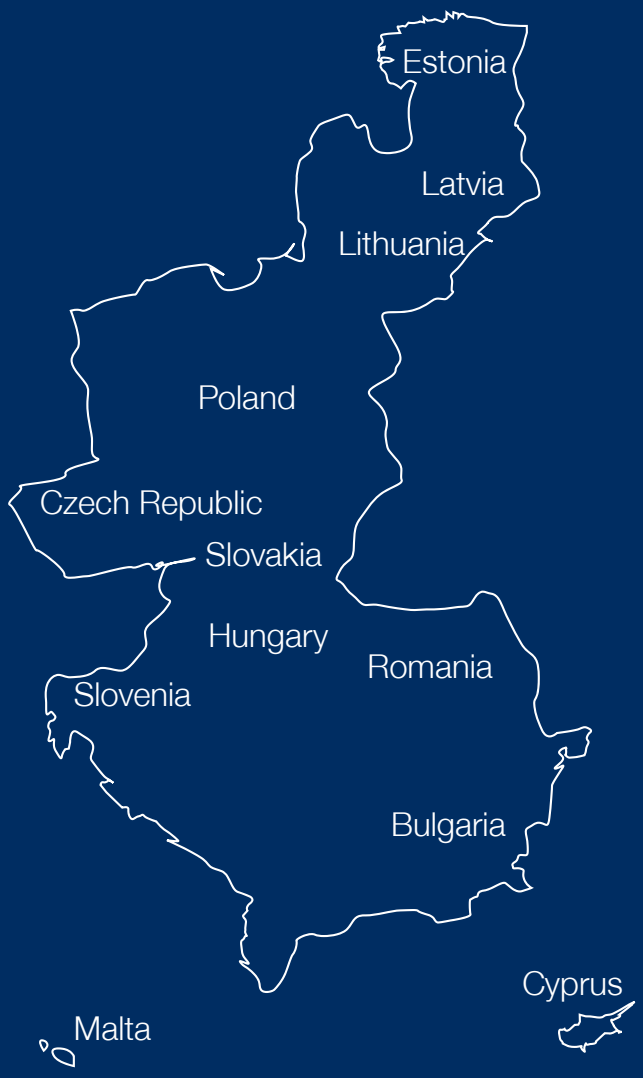


JASPERS - LOT 4: Transport and Urban Development Framework Agreement for TA to JASPERS' Beneficiary Countries

Technical Assistance for Review and Gap Analysis of Sibiu - Pitesti Motorway Feasibility Study

Technical Terms of Reference Report

28th June 2013

Halcrow
A CH2M HILL COMPANY

Document history

Technical Terms of Reference Report (ToR)

TA for Sibiu-Pitesti Motorway Feasibility Study

for

JASPERS

This document has been issued and amended as follows:

Version	Date	Description	Created by	Verified by	Approved by
1.0	28.06.2013	First Issue For Comments	Multiple input from key experts	Bogdan Fodor	Alan Guthrie
2.0	18.07.2013	For Comments	Multiple input from key experts	Bogdan Fodor	Alan Guthrie
3.0	26.07.2013	For Approval	Multiple input from key experts	Bogdan Fodor	Alan Guthrie

Contents

1 Executive Summary

The proposed Sibiu-Pitesti motorway forms part of the pan-European transport corridor IV, Priority Axis number 7 of the Trans–European transport network (Igoumentis/Patra – Athens – Sofia - Bucharest) representing a strategic route which, once opened to traffic, will significantly improve journey time reliability and safety for road users and will contribute towards achieving the European Union objective for improved accessibility to various regions in Romania. The route itself traverses a mountainous region of Romania and is approximately 120km long. Once completed, it will represent a major addition to the EU road network.

JASPERS sought assistance to support the development of the project with a view to improve the quality of project preparation for a project of this scale and national significance. Their requirements include a detailed review of the existing feasibility study in order to identify any omissions and those areas that are of sufficient and proportionate quality in order to have a feasibility study, which would support a successful co-financing application and provide the basis for a high quality, efficient, cost-effective and timely implementation of the project.

Section 2 of the Report provides an overview of Romanian and European transport policies and how these will impact on the development of highway infrastructure in Romania. The Romanian road network is in a relatively undeveloped state compared to other western European countries and will require considerable investment to be comparable with international standards.

Section 3 of the Report outlines the compliance with Task undertaken as part of the Terms of Reference Report for technical assistance for the update of the Sibiu–Piesti Feasibility Study. It describes our understanding of the requirements of this task as follows:

- **Task 3**: Complete Terms of Reference (ToR) for Technical Assistance (TA) for the updated Feasibility Study. Based on outcomes of **Task 1** (Review of Existing) and **Task 2** (Gap Analysis), a technical specification is to be completed for a Feasibility Study including engineering, environmental, social and economic analyses to update and revise motorway alignment options and to select the preferred motorway alignment option using a multi-criteria analysis, including cost benefit analysis.

Section 4 of the Report provides the detailed Technical Terms of Reference (ToR) and includes specific comments on the logistic or administrative items that the Romanian National Company of Motorways and National Roads (RNCMNR) will need to confirm and update prior to tender.

2 Introduction

2.1 Background

The managing authority for the Sectoral Operational Programme, Ministry of Transport and the Romanian National Company of Motorways and National Roads (RNCMNR) requested JASPERS assistance to support the development of the project with a view to improve the quality of project preparation for an investment of this scale and national significance. JASPERS have recommended as a first action that a detailed review of the existing feasibility study be undertaken in order to identify the Gaps which need to be remedied, if necessary, and to identify those areas that are of sufficient and proportionate quality. The aim of this review is to enable the completion of a Feasibility Study which supports a successful co-financing application and provides the basis for the timely implementation of a project which is efficient, cost-effective and of high quality.

Upon review of all relevant existing studies, data and information relevant to the Sibiu–Pitesti motorway, Gaps are to be identified in the existing feasibility study in the context of the latest European Union (EU) and national policy, planning process and standards relevant to the construction of the Sibiu–Pitesti motorway. A recommended plan to complete the feasibility study is to be established and Terms of Reference (ToR) for Technical Assistance (TA) to be procured by the RNCMNR are to be prepared.

This assignment shall provide technical assistance for the review and Gap analysis of the existing Feasibility Study for the Sibiu–Pitesti motorway. Its findings will be used by the Ministry of Transport and Romanian National Company of Motorways and National Roads (RNCMNR) to plan and implement the project within the period of the National Development Plan 2014-2020 with financial support from the EU Cohesion Fund.

2.2 European & Romanian Transport Policy

European Union (EU) policy in the field of road transport was developed around a fundamental principle, identifying transport as one of the keys to success for the Single Market, contributing significantly to the realisation of two of its main objectives:

1. The free movement of goods
2. Free movement of persons.

The primary aims of the Transport Policy are, in summary, as follows:

- Transport Policy must primarily meet the objectives set by the Treaty, as detailed in the legal documents, which highlight the development and enhancement of the EU internal market
- Creating a viable and flexible transportation system that would optimise energy consumption, journey time and road safety, which requires the co-ordination and funding of infrastructure costs at EU level.

In Romania, the responsibility for the implementation of the transport infrastructure policy has so far been assumed by the Ministry of Transportation and Infrastructure.

One of the key objectives of the Romanian Government is to promote transport infrastructure projects that will have a significant impact on economic competitiveness and will contribute to the economic growth of the country.

Transport initiatives proposed for funding from the Cohesion Fund (CF) are therefore aligned with the EU priority transport corridors and are fundamental in achieving the EU objectives for a viable and flexible transportation system.

In order to develop a modern and safe road network to meet growing transport demands, and to comply with EU requirements, Romania initiated in 1993, a substantial programme of road rehabilitation funded by International Financial Institutions and the European Commission through the Instrument for Structural Policies for Pre-Accession (ISPA) and The Programme of Community aid to the countries of Central and Eastern Europe (PHARE) programmes.

Given the actions taken to date and the priorities set for the transport infrastructure programming period 2014-2020, preparation of projects for financing by the Structural Instruments becomes a key factor in ensuring the prerequisites necessary to achieve the objectives of the National Development Plan.

2.3 Romanian Road Network

Based on information made available by the Romanian National Statistics Institution (through press communication Nr. 95, dated 26th April 2013), the road network in Romania at the end of 2012, included a total of 84,185 km of public roads, of which only 20.1% are classified as national trunk roads. The total length of motorway sections constructed at the end of 2012 was 550 Km.

To date there has been only limited development of a new road network, while the recent increase in traffic, coupled with projected future traffic demand, places a considerable strain on the existing network. The situation is made worse by the following deficiencies:

- Almost all trunk roads have direct accesses, an aspect that generates conflicts due to the type and category of traffic accessing the network;
- Concentration of a major proportion of international traffic and transit traffic within inter-urban and rural areas;
- The generally poor condition of the existing road pavement and lack of adequate bearing capacity. Only recently rehabilitated roads will comply with the EU requirements for bearing capacity and axle load. According to the information made available by the Romanian National Statistics Institution (through press communication Nr. 95, dated 26th April 2013) the total length of modernised national road is 15,645 Km;
- The presence of approximately 400 railway level crossings;
- The traffic capacity of existing roads, particularly near major cities, is grossly exceeded. This problem is exacerbated particularly by a lack of suitable bypass roads;
- Major at-grade junctions, particularly those situated along national roads near towns/cities are usually operating at overcapacity constituting a safety risk to road users;
- Traffic management measures, through either physical or soft measures are often deficient;
- Inadequate enforcement of highway behaviour.

Thus the improvement to the road transport network in Romania can be achieved through implementation of strategic development programmes such as the pan-European transport corridor, of which the Sibiu–Pitesti motorway would provide a significant element. The Sibiu–Pitesti motorway is the only missing section of the roads Priority Axis 7 in Romania. In applying these, preparation of a Review of the existing Feasibility Study and the Gap Analysis Report is considered appropriate as a first step towards securing the planned implementation of the project.

Some of the relevant projects along the Priority Axis 7 currently being promoted by the Romanian Government are:

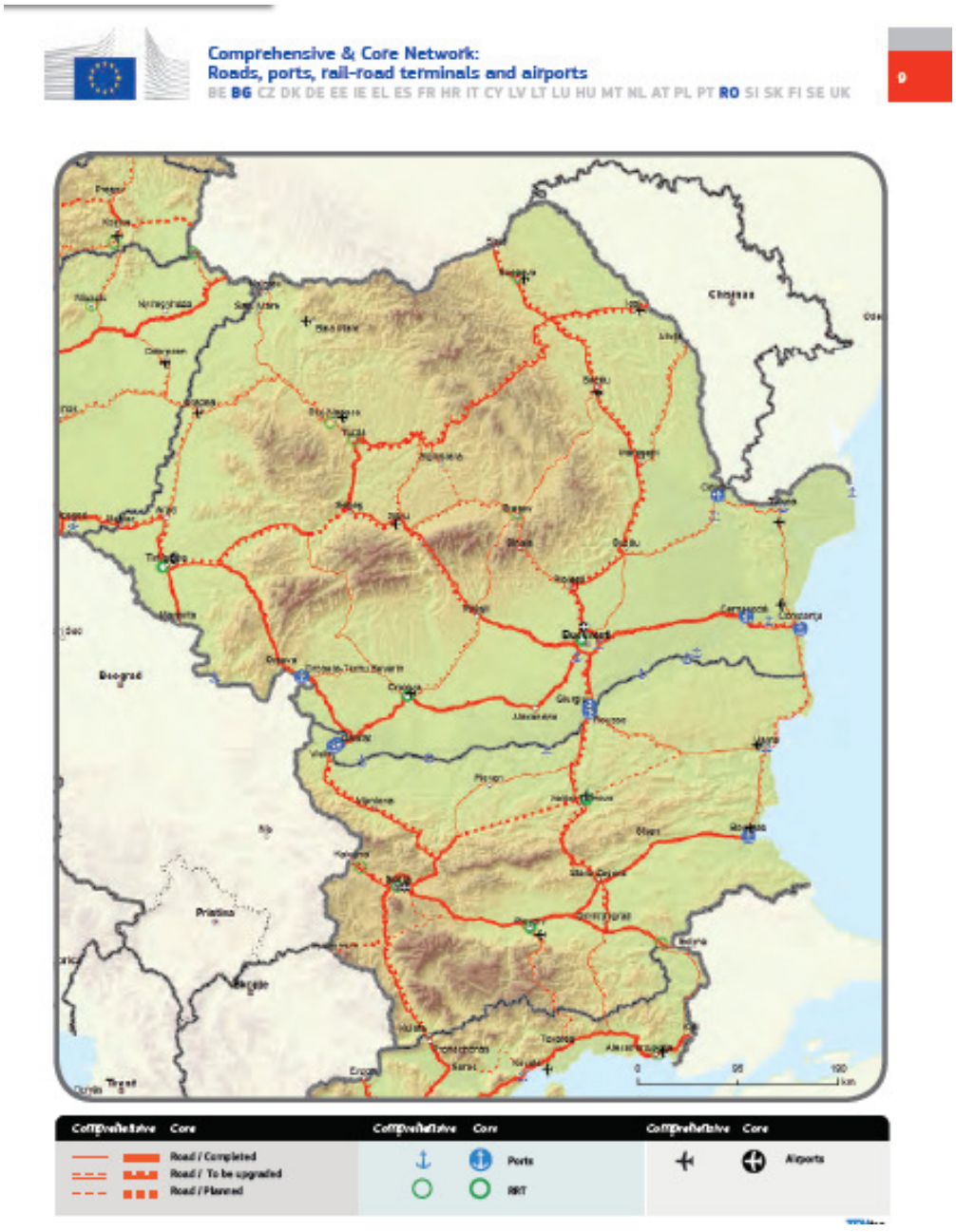
- The construction of Nadlac-Arad motorway;
- The construction of Arad-Timisoara motorway;
- The construction of Timisoara-Lugoj motorway;
- The construction of Lugoj-Deva motorway;
- The construction of Deva-Orastie motorway;
- The construction of Orastie-Sibiu motorway;
- The construction of Cernavoda-Constanta motorway.

