBEKISTAN

K.96 No Case Studies for international traffic in Uzbekistan were put forward for examination with the model.

COMPREHENSIVE INTERNATIONAL CORRIDOR IMPROVEMENTS

Case C1, The North - South Rail link, (Combined case Tu2 and Ka4)

K.97 The combined case of the two North - South schemes taken together attracts more traffic than either of the schemes individually. The scheme location is shown in Figure K45. The results of this combined case test are shown in Figures K46 (Rail Freight) and A47 (Road freight). The principal effects are summarised in Table K25. It can be appreciated from Table K25 that by 2001 the combined schemes are attracting international traffic amounting to almost 600,000 tonnes per year from southern Russia and this traffic is forecast to grow substantially by 2011. Combined with traffic from western regions of Kazakstan and traffic from Turkmenistan the combined north-south schemes highly attractive to traffic.

Table K.25 - Freight Tonnage Forecast for the Combined North - South Rail Links Scheme Kazakstan - Iran (all volumes in 000 Tonnes per year)

Rail / Road Link Flows	International Traffic Only	
	2001	2011 (Change from 2001)
Rail Aktau - Turkmenbashi	2,300	+2900
Rail Kazandzik - Iran	2,600	+1500
Rail Bejneu - Aktau	+ 1,900	+3800
Rail Turkmenbashi-Kazanzik	+ 2,000	+5200
Rail Kazandzik - Ashgabad	+ 1,100	+1300
Rail Bejneu - Nukus	- 550	0
Rail Atyrau - Makat	+ 330	+2200
Rail Makat - Oktjabrsk	+ 600	+4600
Road Kizyl-Arvat - Iran	- 520	+300
Road Aktau - T'bashi	- 230	0
Road T'bashi - Kizyl-Arvat	- 400	+90
Road Kizyl-Arvat - Ashgabad	- 160	+70
Road Astara - Iran	- 480	+540

Case C2, The Traceca corridor Illechevsk - Poti - Baku - Turkmenistan - Kazakstan

K.98 The analyses of the separate schemes described above has identified the traffic attractiveness and routeing effects of individual schemes. In this section we have carried out a tests on networks including comprehensive improvements in the whole of the Traceca corridor. The network in this test included the following improvements:

- Ro-Ro wagon ferry across the Black Sea to Poti operating on a regular schedule;

- improvements at the port of Poti to reduce ship berthing time and loading/unloading time;

- co-ordination of the schedules of the ro-ro ferry with the arrival/departure of the "Pilot Train" to achieve an effective time of 12 hours from arrival to departure at Poti;
- operation of the Pilot Train (Poti - Baku) with improved operating speed as a result of railway rehabilitation in Georgia and Azerbaijan;
- improvements in the port of Baku to achieve faster turnaround time for shipping;
- regular daily scheduled departures of the Caspian Sea Ferry to Turkmenbashi;
- improved frequency of sailing Baku - Aktau;
- improvements at the ports of Turkmenbashi and Aktau to achieve faster turnaround time for shipping;
- rehabilitation of the Aktau - Bejneu railway line;
- reconstruction of the Chardzhou bridges for railway and road traffic.

K.99 The locations of the above network improvements are shown on Figure K9

K.100 The traffic effects of this comprehensive corridor improvement are much more than the sum of the component parts. With co-ordination of the ro-ro vessel sailing schedules and the Trans- caucuses freight train schedule, the model shows there is a possibility of attracting up to 1.1 million tonnes per year of additional international traffic into the Traceca corridor. The traffic attraction would fully utilise a weekly sailing of the Ro-Ro ferry from Illichevsk to Poti in both directions. The additional traffic is diverted principally from the Iran - Turkey road corridor. The results of this test on 2001 flows are shown in Figures K48 for rail traffic and Figure K49 for road traffic. The main changes are summarised in Table K26.

Table K.26 - Freight Tonnage Forecast for the Comprehensive Traceca Corridor Improvement (all volumes in 000 Tonnes per year)

Link Flows	2001		
	Domestic	International	Change in International
Ro-Ro wagon ferry	0	575	+165
Other Black Sea shipping	0	2780	+15
Samtredia - Poti rail	450	1700	+250
Tibilisi - Samtredia rail	1400	3000	+700
Tibilisi - Bujuk-Kasik rail	2100	3200	+1100
Bujuk-Kasik - Baku rail	2650	3200	+1100
Baku - Turkmenbashi CSF	100	1150	+450
Baku - Aktau shipping	50	500	+180
Aktau - Bejneu rail	1200	650	+100
Turkmenbashi - Ashgabad rail	2700	1750	+400
Turkmenbashi - Ashgabad road	800	1100	+50
Ashgabad - Mary rail	3900	1600	+350
Mary Chardzhou rail	5200	1150	+70
Ashgabad - Mary road	2800	400	-30
Mary Chardzhou road	3300	600	+30

K.101 The effects of a 25% reduction in tariff on both the CSF and on the Ro-Ro ferry on the Black Sea have also been assessed to see if such a pricing policy could be of interest in that it may attract additional traffic into the corridor sufficient to have the potential to increase revenues above those achieved with the existing tariffs. The results are summarised in Table K27. The model forecasts that the potential result of this stratagem could be approximately a 50% increase in Trans-Caucuses rail loading and on the CSF. The traffic for the Ro-Ro wagonferry on the Black Sea could increase as much as an 500% above the Reference case level, attracted to the more keenly priced corridor service to achieve some 3.3 million tonnes per year in 2001 on the wagon ferry and up to 5 million tonnes of international traffic on the Trans-Caucuses railway (the trans-caucuses railway also carries non wagon ferry traffic). The CSF would benefit to the extent of an extra 1 million tonnes per year to achieve a total load of 1.7 million tonnes per year. The Baku - Aktau service would also carry extra volume forecast at 230,000 tonnes per year. Traffic on the Aktau-Bejneu rail line and Turkmenbashi - Ashgabad rail line are also shown to increase substantially.

Table K.27 - Freight Tonnage Forecast for the Comprehensive Traceca Corridor Improvement with Reduced Shipping Tariffs (all volumes in 000 Tonnes per year)

Link Flows	2001		
	Domestic	International	Change in International
Ro-Ro wagon ferry	0	3350	+2950
Other Black Sea shipping	0	1850	-700
Samtredia - Poti rail	450	3000	+1650
Tibilisi - Samtredia rail	1400	4400	+2100
Tibilisi - Bujuk-Kasik rail	2100	5100	+3100
Bujuk-Kasik - Baku rail	2650	5100	+3100
Baku - Turkmenbashi CSF	100	1700	+1000
Baku - Aktau shipping	50	655	+230
Aktau - Bejneu rail	1200	1300	+720
Turkmenbashi - Ashgabad rail	2700	2650	+1300
Turkmenbashi - Ashgabad road	300	950	-100
Ashgabad - Mary rail	8900	2350	+850
Mary - Chardzhou rail	5200	1300	+250
Ashgabad - Mary road	2800	80	-330
Mary - Charedzhou road	3300	470	-80

K.102 The additional traffic attracted to the Traceca corridor would come approximately 25% from the southern Russia rail network and 75% from the Turkey - Iran road and rail networks. Changes to the border crossing tariff regimes between the southern Traceca countries and Iran/Afghanistan could further increase the Traceca corridor traffic volumes.

Case C3, North-South Shipping links on the Caspian Sea, Russia/Kazakstan - Iran

K.103 This scheme is shown on Figure K50. The scheme would include the following through shipping links, Atrau-Astrakhan-Baku-Anzali with a rail connection from Anzali to the Iranian railway network. The shipping scheme would be in competition with existing rail links between Southern Russia and Baku and with road links as shown in Figure K50.

K.104 The assignment result to the combined rail/ shipping network is shown in Figure K51. The results of this test are summarised in Table K28. The combined shipping and rail operation attracts traffic from the north-south road connections on both sides of the Caspian, and especially from road connections with Iran. The shipping link between Baku and Anzali is forecast to attract 3.4 million tonnes per year in 2001 much of it coming from the parallel roads. The shipping link from Astrakhan to Baku is apparently much less attractive with 550,000 tonnes per year assigned to this link. This part of the shipping lane is in competition with the existing Astrakhan - Grosny - Derbend - Baku railway connection.

K.105 The attractiveness of the shipping route will be affected by the existing rather high tariff regime prevalent in the Caspian which has been assumed to continue in this test. However since the Astrakhan - Baku shipping link is more than double the distance of the CSF there may be scope for tariff economics on account of a higher proportion of effective sailing time to total trip turnaround time (including cargo discharging time) resulting in greater efficiency of the transport link. There may therefore be scope to reduce the tariff and thereby attract additional traffic. This could be explored further with the model by the local partners should it be of interest.

Table K.28 - Freight Tonnage Forecast for the Caspian Sea North - South Shipping Scheme, Russia/Kazakstan - Iran (all volumes in 000 Tonnes per year)

Links	Domestic	2001 International	Change in International
Ship Atyrau - Astrakhan	100	1060	+150
Rail Atyrau - Astrakhan	11000	6200	+1020
Ship Astrakhan - Baku	60	550	+100
Rail Astrakhan - Grosny	0	2600	+90
Rail Grosny - Derbend - Baku	3900	3100	+150
Ship Aktau - Baku	50	550	+130
Road Aktau - Turkmenbashi	250	100	-130
Ship Baku - Anzali	0	3400	Newlink
Road Baku - Iran	4680	900	-2400
Road Turkmenbashi (Kazandzik) Iran	0	650	-500
Rail Anzali - Tehran	0	3400	Newlink

CONCLUSION

K.106 The model has been used in these Case Studies to test a wide variety of future possible developments in transport in most of the Traceca Countries. These tests have included tariff changes for all of the modes represented in the model involving 6 tests, 16 test of improvements in network performance through rehabilitation and reconstruction measures and 14 tests of possible new links in the network. Four tests of operational changes have been assessed. The transport system developments have been considered individually and in combinations. A total of 46 case studies in all have been assessed.

K.107 The survey of importers and exporters and freight forwarders carried out as part of the study data collection showed that the cost and time of transit are the two most important factors in route choice, in that order. The model has performed logically and shows through the tests completed so far that freight transport route choice reacts to changes in the tariffs and to time savings. Many individual schemes are not sufficient on their own to have any impact on overall routeing due to the relatively small time savings provided by individual schemes. Only when schemes are considered in combinations does this result in substantial extra traffic.

K.108 The data base should be maintained up to date. In particular the matrix of international commodity movement should be kept up to date as a basis for updating the forecasts of future traffic.

FURTHER INVESTIGATIONS POSSIBLE IN THE FUTURE

K.109 From the results of the tests carried out and the Case Studies analysed with the model in the present work the following case studies appear worth further investigation with the model in due course:

- It appears that a co-ordinated corridor wide tariff restructuring project would be worthy of consideration, especially on the railways, on the Caspian Sea Ferry and possibly other shipping routes on the Caspian Sea (e.g. North-south route) and for the proposed Ro-Ro wagon Ferry on the Black Sea;

- Border crossing charges, especially for the external borders of the Traceca countries;

- the relative merits and economic benefits of the north-south rail route Kazakstan -Turkmenistan - Iran compared to parallel shipping services on the Caspian Sea;

- further co-ordination possibilities in the Tracea corridor generally and particularly in the Trans-Cauccuses corridor and it's interaction with the traffic at the border crossings to Southern Russia;

- the new rail linkages proposed in Kazakstan and their re routing effects;

- the Andizan/Osh - Kashgar rail options;

K.110 In addition the extension of the model in each of the countries to include more detailed consideration of National Traffic flows will be advisable in the future, for the full potential of the model as an essential project appraisal tool to be fully realised.

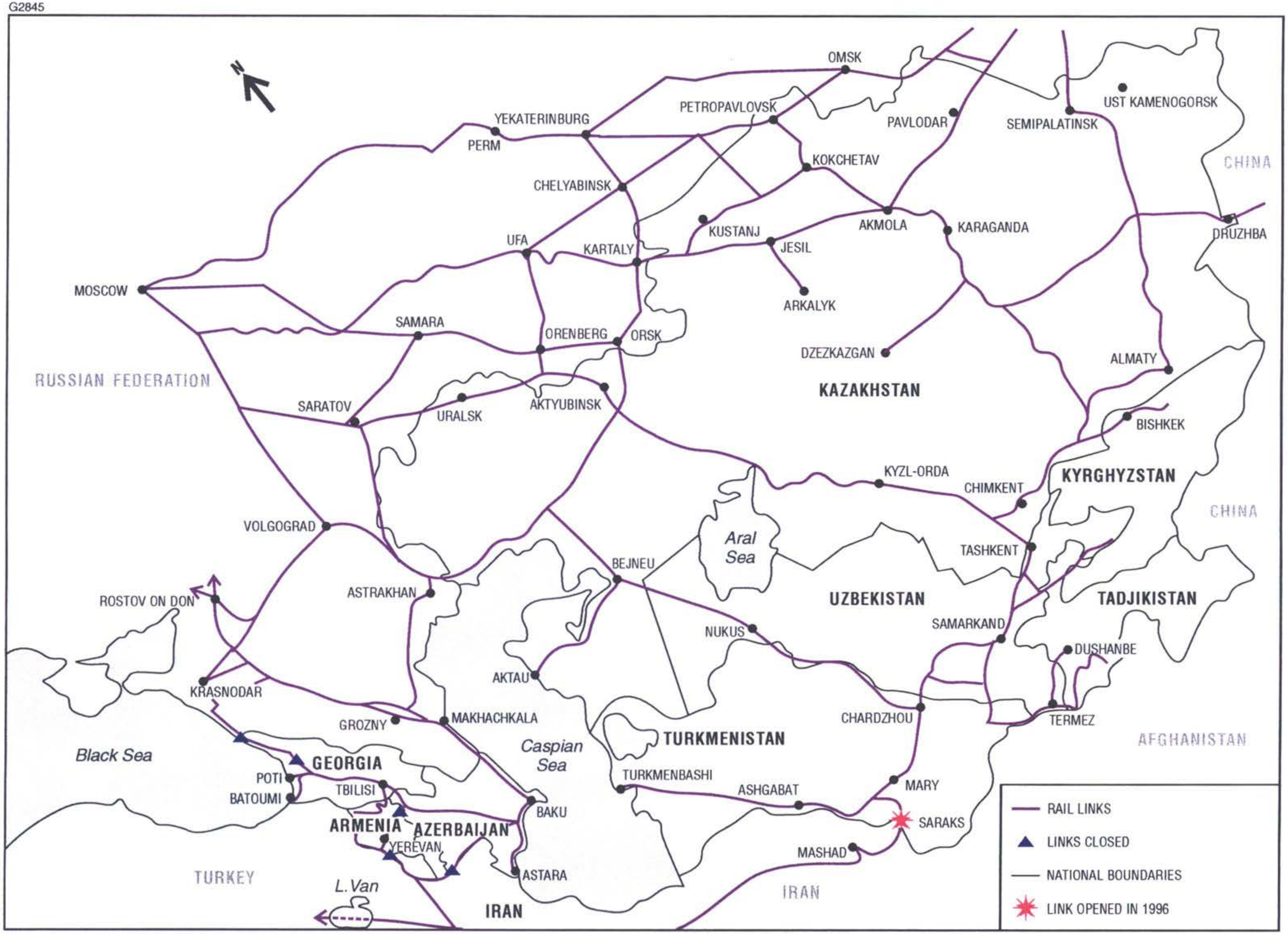

Figure K1(a)
The 1997 'Reference' Rail Network

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G2845

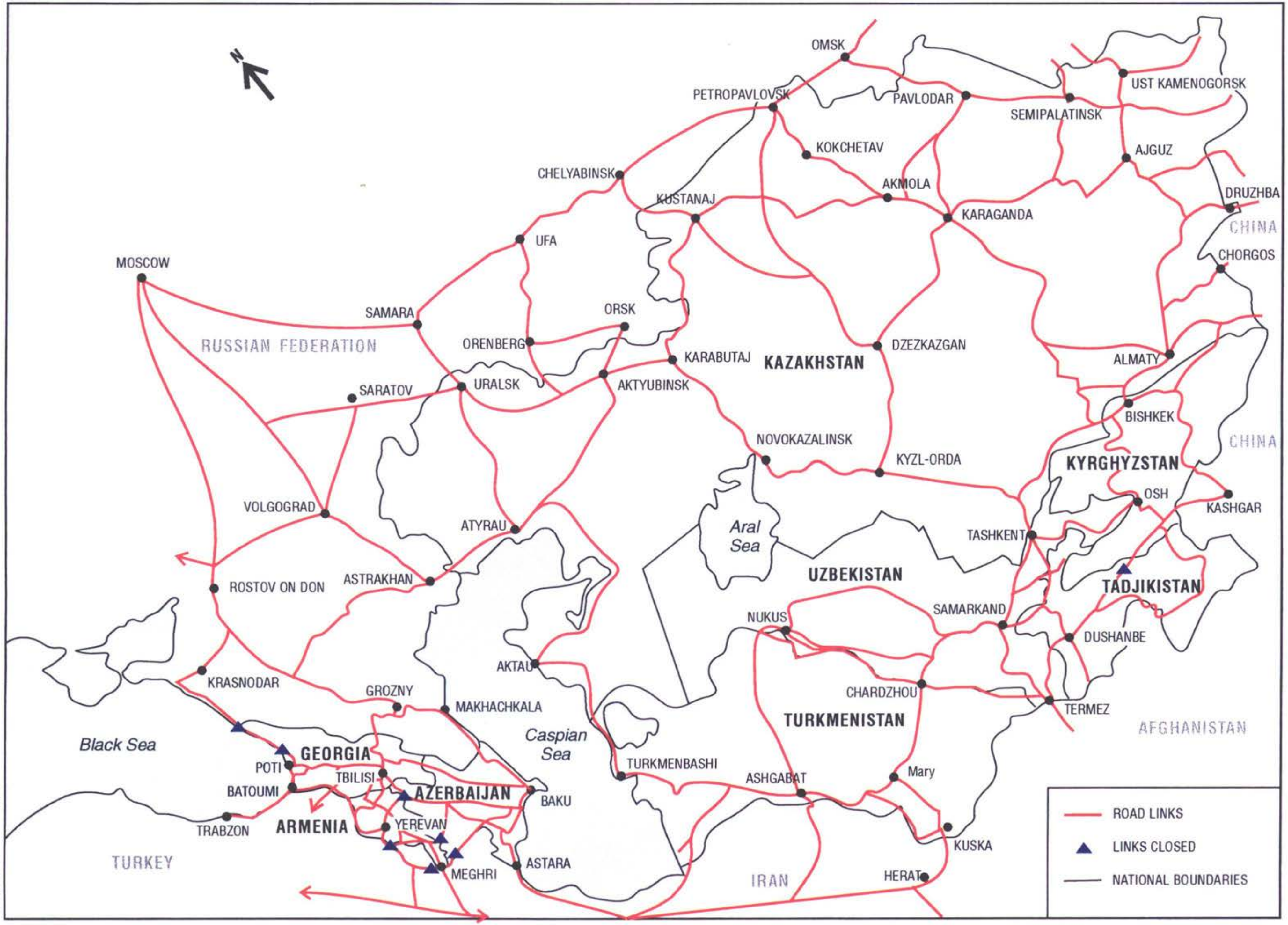

Figure K1(b)
The1997 'Reference' Road Network

142

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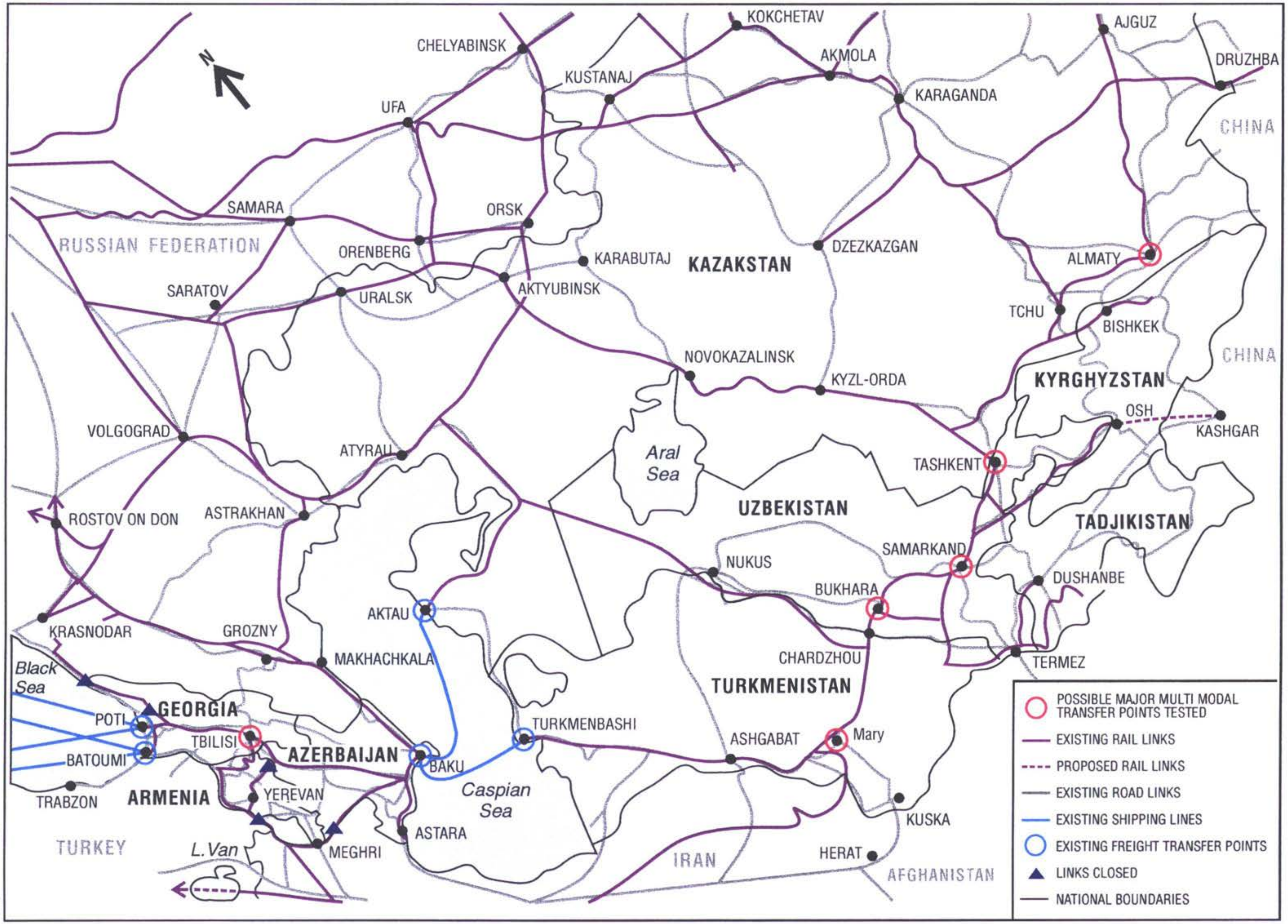

Figure K2
Possible Future MajorMulti Modal Freight Transfer Points on Rail Network

