Construction of the bypass of Podgorica

General information

This project regards the construction of the **bypass of Podgorica**, localised where the Adriatic-Ionian and Bar-Boljare motorways intersect.

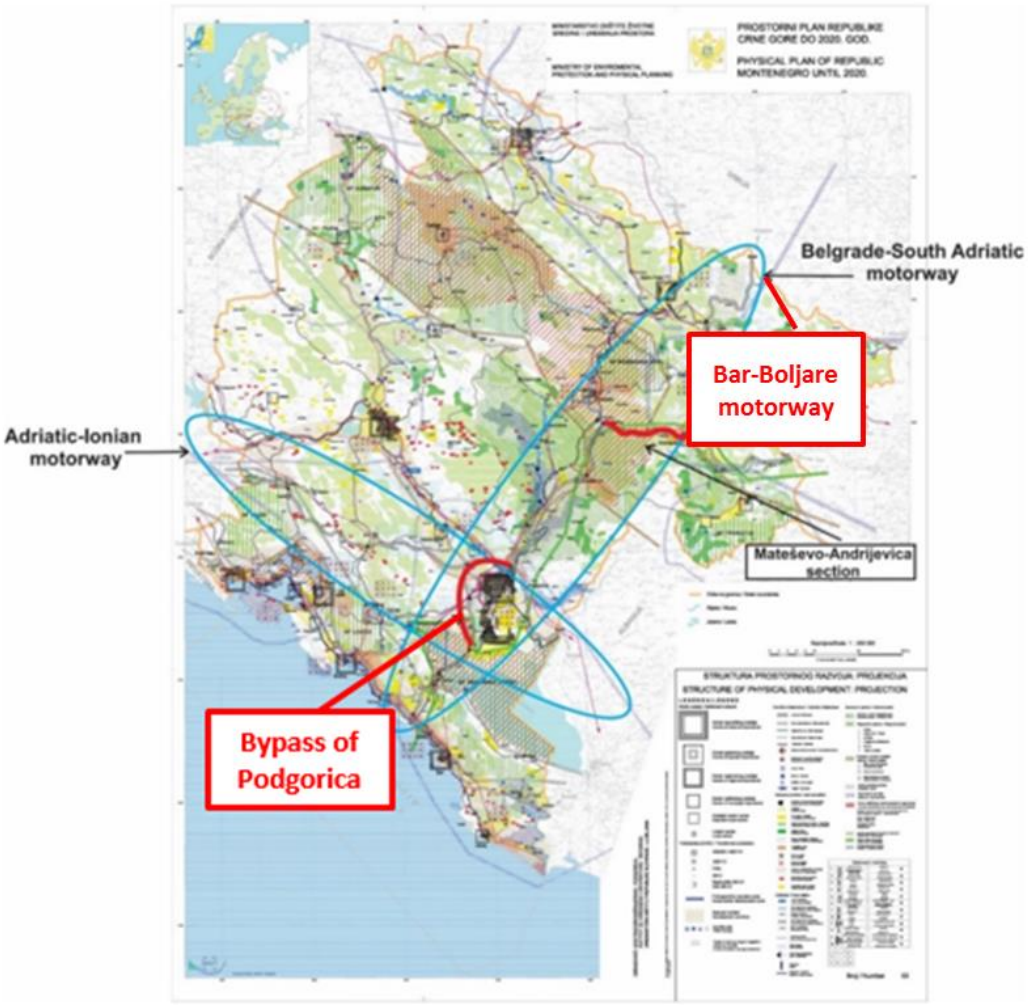
The bypass starts in the vicinity of interchanges at Farmaci and Zelenika and intersects the main roads M-2 and M-3 Podgorica-Cetinje and M-18 (E-762) Podgorica-Niksic. According to the design, the connections of main roads with the motorway will be realised through grade-separated interchanges (i.e., horn type). Moreover, the road section intersects several local roads, without direct connection. The most important are the roads to Krusi and Progonovici, the road to Mareza, the road to Danilovgrad and the road to Piperi.

As regards the **relevance of this project**, the construction of the bypass of Podgorica has been identified as a priority transport project in the Transport Development Strategy of Montenegro.

The **promoter of this project** is the Ministry of Transport and Maritime Affairs of Montenegro.

Figure 6-1 shows the localisation of the project.

Figure 6-1: Localisation of the bypass of Podgorica



Source: TRT elaboration on Ministry of Economic Development of Montenegro (2008)

Technical description

Four different options have been considered regarding the bypass of Podgorica. Two of them on the West side (i.e., options A and C) and two on the East side (i.e., options B and D).