The Romanian Government also initiated a series of large Public Private Partnership (PPP) projects. Some of these projects are listed below:

- The construction of Comarnic – Brasov motorway in PPP system;
- The construction of Bucharest Southern motorway bypass in PPP system;
- The construction of Craiova – Pitetsi motorway in PPP system.

2.4 Sibiu-Pitesti Motorway

The proposed Sibiu-Pitesti motorway, forms part of the pan-European transport corridor IV, representing a strategic route which, once open to traffic, will significantly improve journey time reliability and safety for road users whilst contributing towards achieving the European Union objective for improved accessibility to various regions in Romania.



Trans-Europe North South Motorway (TEM) Network – source http://ec.europa.eu

Investigations into possible routes for the Sibiu-Pitesti motorway have been undertaken by IPTANA in recent years. The original Pre-feasibility Study was developed by IPTANA in two stages:

- Pre-Feasibility Study for Pitesti-Cornetu subsection was completed in 1994;
- Pre-Feasibility Study for Cornetu–Sibiu subsection was completed in 1997.

The Feasibility Study for the section Sibiu–Pitesti was completed by the IPTANA/Egis joint venture in 2008.

This led to a fragmented approach in the decision making process with the possibility that essential elements of the various studies may have been missed or not covered in sufficient detail. The review carried out by Halcrow focused on all available reports including the Pre-Feasibility Studies and the Feasibility Study, and provided comments on aspects that are seen as either omissions (gaps) or indeed aspects that require further in-depth analysis during the update of the Feasibility Study stage.

The route crosses the Carpathian Mountains and is proposed as a dual two-lane motorway. The scheme will connect with the Pitesti bypass (which was opened to traffic in 2007) and the more recently constructed Sibiu bypass, and will have a length of approximately 120km. Completion of the Sibiu-Pitesti motorway will represent a major addition to the Pan-European transport corridor IV.

The complex nature of this project is confirmed by the number of structures and tunnels that were identified as part of the existing Feasibility Study. Based on the existing information these include:

- 82 bridges longer than 100m (longest structure 1140m);
- 35 bridges shorter than 100m;
- 7 tunnels (longest tunnel 1700m);
- 99 culverts.

In addition there are eight grade separated junctions and significant lengths of access roads/tracks, which will provide connections to existing county roads, known as Drum Judetean (DJ), secondary county roads, known as Drumuri Comunale (DC), and unclassified roads.

3 Assignment Compliance and Task Methodology

3.1 Assignment Compliance

In compliance with the Clients Terms of Reference (ToR) this assignment included a comprehensive review of the existing studies (**Task 1** of ToR) in conjunction with the most recent legislation, standards and other strategic Government initiatives such as the National Transport Master Plan.

The outcome of this review is captured in the Gap Analysis Report (**Task 2** of ToR), which shall be used as a platform for the development of a new set of technical Terms of Reference (**Task 3** of ToR) for the updated Feasibility Study.

Halcrow's team of key experts have undertaken and completed **Task 1** and **Task 2** in full compliance with the JASPERS Terms of Reference and in line with the aspects discussed and agreed during various meetings, including the weekly progress meetings.

The new Terms of Reference (ToR) was prepared by Halcrow based on the gaps identified as part of the Gap Analysis Report. The structure of the new ToR is based on the document already published as part of the June 2012 tender process and aims to fill in the gaps identified in the design and provide clear requirements to create the basis for completion of the new Feasibility Study to a level of quality expected by the Romanian Authorities and the European Commission for such a major investment project.

SIBIU – PITESTI MOTORWAY

APPENDIX TO THE REPORT

TERMS OF REFERENCE

Contents

1 Terms of Reference

1.1 List of Abbreviations

AADT	Annual Average Daily Traffic
BOQ	Bill of Quantities
CEA	Cost Efficiency Analysis
CESTRIN	Centre of Road Technical Studies and Computer Science
CF	Cohesion Fund
DGPR	Regional Police Headquarters
DRDP	Regional Department for Roads and Bridges
DTM	Digital Terrain Model
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EIA	Environmental Impact Assessment
AA	Appropriate Assessment
EIB	European Investment Bank
EFRD	European Fund for Regional Development
ESF	European Social Fund
ESIF	European Structural and Investment Funds
EU	European Union
FIDIC	International Federation of Consulting Engineers
FM	Financing Memorandum
GDP	Gross Domestic Product
GTMP	General Transport Master Plan
UDM	Urban Development & Management
IFI	International Financial Institutions
ITS	Intelligent Transport System
ISPA	Instruments of Structural Policies for Pre-Accession
JBIC	Japanese Bank for International Cooperation
JASPERS	Joint Assistance to Support Projects in European Regions
MECC	Ministry of Environment and Climate Change
MTI	Ministry of Transport and Infrastructure
DN	National Road
NSRC	National Strategic Reference Centre
OD	Origin-Destination
PHARE	Poland and Hungary: Assistance for the Reconstruction of Economy
PMS	Pavement Management System
CNAR	National Company of Romanian Waters
RNCMNR	Romanian National Company of Motorways and National Roads
SOPT	Sectorial Operational Programme for Transport
TA	Technical Assistance
TEN-T	Trans-European Transport Network
UNECE	United Nations Economic Commission for Europe
VAT	Value Added Tax

1.2 General Information

1.2.1 Beneficiary Country

Romania.

THE TEXT HIGHLIGHTED IN YELLOW DENOTES PARAGRAPHS THAT REQUIRE RNCMNR REVIEW AND UPDATES IN ORDER TO ENSURE ACCURACY AND ADEQUACY OF DATA

1.2.2 Contracting Authority

The Romanian National Company for Motorways and National Roads S.A. (RNCMNR) is the Contracting Authority, the final Beneficiary of the project and at the same time the Implementation Agency.

RNCMNR is a company subordinated to the Ministry of Transport and Infrastructure (MTI). It is responsible for the management and development of national roads and highways network. It is organised by seven regional directorates. Moreover, the RNCMNR has a Centre of Road Technical Studies and Computer Science (CESTRIN) that carries out research in the following fields: construction materials, road structure, road coating and traffic flows.

1.2.3 Relevant National Framework

Romania became a Member State of the European Union on January 1st, 2007.

Romanian strategy for transport infrastructure follows the guidelines set by the European Union. The EU Partnership Agreement for Romania 2014-2020 provides the fundamental policies that will be used to reduce the socio-economic gap between Romania and other EU countries.

The Partnership Agreement between Romania and the EC covers the use of European Structural and Investment Funds (ESIF) in the period 2014-2020. In the forthcoming financial perspective, Romania will invest €39.34bn allocated from ESIF plus national co-financing in line with the Thematic Objectives of the EU2020 and Romania's national priorities. The Partnership Agreement sets out how these investments will be concentrated to promote competitiveness, convergence and cooperation whilst encouraging smart, sustainable and inclusive growth, by setting national specific investment priorities.

Taking into consideration that the ESIF will be one of the most important instruments to tackle the main development challenges for Romania, as identified in its EU/IMF lending programme and its EU 2020 commitments, the Partnership Agreement explains how the ESIF will be optimised to achieve value added public expenditure through integration of the principles of partnership, equality between women and men, social inclusion and sustainable development. The Partnership Agreement will build upon the positive progress made in Romania with EU support since 2007. In its proposals for co-ordination, spatial and thematic integration, it takes into account the learning from the current period in order to ensure continuing improvement in the efficiency and effectiveness of implementation, while reducing the burden of administration upon beneficiaries.

The Partnership Agreement is elaborated in a manner that provides a flexible framework for Romania to react and refocus European, national and local resources to create growth and employment and to maximise the results achieved. Through this programming document, Romania envisages exploiting, to the maximum potential, the synergies between the ESIF and other sources of EU funding, in a strategic and integrated approach.

1.2.3.1 Road Sector Development Strategy

SOP-T identifies the following priorities regarding the road infrastructure:

- To continue the rehabilitation and improvement of the network. In this respect, the following periods have been agreed during accession negotiations:
  - Access for Heavy Goods Vehicles on the entire TEN-T;
  - The opening of the entire network;
- To provide additional capacity where necessary and particularly along the TEN-T priority axes, by the construction of highway sectors and by-pass roads for urban areas;

  Generally, to increase road safety through the development and improvement of maintenance.

1.2.3.2 Regulations for Structural Funds

The projects under Structural Instruments are implemented by the SOP-T based on a multi-annual scheduling approach with annual budget commitments. The rule N+3/N+2, which is of utmost importance, stipulates that the commitments (or part of them) regarding year "N" for which no valid payment request was made, will be automatically cancelled by the Commission on December 31st of the year "N+3/N+2" and, consequently, they will be "lost" for Romania. This programme also stipulates the rules regarding the eligibility of expenses, where it is specified that VAT and the costs related to land purchase exceeding 10% from the total of eligible expenses are not eligible.

Therefore, the preparation of the group of projects will be based on a detailed analysis of the eligible costs both for preparatory activities (e.g. planning and land purchases) and for the actual works. The awarding documents will be developed so that they take into account rule N+3/N+2 wherever possible.

1.2.4 Current Status in the Reference Sector

The Romanian road network consists of a combination of motorways, European Roads, main and secondary National Roads with a total length of 16,887 km. Moreover, there are county roads, rural roads, and service roads managed by the local authorities. From an economic point of view and transit traffic perspective, the most important network is the network of international roads crossing Romania, constituting routes integrated in the Trans-European Transport Network (TEN-T) that this project is partially addressing.

Most of the main road network consists of two-lane roads (approximately 92%), which since 1993, have been undergoing a substantial rehabilitation effort in six stages. The rehabilitation effort mainly focused on facilitating maintenance by the reconstruction and consolidation of European Roads in order to allow a load of 11.5 tons per axle according to the EU Directives.

Thus, until now, there has only been limited development of the road network. The recent increase in traffic coupled with future estimated traffic demand following Romania's accession to the European Union, puts a significant and increasing pressure on the network. The situation is made worse by the following deficiencies:

- Almost all the main roads have direct access, leading to a conflict between various types of traffic and also between traffic and the needs of local communities;
- The location of important road segments with high international and interregional traffic in residential rural and urban areas;
- Generally, the poor quality of the road system and the lack of an appropriate load capacity; only recently rehabilitated roads (15,645 Km of modernised national roads) have a load capacity of 11.5 tons per axle complying with EU standards;
- There are more than 400 rail crossings within the national road network;
- Capacity issues encountered in the proximity of the most important cities and the lack of bypass roads.

The Romanian road network strategy, as defined by Law no. 203/2003, republished in January 2005 in the Official Gazette of Romania no. 89/26.01.2005, amending Law no. 203/2003 (amended by Law no. 589/2003 and Law no. 451/2003) acknowledges the importance of the TEN-T for the national economy and trade. It also presents the strategic objective of progressive improvement of corridors to highway standards.

1.2.4.1 Maintenance of the Road Network

Currently, the responsibility for road maintenance belongs to the seven regional road authorities known as DRDP, assisted by the Centre of Road Technical Studies and Computer Science (CESTRIN) who collect and process data relating to the status of the roads forming the implementation of a simple system of road structure management.