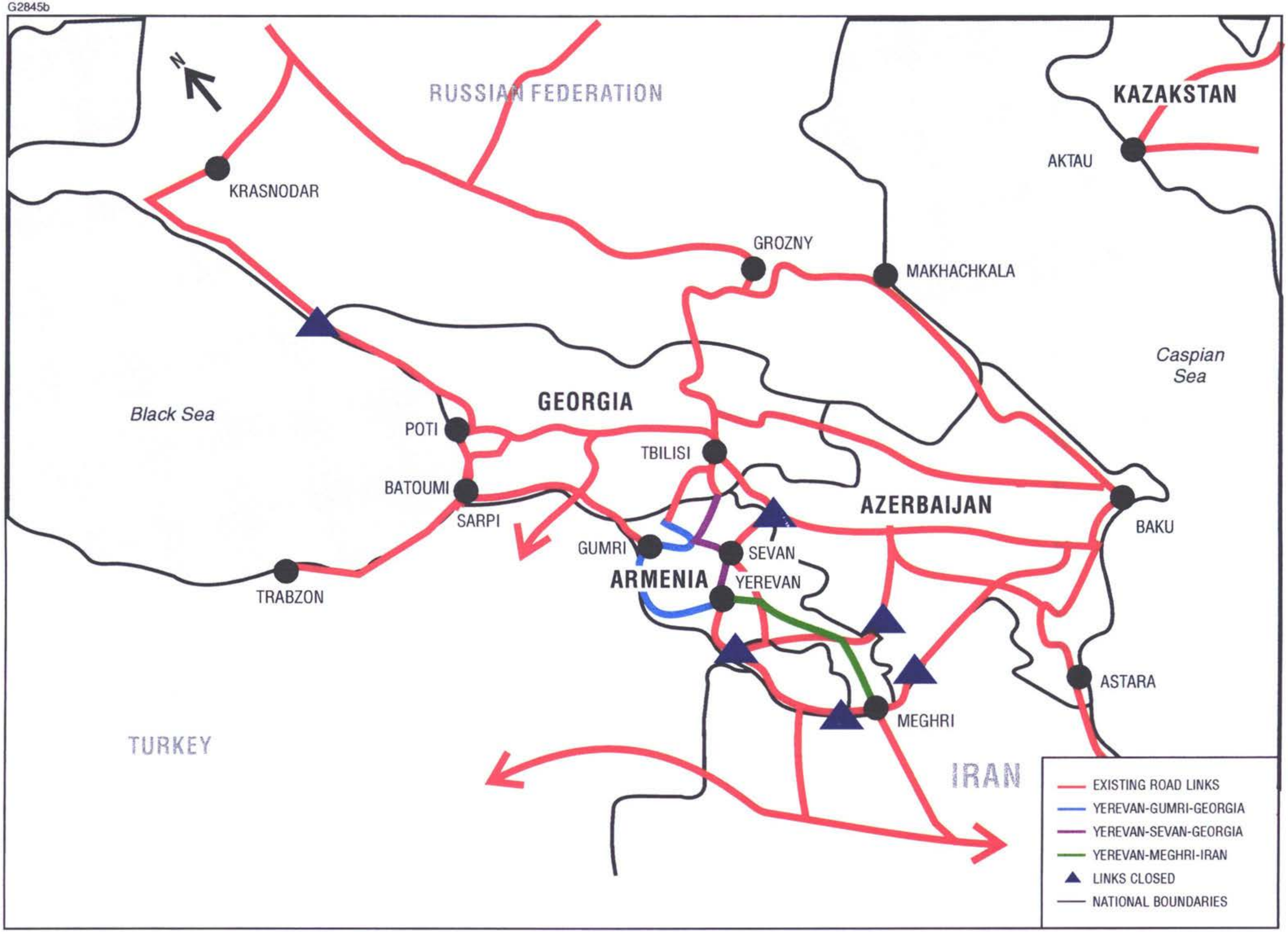

Figure K3
Road Improvement Schemes in Armenia

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Figure K4
2001 Reference Case Flows in Caucases Rail Network

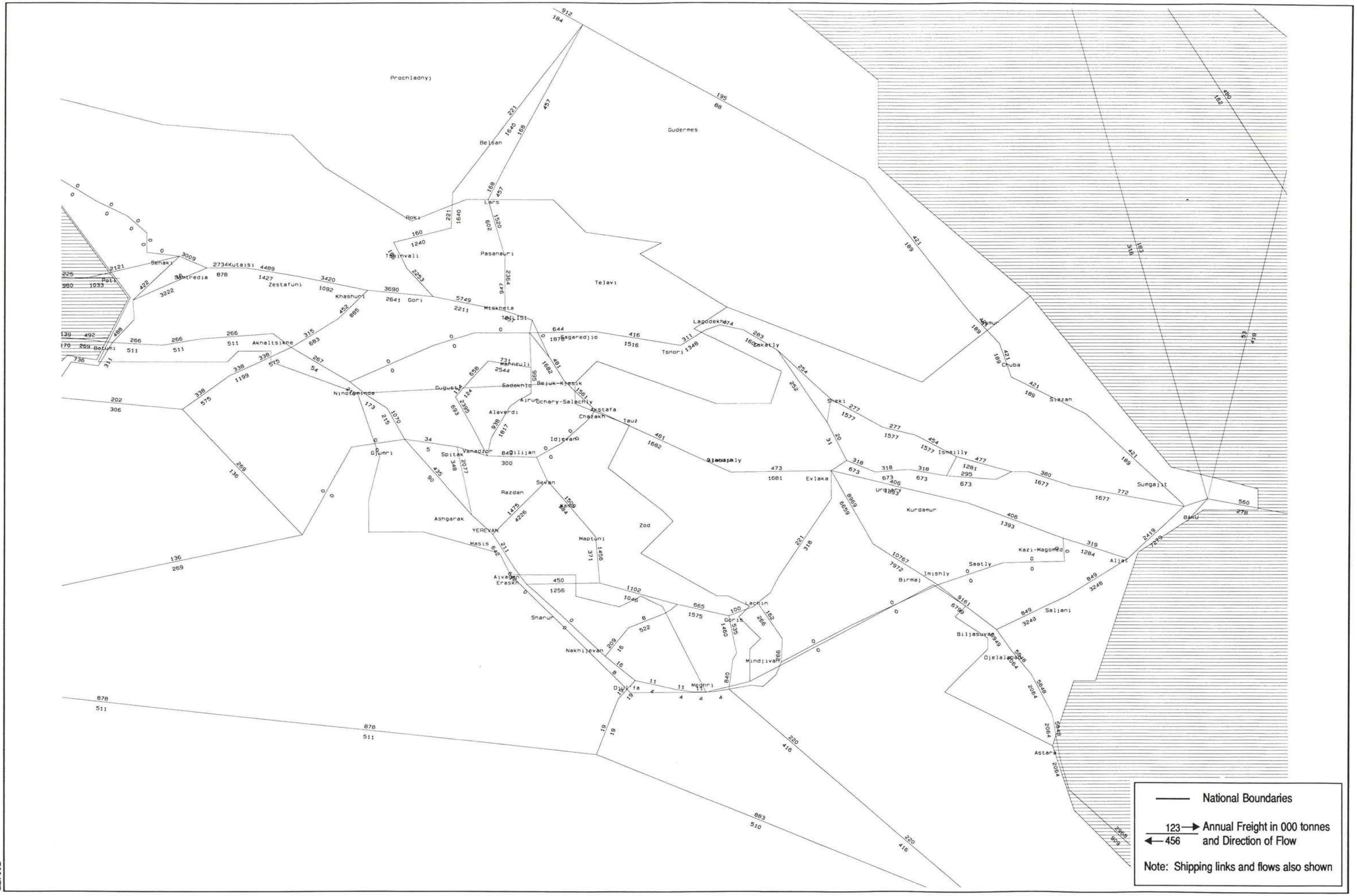

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Figure K5
2001 Reference Case Flows in Caucasus Road Network

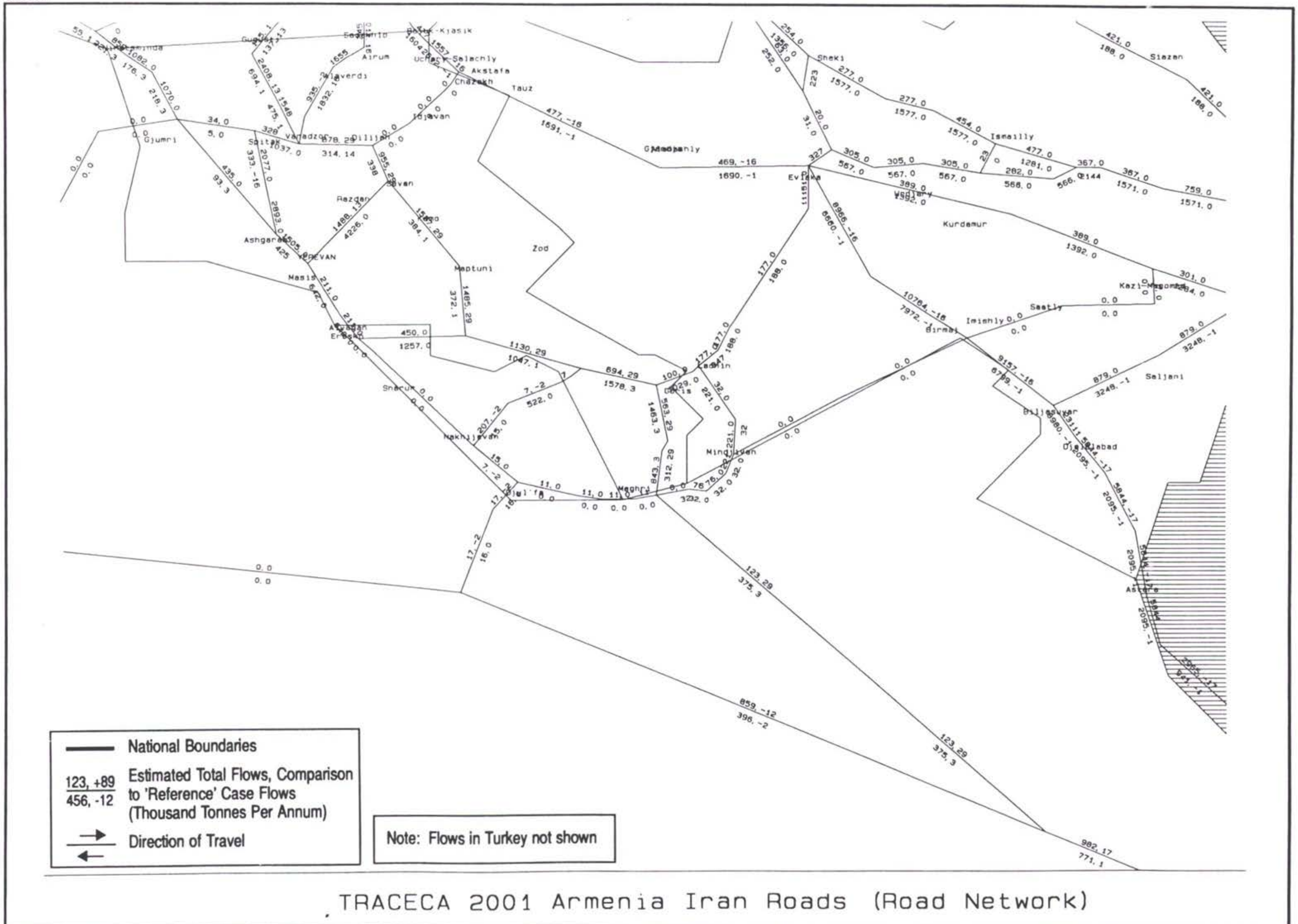

Figure K6

2001 Yerevan - Meghri Road Rehabilitation, Road Network

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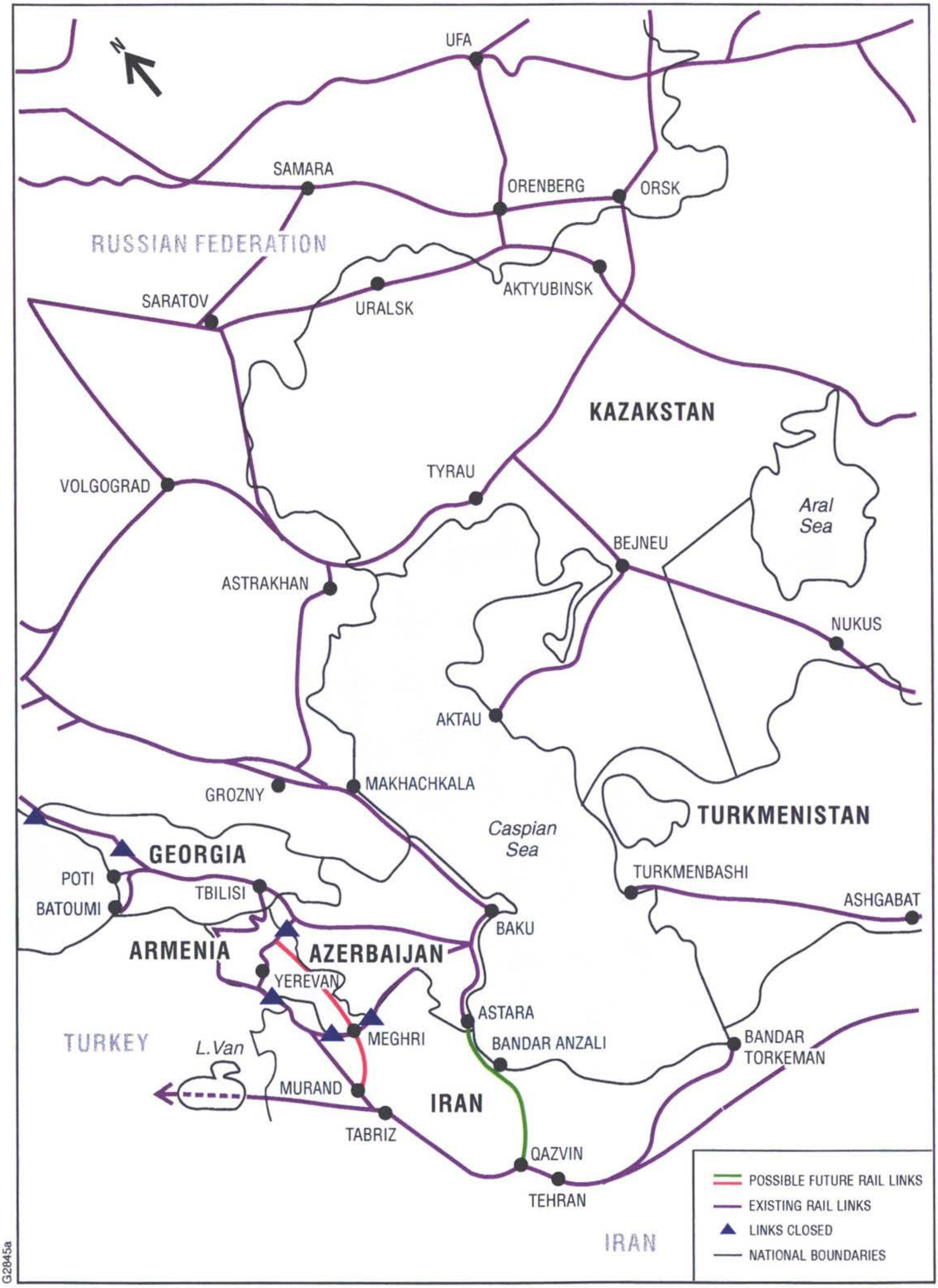


Figure K7
Possible Future Rail Links Caucuses - Iran

G2730A

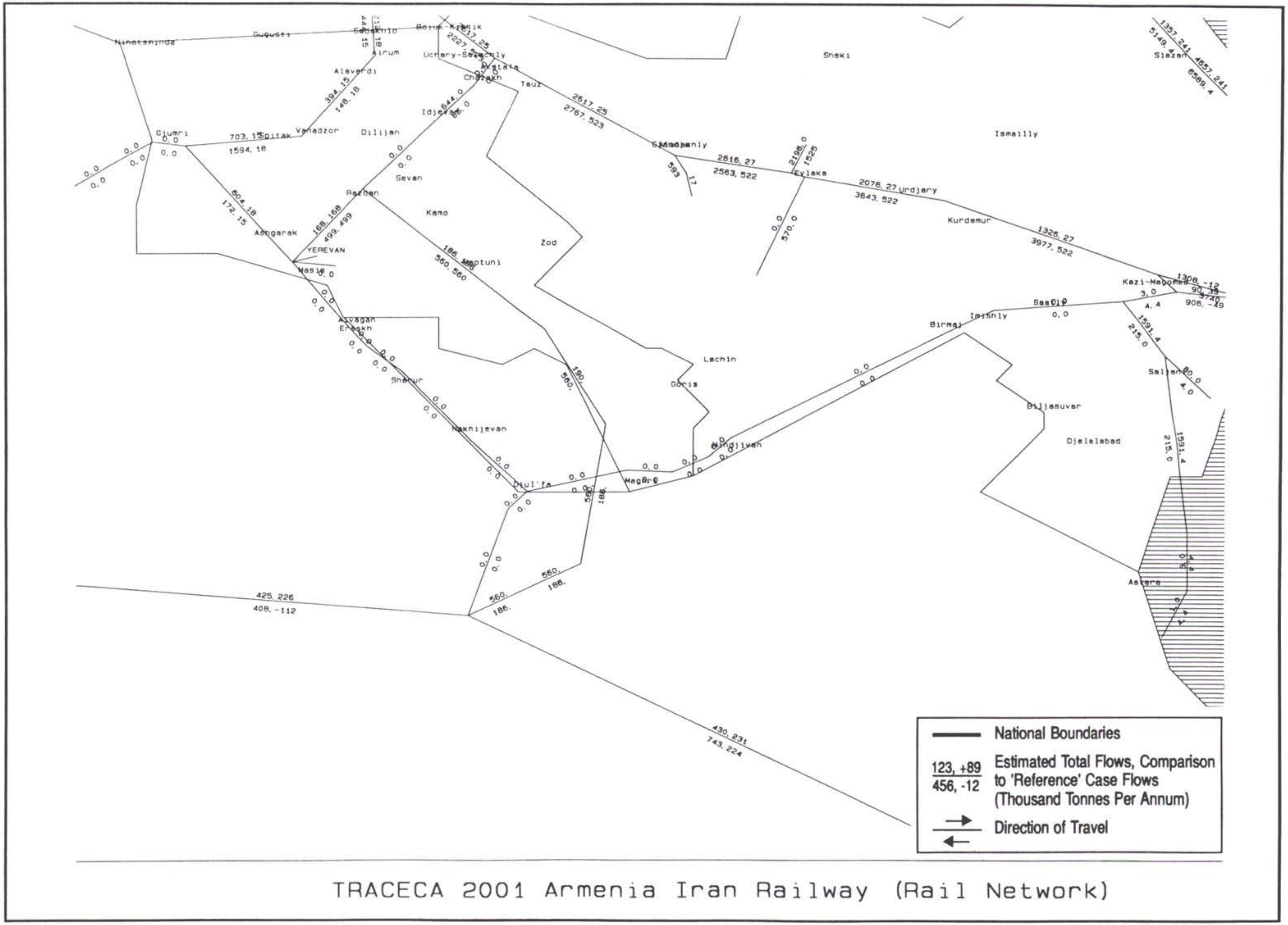


Figure K8
2001 Armenia - Iran Railway Link, Rail Network

G2845b

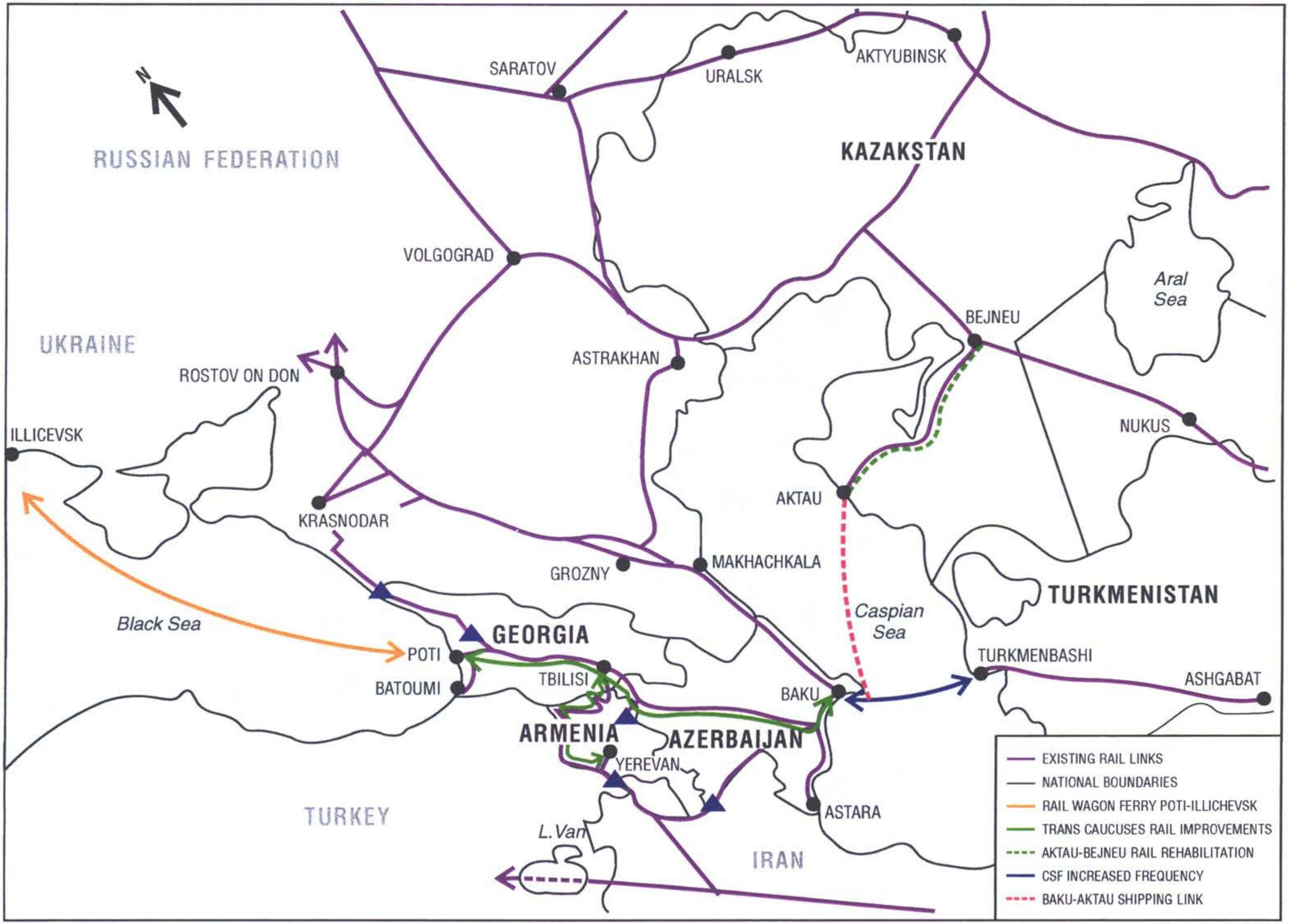
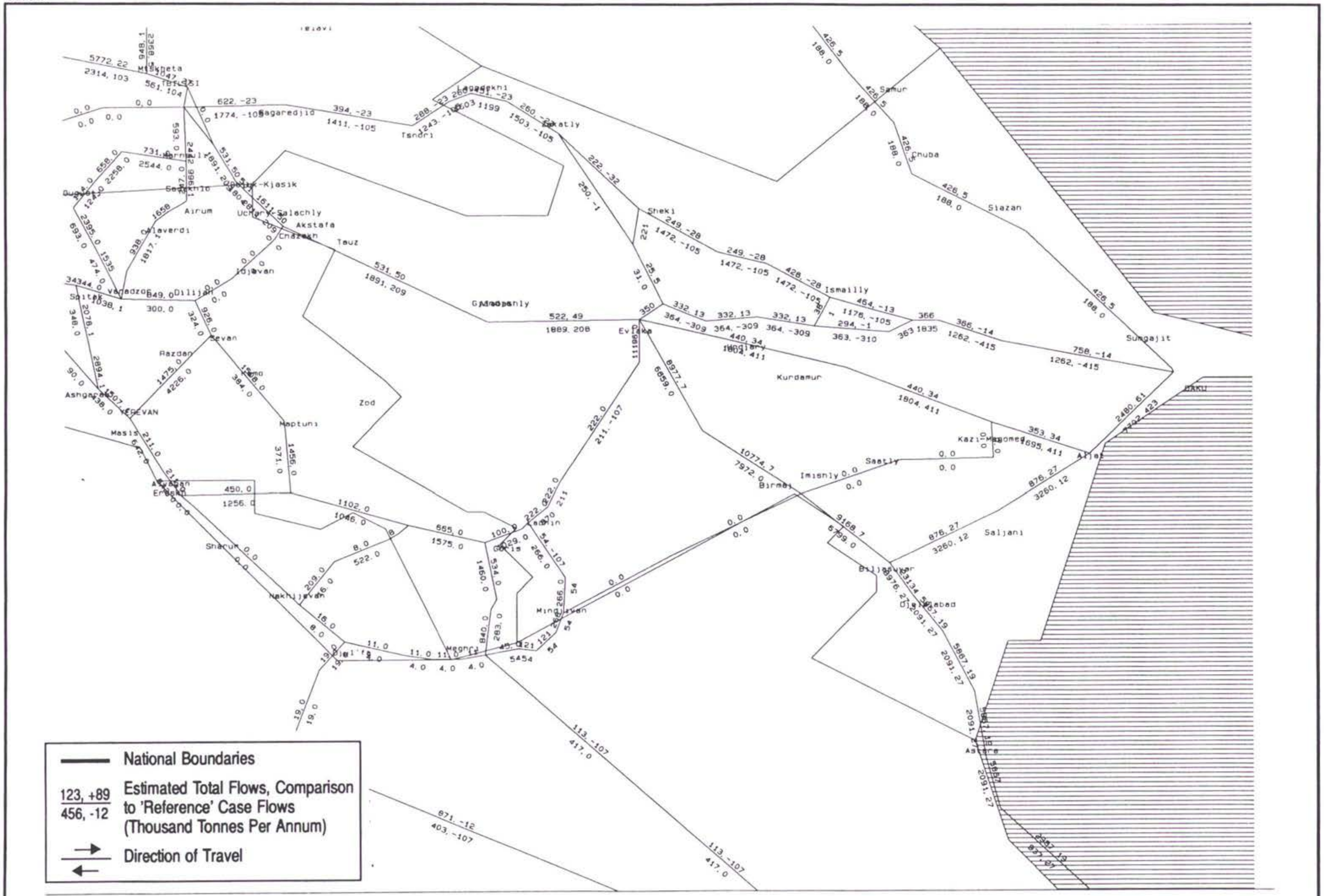