Relying on the analysis of the technical solutions, on the estimation of construction costs and interference with protected areas, the **variant C** emerged as the suitable option. Variants B and D were excluded as not in accordance with the National Spatial Plan.

The characteristics of the road were based on adopted speed (i.e., 100 km/h), importance of the road as per network classification and envisaged traffic load over the assumed period. The adopted variant was designed assuming two separate carriageways. The main transversal and longitudinal elements are illustrated in Table 6-1 and Table 6-2, while the main characteristics of the options are reported in Table 6-3.

According to SEETO MAP (2016), the estimated investment cost is equal to € 280 million.

Table 6-1: Technical characteristics of the transversal section

Element	Dimension [m]	Total width [m]
Carriageways	4 x 3,50	14,00
Emergency lanes	2 x 2,50	5,00
Marginal strips	2 x (0,35 + 0,20)	1,10
Central reserve	1 x 4,00	4,00
Shoulders	2 x 1,00	2,00
Total		**26,10**

Source: Louis Berger (2008)

Table 6-2: Technical characteristics of the longitudinal section

Element	Dimensions
Minimum radius of horizontal curve	450 m
Maximum longitudinal grade	5%
Minimum cross fall of the pavement	2,5%
Maximum cross fall of the pavement in curves	7%
Minimum radius of convex vertical curve	10.000 m
Minimum radius of concave vertical curve	7.000 m
Visibility length at braking	175 m
Percentage of the route with available visibility	53%

Source: Louis Berger (2008)

Table 6-3: Characteristics of the options

SECTION	TOTAL	BRIDGES		TUNNELS	
	Length [km]	Length [km]	%	Length [km]	%
OPTION 1	17,89	2,395	13,38%	1,920	10,73%
OPTION 2	16,66	1,752	10,51%	2,500	15,00%
OPTION 3	17,15	2,293	13,36%	3,415	19,91%

Source: Louis Berger (2008)

Project implementation

The project implementation schedule has been not defined yet. The project management and supervision is not yet defined as well as the procurement plan.

Transport demand

Modelling for traffic estimation was carried out for the years 2007 and 2027. The simulation considered the entire road network of Montenegro. The evolution of the characteristics of the road network was included to take account of all planned improvements, according to the National Spatial Plan.

Traffic modelling considered different scenarios. On the one hand, the evolution of traffic volumes has been estimated in the scenario without measures for road network development. On the other hand, a different phasing development has been considered for Bar-Boljare and Adriatic-Ionian motorways, as well as development of individual subsections. In this regard:

- the full development of the road network assumed both tolled and non-tolled scenarios;
- the scenario of development of the motorway network, but without construction of the motorway along the Adriatic coast (i.e., to determine the influence of the Adriatic-Ionian motorway). Also in this case, the network has been assumed both tolled and non-tolled.

Three different years have been assumed to elaborate transport demand and forecasts: (i) the base year of 2007, for which traffic model was formed and calibrated with respect to road counts and interviews, (ii) the year of possible start of construction of the first part of the motorway network (i.e., 2012) and (iii) the target year of full realisation of the plan of Montenegro (i.e., 2027)[1].

The data collected from the traffic counts allowed to elaborate traffic flows to be used as the starting point for the estimates of future demand. On the basis of socio-economic data, **three scenarios** of evolution over the 20-year period were identified: normal, standard and low. The forecasted demand volume for the scenario of development of the road network are shown in Table 6-4.

Table 6-4: Forecasted transport demand volumes [AADT]

Scenario	Variable	2007	2012	2017	2022	2027
Normal	volume	63.423	93.612	134.774	183.166	222.234
	annual growth rate	-	9,52%	8,79%	7,18%	4,27%
Standard	volume	63.423	90.292	117.952	147.554	176.606
	annual growth rate	-	8,47%	6,13%	5,02%	3,94%
Low	volume	63.423	81.308	102.618	124.816	141.370
	annual growth rate	-	5,64%	5,24%	4,33%	2,65%

Source: Elaboration from Louis Berger (2008)