The financing of maintenance operations mainly comes from the state budget and although improvements have been carried out since the 1990's, following evidence of a serious deterioration in the infrastructure, the budget allocated for road maintenance is insufficient. Compounding this, the annual maintenance budget, which is specified at a central level, is not actually allocated in numerous cases and therefore makes the planning and the prioritisation of maintenance operations even more complicated.

As the main road network is progressively rehabilitated and developed, the demand for funds for maintenance will consequently increase. This aspect, in relation to road maintenance, is important for all the international financing institutions that are active in the roads sector. However, although the methods for roads maintenance organisation and financing means are under debate, no clear agreement has yet been reached.

1.2.4.2 Available Traffic and Road Data

CESTRIN, the research centre of the RNCMNR, is responsible for the collection and processing of data regarding the status of roads and traffic data, the results of which are used for design and maintenance programmes on the road network. The data relating to the status of roads is collected in cycles of 3, 4, and 5 years for the main and secondary National European Roads.

CESTRIN also operates a series of strategically located automatic weighing stations and traffic counting points providing statistical data. Every 5 years, CESTRIN brings its own contribution to the UNECE publication for traffic census by undertaking a complete traffic study, which includes origin-destination matrices, for the main road network across Romania. The last such census started in 2010 and was completed in 2011.

Traffic counts, as well as origin destination surveys, carried out recently as part of the development of the National Master Plan, will be made available to the successful Consultant.

1.2.5 Legal and Institutional Organisation after the Accession to the EU

On 1st January 2007, Romania and Bulgaria became Member States of the European Union. According to article 28 of the "Treaty of Accession of the Republic of Bulgaria and Romania to the European Union" which was signed in Luxembourg on April 25th, 2005, all measures which, on the date of accession, were subject to decisions regarding assistance under (EC) Regulation no. 1267/1999 creating an Instrument of Structural Policies for Pre-Accession and whose implementation was not complete at that date, will be considered as approved by the Commission under (EC) Commission Regulation no. 1164/94 of May 16th, 1994 creating the Cohesion Fund and Regulations 1083/2006 and 1828/2006.

Romania became an EU member state and, consequently, the procedures for the awarding of works, supplies, and services contracts launched after accession comply with the rules of public procurement in Romania. Therefore, the tender documents will be prepared in Romanian.

The Emergency Ordinance no. 34/2006, with its subsequent amendments and supplements, achieves harmonisation between the legislation of public procurement in Romania and relevant EU legislation. The Emergency Ordinance no. 34/2006, with its subsequent amendments and supplements, specifies the documents to be used in various stages of the awarding procedure and presents the financial and fiscal framework to be applied.

The Authority for the Coordination of Structural Instruments (ACSI) within the Ministry of European Funds plays the role of national coordinator in the relation with the EU for the 2007-2013 budget. As national coordinator of the non-reimbursable assistance provided by the European Union, ACSI has attributions and responsibilities for pre-accession financial support and the coordination of structural and cohesion funds.

The institution coordinates the preparation and operation of the legislative, institutional and procedural framework for the management of the structural instruments, while on the other hand it schedules, coordinates, monitors and assesses the use of EU non-reimbursable financial support.

The SOP-T Management Authority is the public entity that ensures the management of the financial support from structural instruments for priority transport investments. According to Government Decision no. 497/2004, the Ministry of Transport, through the Directorate General for External Financial Relations, has the role of SOP-T Management Authority.

1.2.6 Complementary Programs and Related Activities

1.2.6.1 Other Relevant Works

- The construction of Nadlac-Arad highway – pending;
- The construction of Arad bypass and Arad-Timisoara highway – finalised;
- The construction of Timisoara-Lugoj highway – 1st lot finalised (in operation since October 2012) and 2nd lot pending;
- The construction of Lugoj-Deva highway – current Lot 1, pending Lot 2, Lot 3, and Lot 4;
- The construction of Deva-Orastie motorway bypass – finalised;
- The construction of Orastie-Sibiu highway – in progress;
- The construction of Sibiu motorway bypass – finalised;
- The construction of Pitesti motorway bypass;
- The construction of Cernavoda-Constanta highway – finalised;
- Construction of Constanta bypass;
- Construction of Sibiu–Fagaras expressway.

1.3 Objective, Purpose and Expected Results

1.3.1 General Objectives

The general objective of the project is to improve the economic competitiveness of Romania by development of the transport infrastructure on the TEN–T Priority Axis no. 7, which facilitates economic integration with the EU, contributes to the actual development of the internal market and allows for the development of the Romanian economy. Its aim is to create conditions for increased investment activity, the promotion of sustainable transport and spatial cohesion.

1.3.2 Specific Objectives

The specific objectives of this contract are to reduce travel time between the cities of Sibiu and Pitesti, to improve traffic safety conditions whilst managing environmental impacts.

1.3.3 Purpose

The purpose of this contract is to prepare a sound Feasibility Study for the Sibiu-Pitesti motorway which will support the successful application for EU funds from the 2014-2020 budget and for tender documents to procure the works contracts. The complex nature of the Sibiu–Pitesti project is confirmed by the number of structures and tunnels that were identified as part of the existing Feasibility Study, dated 2008, which will require a high level of site investigation and complex design analysis, as well as, identification of significant construction risks and opportunities.

In particular, the scope will include the development of a mature and robust Feasibility Study that shall include adequate levels of information in order to enable the tendering and procurement of the Construction contracts under a Design and Build framework.

1.3.4 Results Expected from the Consultant

The Consultant shall undertake to perform the services, with reasonable skill, due care and diligence, to a level expected of a professional organisation in accordance with the standards set out in the Consultant's technical proposal and this Terms of Reference. The Consultant shall be responsible for risk identification, mitigation and management and shall take ownership of the risks associated with the delivery of the services related to the Sibiu–Pitesti Feasibility study.

1.4 Scope of Works

1.4.1 General

The general definition of the activities to be carried out is stipulated in general terms below. However, the purpose of services, priorities and the programme vary according to the aspects explained in the following sections. The Consultant is required to prepare and deliver a robust and well prepared Feasibility Study for this complex motorway project.

The Sibiu–Pitesti motorway represents a vital link for Romania and presents many technical challenges, which the Consultant is required to address to ensure the mature preparation and subsequent award of the Construction contracts under a Design and Build framework.

1.4.2 Description of the Project

Sibiu-Pitesti motorway

The objective of this contract is to prepare a sound Feasibility Study for the Sibiu–Pitesti motorway. The new Feasibility Study shall take account of the existing Pre-Feasibility Studies completed in 1994 and 1997 and the Feasibility Study completed in 2008. It shall utilise the information deemed by the Consultant as relevant and compliant with the current requirements and legislation in force.

The route crosses the Carpathian Mountains and is proposed as a dual two-lane motorway. The scheme will connect with the Pitesti bypass (which was opened to traffic in 2007) and the more recently constructed Sibiu bypass, and will have a length of approximately 120km. Completion of the Sibiu-Pitesti motorway will represent a major addition to the pan-European transport corridor IV.

The complex nature of this project is confirmed by the number of structures and tunnels that were identified as part of the existing Feasibility Study dated 2008. These include:

- 82 bridges longer than 100m (longest structure 1140m);
- 28 bridges shorter than 100m;
- 7 tunnels (longest tunnel 1700m);
- 99 culverts.

In addition there are eight grade separated junctions and significant lengths of access roads/tracks, which will provide connections to existing county roads, known as Drum Judetean (DJ), secondary county roads, known as Drumuri Comunale (DC), and unclassified roads.

The Feasibility Study to be prepared, shall connect with the existing Sibiu bypass near Selimbar and the existing Pitesti bypass near Bascov reservoir. The length of the scheme is approximately 120 km and the route, once completed, will provide the only missing section of the Priority Axis 7 in Romania.

The tasks, which the Consultant shall carry out include, but are not limited to, the following:

Sibiu-Pitesti motorway activities to be carried out (yet without limitation):

- Route Alignment Options Report;
- Road works;
- Structures and culverts and retaining walls;
- Earthworks;
- Hydro-technical works;
- Tunnel Engineering including Tunnel Ventilation and Fire Safety;
- Motorway facilities;
- General Cost Estimates including estimates for all of the project's components including: works design and build), contracts, supervision consultancy services, land acquisition etc.;
- Traffic Study;
- Cost Benefit Analysis;
- Multi-criteria Analysis;
- Environmental Impact Assessment and Environmental Decision;
- Appropriate Assessment (AA);
- Motorway Communication, Intelligent Traffic System and Traffic Control;
- Maintenance and Operation Plan;
- Carbon Footprint and Whole Life Cost Estimates;
- Land Acquisition: Land acquisition services Phase 1: Identification of the areas affected by the proposed works, including by the relocation/protection of Public Utilities, environmental and landscaping works, reinstatement of local roads continuity and access to properties, maintenance and service roads and the provision of detailed plans and

information with respect to owners. Development of individual cost evaluations for the expropriation of each plot of land. This shall include all the documents required for the issuance of the Government Decision provided in Law 255/2010 and issuance of the Government Decision or similar document that might be required for the free of charge transfer of the state owned land administrated by other public authorities. In addition, for any agricultural land areas the Consultant is required to produce Pedological Studies and obtain the necessary approvals from the relevant authorities for the removal of such areas from the agricultural regime;

- Urbanisation Certificates, Permits, Approvals, and Authorisations;
- The Relocation and Protection of Public Utilities at detailed design level;
- Assistance with the preparation of the Application for Structural Funds;
- Development of Prequalification, Tender and Contract Documents for the Award of the Construction Contract;
- Detailed hydrological and hydraulic studies;
- Ground Investigations Phase 1;
- Ground Investigations Phase 2;
- Detailed topographic studies;
- Archaeological investigations;
- Noise surveys;
- Biodiversity surveys;
- Technical Expertise (condition survey) of any structures that will be proposed to be retained as part of the project;
- Soils, Materials, Construction Processes and Health & Safety;
- Design calculations and reports;
- Prepare the documents required for the issuance of the Government Decision for the investment approval in accordance with Law 500/2002 provisions;
- Any other documents or tasks relevant for the completion of the project such as attendance to meetings, liaison with third parties and other authorities, provision of reports and general contract management.

The Feasibility Study shall also comply with the requirements of HG 28/2008.

1.4.3 Beneficiary Groups

The final beneficiary is the RNCMNR by means of MTI. The other beneficiaries will be road users.

The Beneficiary is to be confirmed by the RNCMNR as this may involve the Ministry of Large Infrastructure Projects.

1.5 Specific Activities

1.5.1 Compliance with Existing Standards and Norms

For the purpose of design, the Consultant will comply with the Romanian national standards in force.

The Romanian national standards are updated annually and published by the Romanian Standardisation Association in the Romanian Catalogue of Standards (STAS). The Consultant is required to include as part of the Inception Report (see section 1.7.3 of this Terms of Reference) a list of current standards proposed as part of the design for Sibiu–Pitesti motorway project.

The list of standards shall identify potential conflicts (if any) between the Romanian STAS and the European Norms adopted in Romania.

For instance, the applicability of safety barrier standard STAS 1948 for safety barriers comes, to some extent, into conflict with the adopted European norm SR EN 1317. It is acknowledged that an application methodology (Norm AND 593/2012 criteria for provision of safety barriers) aligned to the SR EN 1317 was developed and published and this shall be used in the design. Therefore the design of safety barriers shall comply with the requirements of the SR EN 1317 standards and their relevant application methodology adopted in Romania.

For the pavement design, the Consultant will observe the European Union Directive 96/53 regarding loads and dimensions in addition to the Romanian norms.

The geotechnical design and structural design shall comply with the following Eurocodes:

- Eurocode 0 SR EN 1990 - Basis of design;
- Eurocode 1 SR EN 1991 - Actions on Structures;
- Eurocode 2 SR EN 1992 - Design of concrete structures;
- Eurocode 3 SR EN 1993 - Design of steel structures;
- Eurocode 4 SR EN 1994 - Design of composite structures;
- Eurocode 7 SR EN 1997 - Geotechnical design;
- Eurocode 8 SR EN 1998 - Seismic design.

For the motorway design the Consultant shall use the normative PD 162-2002 - The Design of Rural Motorways in conjunction with the TEM Standards and Recommended Practice, Third Edition. The European Agreement on Main International Traffic Arteries (AGR) shall also be observed by the Consultant.

The Ground Investigations shall correlate the requirements of the Romanian Normative NP 074-2007 with the Eurocode 7 – Geotechnical design.

For the design of the sections of tunnels that shall be constructed on this motorway, Law 277/2007 regarding "minimum safety requirements for tunnels situated on the national sections of the Trans-European Road Network" shall be consulted.