Figure K9
TRACECA Corridor Improvement Schemes

G2730A



TRACECA 2001 Azerbaijan Trans Cauc Road Rehab (Road Network)

Figure K10

2001 Trans - Caucuses Road Rehabilitation in Azerbaijan, Road Network

G2730A

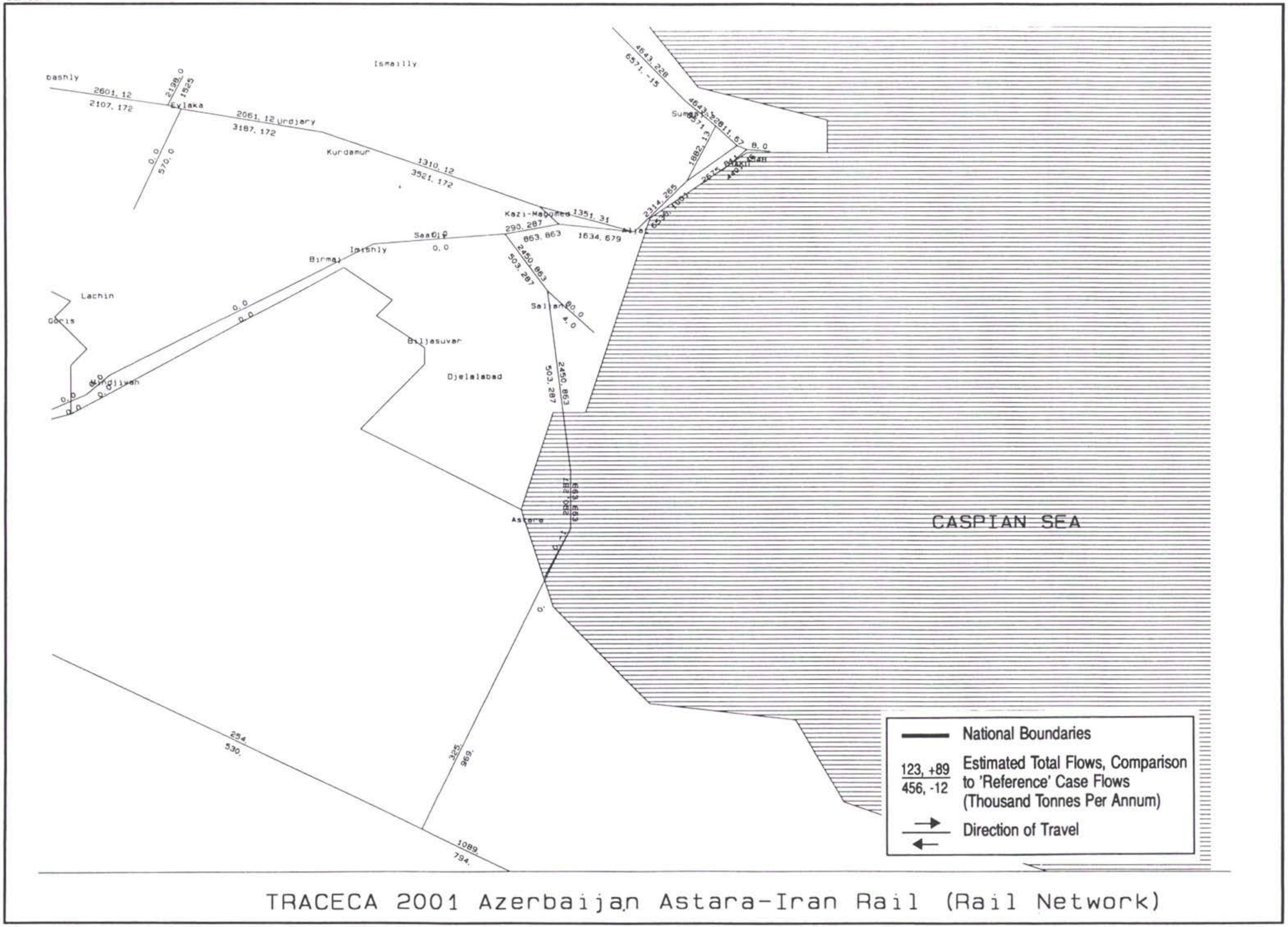


Figure K11
2001 Azerbaijan, Astara - Iran Railway Link, Rail Network

G2730A

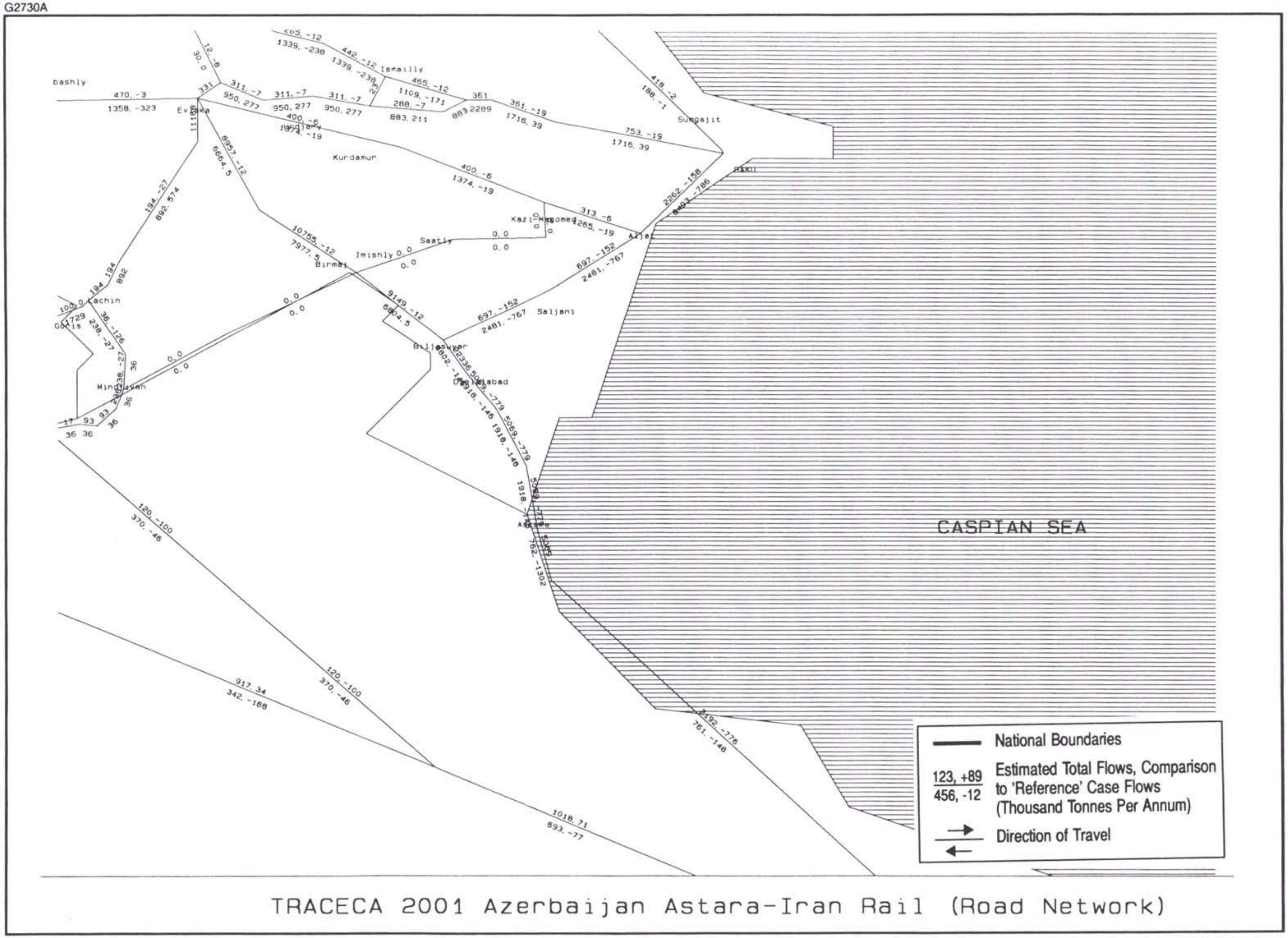


Figure K12
2001 Azerbaijan, Astara - Iran Railway Link, Road Network

G2730A

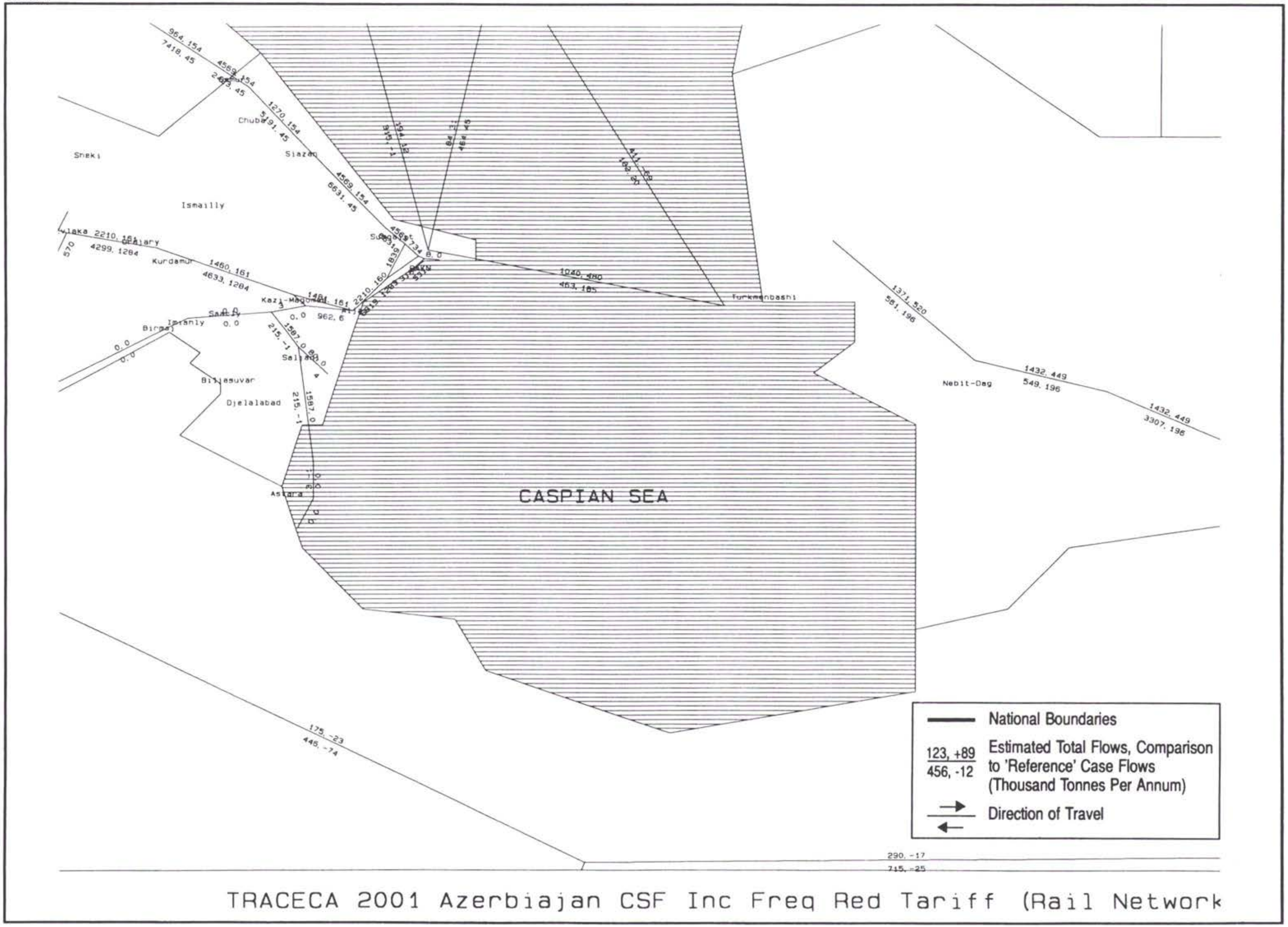


Figure K13
2001 Azerbaijan, Caspian Sea Ferry Frequency Increase, Rail Network

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G2730A

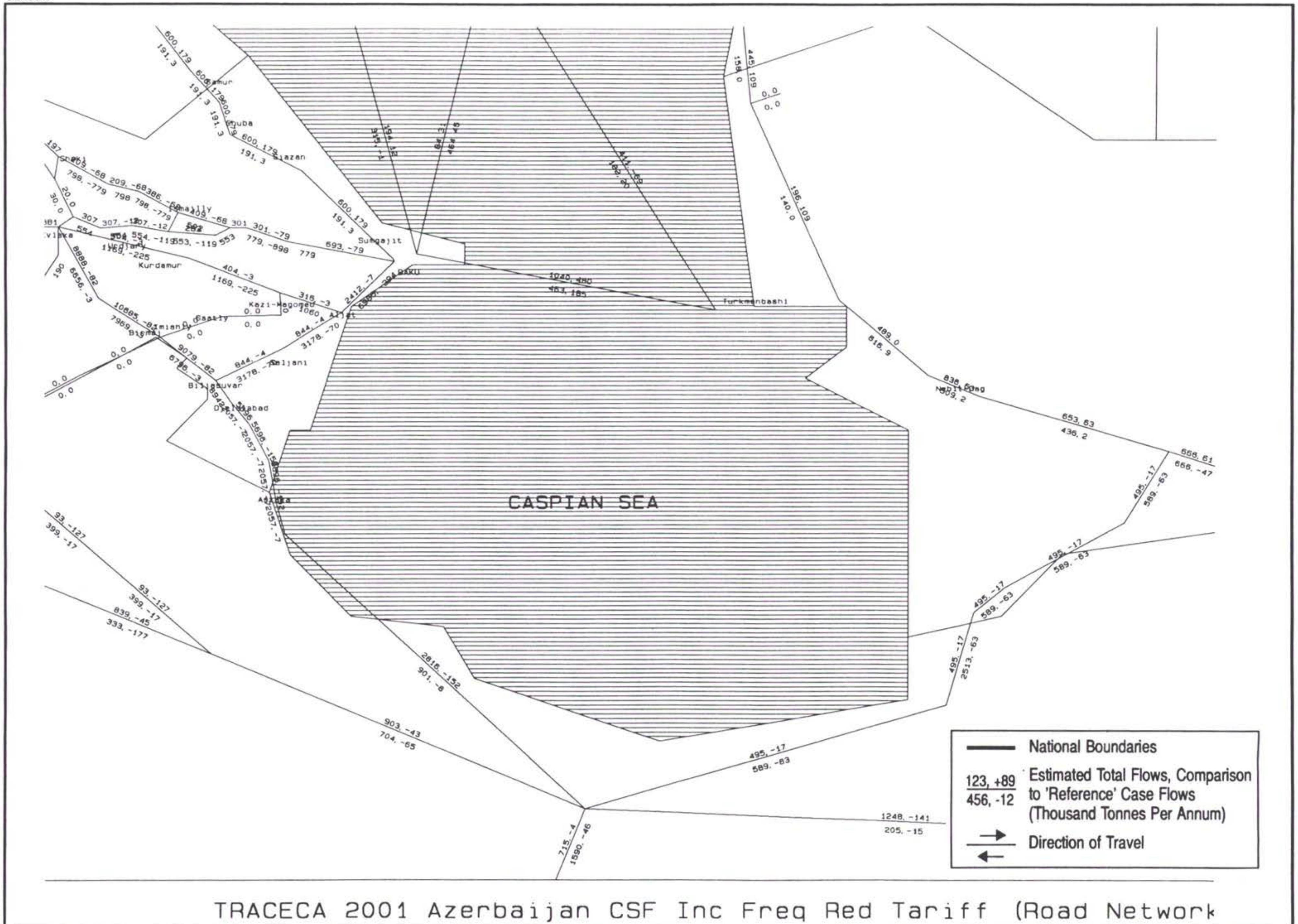

Figure K14
2001 Azerbaijan, Caspian Sea Ferry Frequency Increase, Road Network

155

G2845b

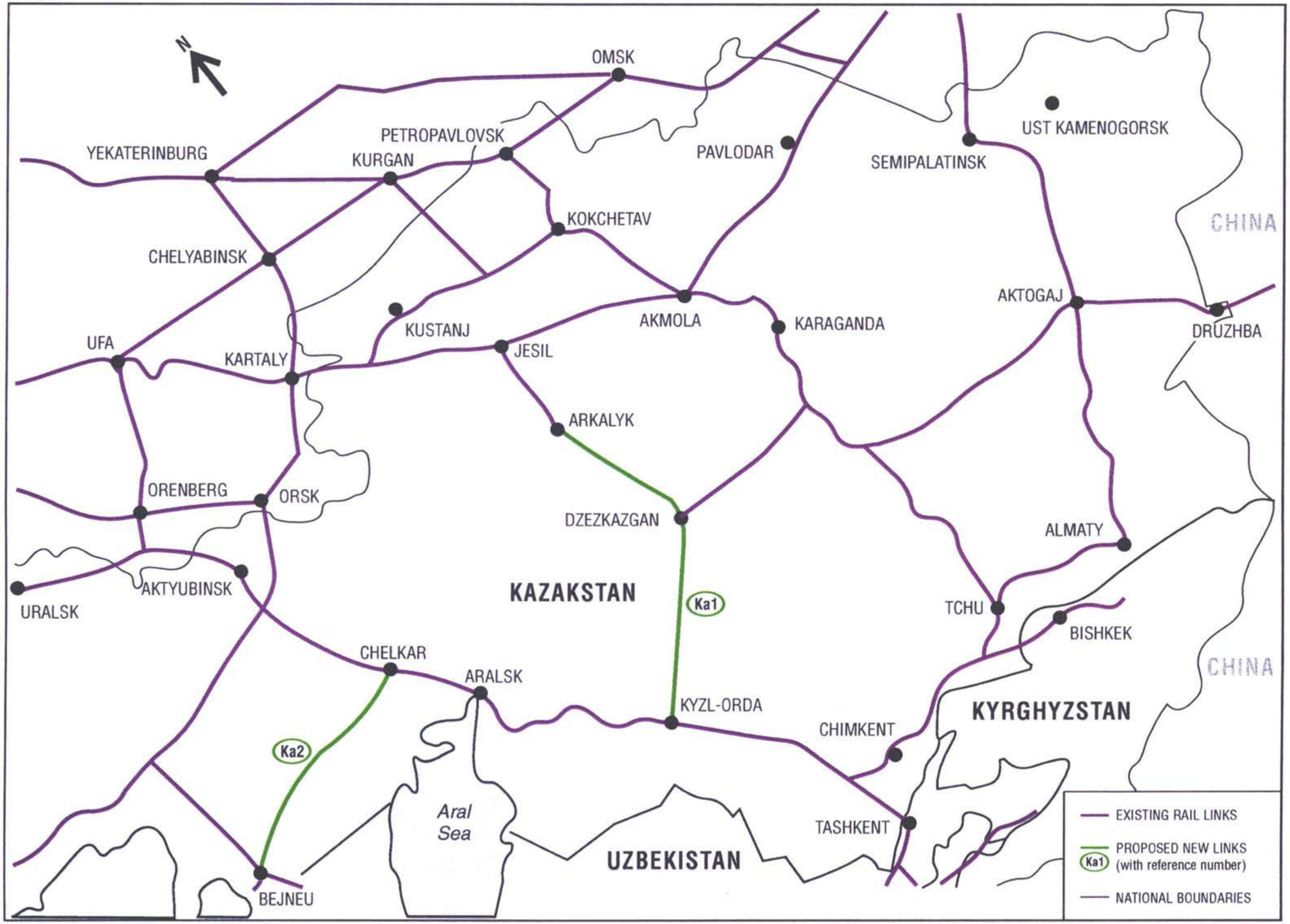

Figure K15
New Links in the Kazakstan Rail Network

Figure K16
Future North-South Rail Links (Kazakstan-Turkmenistan-Iran)