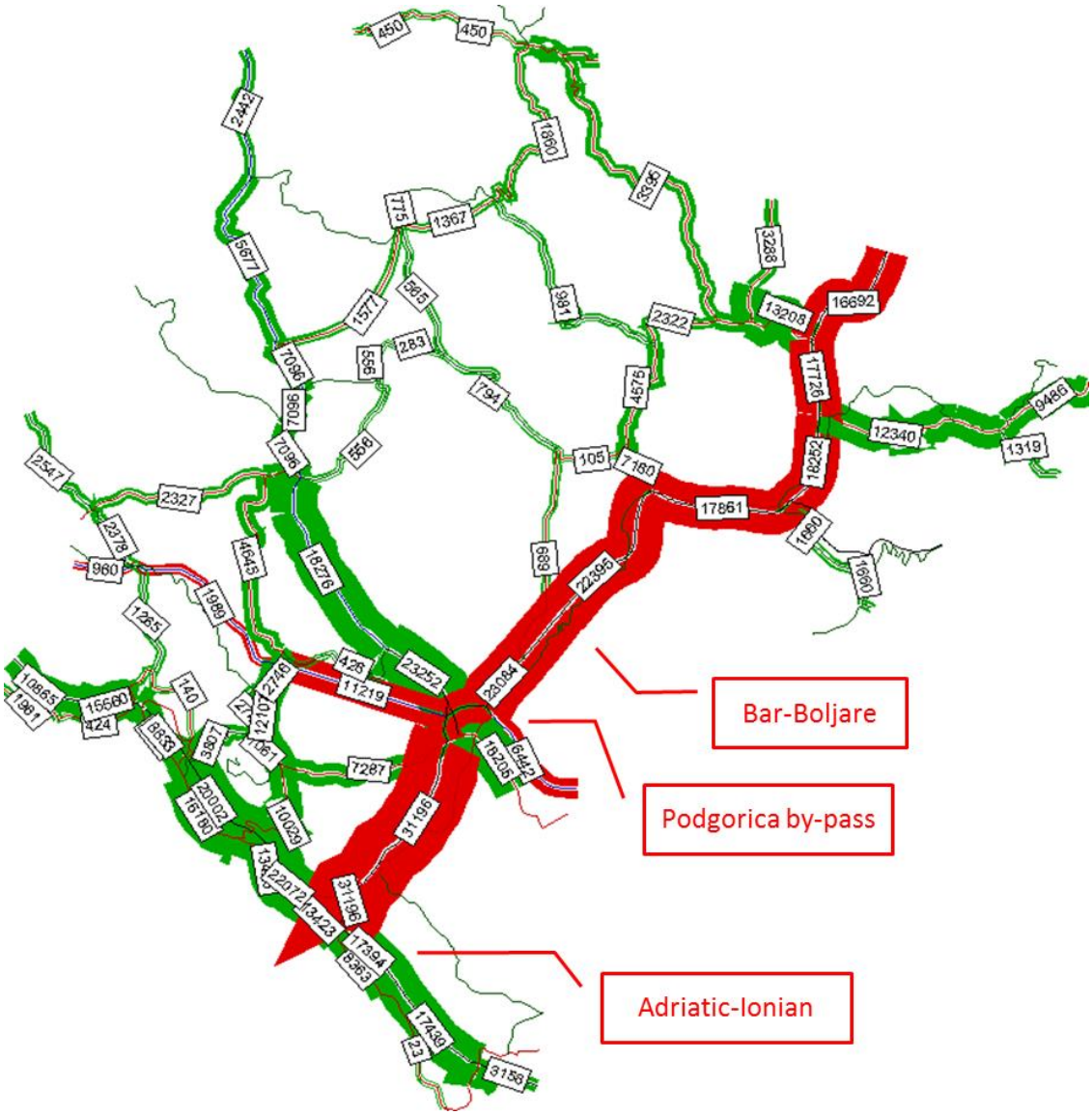
According to IBRD (2015), the GDP growth of Montenegro assumed an annual average rate of 2,41% and 3,18%, respectively for low/moderate and moderate/high scenarios, over the period from 2020 to 2030. On average, the annual growth rate of the estimated demand volume for the time period from 2022 to 2027 is equal to 5,72%, 4,48% and 3,49%, respectively for the three scenarios developed. On the long term, the estimated GDP growth is more in line with the low scenario of transport demand growth.

The **normal evolution scenario** has been assumed as the starting point from which to obtain the origin-destination matrix and assign the volumes to the modelled network. According to the estimation, the highway Bar-Boljare is expected to take the majority of traffic compared to the Adriatic-Ionic motorway (see the section in red of Figure 6-2).

[1] Traffic counting was conducted by the Crnagoraput company to form the base for traffic volume determination of the road network of Montenegro. In order to determine future forecast of the transport model, interviews were conducted on the road to elicit on users' preferences.

Comparing the two routes, roughly 80% of the estimated volume of vehicles of 2027 is expected to transit on the Bar-Boljare route and 20% on the Adriatic-Ionian motorway. The section with the highest traffic load in 2027 on the Bar-Boljare is between Podgorica and the Adriatic Sea with approximately 31 thousand vehicles per day. Information on transport demand segments (i.e., long and short distance) and the modal share between cars and trucks is not available.