With regard to the legal framework relating to the regime of roads, the Consultant shall comply with the provisions of Government Decision no. 28 of 09/01/2008 and the Government Ordinance no. 43/1997, approved by Law no. 82/1998 (including subsequent amendments and supplements).

The Feasibility Study shall include data relating to the Directive 89/391/EEC which was introduced on 12 June 1989. This Directive outlines measures to encourage improvements to the safety and health of workers at work – "Framework Directive" and outlines the duties and responsibilities of, amongst others, clients, project coordinators and designers – especially at the project preparation stage.

The specific application of the Directive 89/391/EEC in Romania is through law number 319/2006, the application methodology set out by the Government Decision HG 1425/2006 and through the Government Decision number 300, dated 2nd March 2006.

The design shall comply with the relevant decisions of the RNCMNR Director General including the decision number 18/1280, dated 27.08.2009, issued by the Road Safety Department of RNCMNR relating to public lighting.

1.5.2 Review of Existing Information

The Consultant shall review all existing studies and background information and identify and analyse all significant motorway alignment options previously developed in terms of engineering, economic, social and environmental aspects and provide an assessment of their quality and suitability for use in identification of a preferred option and preliminary design.

Studies and information to be reviewed include, but are not limited to:

- Gap Analysis Report, dated June 2013, prepared on behalf of JASPERS;
- Pre-feasibility Studies (Iptana, 1996/1997);
- Feasibility Studies (including Iptana and Sceauroute [EGIS], 2008);
- Existing survey data (geotechnical, geological, seismic, meteorological, topographic, traffic and transport, archaeological);
- Transport studies e.g. National Transport Master Plan;
- CESTRIN datasets;
- Environmental studies (including Environmental Impact Assessment (EIA) /Appropriate Assessment (AA) study);
- Planning and land use studies;
- Public utilities studies;

- Archaeological studies;

The review carried out by the Consultant shall cover the existing Pre-Feasibility studies completed in 1994 and 1997 as well as the Feasibility Study completed in 2008 which had the following structure:

Pre-Feasibility Studies completed in 1994 and 1997 werw structured as follows:

Volume no.	Description	Sub-section
Volume 2	Prefeasibility Study dated December 1994	Covers route options for the section Pitesti – Curtea de Arges - Cornetu
Volume 3	Prefeasibility Study dated January 1997	Covers route options for the section Cornetu - Sibiu

The Feasibility Study completed in 2008 was structured as follows:

Volume no.	Description	Sub-section
Presentation Report	Route Alignment Assessment	Covers route options for the entire scheme between Sibiu to Pitesti.
Vol. 1	Synthesis	
Vol. 2.1	Road Works	Section I Sibiu – Cornet ch 0+000 to ch 40+200
		Section II Cornet – Tigveni ch 40+201 to ch 78+500
		Section III Tigveni – Pitesti ch 78+500 – ch 116+640
Vol. 2.2	Bridges, Overpasses, Viaducts works	Section I Sibiu – Cornet ch0+000 to ch 40+200
		Section II Cornet – Tigveni ch 40+201 to ch 78+500
		Section III Tigveni – Pitesti ch 78+500 – ch 116+640
Vol. 2.3	Tunnel Works	ch 0+000 to ch 116+640
Vol. 2.4	Motorway Facilities	Section I Sibiu – Cornet ch 0+000 to ch 40+200

Volume no.	Description	Sub-section
		Section II Cornet – Tigveni ch 40+201 to ch 78+500
		Section III Tigveni – Pitesti ch 78+500 – ch 116+640
Vol. 3	General Bills of Quantities and cost estimates	
Vol. 4	Traffic Study	
Vol. 5	Economic Analysis	
Vol. 6.1	Topographical Studies	Sibiu County
Vol. 6.2	Topographical Studies	Valcea County
Vol. 6.3	Topographical Studies	Arges County
Vol. 7	Geotechnical Study	
Vol. 8.1	Environmental Impact Assessment Study	
Volume 8.2	Report to the Environmental Impact Study	
Vol. 8.3	Environmental Impact Assessment Study – Drawings	
Vol. 8.4	Environmental Impact Assessment Study – Annexes	
Vol. 8.5	Environmental Impact Assessment Study Non-Technical Report	
Vol. 8.6	Environmental Impact Assessment Study – Public consultations	
Vol. 9	Documentation for Identification of Land Owners	
Vol. 10	Motorway communication and Traffic Control	
Vol. 11.1	Relocations, Protection of Petrol, White Products, Gas, Water and Sewage Installations	
Vol. 11.1 (1)	Relocations, Protection of Petrol, White Products, Gas, Water and Sewage Drawings	
Vol. 11.2	Relocations and Protection of Land Reclamation installations	

Volume no.	Description	Sub-section
Vol. 11.3	Relocations and Protection of Electrical Installations	
Vol. 11.4	Relocations and Protection of Telecommunication Installations	
Vol. 12	Permits and Agreements	
	Maintenance and Operation Plan	

1.5.3 Site Investigations

The Consultant shall carry out adequate levels of site and ground investigations in order to enable the completion of a robust and informed design for this complex motorway project.

1.5.3.1 Soil, Material, Construction Processes and Health and Safety

With regard to the quality and availability of construction materials, the Consultant shall undertake a complete investigation of soils and materials, including their sampling and laboratory testing. The investigation shall also include an appraisal of the available quantities, in compliance with international practice, to establish potential sources of construction materials, as well as, their distance to the location of the site works. The tasks to be undertaken by the Consultant shall include, but will not be limited to:

- Correlation of the project with construction processes, including anticipated temporary works, logistics and the need for temporary access roads;
- Assessment of the potential need for transport of abnormal loads and identification of adequate transport routes;
- Identification of material sources (including borrow pits) and transport distances. This shall also include information on the quality and quantity of materials that could be offered by each supply source;
- Identification (although avoid recommendation) of any sources of materials, which might be affected by any restrictions imposed by statutory authorities (i.e. Environmental Agency, National Agency for Mineral Resources, etc.);
- Identification of the potential need to process in-situ unsuitable material resulting from excavations and the provision of estimative quantities. If required, include such areas within the land to be acquired for the project;
- Identification of the potential need to dispose of unsuitable and or hazardous materials and the provision of estimative quantities for each category. Identify suitable locations for the disposal of unsuitable materials and if required, include such areas within the land to be acquired for the project;
- Assessment of buildability related issues ensuring that such aspects are detailed within the Technical Report to be delivered as part of the Synthesis volume of the future Feasibility Study. Some of the key

buildability aspects relate to the construction of tunnels, the transitions from tunnel to bridge, the impact of construction on existing transport network (rail, road and water) and the standardisation of superstructures proposed in the design;

- Identification of possible locations for future site compounds, with due consideration for any related environmental aspects.

- Consideration of health and safety in design with specific identification of risks. The risks may include, but are not limited to, deep excavations, impacts on existing public utilities, handling of hazardous materials resulting from excavations etc. The tasks shall include the production of a risk assessment and risk management plan, which will aim to identify key design and construction risks. A template for the health & safety risk register is presented below:

DESIGNER'S RISK ASSESSMENT			
Hazard/Risk	**Operations /Tasks**	**Actions or Mitigation Measures**	**Health and Safety Information to be Provided**

The soil, material, construction processes and health & safety report shall be included as a separate Volume to the Feasibility Study under Volume 22 Report on soil, material, construction processes and health & safety

1.5.3.2 Specifications for site Investigations

The Consultant's team will include key experts in order to plan, organise, monitor, process and ensure the quality of the investigations undertaken and of the data received.

The Consultant shall develop a detailed Specification for Site Investigations, such as archaeology, ground investigation, noise surveys, biodiversity surveys etc., which is compliant with the standards and legal provisions in force, and shall submit this detailed Specification for Site Investigations to the Employer for comments and review prior to the commencement of such investigations on site.

1.5.3.2.1 Ground (Geotechnical) Investigations

A new ground investigation study will be required for the Sibiu–Piesti motorway. A phased approach to the completion of ground investigations is required for this project, as follows:

- Ground investigation phase 1: this will be carried out in accordance with the phase described within this Terms of Reference and as outlined within clause 2.1 of NP074-2007: Desk Study, which will include a preliminary appreciation of the site which is generally based on historical data and site observations. This phase will also include the execution of ground investigations as detailed within these Terms of Reference. Phase 1 forms part of the scope of this project;

- Ground investigations phase 2: this will be carried out in accordance with the phase described within this Terms of Reference and as outlined within normative NP 074/2007: Detailed Geotechnical Study, which is required generally for Technical Project Stage, as defined within NP 074/2007 clause 2.2. This stage forms part of the scope of this project;

- Ground investigations phase 3: as defined within clause 2.3 of NP074/2007: Main Site Investigations required for the commencement of the construction works. This phase is suitable for post construction contract award and does not form part of the scope of this project and is referenced herein for information purposes only.

Ground investigation information was presented in the existing Feasibility Study, dated 2008, comprising circa 300 boreholes. However, this data has not yet been validated. The Consultant is therefore required to ensure that the Phase 1 Ground Investigation is planned such that validation of the existing boreholes is enabled. This would involve locating a small proportion of the Phase 1 boreholes in the vicinity of the existing boreholes and providing a comparison of the two investigations.

The new ground investigations shall address the following aspects:

- Desk study requirements;

- Ground investigation required for cuttings and embankments, including those required to assess the general stability of the cutting and nearby slopes;

- Ground investigation required for structures;

- Ground investigation and geophysical investigations required for tunnels;

- In-situ and laboratory testing to be included in all ground investigations.

The existing design for the Sibiu-Pitesti motorway was developed in three main sub-sections as follows:

- Section I – Sibiu (Vestem) – Racovita (Cornet) - ch 0+000 to ch 40+200

- Section II – Racovita (Cornet) – Tigveni – ch 40+200 to ch 78+500

- Section III – Tigveni – Curtea de Arges - Pitesti – ch 78+500 to ch 116+000.

The Terms of Reference for ground investigation therefore refers to sections, which shall make for easier cross referencing with existing Feasibility Study, dated 2008. The new ground investigations report shall, however, be structured in compliance with the five sections identified within chapter 1.5.4 of this ToR. In addition, these terms of reference include requirements for ground investigations on the approximately five kilometres long section linking the already constructed Sibiu bypass with the alignment developed as part of the existing Feasibility Study, dated 2008.

It is considered that the new Feasibility Study and subsequent design phases should follow the phases set out in Romanian Normative NP074-2007, which are outlined previously and referred herein.

It should be noted that NP074-2007 does not provide clear guidance on borehole frequency and therefore the requirements of Eurocode 7, complemented by the requirements outlined within the series of standards STAS 1242, shall be adopted by the Consultant.

The Consultant is responsible for the completion of Phase 1 and Phase 2 described previously and referred herein.

Desk study

Geology

Large scale geological maps ranging from 1:50,000 to 1:500,000 have been used as part of the existing Feasibility Study, dated 2008, to characterise the geology along the route (see Section 1.3 of the Geotechnical Study, dated 2008). The Consultant shall use smaller scales maps, such as 1:25,000 and 1:10,000 for the desk study stage. Extracts from these maps shall be presented in a series of desk study summary plans showing engineering interpretation.

Preliminary geotechnical risk register

This Register shall be set up to capture major risks identified during the desk study. The Register will be carried through to subsequent design phases and ultimately to the construction phase. The hydrogeology of the scheme shall also be detailed by the Consultant, with reference to hydro-geological maps along the proposed alignment.

Landslides

It is known that large sections of the proposed route are in areas which have frequently experienced landslides. Much of the proposals developed within the existing Feasibility Study, dated 2008, in these areas involves cutting into soil and rock slopes. As such, the presence of this hazard (landslides) and its likelihood of occurrence, presents a major risk to the scheme. Section 3.2 of the existing Geotechnical Study, dated 2008, presents background information on the landslide areas.

It is stated in the Feasibility Study that Sector I is not at risk from landslide. In Sector II, 721m (over seven sections) of known landslide has been identified, 518m of which are active. In Sector III, 613m (over five sections) of known landslides have been identified of which 412m are thought to be active. Cuttings affected include C48, C53, C54, C70, C71, C72 and C73. Embankments affected are E40, E56, E57, E58 and E59 (see Annex A to this Terms of Reference for list of cuttings, embankments and structures). Three structures are affected and these are S80, S86 and S116. The area around the Poiana Tunnel is also prone to landslides. The existing Geotechnical Study, dated 2008, recommends that monitoring of each potential landslide zone is carried out.