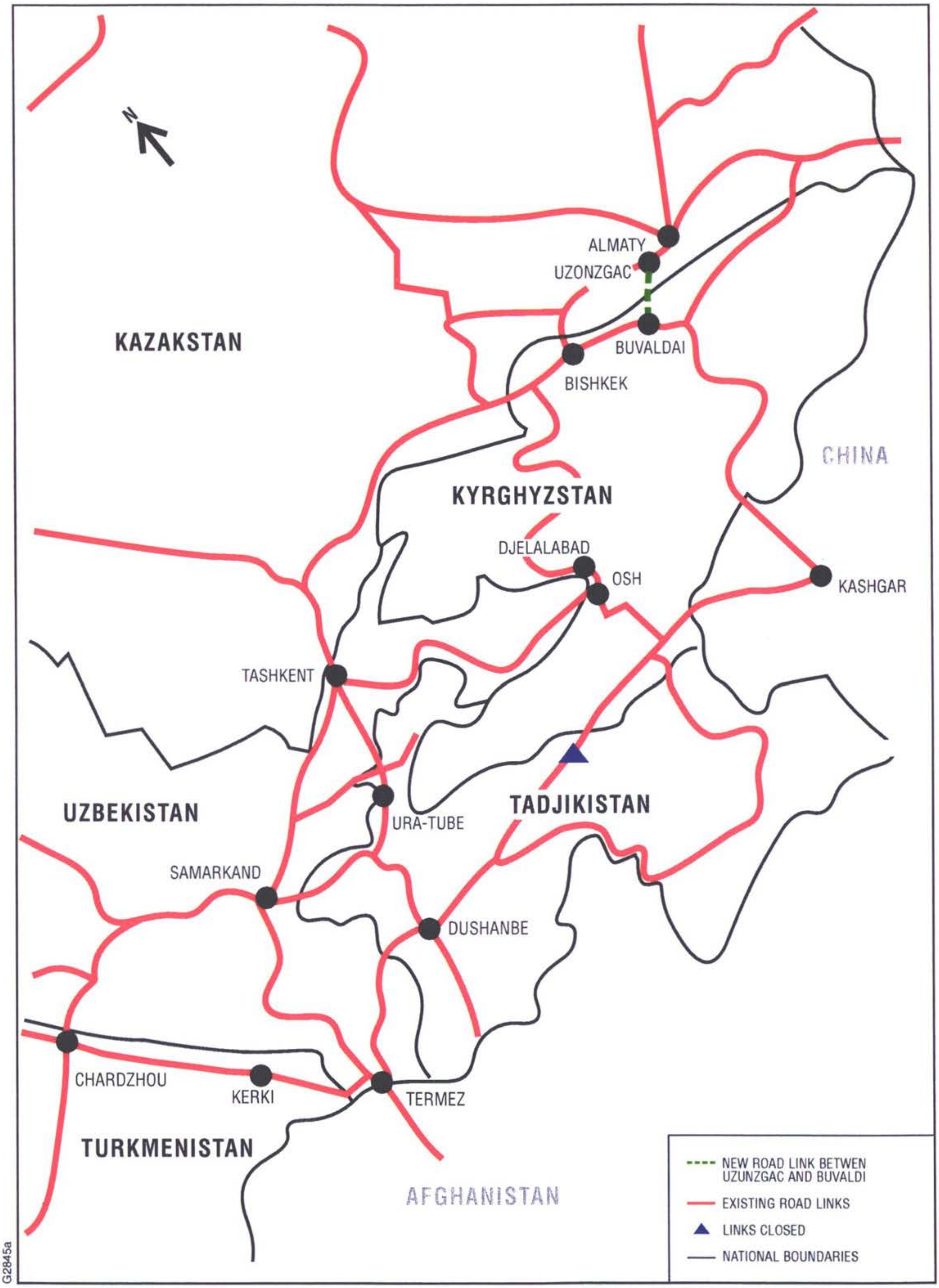

Figure K17
New Road Connecting Almaty and Buvaldi

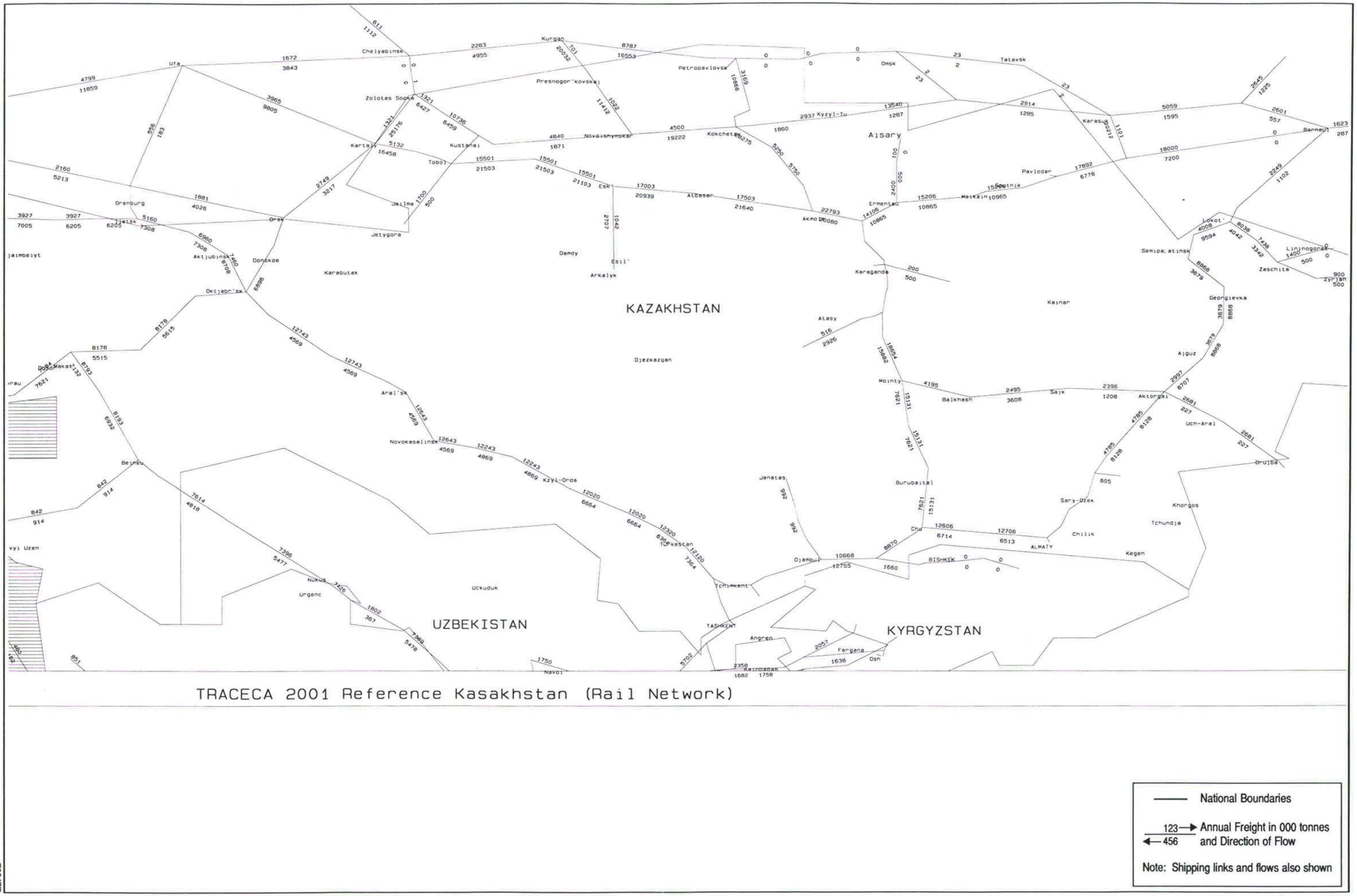

Figure K18
2001 Reference Case Flows for Kazakstan Rail Network

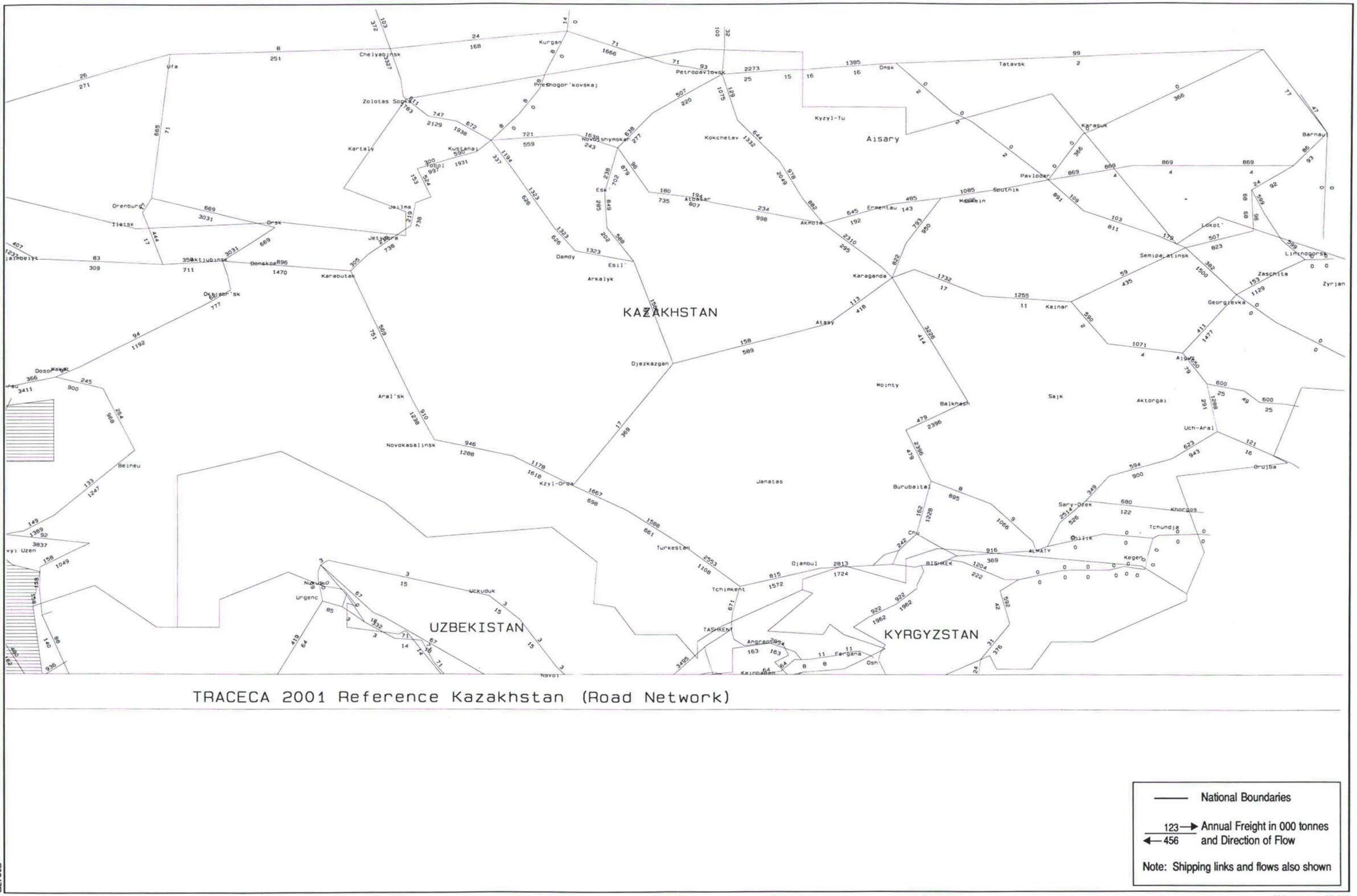

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Figure K19
2001 Reference Case Flows for Kazakstan Road Network