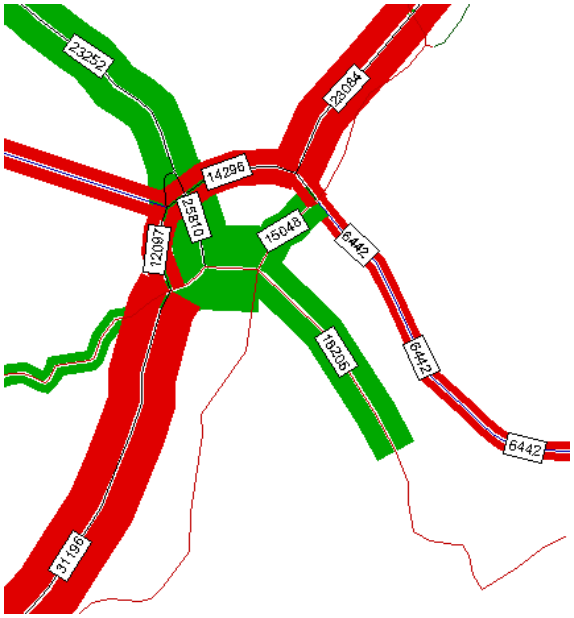
Figure 6-2: 2027 AADT of the motorway Bar-Boljare (in red)



Source: Louis Berger (2008)

The section from the junction in Smokovac to the junction in Mateševo, part of the by-pass around Podgorica, has been identified as the first section for future implementation. Figure 6-3 presents a detail of the demand volumes estimated at the bypass of Podgorica. The section with the highest traffic load in 2027 foresees approximately 14 thousand vehicles per day.

Figure 6-3: AADT (2027) of the bypass of Podgorica (in red)



Source: Louis Berger (2008)

Financial analysis

The financial analysis has not been carried out. The implementation scheme is still an open question. Loan, Concession or PPP scheme (in form of Design and Build and other infrastructure delivery models) are options considered for project implementation.

Economic analysis

The economic analysis has not been carried out.

Environmental analysis

A separate study[2], yet an integral part of the General design, analysed the issue of **environment protection** for section Farmaci-Smokovac on the Bar-Boljare motorway.

The impact assessment involved the description and evaluation of current conditions and protection measures. The issues of noise, vibrations, air pollution, contamination of water, contamination of soil, occupation of areas, flora and fauna, visual contamination and cultural heritage were discussed under the previous environmental impact assessment of the newly-designed motorway by using a defined methodology.

The analysis and evaluation of the current environmental status and assessment of potential environmental risks of the construction of the bypass of Podgorica indicate that only a detailed analysis of the potential impacts can provide the quantification of potential consequences.

Preliminary assessment showed that the most distinctive negative impact is the **contamination of water**, especially the underground water. The reason is the hydro-geological characteristics of soil in the region of the alignment. It is mostly limestone with high filtering coefficient, which results in quick penetration of surface water from the pavement into the soil and a quick contact with the

[2] Louis Berger (2008). General design of the Bar-Boljare motorway - Environmental Impact Pre-assessment - Motorway section Farmaci-Smokovac.

underground water, which is an important resource for water supply of the region of Podgorica and the surrounding area.

In this respect, it will be necessary to conduct appropriate studies during the next designing phase and identify protection measures, like the construction of a closed drainage system for the pavement and building impermeable film at the contact point between embankment and subsoil. The construction of protection structures is planned for noise protection.

Safety levels

The design of the road network according to EU standards can contribute to a **significant improvement of safety levels**. However, regarding this project there is not a specific quantification of safety levels and identification of black spots.

According to documents available, some general considerations are provided regarding road safety during the operation phase. In this respect:

- a proactive approach to the maintenance contracts. Each section of road included in a contract will be subject to a Safety Audit which will guarantee on the implementation of the required measures to maintain and improve the safety conditions of the highway;
- the establishment of road safety councils is envisaged to evaluate and recommend the adoption of road safety policies such as:
  → mandatory use of seat belts;
  → compulsory driver training and testing;
  → prohibition and punishment of drivers under the effects of drugs or alcohol;
  → traffic safety education for children;
  → testing and inspection of all vehicles according to EU vehicle safety standards;
  → restricting access for NMV (non-motorized vehicles).

  Road councils, with the help of agencies and ministries, are also obligated to develop national or regional road safety plans to:
  → ensure post-accident emergency assistance and medical care available to all accident victims;
  → develop an accurate accident data recording system;
  → conduct research and regularly monitoring the state of road safety;
  → determine the need for further road improvements (based on accident data);

encourage research and development of new, safety-oriented road technologies.