The Consultant shall therefore implement a monitoring regime at each area of landslide identified. The purpose of this monitoring regime is to determine the nature of the instability (including ground movement and movements in groundwater level) in order to design appropriate stabilising measures. It is considered that landslides may be triggered by seasonal weather events (e.g. frost action, heavy rainfall and the like) and the monitoring regime must therefore be continuously implemented for a minimum of 12 months. The Consultant shall provide details of the intended frequency of monitoring within this 12 month period. It is expected that each Consultant shall propose a frequency of monitoring which will capture a sufficient quantity of data to properly assess the stability of the affected slopes.

In addition, the Consultant shall determine the appropriate method of monitoring including type of instrumentation (e.g. piezometer, inclinometer and the like) and the means by which these instruments shall be observed and maintained. The Consultant shall also provide preliminary proposals for specific monitoring locations within the location of each slope.

In addition to the areas of landslide and land instability, identified as part of the existing Feasibility Study, dated 2008, the Consultant shall identify any other similar areas along the route between Sibiu to Pitesti and propose monitoring regimes that will subsequently inform the Design team with respect to the required soil stabilisation measures. Thus the detailed specification targeting individual sections of landslide and other known areas of land instability susceptibility shall be developed by the Consultant.

Re-use of material

The desk study shall identify possible borrow areas which may provide materials for embankment and pavement construction. These areas would then be subject to intrusive investigations as described within this ToR in order to establish the acceptability of materials located within the borrow pits. Areas of potential borrow pits shall be identified by the Consultant.

Embankments

Based on information from the existing Feasibility Study, dated 2008, 81 sections of proposed embankment have been identified, comprising some 52.1km of the proposed route. At Feasibility Stage, information is required to make an initial assessment of embankment stability and settlement. Table 3 of Annex A to this Terms of Reference, includes an inventory of ground investigations data available in the existing Feasibility Study and comments on adequacy of data, as well as, required additional boreholes. It is considered that to adequately inform the Feasibility Study, a further 225 boreholes are required.

The location and depth of boreholes shall be proposed by the Consultant following the desk study stage.

The desk study shall also identify areas of high geotechnical risk so that areas of investigation can be targeted accordingly. It is also essential that the new boreholes, whether Phase 1 or Phase 2, satisfy the following minimum criteria:

- Boreholes should be positioned so that adequate coverage of embankments is achieved. It will be necessary to locate boreholes at certain critical sections, such as, high sections of embankment or areas of suspected poor or variable ground;
- The depth of boreholes shall reflect the height of the proposed embankments. Higher embankments will tend to give rise to stability and settlement issues at greater depths and boreholes must be specified to reach these depths;
- Prior to commencement of ground investigations on site, the Consultant shall develop a specification for in-situ testing for all new boreholes. The SPT (standard penetration test) test (or similar) will be required, for example, to provide information on soil strength and stiffness;
- In-situ groundwater monitoring data;
- The Consultant shall develop a specification for laboratory testing in order to adequately characterise each strata. These tests, as a minimum, should provide classification, strength, stiffness, permeability and geochemical data.

Cuttings

Based on information from the existing Feasibility Study, dated 2008, 76 sections of cutting have been identified and these constitute 25.3km of the proposed route. For the purpose of the new Feasibility Study, it is necessary to make an initial assessment on the stability of cutting slopes. Table 4 of Annex A to this Terms of Reference includes an inventory of ground investigations data available in the existing Feasibility Study and comments on adequacy of data, as well as, requirements for additional boreholes.

It is essential that the new boreholes, whether Phase 1 or Phase 2, satisfy the following minimum criteria:

- Boreholes are to be located such that good coverage of cuttings is achieved. Key sections will need to be targeted, especially areas of weak soil and rock and where adverse groundwater may be encountered;
- In-situ testing, as per embankments;
- In-situ groundwater monitoring data;
- Laboratory test data shall be planned as per requirements for embankments. In addition, testing shall target the possible re-use of materials.

For the proposed route, it is expected that the amount of fill material required will far outweigh the amount of material that can be won from areas of cutting. It is therefore essential that the Consultant identifies areas of re-usable material for embankment construction.

In addition, it is important that the Consultant identifies sources of materials suitable for use in pavements (for example, capping and sub-base) and for re-use as aggregate in concrete. The information obtained, shall therefore enable an assessment of the following aspects:

- The suitability for the intended use;
- The extent of deposits;
- Whether it is possible to extract and process the materials, and whether and how unsuitable material can be separated and disposed of
- The prospective methods to improve soil and rock
- The workability of soil and rock during construction and possible changes in their properties during transport, placement and further treatment;
- The effects of construction traffic and heavy loads on the ground;
- The prospective methods of dewatering excavations and the effects of precipitation;
- Resistance to weathering and susceptibility to shrinkage, swelling and disintegration.

The information gained concerning re-use of materials can bring significant economic and environmental benefits to the scheme and will heavily influence the scheme's overall cost. It is therefore imperative that a thorough ground investigation is planned and carried out by the Consultant in this respect.

Structures

Based on information from the existing Feasibility Study, dated 2008, approximately 114 structures are proposed for the currently adopted route. Of these, and subject to validation of GI data, only 26 structures are deemed to have adequate information for Feasibility Stage, therefore a much greater coverage of ground investigation is required. Table 1 of Annex A to this Terms of Reference includes an inventory of ground investigation data available in the existing Feasibility Study and comments on adequacy of data, as well as, requirements for additional boreholes.

These boreholes should, as a minimum, provide the following information:

- Adequate definition of ground model;
- Sufficient information to make a detailed proposal on the form and dimensions of foundations i.e. whether shallow or deep foundations are to be adopted and then the extent of these foundations;
- Interface between structures and earthworks. Variable ground conditions may give rise to differential settlement and this should be considered at Feasibility Design Stage;
- In-situ testing as per embankments and cuttings;
- In-situ groundwater monitoring data;

- Laboratory test data, as per embankments and cuttings. Greater emphasis on soil aggressivity is required, in order to inform preliminary foundation design. This shall be in accordance with the guidelines set out in SR EN 206-1. The Consultant shall undertake all necessary investigations to determine the chemical aggressivity of the existing ground.

Tunnels

Based on information from the existing Feasibility Study, dated 2008, the total length of tunnels is 7430m. Due to envisaged areas of difficult tunnelling, the Consultant shall plan the new boreholes at a maximum nominal spacing of 50m. This means approximately 150 new boreholes are required to inform the design. It is likely that some of these boreholes will be inclined or horizontal. Out of the 150 anticipated boreholes, the Consultant shall execute 75 boreholes in Phase 1 and another 75 in Phase 2. This intrusive ground investigation shall be complemented by geophysical investigation techniques. The geophysical tests are also required to obtain subsurface information (stratigraphy and general engineering characteristics) over a large area to help define stratigraphy and to identify appropriate locations for performing borings (although noting that the depth of the tunnels may limit the effectiveness of some of these techniques, in some locations).

Laboratory testing, providing a wide variety of engineering properties and index properties from representative rock cores retrieved from the borings, shall be planned and executed by the Consultant.

In the context of tunnelling through rock, the following information shall be obtained:

- Unconfined compressive strength of intact rock, intact rock modulus and intact bulk unit weight;
- Triaxial compressive strength and modulus of intact rock;
- Abrasiveness (Cerchar Abrasivity Test);
- Hardness;
- Fracture toughness;
- Punch penetration (to inform excavatability);
- Point Load Index and Brazilian test (tensile strength);
- Petrographic analysis (providing information on microfracture, anisotropy, mineral hardness, grain size and shape);
- Slake durability (in certain weaker rock types only).

Interpretation of the data shall be undertaken to provide a preliminary classification of the rock mass quality along the length of each tunnel, together with other design data, such as, estimated rock mass permeability, groundwater inflow predictions and the potential for overstressing of the rock around a tunnel (i.e. 'squeezing' potential). This information is typically presented on a longitudinal geological section of a tunnel.

It is expected that access for ground investigation at tunnel sites will be difficult due to the presence of steep slopes, heavily forested areas and the fact that some locations are distant from local transport links.

The Consultant shall highlight these difficulties as they represent potential increased costs and impacts upon the programme. The Consultant shall plan effective methods for the execution and completion of the required ground investigations.

Final requirements on ground investigation

The Consultant shall demonstrate due consideration for the programming and execution of the ground investigation. The investigation requires a large number of boreholes to be executed in Phase 1 and 2 and therefore a significant number of drillings rigs are required.

Access to borehole positions will be difficult in many locations, particularly at the sites of proposed cuttings and tunnels in the Olt Valley. Substantial site clearance shall be required, which will include time-consuming activities, such as, de-forestation and provision of access roads.

The Consultant shall give consideration to laboratory testing requirements. Large amounts of samples will require temporary storage at appropriate temperature and humidity. Subsequent tests will also need to be performed.

Programming of the ground investigation is of vital importance and the Consultant shall comply with the requirements outlined within clause 1.5.3.2 of this Terms of Reference.

The gathering of information is to be planned in a phased approach, as progressively more information comes to light. This phased approach shall begin with a thorough desk study which would then enable the planning of the Phase 1 ground investigation. The Phase 1 ground investigations shall allow targeting of specific areas of the scheme which will have a significant impact on the proposed solutions. Interpretation of the Phase 1 GI, combined with the validation of the data available in the existing Feasibility Study will then allow the planning of the Phase 2 GI.

The ground investigation requirements for Phases 1, 2 and 3 are summarised in Table 1 of this Terms of Reference. This represents the minimum level of investigation, in order to meet the requirements of EN 1997-2. It should also be noted that the number of boreholes provided in Table 1 is an estimate and that the requirement may increase or decrease as the design develops. The Consultant is therefore responsible for the assessment, planning and pricing of the Ground Investigation to meet the requirements of Eurocode 7.

Solution	Estimated number of boreholes	Comments
Embankments	225 at Phase 1 500 at Phase 2 500 at Phase 3 - Detailed Design Stage **1225 total**	Based on the existing Feasibility Study, dated 2008, 81 separate sections of embankments have been proposed, covering 52.1km of the route. EN 1997-2 calls for a borehole spacing of 20-200m for linear structures, such as, road embankments. The provision of 1000 boreholes gives a nominal spacing of 50m. Consideration of the individual scheme elements indicates that a greater concentration of boreholes would be provided at high embankments, embankments on soft or variable ground and approach embankments. Lesser concentration would be appropriate for lower embankments and embankments on competent or homogenous ground.
Cuttings	90 at Phase 1 250 at Phase 2 250 at phase 3 - Detailed Design Stage **590 total**	Based on the existing Feasibility Study, dated 2008, 75 sections of cutting are proposed, covering 25.3km of the scheme. Considering the EN 1997-2 recommendations for borehole spacings of 20-200m, an additional 500 boreholes are recommended. This provides a nominal borehole spacing of approximately 50m. It is expected that a greater density of information will be required at complex sites such as anchored rock cuttings, whilst less information will be targeted at shallow cuttings in less complex ground conditions.
Structures	125 at Phase 1 700 at Phase 2 700 at Phase 3 - Detailed Design Stage **1525 total**	Based on the existing Feasibility Study, dated 2008, 114 structures have been proposed for the scheme comprising circa 712 separate structural foundations. Eurocode 7 (EN 1997-2) calls for 2-6 boreholes per foundation. The figure of 1424 boreholes is based on the lower bound of 2 boreholes per foundation.
Tunnels	75 at Phase 1 75 at Phase 2 **150 total**	Based on the existing Feasibility Study, dated 2008, 7.4km of new tunnelling is proposed. For tunnels, EN 1997-2 recommends boreholes spacing of 20-200m. Given the expected complex nature of the rock mass, it is considered that a borehole spacing of 50m is adopted.
Culverts	**Phase 2: 99 Total**	Based on the existing Feasibility Study, dated 2008, a total of 81 culverts have been proposed and it is considered that a single borehole per culvert would be appropriate. The final number of boreholes will depend on the number of culverts proposed by the Consultant.

Solution	Estimated number of boreholes	Comments
Borrow Pits	Phase 2: At 50m grid centres within borrow area (as recommended in STAS 1242/2-83).	Location of borrow pits is to be identified by the Consultant.
5 Km link to Sibiu bypass	36 at Phase 1 54 at Phase 2 **90 total**	The final number of boreholes required for the approximately 5 km long link to Sibiu bypass is to be confirmed by the Consultant.
Total number of boreholes Phase 1, Phase 2 and Phase 3 = 3679 **Total estimated minimum number of boreholes for Phase 1 and 2 that are to be carried out by the Consultant = 2229 out of which Phase 1 includes 551 boreholes and Phase 2 includes 1678 boreholes. The total number of boreholes specified for Phase 1 and 2 does not include the investigations relating to borrow pits, which shall also be planned and executed by the Consultant.** **The location and depth of boreholes, as well as, level of planned testing shall be confirmed by the Consultant following the desk study stage. The desk study shall also identify areas of high geotechnical risk so that areas of investigation can be targeted accordingly. The Consultant shall comply with the requirements outlined within Clause 1.5.3.2 with respect to the specification for Ground Investigations.**		

Table 1 - Estimated ground investigation requirements for each phase of design

The ground investigation report completed as part of the existing Feasibility Study, dated 2008, shall be used for information only.