G2730A

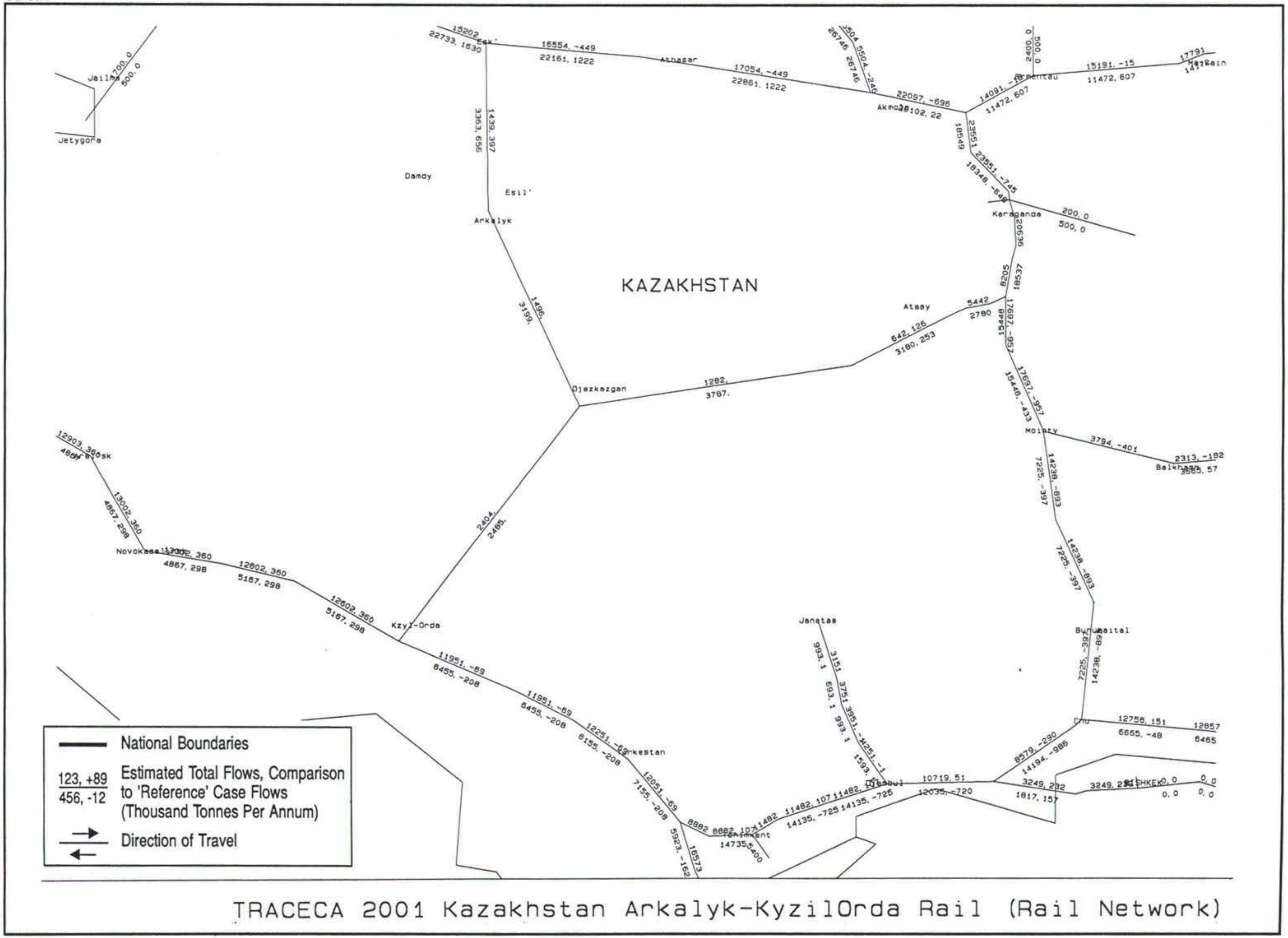

Figure K20
2001 Rail Link from Arkalyk to Kyzil-Orda in Kazakstan, Rail Network

G2730A

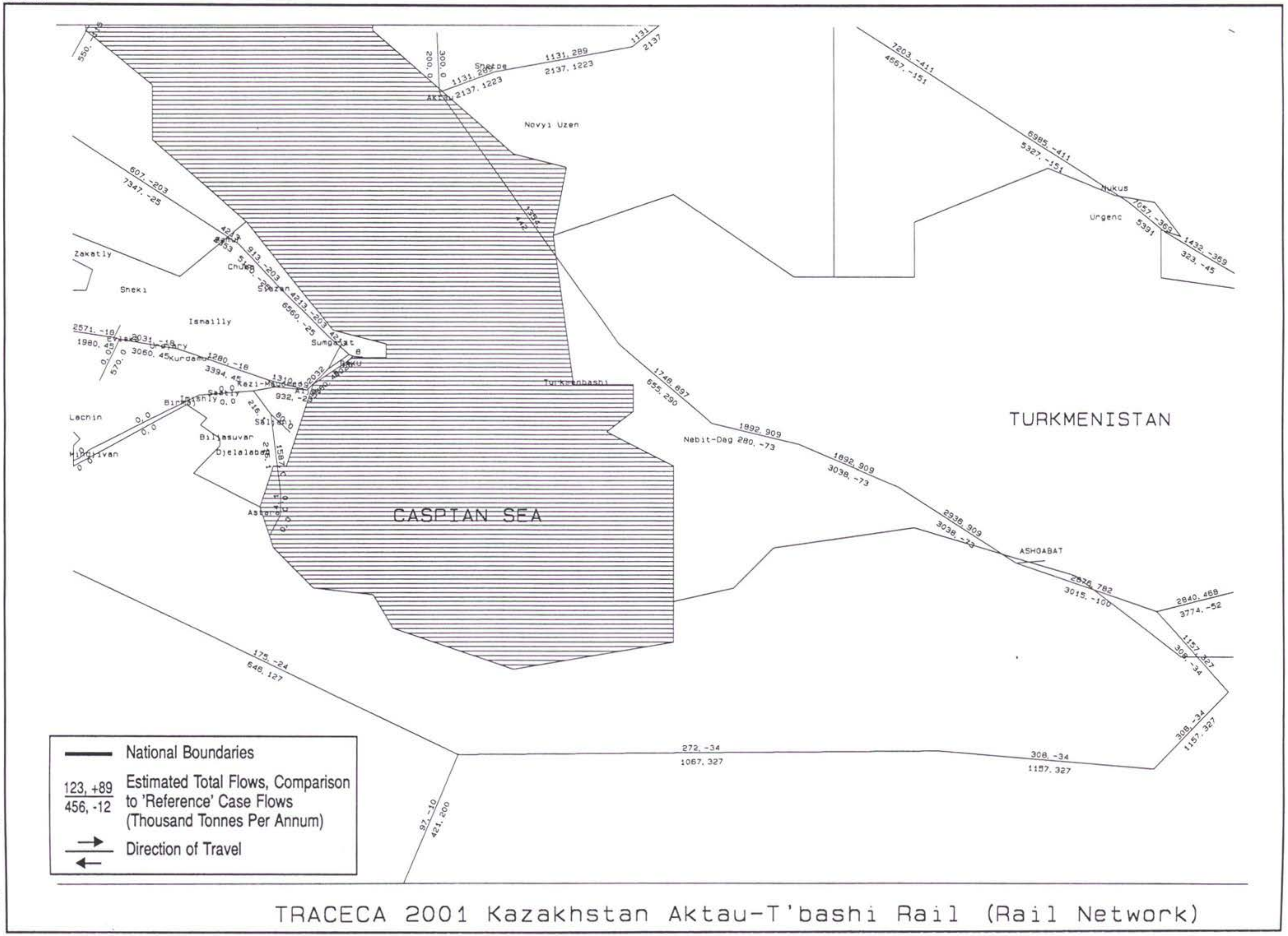

Figure K21
2001 Rail Link between Aktau and Turkmenbashi, Rail Network

G2730A

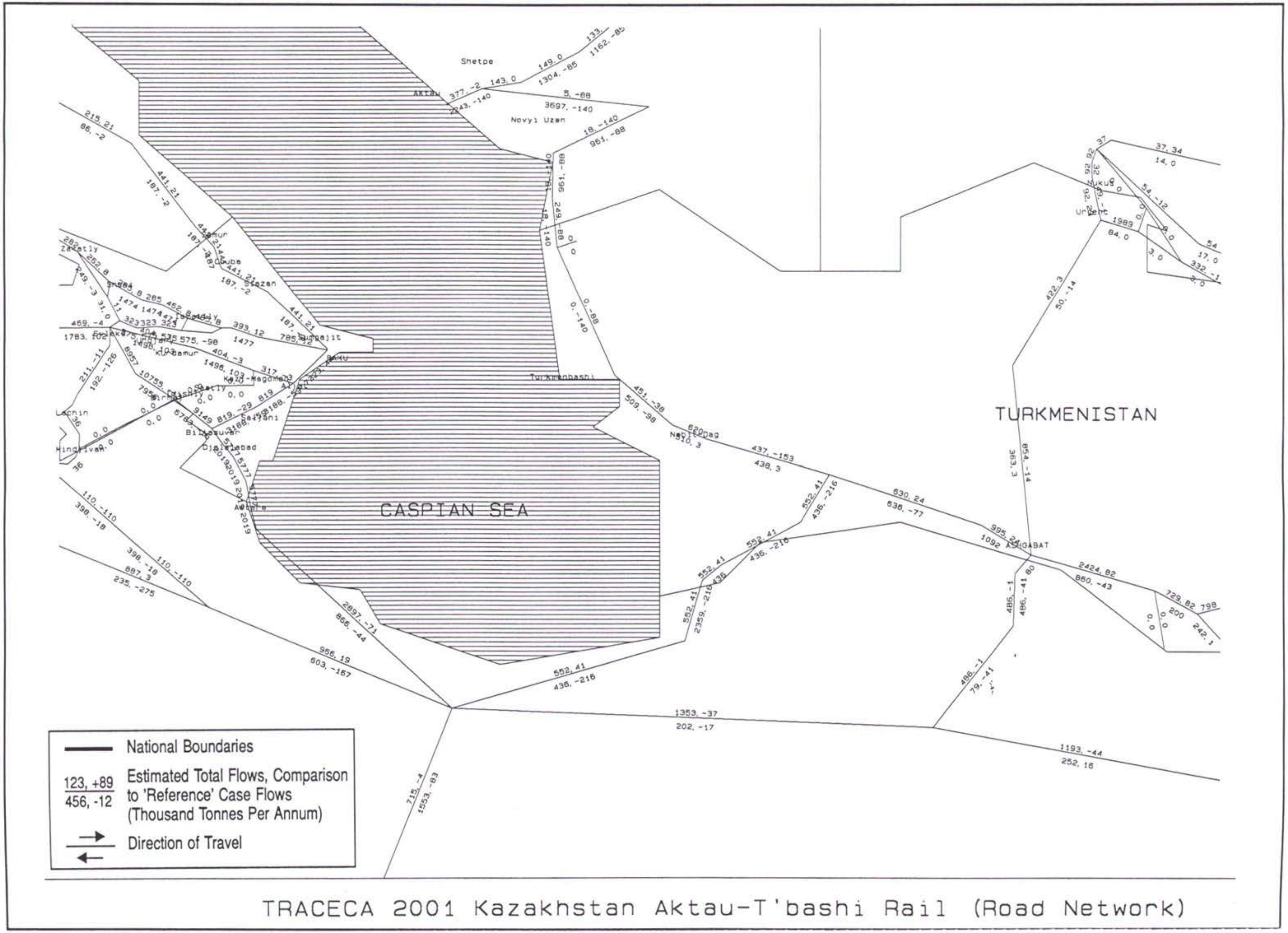

Figure K22
2001 Rail Link between Aktau and Turkmenbashi, Road Network

G2730A

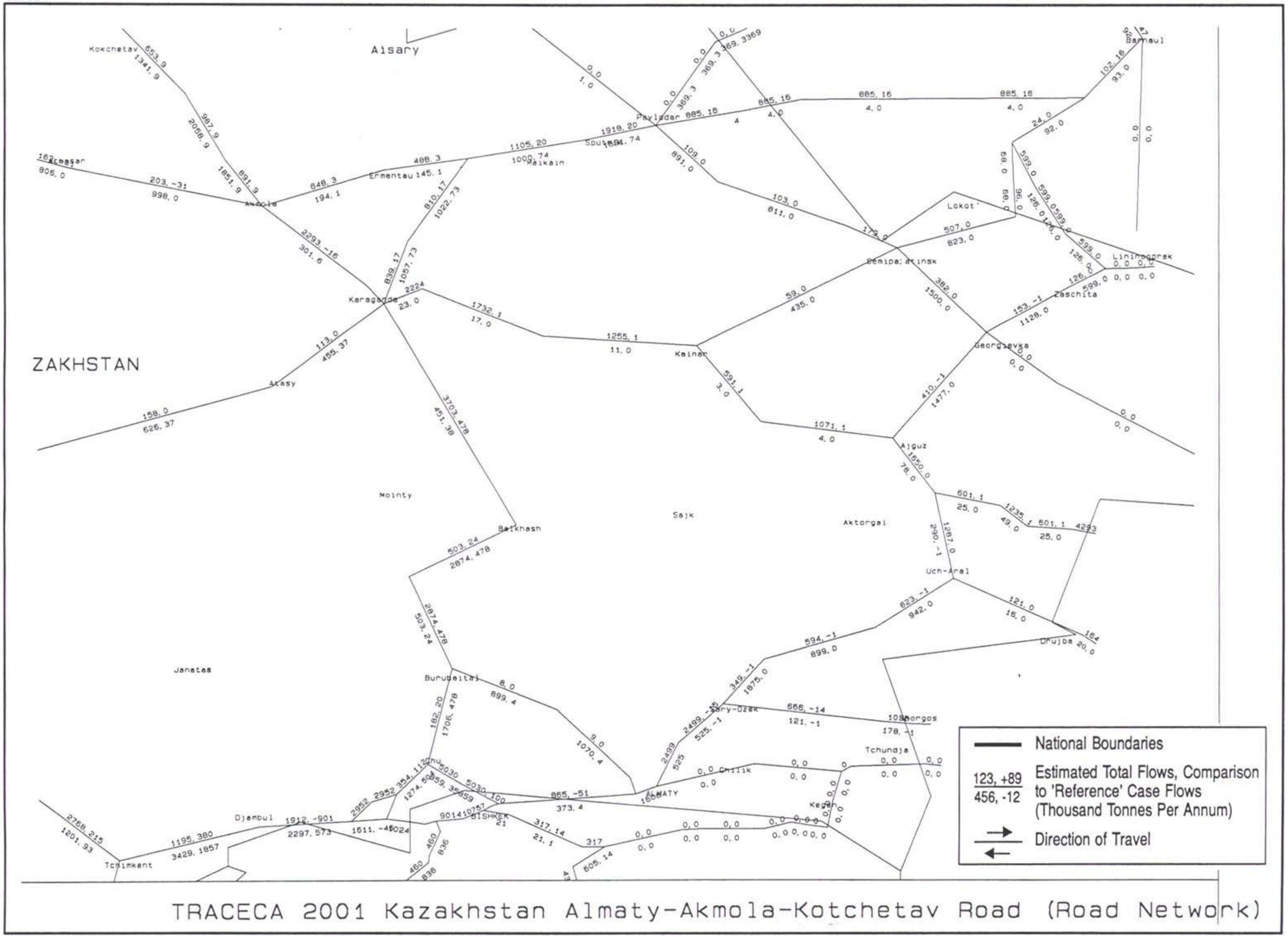

Figure K23
2001 Road Improvements Almaty - Akmola - Kotchetav, Road Network

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G2730A

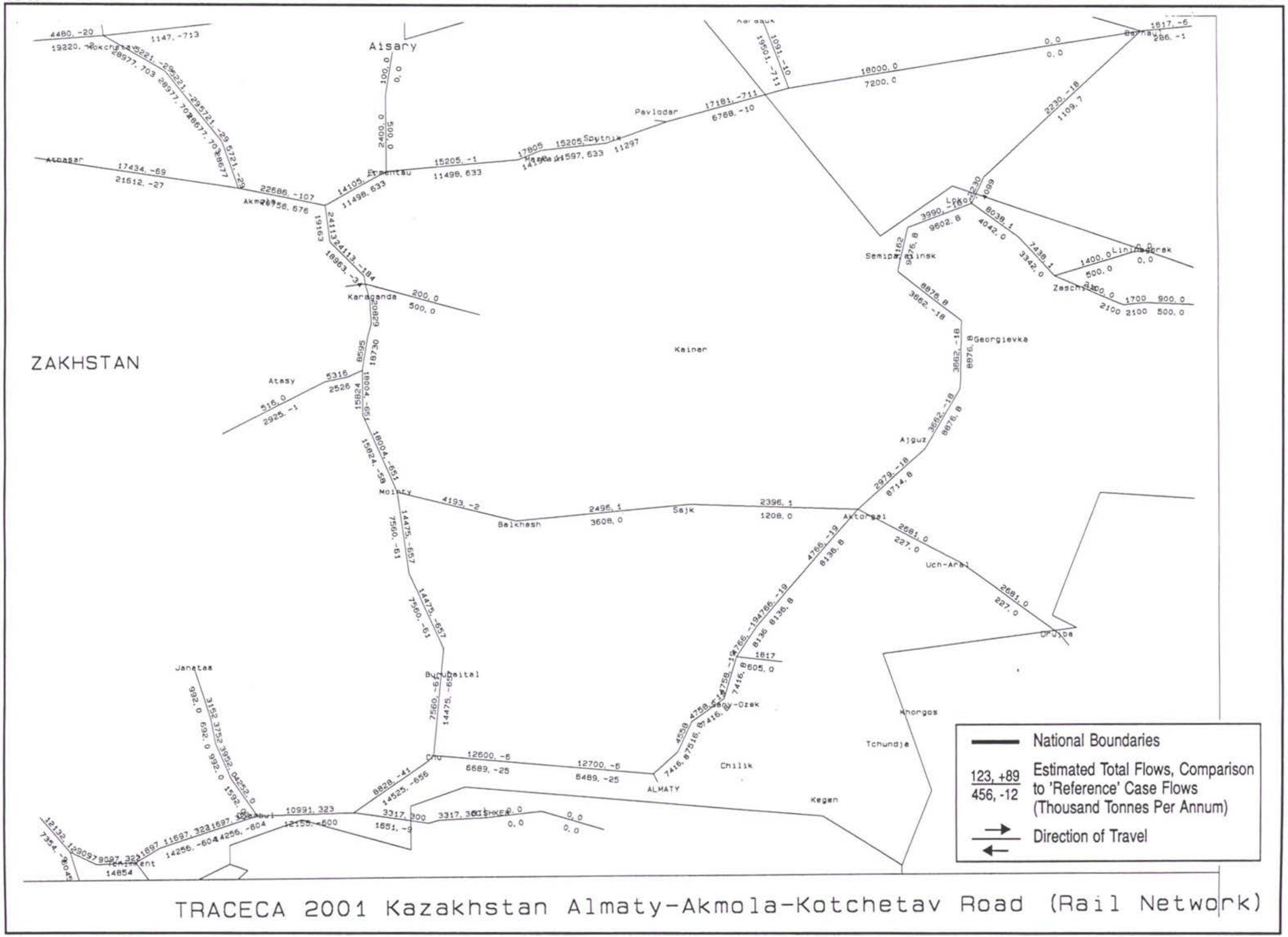

Figure K24
2001 Road Improvements Almaty - Akmola - Kotchetav, Rail Network

G2730A

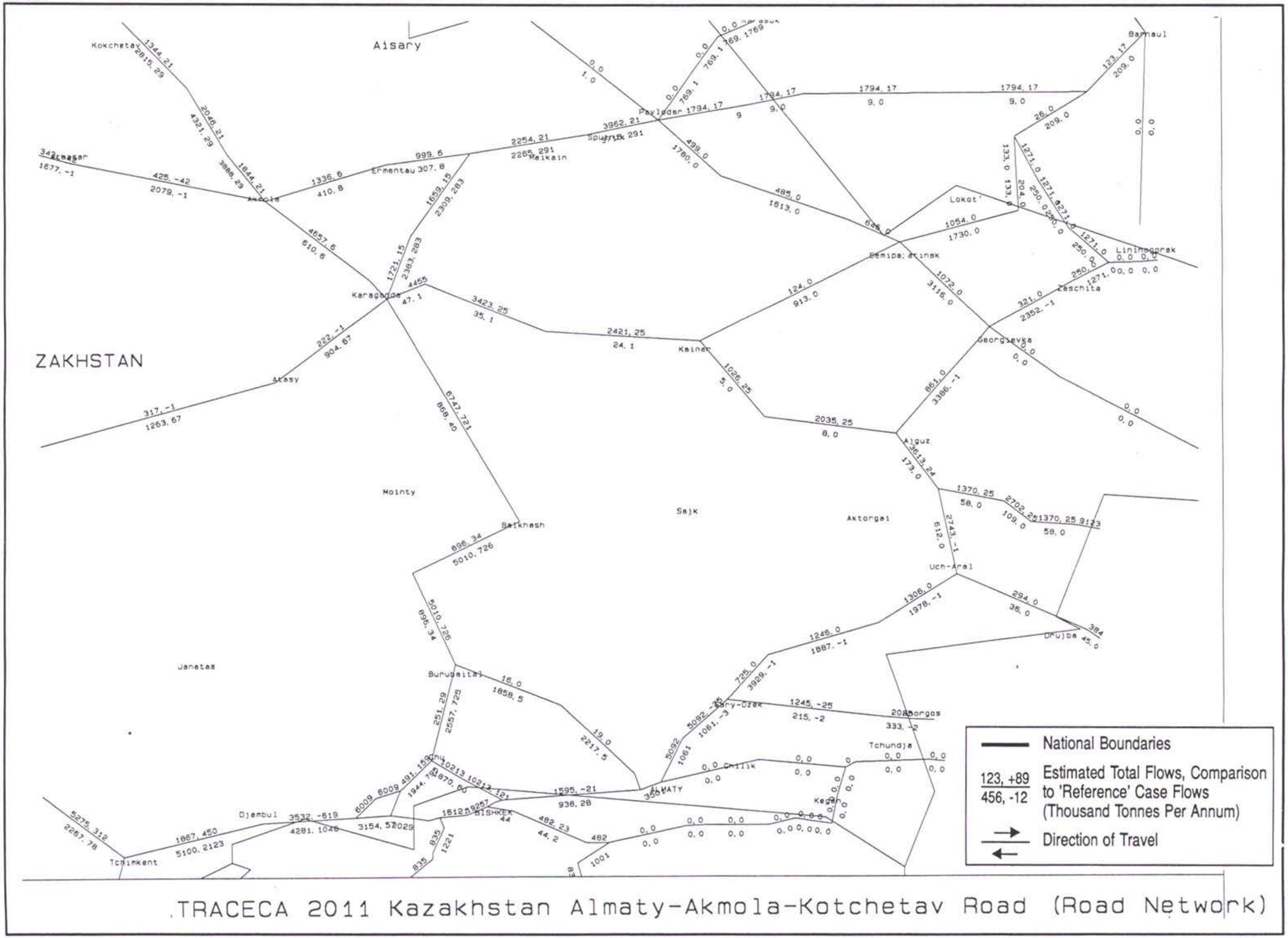

Figure K25
2011 Road Improvements Almaty - Akmola - Kotchetav, Road Network

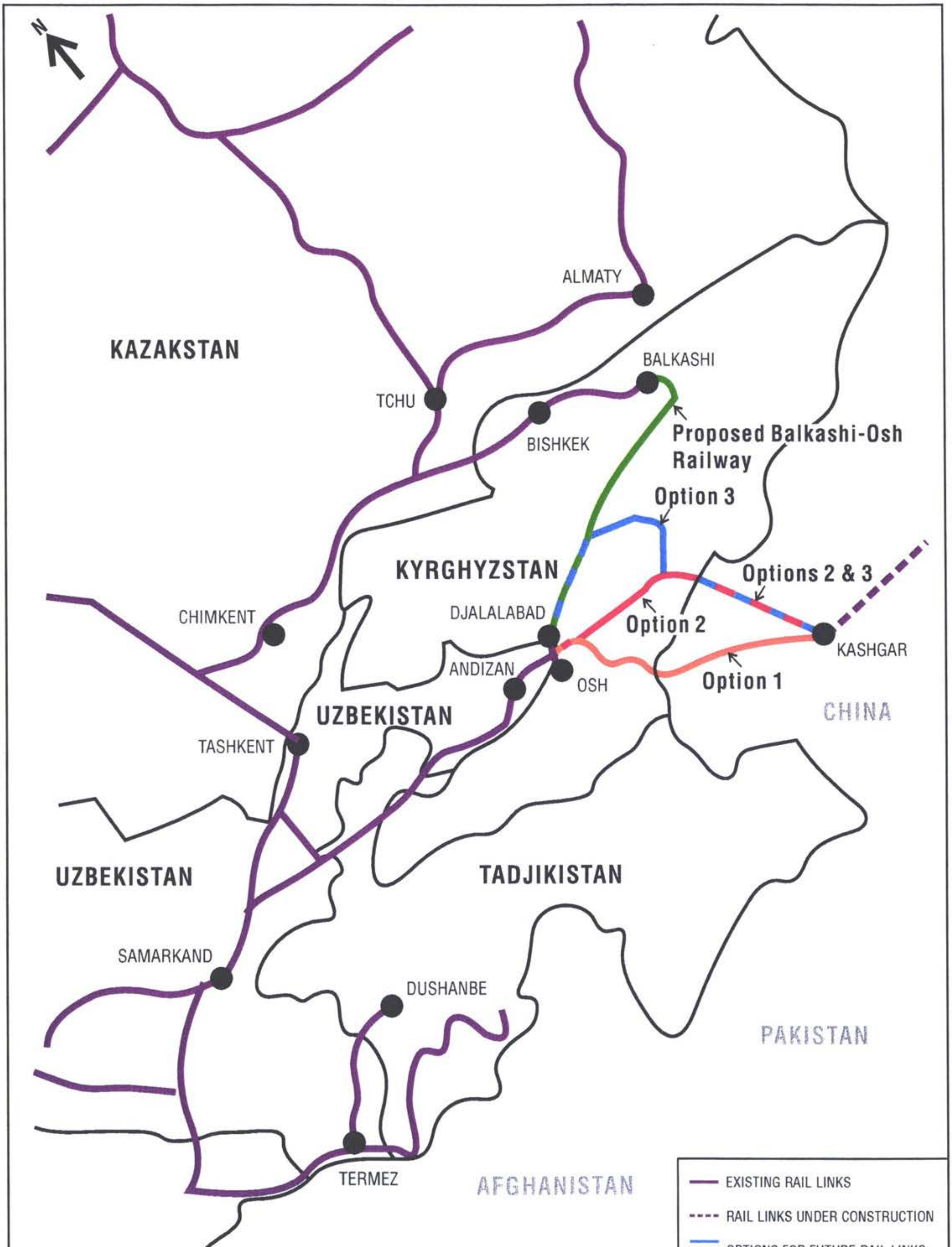

Figure K26
Options for New Rail Links in Kyrghyzstan

Figure K27
Improved Road Links to Kashgar

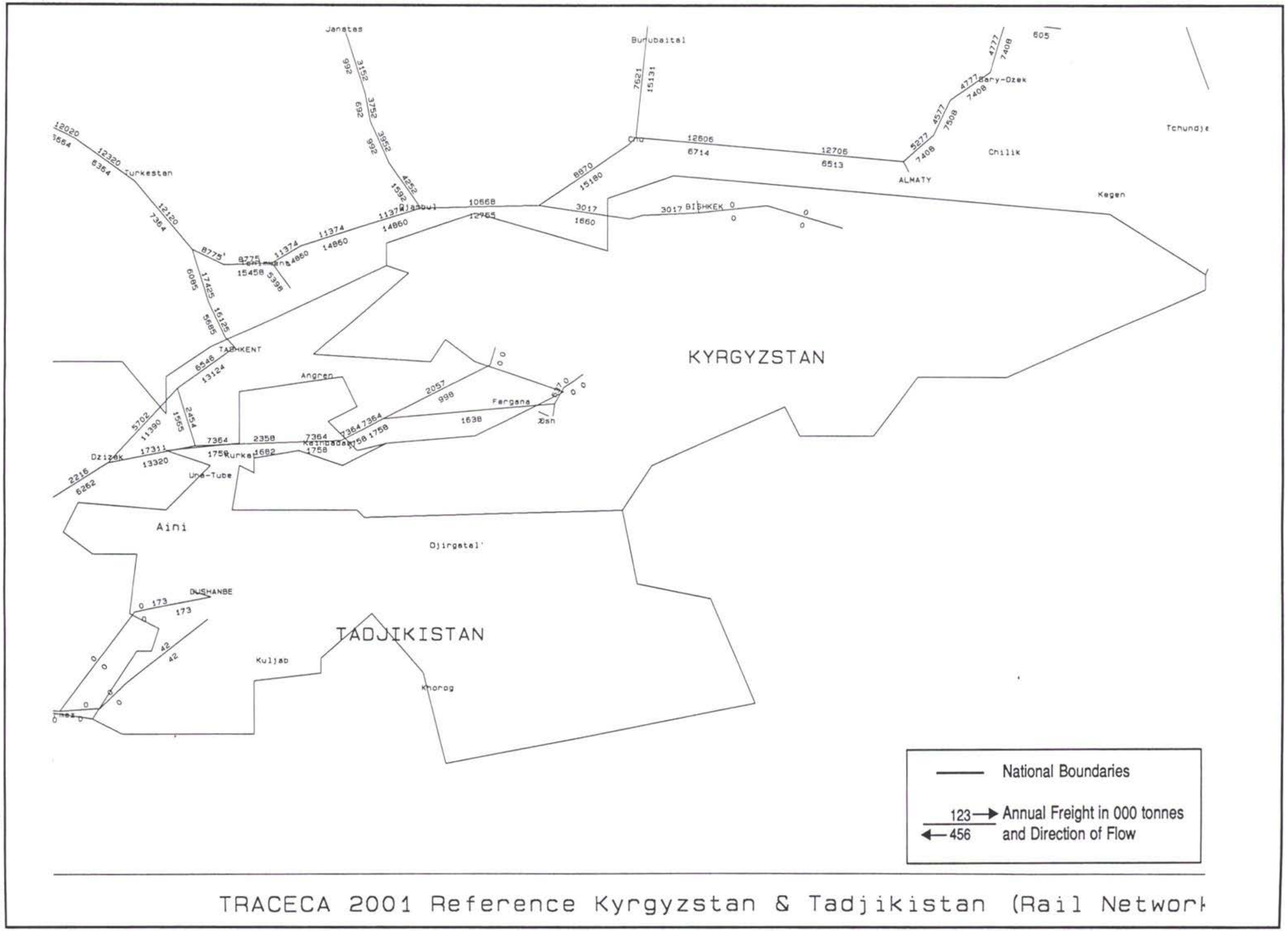

Figure K28
2001 Reference Case Flows for Kyrgyzstan, Rail Network

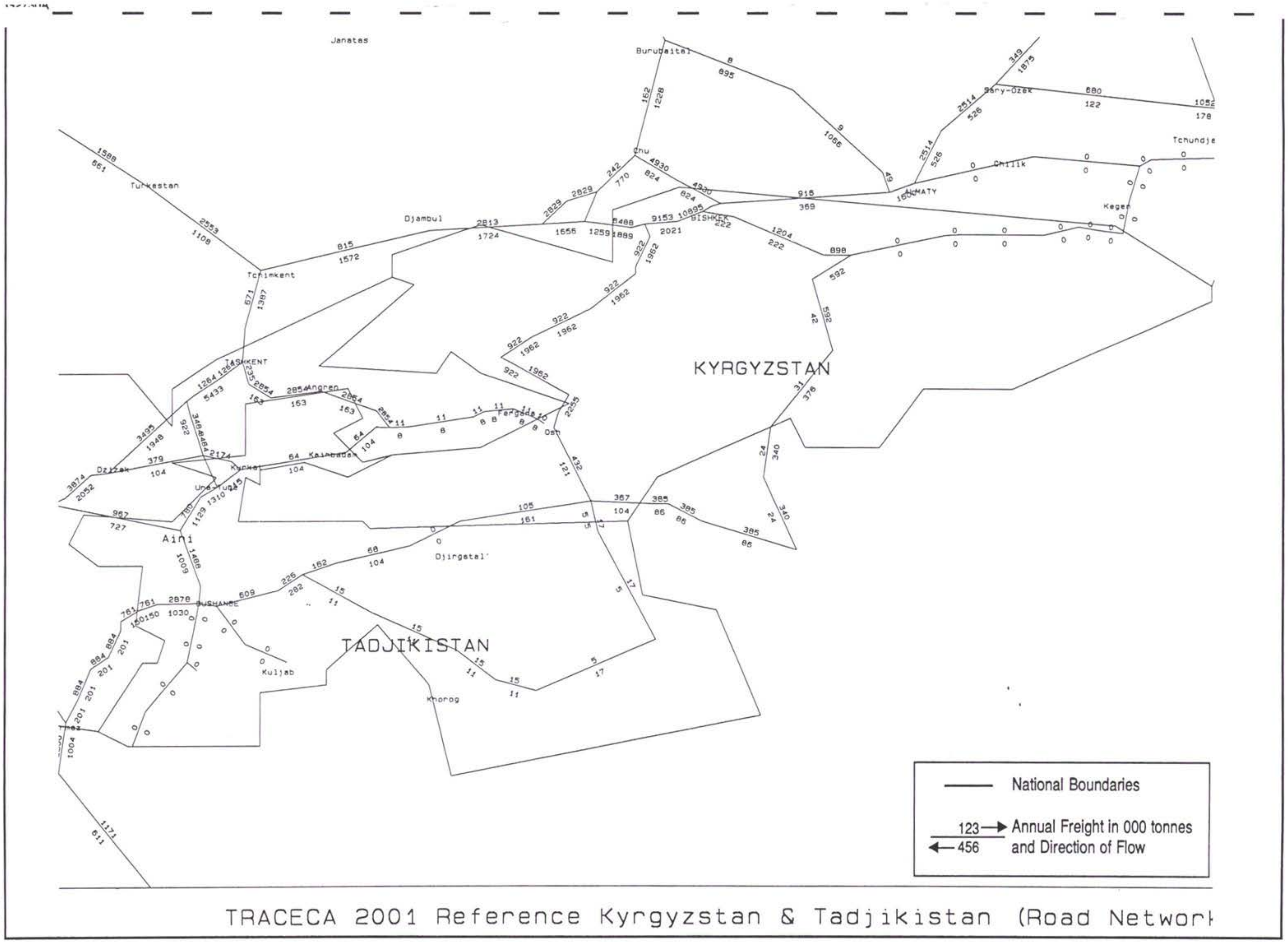

Figure K29
2001 Reference Case Flows for Kyrgyzstan, Road Network

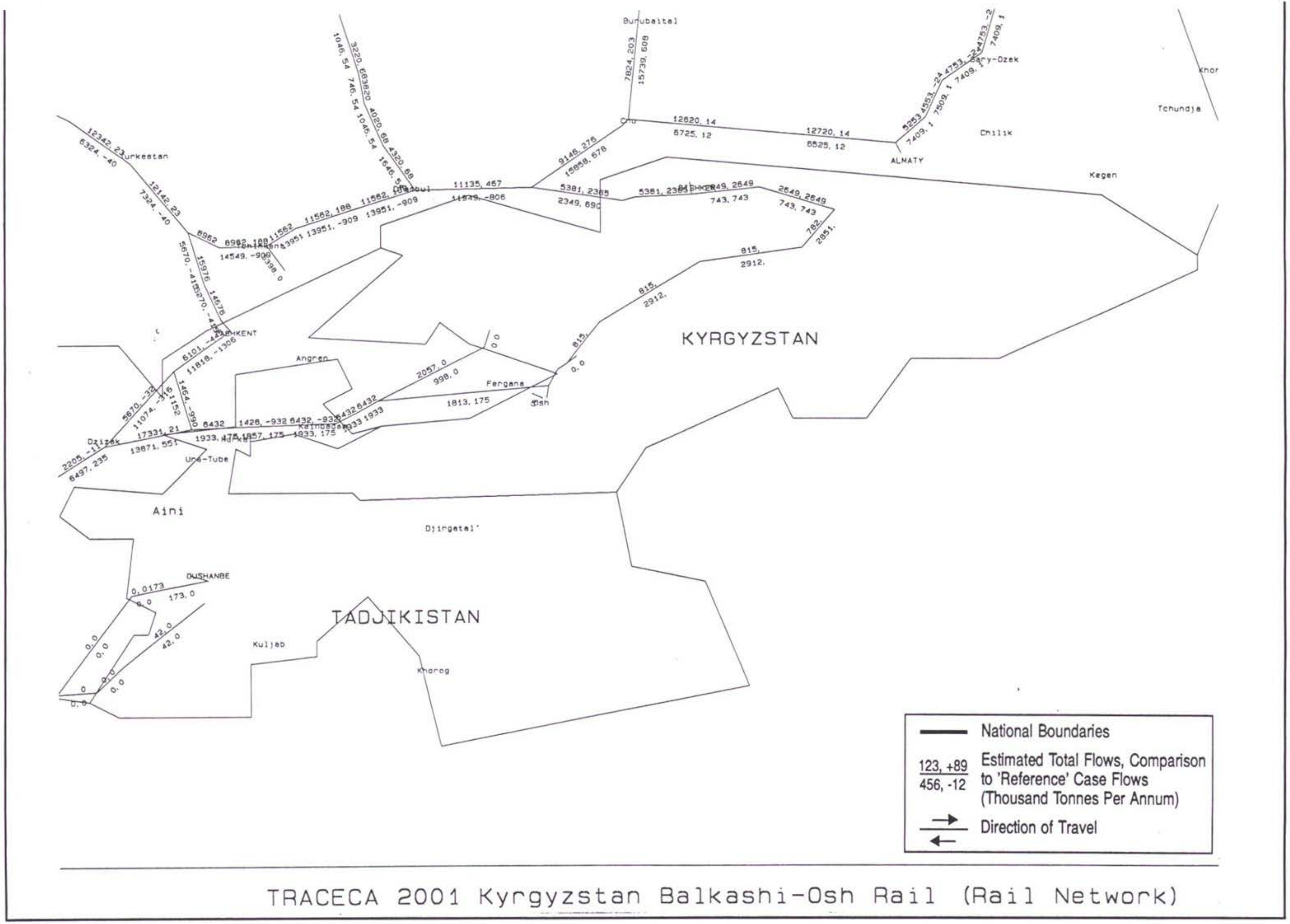

Figure K30
2001 New Rail Link Balkashi - Djelalabad - Osh, Rail Network

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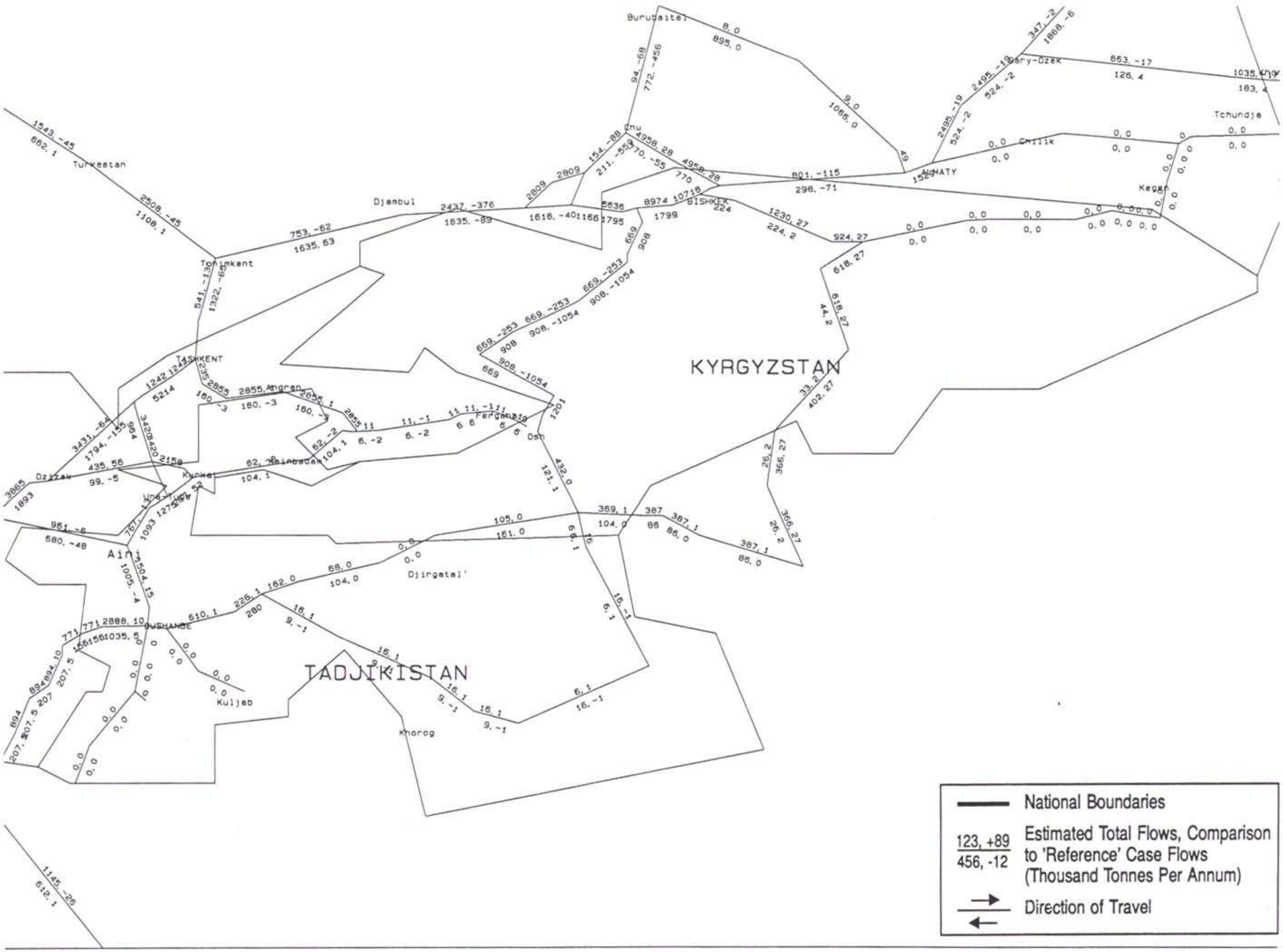
Figure K31
2001 New Rail Link Balkashi - Djelalabad - Osh, Road Network