Due to environmentally sensitive areas traversed by the motorway route, as well as, the anticipated need to create temporary access roads and potentially remove trees, the Consultant is made aware of the need to apply for third party permits, relating to site access for any intrusive geotechnical investigations, prior to the commencement of such investigations. The duration for the application and receipt of such permits shall be included in the Consultants project programme. These permits may include Environmental Agency, Forestry Authority, Water Authorities, Public Utilities owners/administrators or other statutory authorities.

The Consultant shall be responsible for obtaining any such permits, approvals and authorisations. The fees for such permits, taxes and authorisations, shall be paid by the Consultant and reimbursed by the RNCMNR.

In addition, the Consultant shall request formal right of access to the site from the RNCMNR, based on the provisions of Law number 255/2010 and will be responsible for payment of any temporary rental fees and or compensation, indemnity or damages, required by the land owners affected by the ground investigations.

The Consultant shall also be responsible for any site clearance and for the design and build of any temporary access roads, platforms or other facilities that may be required for the proper performance of ground investigations. The Consultant shall obtain any permits, approvals or authorisations that may be required for such works.

The Ground Investigations report shall include photographs for each borehole location, taken during the execution of the boreholes in order to clearly show the site and the equipment used.

Furthermore, each borehole log will include, in addition to the ground strata information, the x and y coordinates in the Stereo 70 system for each borehole. Where possible, the GI report shall include a narrative description of the location of each borehole referenced to any land features identified on site (i.e. electricity pylon, fences). The Consultant shall be responsible for the monitoring on site of the execution of the ground investigations, in compliance with the detailed specification prepared by the Consultant.

The ground investigations report shall be verified by a licensed verifier authorised in accordance with law 10/1995 and order no. 777/2003. The ground investigations report for both Phase 1 and Phase 2 shall be delivered as a separate volume to the Feasibility Study. The licensed verifier shall be employed by the Consultant.

1.5.3.2.2 Archaeological Investigations

The Consultant shall be responsible for the archaeological investigations and will conclude any specific contracts with authorised entities, in accordance with legal requirements on the archaeological standards and procedures, set out in Chapter 2-3, of the Order of Ministry of Culture and Religious Affairs no. 2392/2004.

Thus, based on the planned archaeological works the Consultant shall carry out the following aspects:

Completion of a Desk Study (Theoretical Evaluation) (to be completed at route option stage):

- Carry out research into any historical data (documents, photos, maps sketches, etc.) and review any relevant references to existing literature;
- Development of an archaeological topography study correlated with the proposed route options including the preferred route;
- Assess the likely position and extent of the archaeological sites, prepare estimates of the likely costs and duration of the archaeological discharge activities envisaged for each route option and consider this aspect as part of the multi criteria assessment, which shall be carried out.

Completion of the Field Investigations (Required for the Preferred Route)

- Performance of aerial photogrammetric investigations;
- Performance of geophysical investigations;
- Performance of a detailed field exploration (known as periegheza) and of archaeological surveys for the entire route of the future motorway;
- The performance of a predictive pattern (regarding the distribution of the archaeological patrimony sites) in certain areas. This is to be achieved through the correlation of archive and field investigation data, with preparation of the main documentation validating areas of low archaeological risk.

Drafting of an Assessment Report (Diagnostic Study) which must comprise:

- Distribution in plan with clear delineation of the sites that shall be impacted by the future highway project, in STEREO 70 coordinates including GIS registration;

- Classification of archaeological sites through significance of sites and the prioritisation of sites based on the need for further in depth research;
- Identification and planning of specific measures for the attenuation of impacts on archaeological patrimony, summarised in a management plan;
- Proposing a preventive archaeological research methodology adapted to the actual situation on site;
- Assessment of the necessary costs for envisaged preventive archaeological research, the structure of the research team and the development of a works schedule, which shall include plant, equipment, labour, auxiliary materials, etc;
- Analysis of benefits / profitability of the project from the perspective of specific costs relating to the research, protection, preservation and capitalisation of archaeological heritage (in accordance with the specific provisions of the European Convention in Malta – 1992);
- Specific proposals relating to the approach adopted for archaeological heritage aspects such as monitoring, preventive research, modification to the technical project;
- Planning for transition from archaeological diagnostic study stage to site archaeological investigations;
- For areas where no evidence of archaeological sites are found, the diagnostic study may conclude with a recommendation for archaeological monitoring during the construction stage.

Due to the environmentally sensitive areas traversed by the motorway route, as well as, the anticipated need to create temporary access roads and potentially remove trees, the Consultant is made aware of the need to apply for third party permits, relating to site access for any intrusive archaeological investigations, prior to the commencement of such investigations. The duration for the application and receipt of such permits shall be included in the Consultants project programme. These permits may include Environmental Agency, Forestry Authority, Water Authorities, Public Utilities owners/administrators or other statutory authorities.

The Consultant shall be responsible for obtaining any such permits, approvals and authorisations. The fees for such permits, taxes and authorisations, shall be paid by the Consultant and reimbursed by the RNCMNR.

In addition, the Consultant shall request formal right of access to the site from the RNCMNR, based on the provisions of Law number 255/2010 and will be responsible for payment of any temporary rental fees and or compensation, indemnity or damages required by the land owners affected by the ground investigations.

The Consultant shall also be responsible for any site clearance and for the design and build of any temporary access roads, platforms or other facilities, which may be required for the proper performance of ground investigations. The Consultant shall obtain any permits, approvals or authorisations necessary for such works. Archaeological investigations shall be included as a separate Volume to the Feasibility Study.

1.5.3.2.3 Biodiversity Surveys

For requirements relating to biodiversity surveys, refer to the Appropriate Assessment section no. 1.5.4.12 of this document.

The results of the biodiversity surveys, shall be included as a separate Volume to the Feasibility Study.

1.5.3.2.4 Noise Surveys

For requirements relating to noise surveys, refer to the Environmental Impact Assessment section no. 1.5.4.12 of this document.

The results of the noise surveys, shall be included as a separate Volume to the Feasibility Study.

1.5.3.2.5 Topographical Surveys

The route options stage of the Feasibility Study shall be completed using aerial maps (ortho-photography). The aerial maps shall comply with the following requirements:

- Image scale 1:5,000 with image pixels of ½ m
- Digital Terrain Model with vertical accuracy of 30 cm on well defined points.

Ideally, aerial photogrammetric images should be performed before spring foliage and the resulting photogram and DTM should be used as support for the route selection stage. For the route selection stage, the Consultant can use, with appropriate verification and validation (site visits etc), any aerial survey maps already available for this project. This approach would aim to ensure an effective use of time at route selection stage.

A LiDAR (light detection and ranging) survey shall be carried out along the preferred route. The LiDAR survey shall comply with the following requirements:

- Surveyed corridor width 520m either side of the proposed motorway centre line;
- Altimetry precision for the measured laser points: 50mm;
- Precision in plan for the measured points: 200mm;
- Density of points surveyed: 10 pts/square metre.

Deliverables:

- Digital Terrain Model;
- Topographic Survey to include the linear features: roads, houses, streams etc., shall be represented using continuous joined polylines and shall be labeled accordingly by layer. All stand alone surveyed features, such as electricity poles, shall be represented with adequate symbols and shall be labeled by layer accordingly;
- All digital data will be delivered in an industry standard software format;

- 10cm Ortho-photos to be delivered in an industry standard software format;

The LiDAR survey shall also include aerial imagery. The accuracy of aerial imagery data shall be: DTM +/- 25cm, topographical features +/- 30cm.

The topographic surveys will be performed based on the STEREO 70 system and the levels shall be referenced to MAREA NEAGRA 75 datum. The topographical surveys shall be delivered to the RNCMNR endorsed by the cadastral authority ANCPI.

The topographical surveys report shall be included as a separate Volume to the Feasibility Study.

1.5.3.3 Hydraulic and Hydrologic Study

Hydrological and hydraulic studies shall be developed in accordance with Romanian and European Union (EU) regulations, integrating the provisions from the River Basin Management Plans (RBMP) and Flood Risk Management Plans (FRMP) for the River Basin Water Administrations of the Arges-Vedea and Olt Rivers, as well as, related issues on climate change and land use - land cover change (LUCC).

The study shall provide design parameters for all types of hydraulic structures, including allowances for Climate change, of surface and subsurface hydrological processes.

The hydraulic study shall provide consistent statistical assessments based on data sets for river flows, water management, subsurface flows, precipitation, land use, soil mapping and updated topographic data in combination with project data from the ground survey.

The main drainage issues identified in the Sibiu–Pitesti project area are:

- Project integration with high flow management schemes: to agree the structure design/class of importance with specific requirements in the hydraulic scheme for flood alleviation and FRMP;

- Project integration with river basin management plans (for water quality protection): to mitigate road ecological impacts on water bodies and water dependant habitats in compliance with the provisions of the RBMP;

- High flow assessments aimed at providing design parameters for bridges, culverts and ditch locations, including predictions for flood mapping.

  The flood mapping shall take account of any flood mapping already available for the main rivers and tributaries within the two river districts;

- subsurface water drainage to protect road structures, retaining walls, slope consolidation works and more detailed assessments on local geologic and hydrologic conditions aimed at providing sufficient water structure permeability and further safety;

- Water erosion in ravines, torrents and riverbeds at culverts and bridges: regressive erosion on streams and in riverbeds will be at the highest rates in the project area, with more aggressive behaviour in the downstream reaches from the road;

- Specific requirements for river crossings and lateral structures' protection, maintenance and monitoring: complementary non-structural measures will highly increase structural safety.

The Consultant shall review all related studies referenced within section 1.5.2 of this Terms of Reference, to develop a hydrologic and hydraulic study based on recent and accurate data sets (e.g. a detailed aerial survey for flood mapping) in compliance with the specific requirements for water management in the two Water Basin Administrations. This will also help with the application process for the Water Authority permit.

The management of surface and subsurface drainage shall take account of high flow and flood risk assessments and include aspects of water erosion relative to specific local conditions, such that the structures (viaducts, bridges, culverts, bottom sills) and lateral structures (road ditches, manholes, grease/oil separators, cut-off ditches, riverbed realignments) are adequately designed. Lateral road drains will help to slow down runoff within a highly erosive environment.

Subsurface processes relating to ground (subsurface) water drainage of the road structure, lateral drains, retaining walls, slope consolidations, slope stabilisation for creep and landslides shall be designed for both road safety and environmental integration. In case of steep rocky slopes and or clay soils, water drainage will require efficient solutions, i.e. with high structural permeability or scattered drainage solutions over the slope areas.

An existing EU policy refers to the adaptation of infrastructure projects to climate change scenarios and includes references to greenhouse gas emissions and impacts generated by transport projects. More information can be found at the following web address: *http://ec.europa.eu/clima/policies/transport/index_en.htm.*

Climate change, with particular reference to the risk of flooding, shall be considered in this project with allowance for a 10% increase in the design storms. If available, long event records and statistical inference of rain events parameters will help to improve such coefficients of change in the project area. In small catchments, the changes of land use and land cover through deforestation, pavements, watershed fragmentation, may have significant impacts by increasing the magnitude and intensity of runoff. These issues shall require complex rainfall-runoff modelling and consideration must be given to minimise the areas of change through equivalent/extended reforestation with similar species of forest trees and bushes from the local area.

In the case of the large rivers (Arges, Olt and Topolog), the vertical alignment of the new motorway shall be designed at 2% probability of annual maximum rates of the river flows, with verification at 0.5% probability. Hydraulic modelling will help the infrastructure design integrate with the existing flood mapping thus avoiding significant impacts. Where applicable, the design parameters on the Arges River will match the requirements relating to the existing hydraulic scheme for dam safety and flood defence assets. If justified, the assurance risk level may decrease, for example, in the case of small rivers. An increase of 10% in the probability of exceeding the annual maximum rates shall apply to the design of road ditches, cut off ditches or anti-erosion works on slopes. When traversing sloping catchments, distinction shall be made between the road area to be drained, through road lateral drains, and the much larger runoff areas where flow management by means of cut off drains or other similar measures such as anti-erosion works or changes and enhancements to drainage systems of the neighbouring roads, shall be required. The aim of these measures is to minimise the need for large sized open ditches, which would represent a hazard to road users and would require more complex control measures at outfall points.

Hydrologic context of project location

The motorway route may be divided into three major road sections of comparable lengths in terms of hydrography and hydrological issues:

1. The Olt Valley: a narrow corridor bordered by steep rocky slopes with a known risk of instability due to water infiltration;

2. High hills crossing along the valleys of Baias and Topolog rivers and some tributaries, including a tributary of the Arges River: this is a highly fragmented area of steep and deep valleys with river-networks. Its formation is due to very active water erosion on steep slopes with clay soils above a marl formation at low depths, with ravines and creep processes on deforested slopes, a generally high risk of landslide and low subsurface capacities for water drainage;

3. The Arges Valley, in the river flood plain on the lower bank along the contour levees of three hydropower reservoirs (Zigoneni, Valcele and Bascov), including a number of overcrossing of both the hydro-power and old river channels. This is a restricted area with regard to levee safety, flood risk prevention and moisture excess (similar issues are also found in the area of Suici reservoir on the Topolog River).

Route constraints in protected area:

- Cozia National Park and reservation: motorway section in the Baias Valley, km 40 to km 50 (Copaceni – Poiana): possible requirements for green corridors and other measures of environmental integration within a high-energy topography as furthering with additional water issues;

- The Valsan natural reservation: more severe constraints to waste water discharges;

- Reservoir areas on the Topolog and Arges Rivers: in the case of reservoirs, the protection area relates to the basin area from the normal top water level to the weir crest level; in this case, it will mainly refer to levee safety area.

Motorway route alternatives

Outline route alternatives were analysed as part of the Gap Analysis Report completed on behalf of JASPERS and are as follows:

1. Talmaciu-Boita (which aimed at avoiding two bridge crossings over the River Olt);

2. Caineni area (which kept the route to the east of the Olt River to remove the double rail and river crossings);

3. The Suici reservoir area (which reduced the impact on the existing river and reservoir);

4. The section between the Zigoneni and Valcele reservoirs (which aimed to avoid or minimise the impacts relating to motorway construction near the old channel of the River Arges).

The motorway route alternatives outlined at points 3 and 4, are seen as beneficial and it is envisaged that other similar areas could be identified by the Consultant to minimise the amount of river diversions thus reducing subsequent environmental impacts related to such works.

Drainage issues to be considered for the motorway sections:

1. The Olt Valley:

- The motorway platform will require severe excavations on steep slopes and on approaches to viaducts and tunnels. The works may include staggered carriageways, which shall require detailed analysis of drainage measures by means of highly permeable reinforcing structures on slopes (e.g. reinforced earth retaining walls);

- River crossings: structural protection by means of upstream-downstream bottom sills and free flows of sediments;

- Proper consideration of flooding extents and any generated impacts for the safety of the structures.

2. The Olt and Arges tributaries' valleys:

- Significant number of river crossings: with proper design of the vertical river profile, consideration shall be given to upstream-downstream bottom sills for local stabilisation without these having a significant impact on sediment fluxes;

- Transverse slope crossings in areas of high erosion and landslide risk: adequate solutions for surface and ground water drainage (including cut off ditches, herringbone subsurface water drainage, etc.,) and anti-erosion and consolidation works on slopes and ravines in combination with herringbone water drainage and re-vegetation measures by means of local species of forest trees and bushes;

- Areas of high ground water table: identify alternative local realignment of the motorway route or provide adequate solutions for subsurface water drainage.

3. The Arges Valley, and the Topolog in the Suici reservoir area

- Improved options for motorway routes to avoid areas where there is a high ground water table;

- Increased risk level to structure assurance, if required in the existing hydraulic scheme of flood management;

- Structural integration with existing flood extent mapping to avoid flood risk increasing.

The hydraulic and hydrologic study and calculations report shall be included as a separate Volume to the Feasibility Study.

1.5.3.4 Seismicity Study

The seismicity study will follow the classification of the area traversed by the motorway route according to the provisions of the relevant Romanian standards. At European level, Romanian seismic activity can be characterised as average, but recognising that the earthquakes generated in the Vrancea area, located in central eastern Romania, may cause damage to vast areas including regions outwith Romania. With the propensity for damage, it is therefore important that sufficient investigation is carried out to evaluate mitigation of any seismic impact on proposed structures, road infrastructure and nearby slopes. The Sibiu–Pitesti motorway is situated within the seismic intensity area equivalent to a grade 7 earthquake measured from the Medvedev–Sponheuer–Karnik scale, also known as the MSK. Due to this, special consideration shall be given in the design to seismic analysis of all structures.

The seismic study report shall be correlated with the requirements of Eurocode 8 and shall be included as a separate Volume to the Feasibility Study.

1.5.3.5 Condition survey of existing structures

The Consultant shall undertake condition surveys known in Romanian as *Expertize Tehnice* for any existing structures proposed to be retained as part of the project. This includes, but is not limited to:

- Bridges, viaducts, overpasses
- Retaining walls

In addition, any sections of existing road pavement proposed to be retained and or upgraded as part of the project will require survey and investigation work to enable the development of adequate design proposals for either pavement overlay or indeed pavement reconstruction.

1.5.4 Feasibility Study

The format and content of the Feasibility Study shall comply with the Government Order HG 28/2008. The structure of the Feasibility Study shall include the following volumes:

Volume no.	Description	Remarks
Volume 1	Route Alignment Options Report	Covers route options for the entire scheme between Sibiu to Pitesti. This report shall include Multi Criteria Analysis, as well as, Cost Benefit Analysis and Traffic Information for the proposed route options.
Vol. 2	Synthesis	Provides information for the entire scheme but is structured with clearly identified chapters for each of the five sections identified in Vol. 3.1 below. This also includes the Deviz General for the entire project and a separate Deviz General for each of the five sections identified in Vol. 3.1 below. The content of the technical report shall comply with the requirements outlined within HG 28/2008
Vol. 3.1	Road Works	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni
		Section IV Valeni – Curtea de Arges
		Section V Curtea de Arges - Pitesti
Vol. 3.2	Bridges, Overpasses, Viaducts works	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni
		Section IV Valeni – Curtea de Arges
		Section V Curtea de Arges – Pitesti
Vol. 3.3	Tunnel Works	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni

Volume no.	Description	Remarks
		Section IV Valeni – Curtea de Arges
		Section V Curtea de Arges - Pitesti
Vol. 3.4	Motorway Facilities	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni
		Section IV Valeni – Curtea de Arges
		Section V Curtea de Arges - Pitesti
Vol. 4	General Bills of Quantities and cost estimates	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni
		Section IV Valeni – Curtea de Arges
		Section V Curtea de Arges – Pitesti
Vol. 5	Traffic Study	Entire Scheme
Vol. 6	Cost Benefit Analysis	Entire scheme
Vol. 7	Topographical Studies	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni
		Section IV Valeni – Curtea de Arges

Volume no.	Description	Remarks
		Section V Curtea de Arges – Pitesti
Vol. 8	Geotechnical Study (ground investigations)	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni
		Section IV Valeni – Curtea de Arges
		Section V Curtea de Arges - Pitesti
Vol 9	EPA Notification	Initial Assessment, Site visit, EPA decision
	Presentation memorandum	Screening Stage, TAC meeting, public information, respond to public comments, EPA decision, decide about the necessity of Appropriate Assessment
	Environment Impact Assessment Report	Scoping Stage and REIA analyses stage; public information, public hearings (debate), responses to public comments, TAC meetings, EPA makes the decision. Covers the entire scheme but structured with clearly identified chapters for each of the five sections identified above.
	Appropriate Assessment Study	Initial Assessment and Screening stages (common with EIA initial stages); Appropriate Assessments stage and Alternative Solution stage, Compensatory Measures stage; Public information, respond to public comments, TAC meetings, EPA makes the decision. Covers the entire scheme but structured with clearly identified chapters for each of the five sections identified above.
Vol. 10.1	Documentation for Identification of Land Owners – Phase 1 required for the issuance of the Governmental Decision in accordance with Law 255/2010 (this shall include the land required	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni
		Section IV Valeni – Curtea de Arges

Volume no.	Description	Remarks
	for the main project as well as land required for the relocation and protection of public utilities)	Section V Curtea de Arges - Pitesti
Vol. 10.2	Documentation for Identification of Land Owners – Phase 2 following the published Governmental Decision in accordance with Law 255/2010 (this shall include the land required for the main project, as well as, land required for the relocation and protection of public utilities)	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni
		Section IV Valeni – Curtea de Arges
		Section V Curtea de Arges – Pitesti
Vol. 11	Motorway communication, Intelligent Traffic System and Traffic Control	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni
		Section IV Valeni – Curtea de Arges
		Section V Curtea de Arges - Pitesti
Vol 12.1	Relocations, Protection of Petrol, White Products, Gas, Water and Sewage Installations	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni
		Section IV Valeni – Curtea de Arges
		Section V Curtea de Arges - Pitesti

Volume no.	Description	Remarks
Vol 12.2	Relocations and Protection of Land Reclamation installations	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni
		Section IV Valeni – Curtea de Arges
		Section V Curtea de Arges - Pitesti
Vol 12.3	Relocations and Protection of Electrical Installations	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni
		Section IV Valeni – Curtea de Arges
		Section V Curtea de Arges - Pitesti
Vol. 12.4	Relocations and Protection of Telecommunication Installations	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni
		Section IV Valeni – Curtea de Arges
		Section V Curtea de Arges - Pitesti
Vol 12.5	Relocation and protection of any other public utilities	Section I Sibiu – Boita (includes the section between Vestem and the existing Sibiu bypass)
		Section II Boita – Racovita
		Section III Racovita – Valeni

Volume no.	Description	Remarks
		Section IV Valeni – Curtea de Arges
		Section V Curtea de Arges - Pitesti
Vol. 12	Permits and Agreements	Entire scheme but structured with clearly identified chapters for each of the five sections identified above.
Vol. 13	Maintenance and Operation Plan	Entire scheme but structured with clearly identified chapters for each of the five sections identified above.
Vol. 14	Soil, Material, Construction Processes and Health & Safety Report	Entire scheme but structured with clearly identified chapters for each of the five sections identified above.
Vol. 15	Archaeological Investigations Report	Entire scheme but structured with clearly identified chapters for each of the five sections identified above.
Vol. 16	Biodiversity Survey Report	Entire scheme but structured with clearly identified chapters for each of the five sections identified above.
Vol. 17	Noise Surveys Report	Entire scheme but structured with clearly identified chapters for each of the five sections identified above.
Vol. 18	Hydraulic and Hydrologic Report	Entire scheme but structured with clearly identified chapters for each of the five sections identified above.
Vol. 19	Seismic Study Report	Entire scheme but structured with clearly identified chapters for each of the five sections identified above.
Vol. 20	Grade separated junctions	Entire scheme but structured with clearly identified chapters for each of the five sections identified above.

Volume no.	Description	Remarks
Vol. 21	Maintenance roads and reinstatement of local roads continuity and new access roads to ensure connectivity of the affected properties.	Entire scheme but structured with clearly identified chapters for each of the five sections identified above.
Vol. 22	Report on soil, material, construction processes and health & safety	Entire scheme but structured with clearly identified chapters for each of the five sections identified above

The Consultant will be encouraged to present an updated or enhanced version of the Feasibility Study structure as part of the Inception Report. The exact start end chainage for each of the above subsections shall be determined and proposed by the Consultant.

With regard to section IV, Valeni–Curtea de Arges, it should be noted that the Consultant is required to carry out an analysis at Route Option Stage for the feasibility of including the rehabilitation of a 20km long sector of the DN73C between Tigveni grade separated junction and Malureni, thereby bringing a connection with Ramnicu Valcea into the scope of the Sibiu–Pitesti motorway construction. Such an analysis requires a Traffic Study and Cost Benefit Analysis to be carried out as part of the Route Options study. The inclusion of the DN73C within the scope of the Sibiu–Pitesti motorway construction contract will require a final decision from the RNCMNR. The procurement of the services relating to the rehabilitation of DN73C under a separet contract will be subject to final decision by the RNCMNR.

1.5.4.1 Route Alignment Options Report

The route options study prepared as part of the existing feasibility study was mainly based on the two Pre-Feasibility Studies developed for section Pitesti–Curtea de Arges–Cornetu, dated 1994, and Cornetu–Sibiu, dated 1997. In addition to the Pre-Feasibility Study for the Pitesti–Curtea de Arges–Cornetu section of the motorway, three more route corridors were studied as part of the Feasibility Study mainly aimed at bringing the motorway closer to Ramnicu Valcea.