TRACECA 2001 Kyrgyzstan Balkashi-Osh Rail (Road Network)

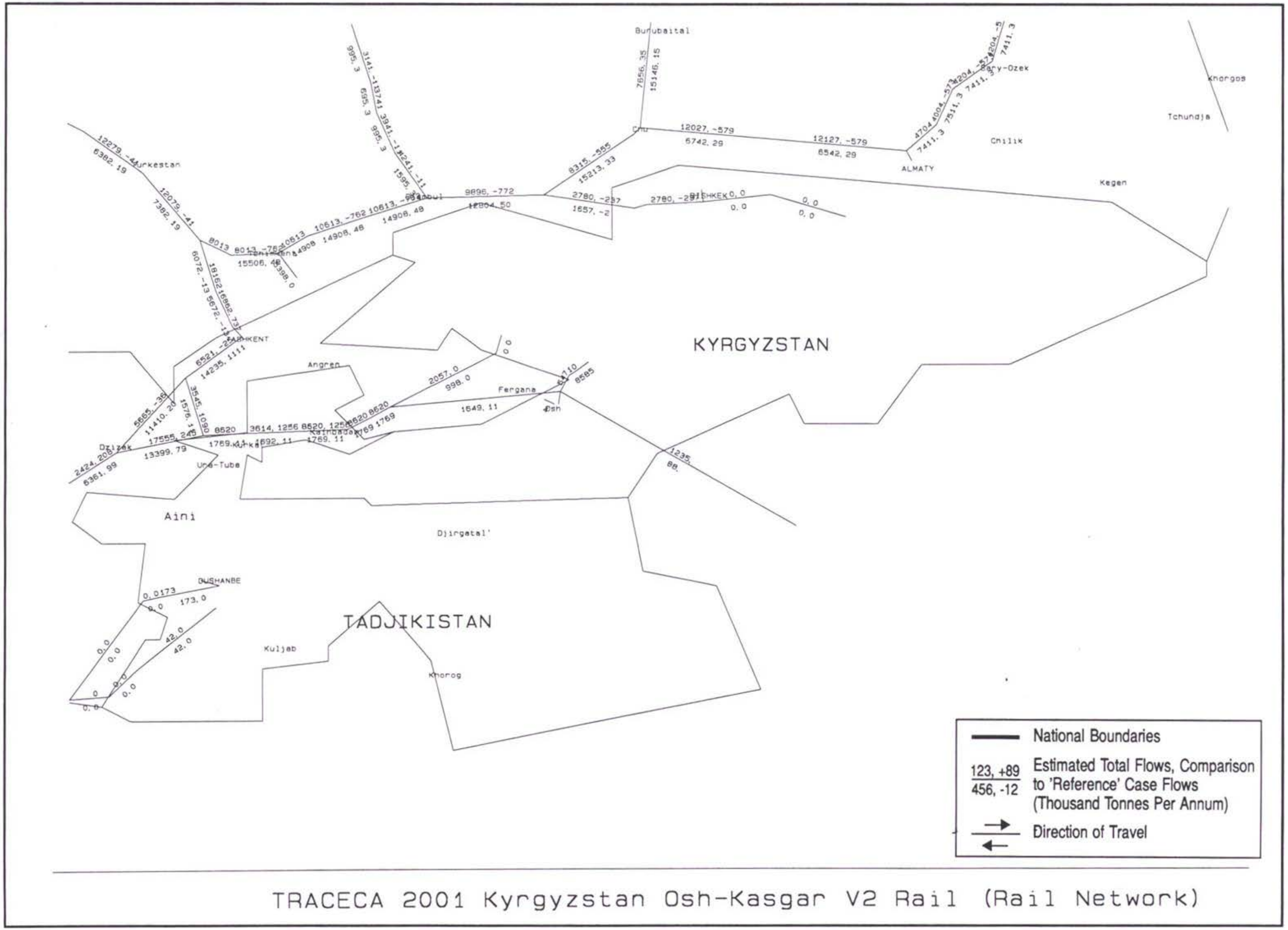


Figure K32
2001 Shortest Rail Link between Osh/Djelalabad and Kashgar, Rail Network

G2730A

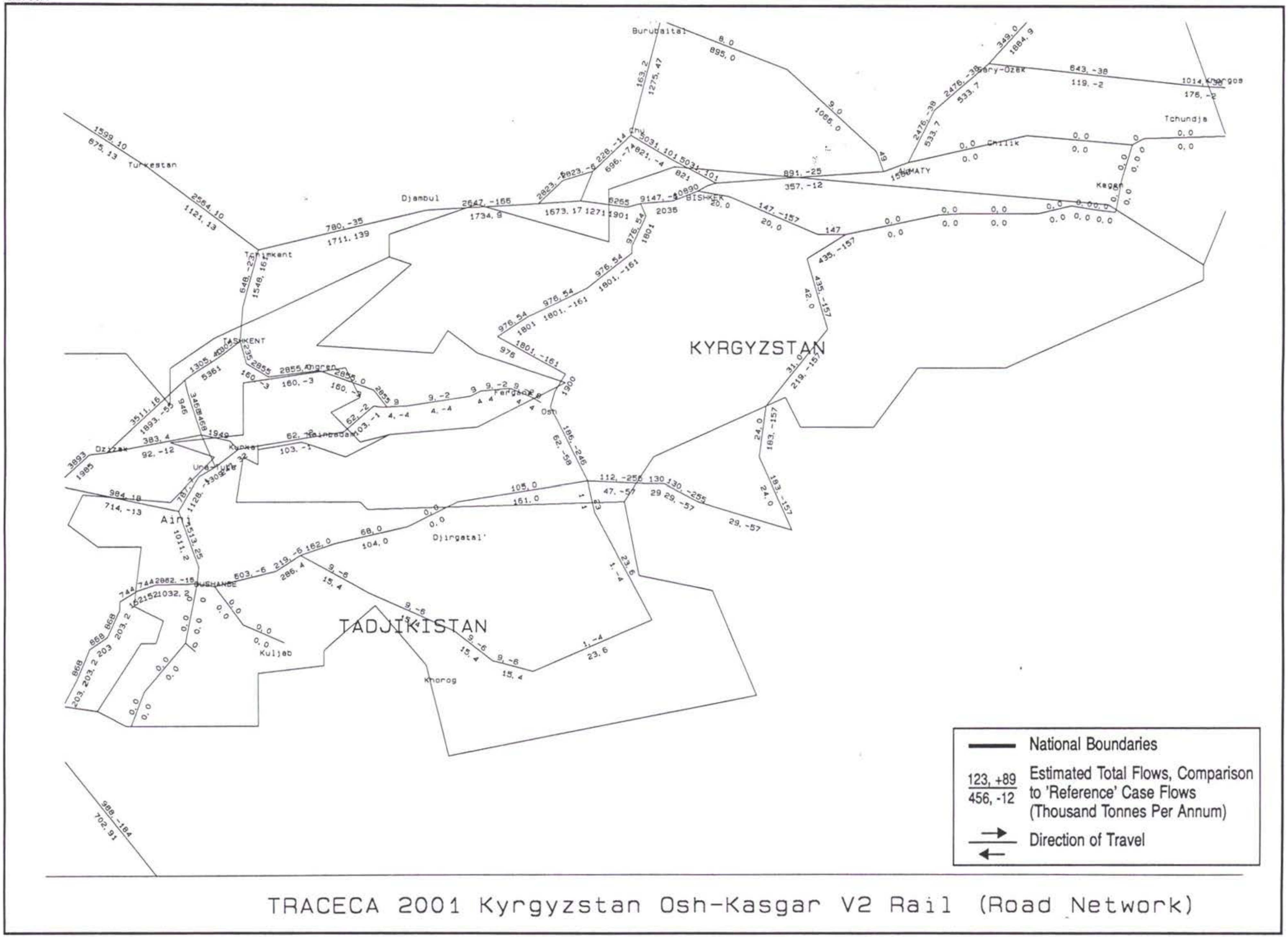


Figure K33
2001 Rail Link between Osh/Djelalabad and Kashgar, Road Network

G2730A

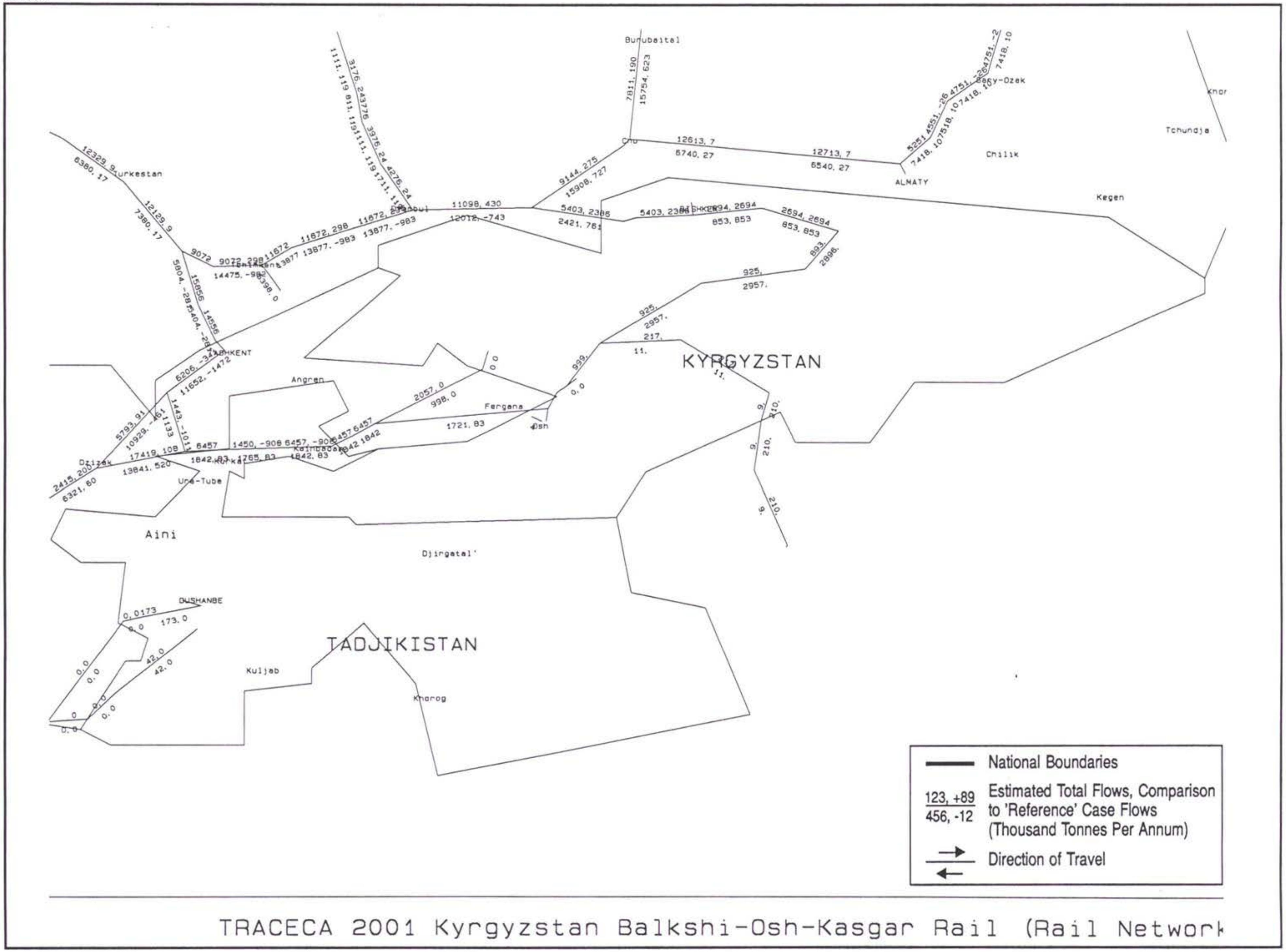


Figure K34
2001 Combined Rail Links Bishkek - Djelalabad - Osh and Djelalabad - Kashgar (Option 3), Rail Network

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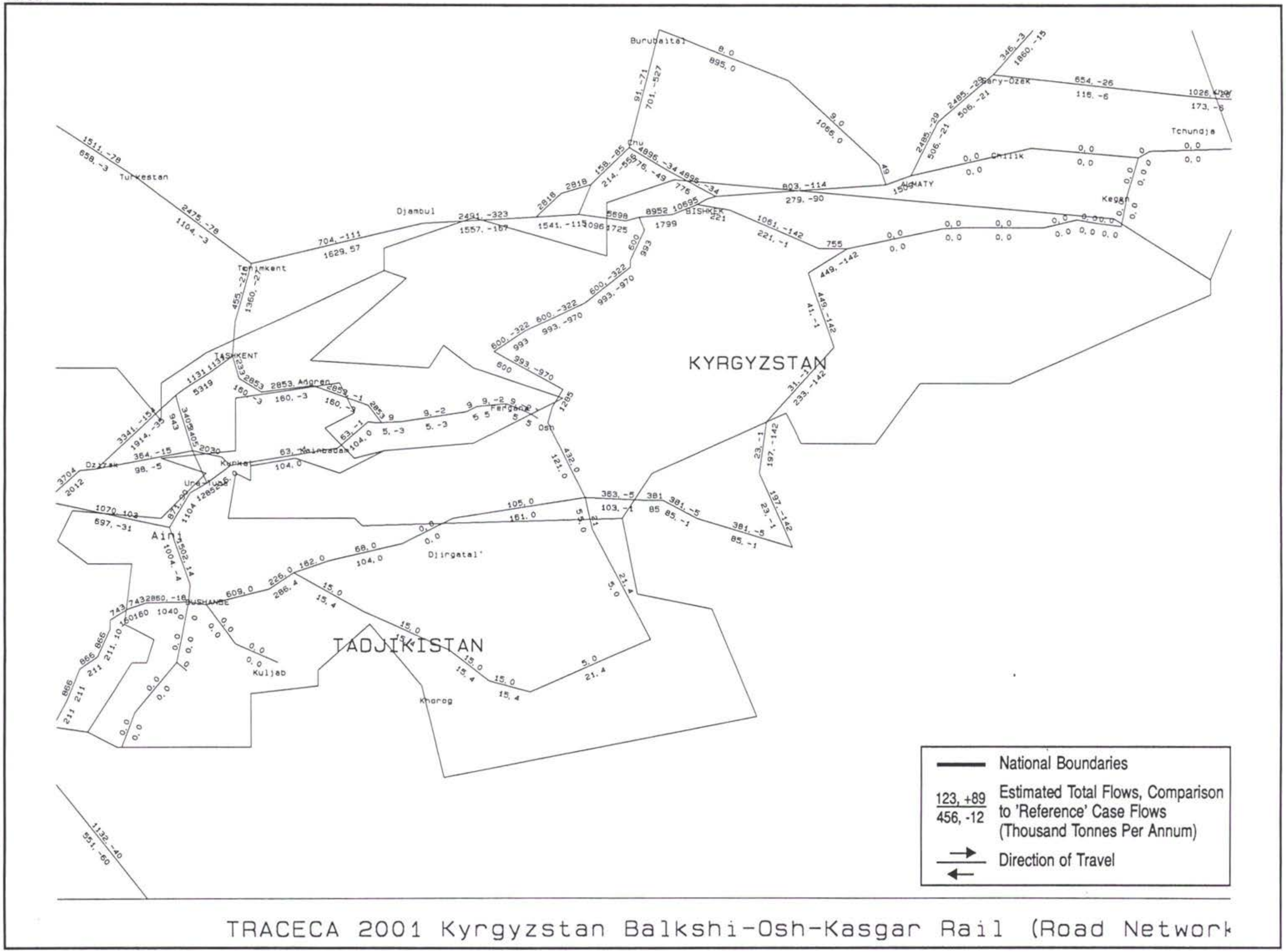

Figure K35
2001 Combined Rail Links Bishkek - Djelalabad - Osh and Djelalabad - Kashgar (Option 3), Road Network

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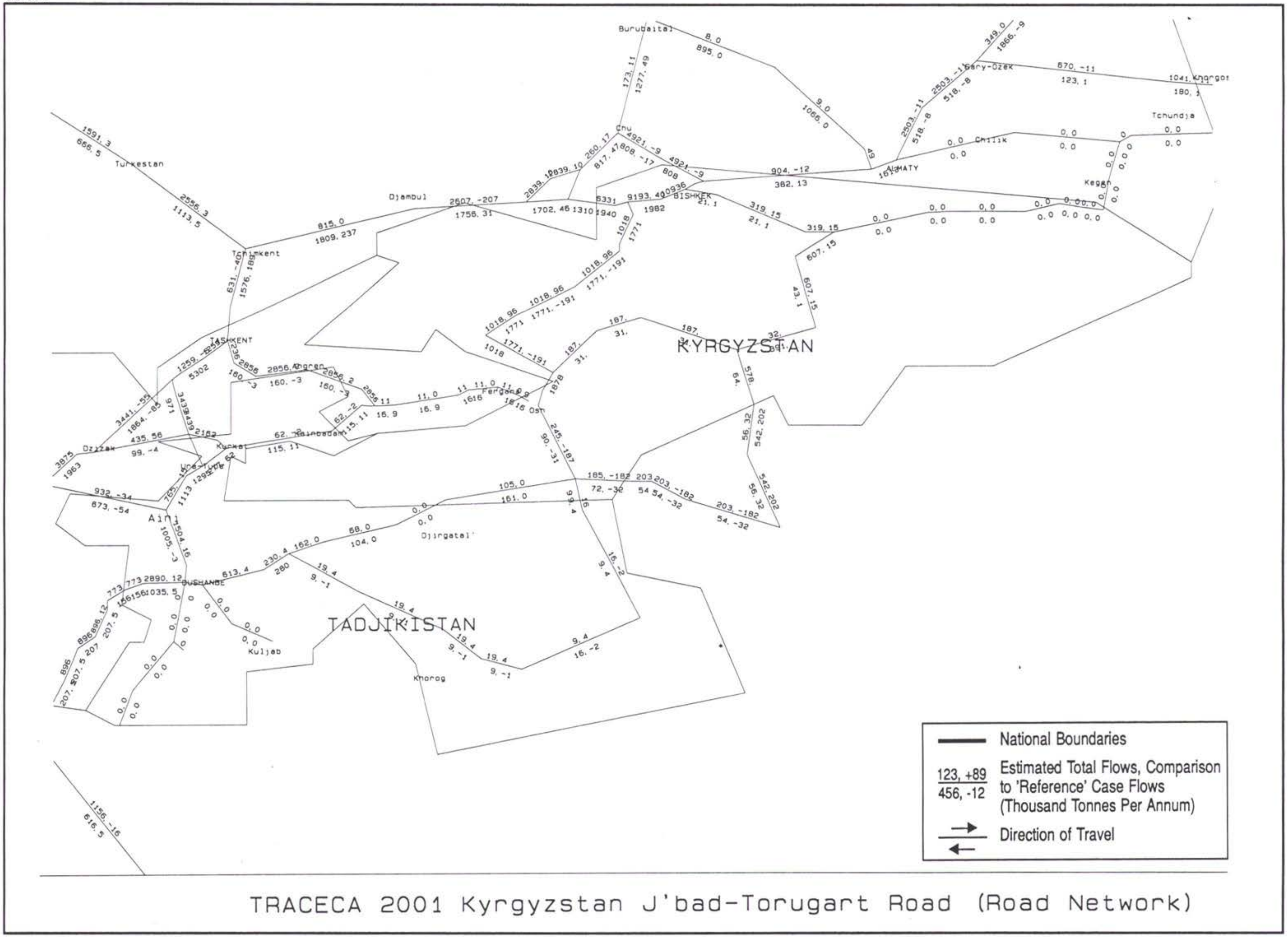

Figure K36
2001 New Road Link Djelalabad - Torugart in Kyrgyzstan, Road Network

Figure K37
Proposed Road Schemes in Tadjikistan

G2730A

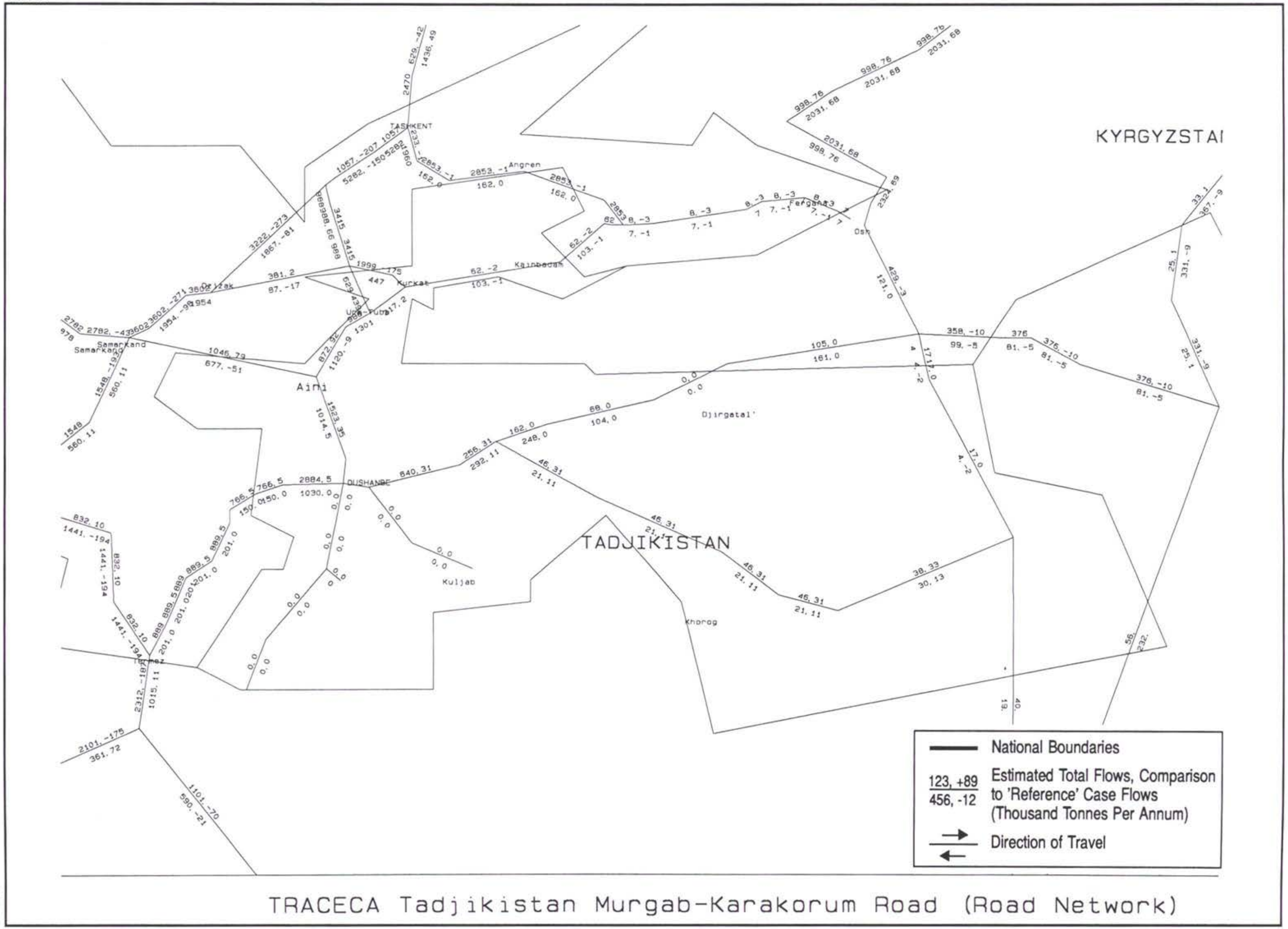

Figure K38
2001 Road Link Murgab - Karakorum Highway, Road Network

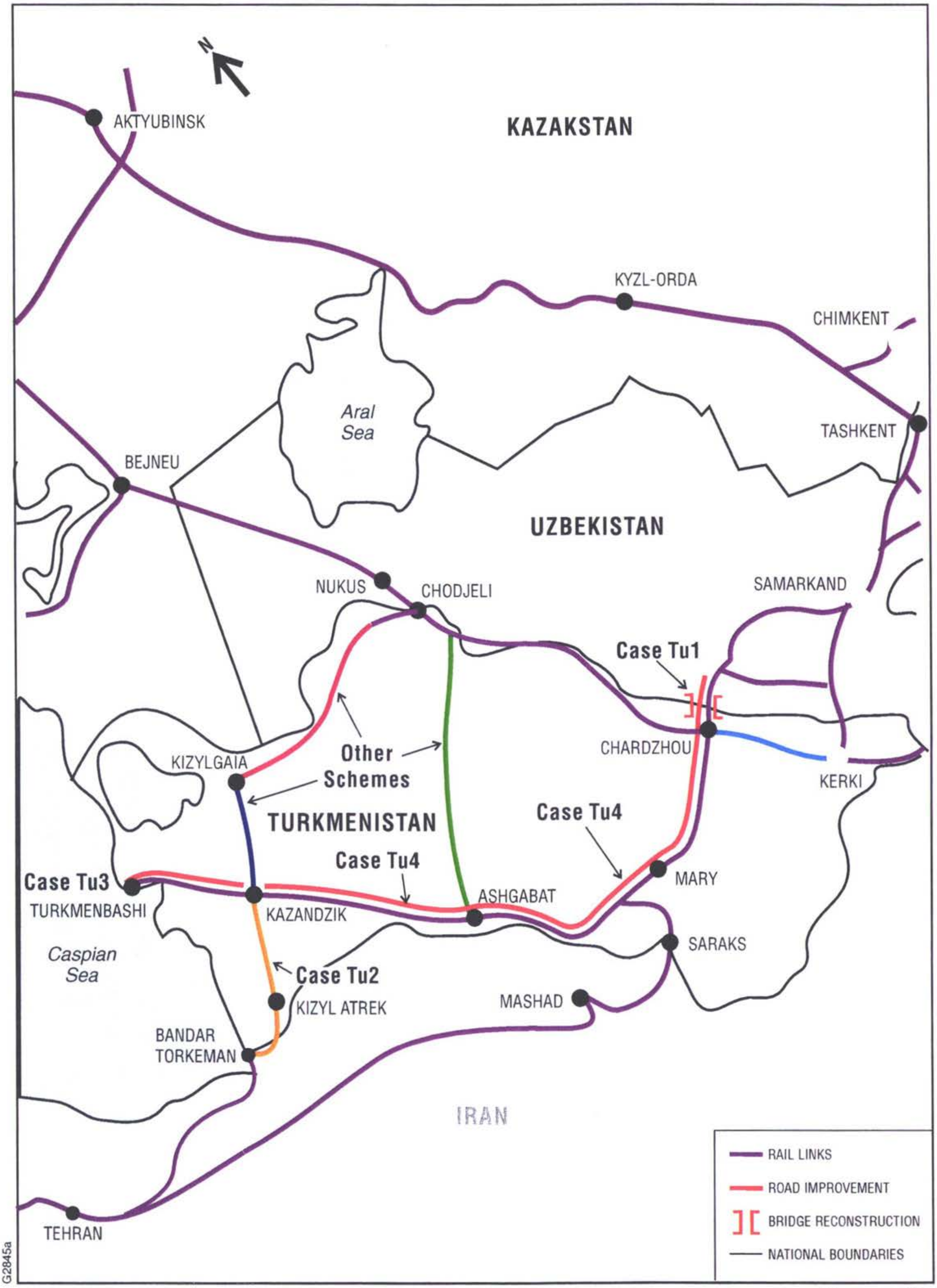

Figure K39
Turkmenistan Network Schemes

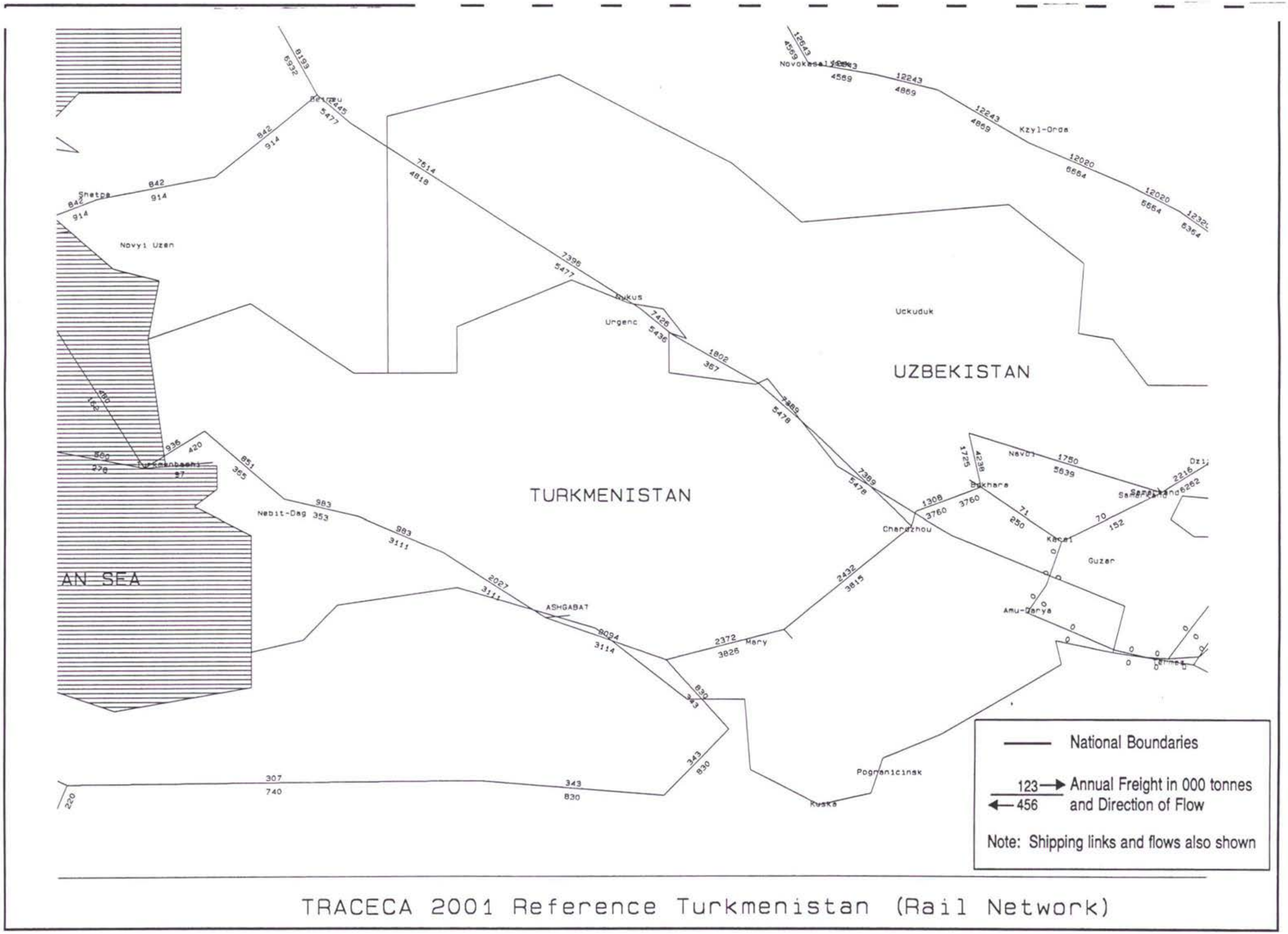

Figure K40
2001 Reference Case Flows for Turkmenistan, Rail Network

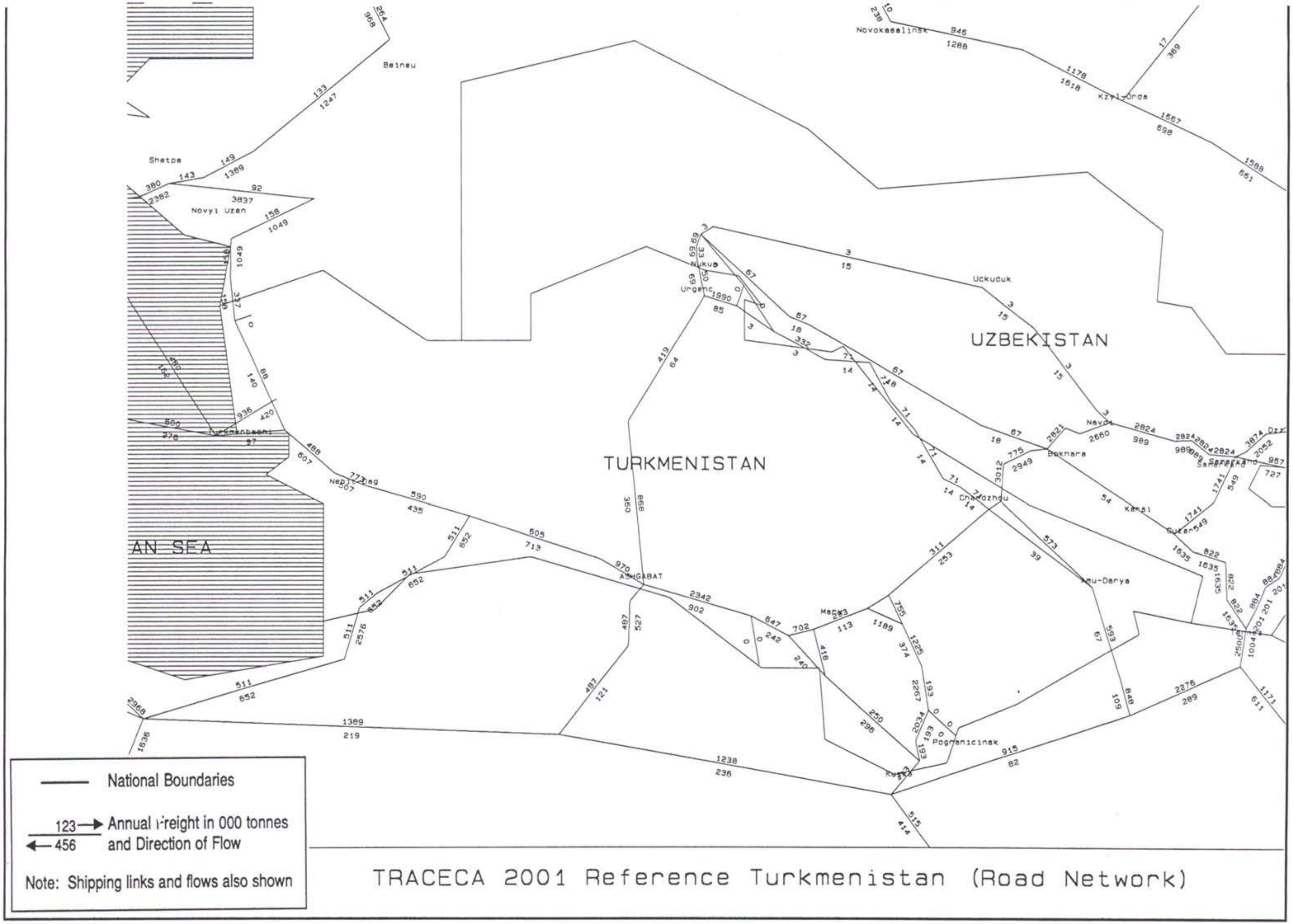

Figure K41
2001 Reference Case Flows for Turkmenistan, Road Network

G2730A

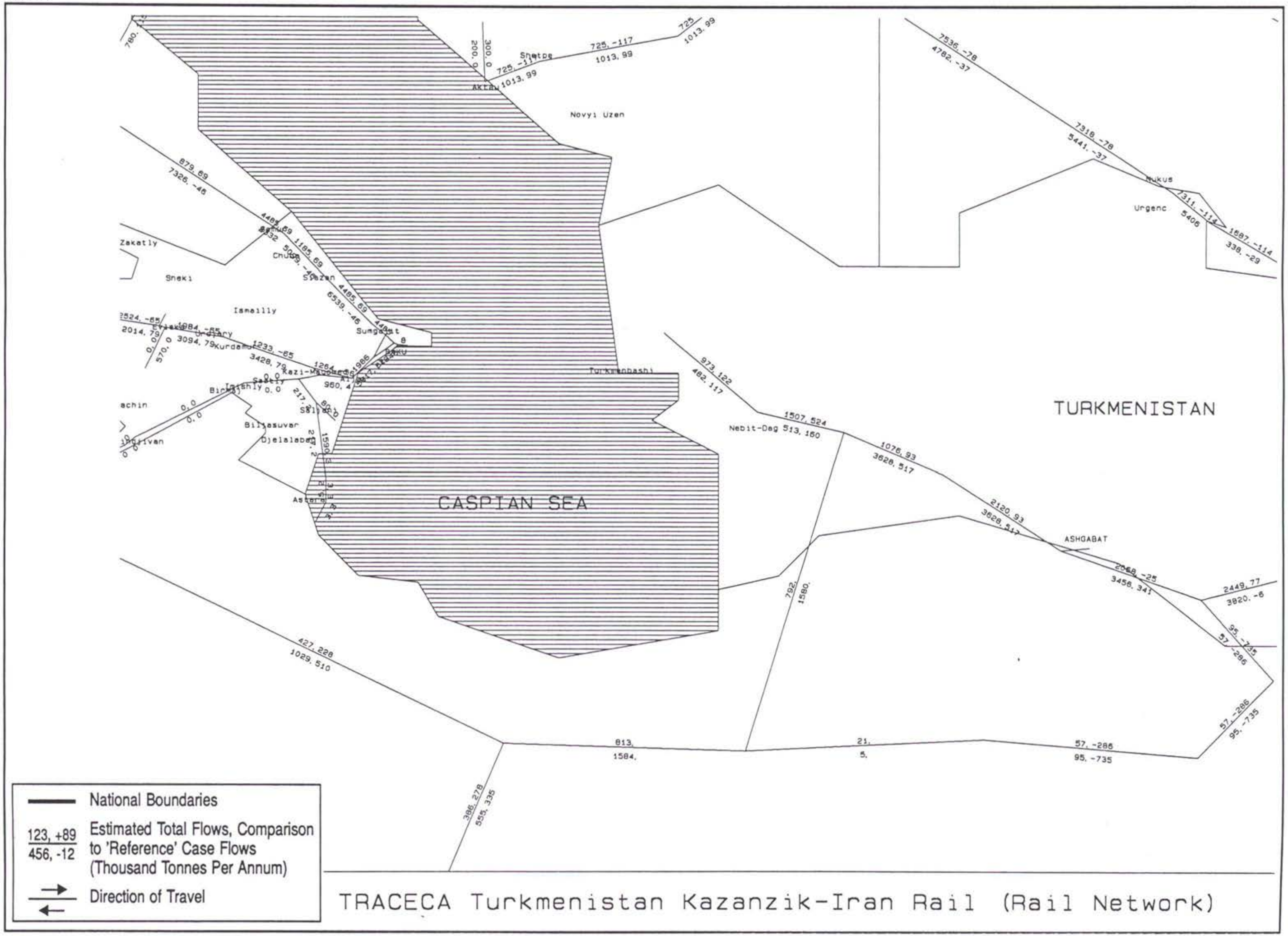

Figure K42
2001 Flows on New Rail Link Kazandzik - Kizyl - Atrek - Bandar Torkeman

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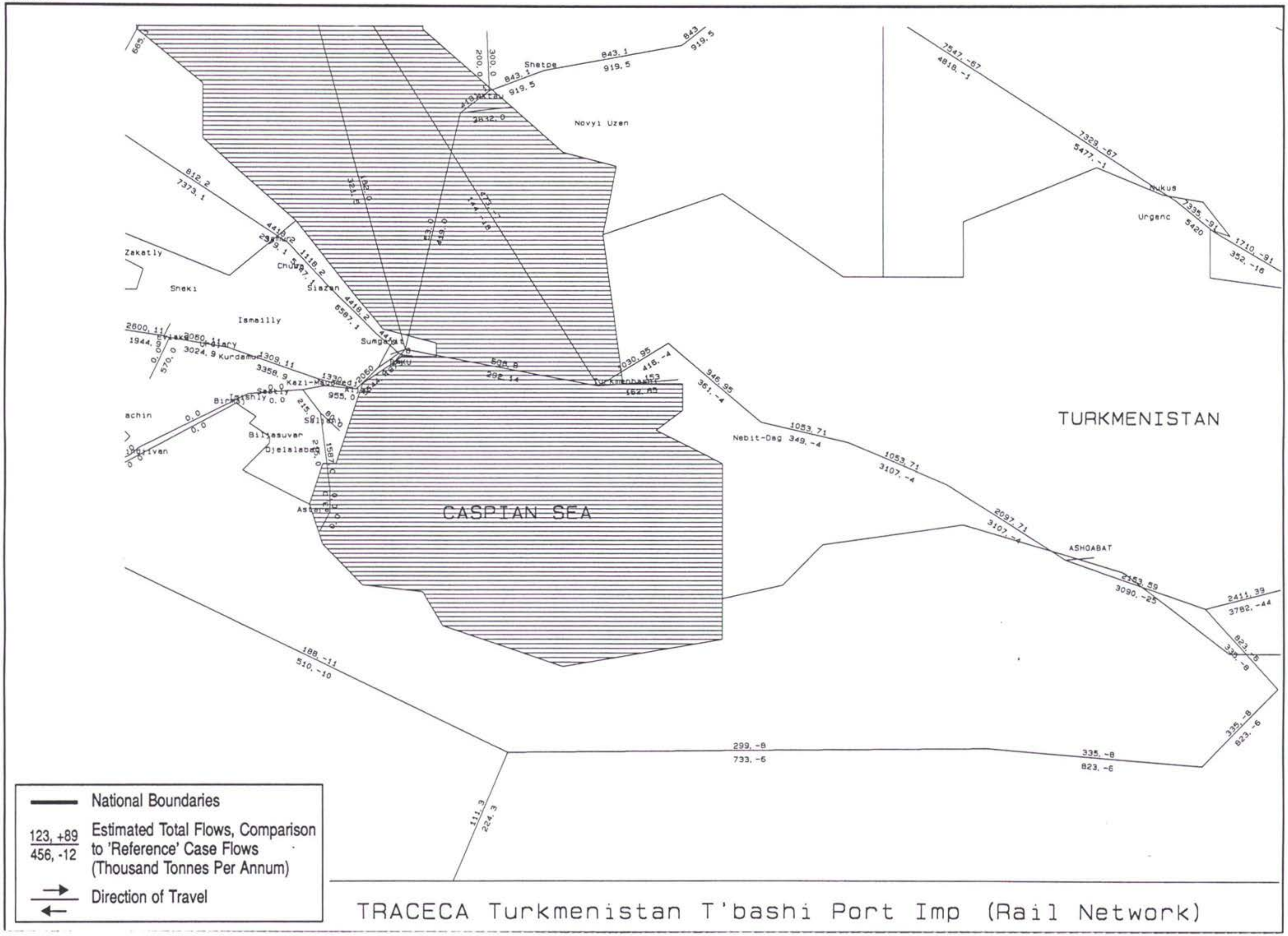
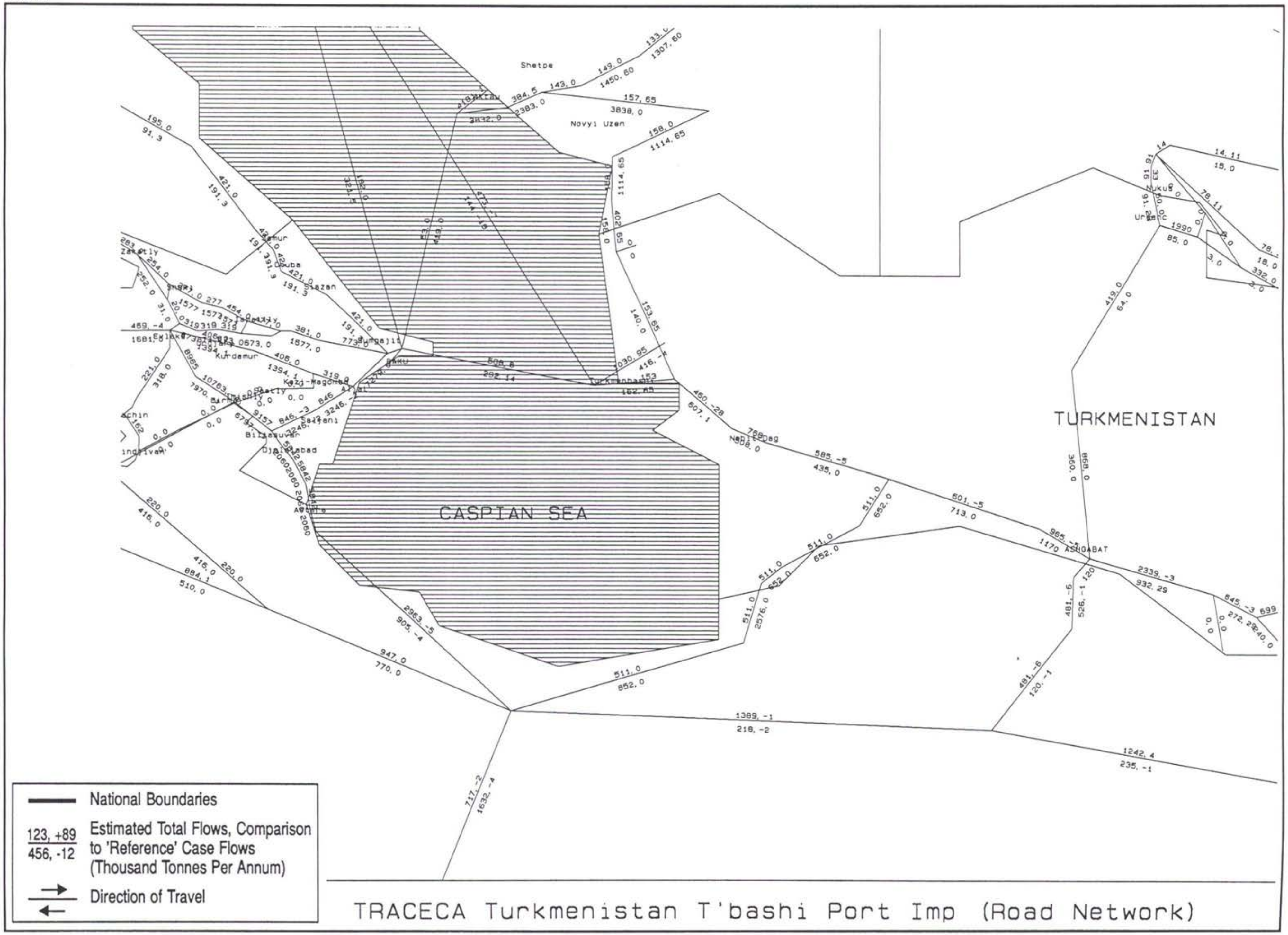


Figure K43
2001 Turkmenbashi Port Improvements, Reduced Loading Delays, Rail Network

Figure K44

2001 Turkmenbashi Port Improvements, Reduced Loading Delays, Road Network

G2730A



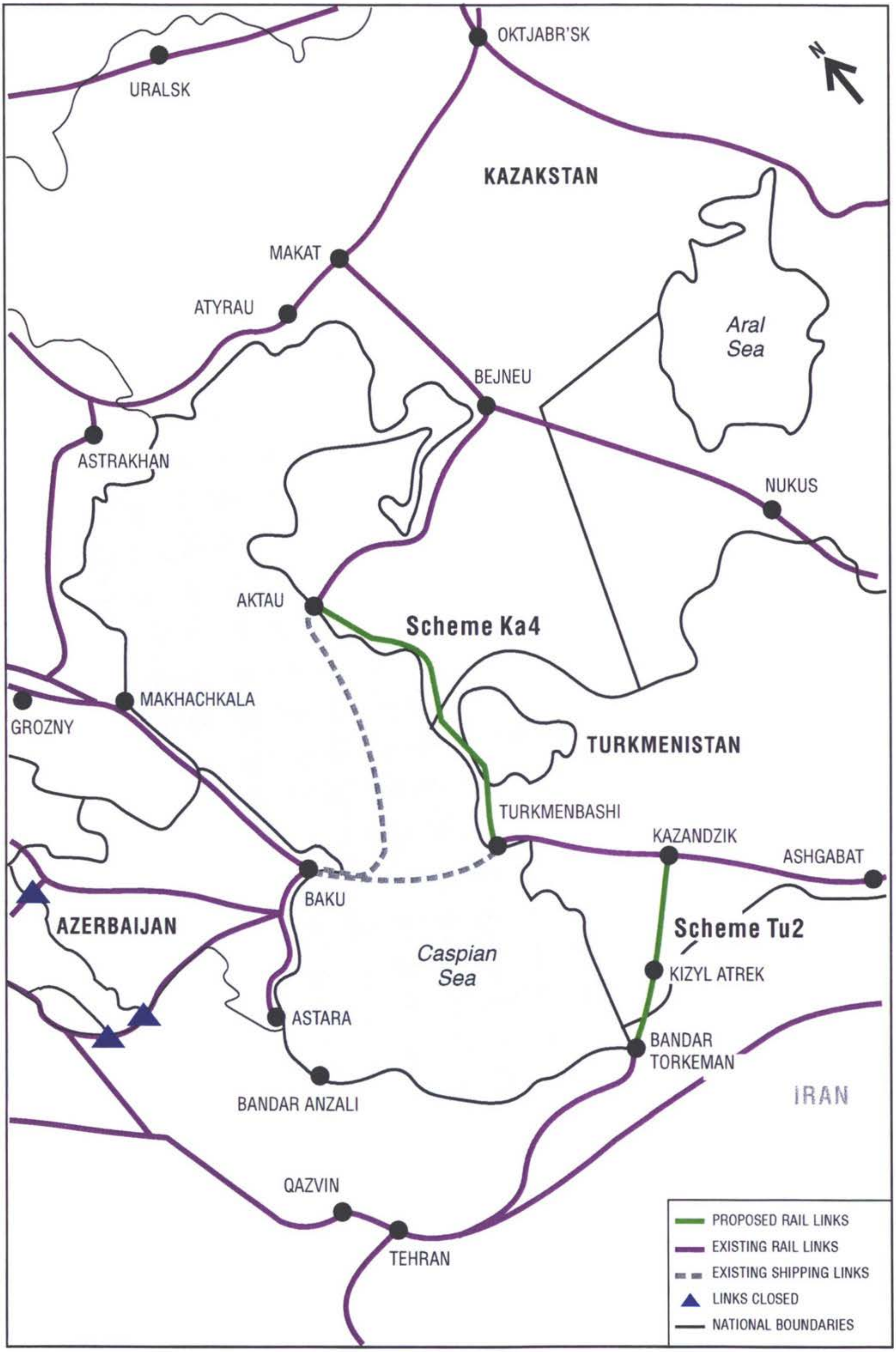
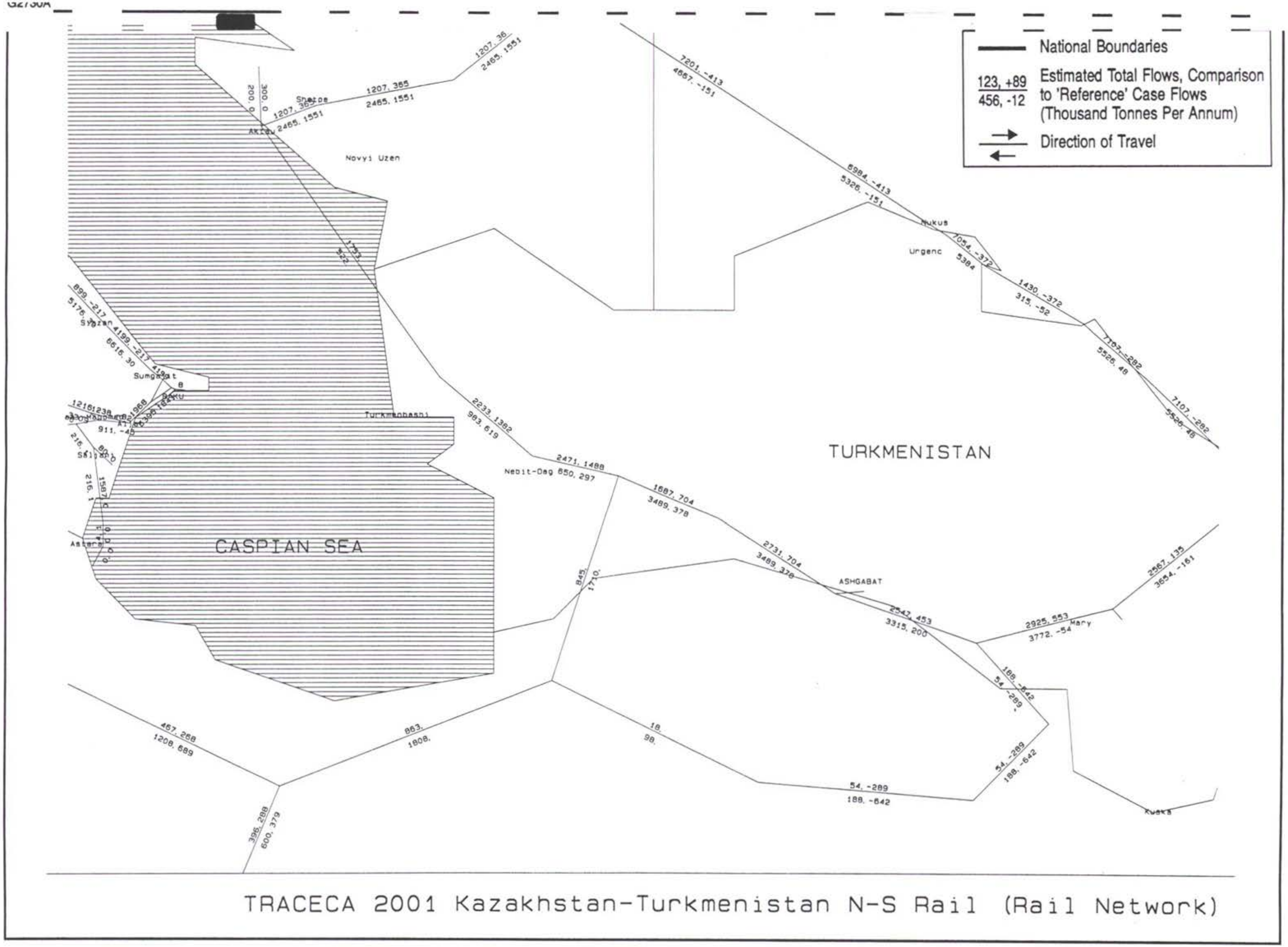


Figure K45
Case C1, The North - South Rail Link (Combined Case Tu2 and Ka4)

Figure K46

2001 North - South Rail Link (Combined Case Tu2 and Ka4), Rail Network



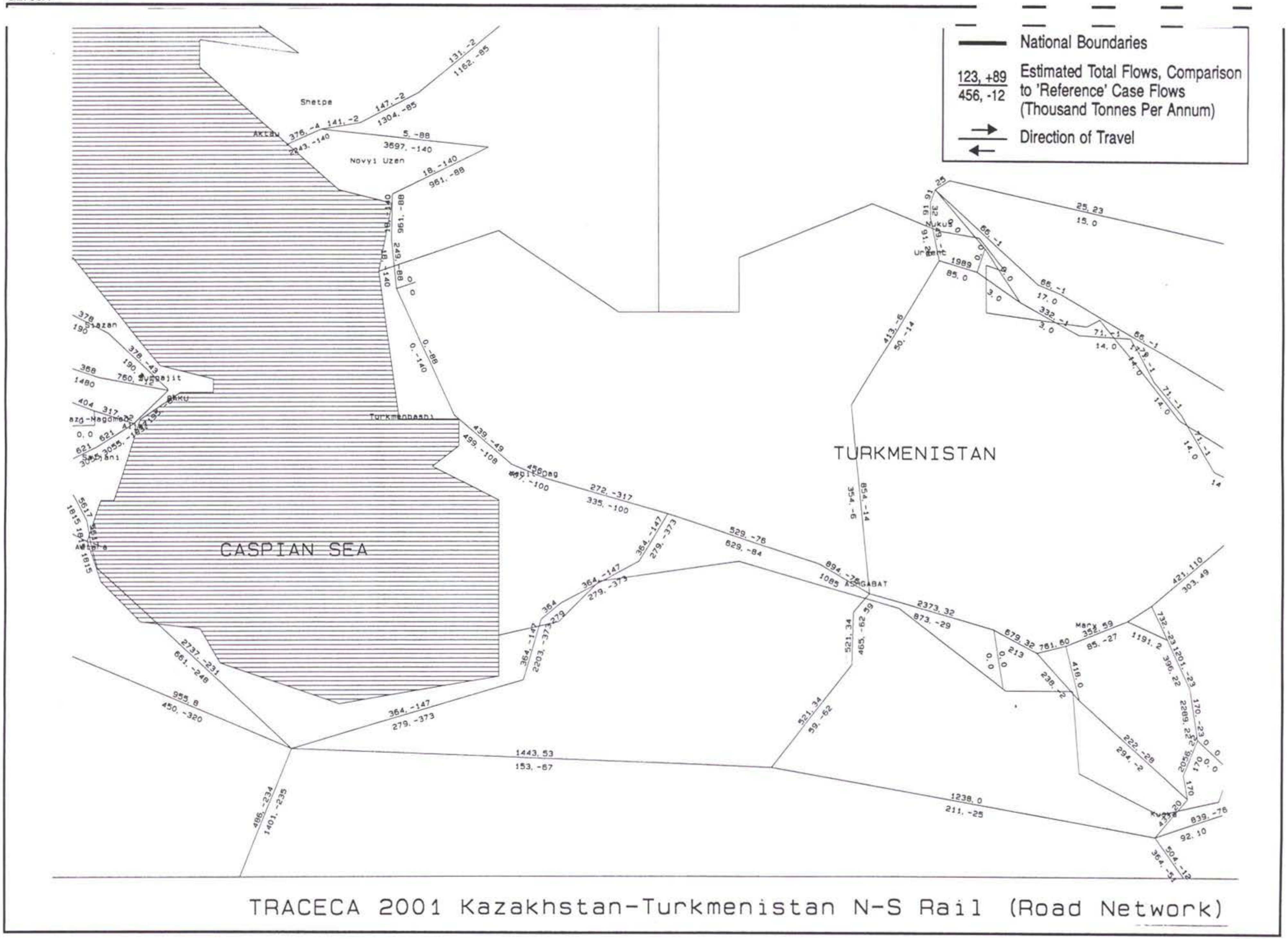


Figure K47
2001 North - South Rail Link (Combined Case Tu2 and Ka4), Road Network

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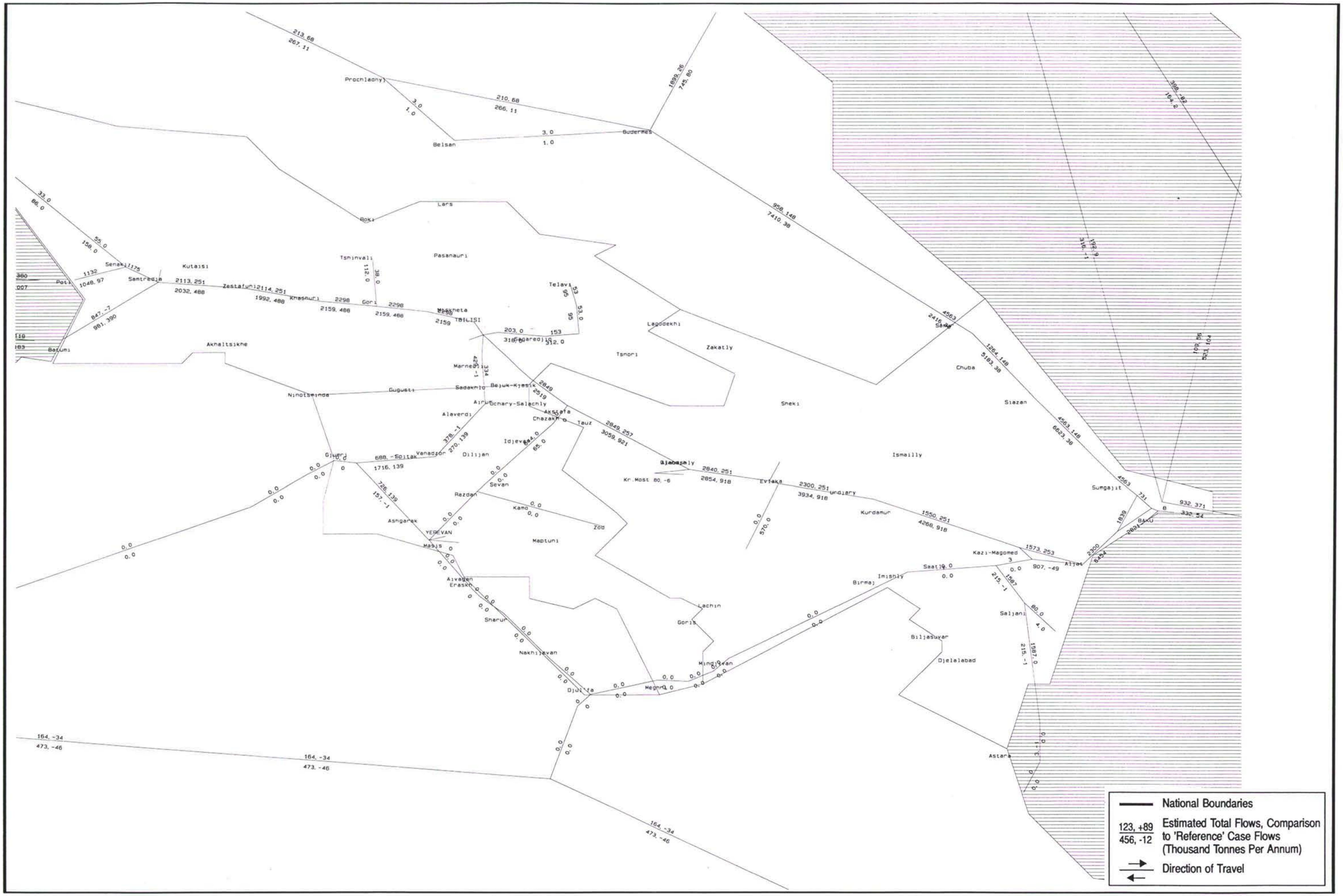

Figure K48
2001 TRACECA Corridor Illechevsk - Poti - Baku - Turkmenistan - Kazakstan, Rail Network

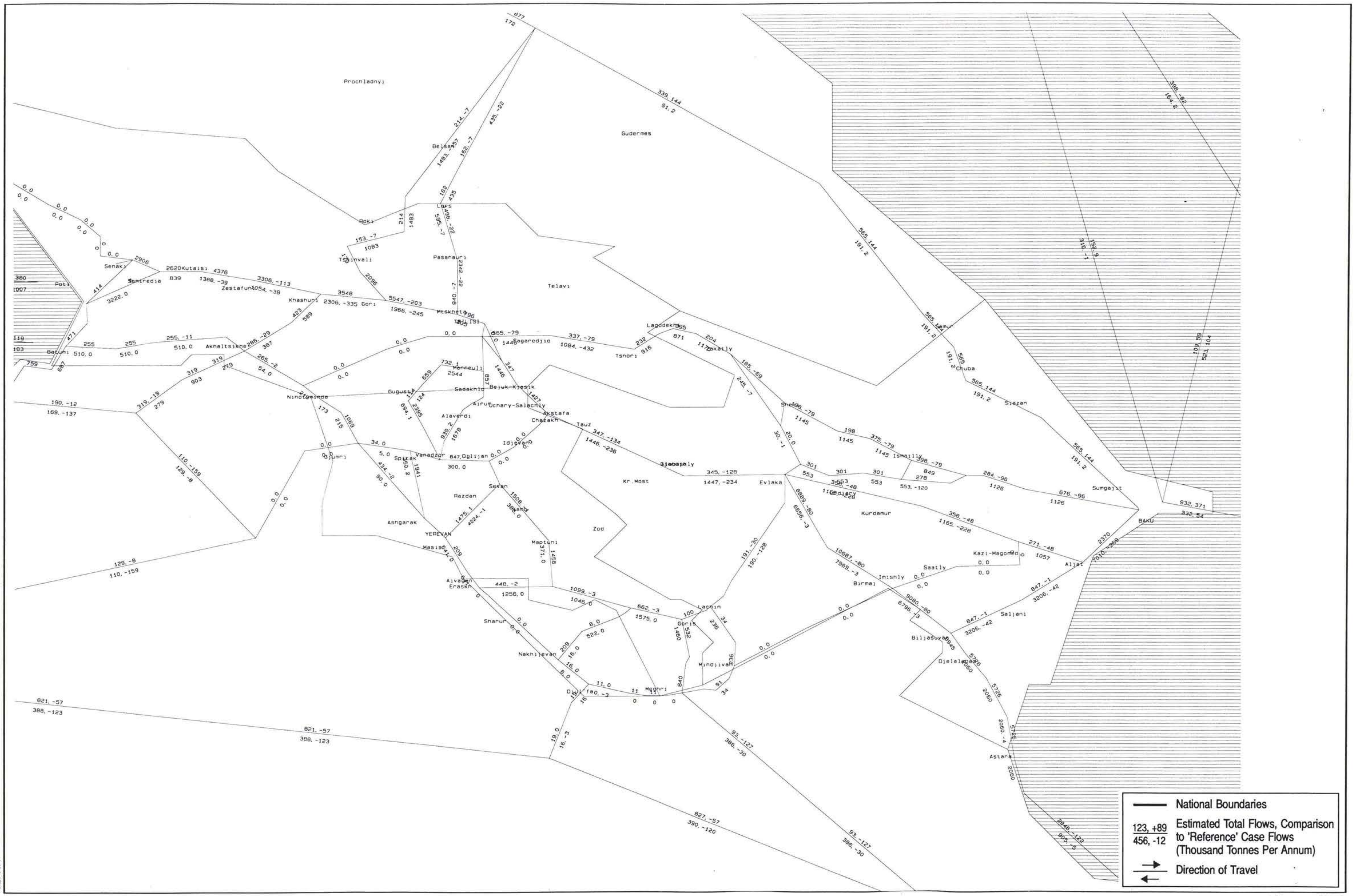

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Figure K49

2001 TRACECA Corridor Illechevsk - Poti - Baku - Turkmenistan - Kazakstan, Road Network

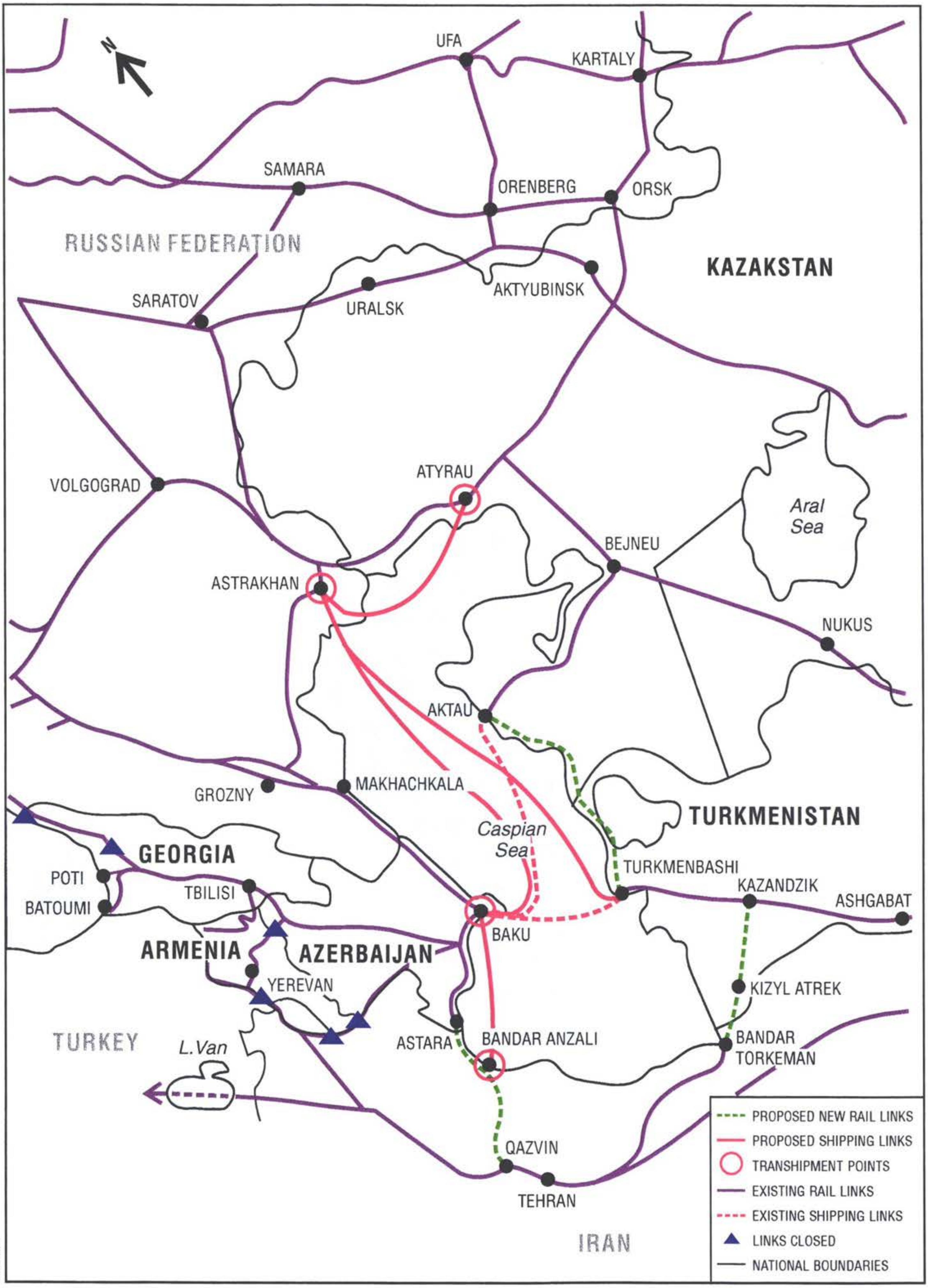

Figure K50
Competing North-South Connections in the Caspian Basin

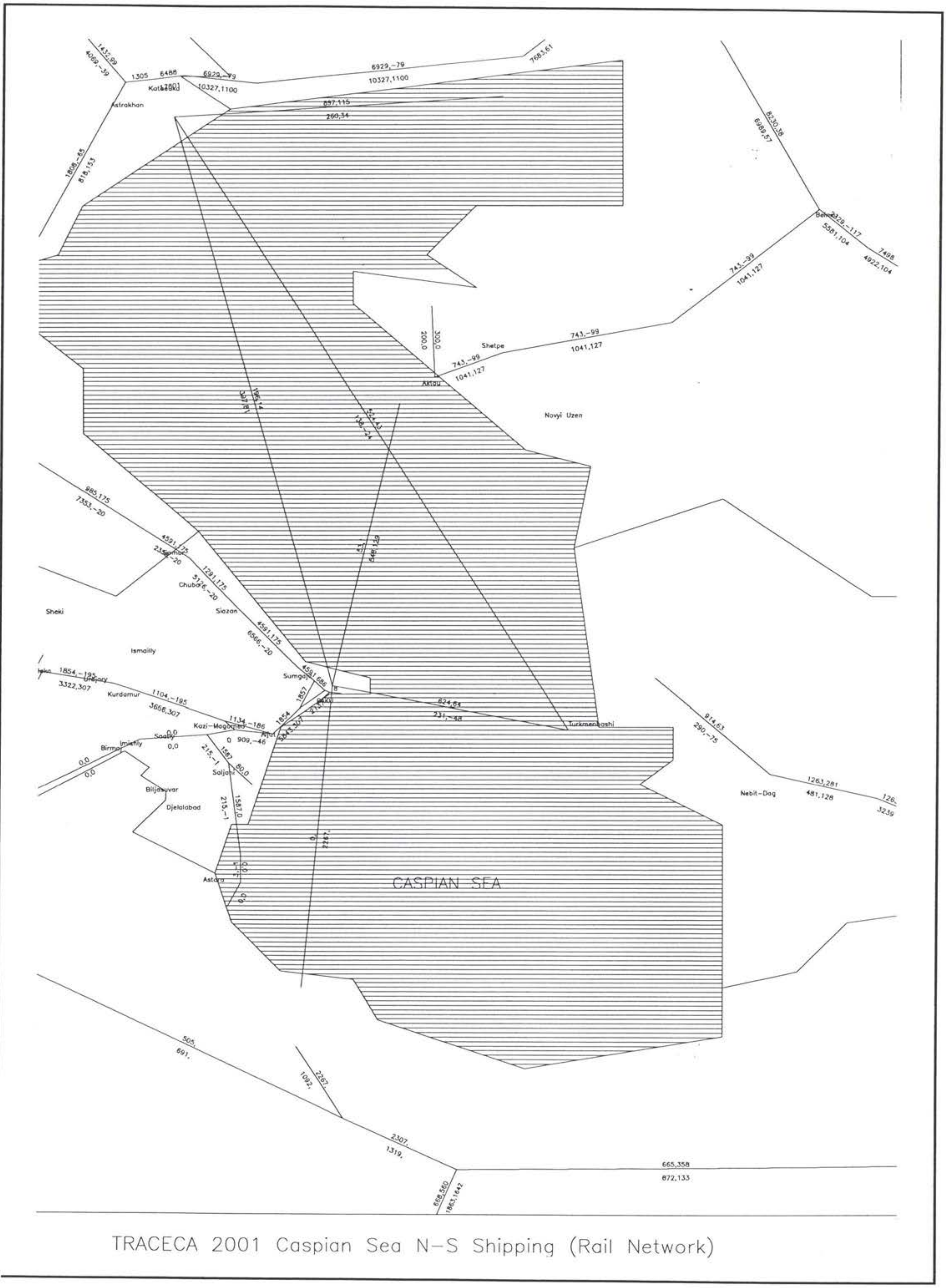

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Figure K51
2001 North - South Shipping Links on Caspian Sea (Russia/Kazakstan - Iran), Rail and Sea Networks