The existing route options report, presented as part of the existing Feasibility Study, dated 2008, does not include:

- Identification of possible improved connections to Ramnicu Valcea;
- Connection between the recently constructed Sibiu bypass and the proposed Sibiu–Pitesti motorway.

The new route options report stage shall focus on at least two route options for the entire route of the Sibiu–Pitesti motorway to identify the most technical and economically advantageous option.

Detailed investigation into the various route options (corridors) for the future Sibiu–Pitesti motorway were carried as part of the existing Feasibility Study and the reviews and recommendations were included within the Route Assessment Report included within the 2008 Feasibility Study. It is acknowledged that the existing topography represented a significant constraint along the route studied, which largely dictated the selection of the preferred corridor which was approved through the Technical Economic Committee (TEC) RNCMNR decision number 2968 dated 18.12.2007.

The existing Route Options Report, however, requires additional justification for the selection or rejection of the various alternatives and shall include, but not be limited to, the following:

- Clear and extensive list of constraints (terrain, geology, environmental including Natura 2000 sites, habitats, archaeological, socio-economic, climate change impact; safety including operation and maintenance;

- In addition to the route options presented as part of the existing Feasibility Study, date 2008, the Consultant shall consult the Gap Analysis Report, completed in June 2013, and further assess the outline proposals presented within the report, including the fine tuning of the alignment within the areas requiring river realignments;

- A robust cost benefit analysis and multi criteria analysis to provide a sound basis for the selection of the preferred option. The requirements for cost benefit analysis and multi criteria assessment are outlined within section 1.5.4.10 of this Terms of Reference;

- Traffic assessment for each of the proposed routes;

- Assessment of the feasibility and viability of an improved connection to Ramnicu Valcea using the DN73C road;

- Use the most up to date technical surveys, traffic and economic data.

The Consultant is requested to develop the route options assessment in two stages:

- Stage 1: review and summarise the broader options analysis undertaken within the Gap Analysis Report, dated June 2013, and include any previous studies, summarising the rationale for selection of the preferred alignment. This stage shall involve the completion of a multi criteria assessment and this initial process shall be described in the EU Funding Application Form;

- Stage 2: Review and in depth analysis centering on a number of alignments within the vicinity of the current preferred alignment, focusing more on identifying minor alignment refinements rather significantly different route options that have been discussed in the Gap Analysis Report, dated June 2013, and in the existing Feasibility Study, dated 2008.

The route options identified as part of Stage 2 shall be issued to the RNCMNR and other third parties such as Regional Roads and Bridges DRDP, Ministry of Defence, Ministry of Culture, Environmental Agency and others with the view to obtain their opinion on the advantages and disadvantages related to each of the proposed routes. The Consultant route selection report shall include the feedback received from the third parties which will be considered by the RNCMNR as part of the final decision for the preferred route.

The route options report along with the Consultant recommendation shall be issued to the RNCMNR for approval by the CTE RNCMNR.

1.5.4.2 Road works

The design speed for the Sibiu–Pitesti motorway shall generally be 120 km/h and the platform shall generally be minimum 26.00 m wide.

However in certain sections, e.g. Vestem – Racovita, a lower design speed and narrower platform width (23.50 m) may be considered appropriate. The Feasibility Study shall recommend the optimal design speed and platform width for each section of the Sibiu-Pitesti scheme, based on a rational analysis of relevant factors e.g. identified constraints, buildability issues, environmental impacts, investment costs, travel times, safety, and Romanian norms/standards.

The typical cross sections for all other categories of roads shall be presented by the Consultant within the Inception report.

The platform widths provided in 1.5.4.2 are the minimum required and the Consultant shall include in the design the following additional provisions:

- The minimum width of the soft verge shall be 2.50m to accommodate safety barriers and longitudinal ducting for motorway communications and lighting, drainage systems etc. This width shall be increased as required to meet visibility requirements;
- The width of the central reservation of 3.00m or 3.50m is the minimum required and this shall be increased as required to provide adequate forward visibility.

The design shall include provisions for climbing lanes where required. Calculations for the provision of climbing lanes shall be in accordance with the requirements of the TEM standards and the Romanian PD162 norm and shall be presented as an annex to the Synthesis report.

The TEM Standards clause 1.2.2.11 – Subsequent Stages, provides an outline of considerations relating to future provisions for additional lanes. The traffic study, completed as part of the existing Feasibility Stage, provides information about traffic growth for years 2030 and 2035. The forecasts provided seem to suggest that the section Pitesti–Curtea de Arges may require three traffic lanes in each direction as of 2035, while the Vestem–Sibiu section may require three traffic lanes each way as of 2030. A new traffic study will be required and this shall clarify the need for additional lanes. Based on the outcome provided by the updated traffic study, the roads design shall consider and discuss the provision of a future third lane and shall assess the following possible options:

- Acquisition of land required for future widening;
- Provision for the addition of a third lane at structures;
- Earthworks design to enable future addition of a third lane either to the outside or to the inside through provision of a widened central reservation.

For these options, an analysis that will include costs, operation and maintenance, safety, environmental and socio–economic impacts shall be presented by the Consultant in order to justify the most advantageous technical and economic solution.

Grade separated junctions

Provision of lighting shall be included for all grade separated junctions. The lighting will be provided from the start of the diverge taper to the end of merge taper. Where the distance between two interchanges is less than three times the stopping sight distance then the motorway section between the junctions shall also require provision of public lighting. Adequate verge width shall be provided in order to accommodate lighting columns. The lighting columns shall be designed behind the safety barriers.

The distance between the trafficked face of the safety barrier and the lighting column shall comply with the working width specified for the safety barrier system. The Consultant shall assess the option of providing lighting columns either within the central reservation or verge and shall make recommendations taking account of costs, health and safety, maintenance etc.

The existing grade separated junction at Sibiu bypass shall be reconfigured to accommodate the new Sibiu–Pitesti motorway. Consideration shall be given to safety and traffic flows for a free flow interchange layout with elimination of left turning manoeuvres on DN1/DN7 roads, the results of which shall be presented by the Consultant.

The grade separated junction at Vestem, chainage zero of the existing Feasibility Study may no longer be required and therefore consideration and proposals for the accommodation of the future Sibiu–Fagaras Expressway shall be presented by the Consultant.

The layout for all grade separated junctions shall consider traffic volumes, safety, junction visibility etc. The Consultant shall review the relevant information included in the Gap Analysis report, dated June 2013, to decide whether any of the proposals outlined will be implemented in the new Feasibility Study.

The proposed design for all grade separated junctions and all at-grade junctions shall include road markings and signs drawings. The layouts along with a copy of the junctions' traffic capacity analysis reports shall be issued to the RNCMNR for approval by the Road Safety department and Police.

Reinstatement of local road network

The Consultant shall assess the impact of the Sibiu–Pitesti motorway on existing communication paths (roads, access tracks, footpaths, land plots divided by the proposed alignment) and shall propose access tracks, structures (underpasses, overpasses or footbridges) for the reinstatement of existing communication paths. This may include, but is not limited to, the design of new access roads along the motorway to reinstate access to the affected properties and land.

Interface with the railways

The Consultant shall assess the impacts on the existing rail network and seek approvals from the rail owner/administrator for the works situated in the vicinity of rail assets. In addition the Consultant shall correlate the design with any future rail investment projects.

Proposed drainage system

Highway drainage is one of the most important features for longevity of the road and for providing adequate operation under safe conditions. The drainage design shall therefore be given due consideration by the Feasibility Study Consultant.

The drainage design shall include:

- hydraulic design calculations;
- Inclusion of an allowance for global climate change through increase of rainfall intensities by 10%, if not already captured in the flows and data made available by the relevant Water Authorities;
- Analysis of two drainage options: opened drainage channels and piped drainage systems. An analysis into the most feasible option shall be presented by the Consultant and this will include considerations for safety, construction cost, maintenance and operation costs, as well as, environmental considerations;
- Review of other measures aimed at reducing the volume of surface water runoff which reaches the motorway drainage system. These measures could include, but are not limited to, cut-off drains/ditches and herringbone filter drains for cuttings;
- Proposals for the drainage system within the central reservation of the motorway, where required.

Pavement design

The road pavement shall be designed for a 40 year design life. The standard axle load shall be 11.5 tonne.

The consultant shall assess the following pavement options:

- Flexible pavement;
- Flexible composite pavement.

Continuously reinforced concrete pavement and rigid jointed pavements shall not be permitted in the design.

The pavement design report, which will be included as an annex to the Synthesis volume shall provide a technical–economic assessment of each of the two options and consider aspects such as cost, operation and maintenance, behaviour under similar climate conditions and the particularly likely behaviour given climate changes aspects, such as,

significant variations in temperature, safety and environmental impacts. Based on these considerations, the Consultant shall make a recommendation for the most advantageous option.

Road Safety features

The design shall allow for widening of central reservations or verges for provision of forward visibility. The width of the soft verge shall also be designed to accommodate features such as safety barriers, motorway communication systems and lighting, where required.

The Consultant shall consider the adequacy of at-grade T junctions and assess options for replacing them with roundabouts (if justified by traffic flows) to reduce the risk of accidents.

Junction visibility shall be checked as part of the design to ensure that the land to be acquired includes adequate allowance for widening at junctions. Most accidents occur around junctions and it is of paramount importance that aspects such as visibility or requirements for lighting, are reviewed.

The Consultant shall also comply with the requirements of chapter 1.5.4.21 regarding the road safety audit.

3D modelling of the design

The 3D modelling of the mainline, as well as, accommodation tracks, parking, rest and services areas shall be developed by the Consultant. The 3D modelling aims to provide an increased level of accuracy in terms of requirements for land take, retaining walls and in some cases, buildability of the outline proposal. The 3D design model shall be made available in an editable and re-usable electronic format to the RNCMNR along with a licence of the software used (which shall also include four years prepaid maintenance services) by the Consultant for future use as part of the contract implementation programme.

Systems for protection against avalanches or snow drifts

An important aspect that needs to be considered relates to the provision of systems for protection of the motorway against avalanches and snow drifts. In determining the outline provisions, the designer shall consider any historical data within the region, with particular reference to sections of the existing road network that may have been subject to blockage or closure due to snowdrifts or avalanches. It is advisable, subject to other constraints, to design shallow side slopes (particularly for cuttings), thus providing an open space for easier maintenance while also reducing the risk of snow drifts. Tree screening or similar protection, shall be designed where deemed appropriate.

Mass haul diagram and earthworks quantities

The consultant shall include a mass haul diagram which will detail the earthworks quantities and the cut/fill balance. The mass haul diagram shall also show the main constraints for transportation of earthwork materials. Based on the results of the ground investigations report, the earthworks quantities shall include estimates for usability of materials resulting from excavations and provide outline requirements for in-situ processing of such material.

The potential deficit of fill shall be compensated by materials imported from borrow pits, which are also to be identified by the Consultant. The schedule of earthworks material usability shall also include estimates of hazardous materials from cuttings requiring special disposal measures.

Maintenance service tracks

The Consultant shall design maintenance service tracks along both sides of the motorway to provide access for future maintenance. The service tracks shall be 3.50m wide and shall be situated between motorway fencing and either toe of embankment or top of cut slope or the outer edge of the drainage channel. The pavement construction for the service tracks shall be proposed by the Consultant. It shall be noted that the service tracks are not to be used as a replacement for reinstatement of other communication paths to the affected plots of land or local roads. The sole purpose of the services tracks is to ensure facile access for maintenance. The maintenance tracks can be situated within the motorway safety zone known as "*zona de siguranta*".

Information relating to buildability, including details relating to temporary works and impacts generated by the construction traffic

The Consultant shall consider and discuss information relating to temporary works and temporary access to site. This is particularly important for the section of motorway situated along the Olt River, where the motorway moves from the east bank to the west bank of the river and in most cases requires construction to be undertaken while the existing railway line and DN7 will be in full operation. Consideration shall also be given to the impact of construction traffic on local communities, which was not addressed in the original studies.

The Consultant shall address the interface between the road works and other types of works such as tunnels, structures, retaining walls, services and rest areas. For example, the horizontal alignment will require specific changes on approach to twin tunnels.

The Consultant shall assess the feasibility for provision of emergency accesses to the motorway within the section Vestem to Cornetu.

The design shall include a schedule of proposed central reservation crossover points, which ideally will be located on approaches to major structures and tunnels.

Departures from Standards

The Consultant shall clearly identify any departures from Standards and will include a list of departures, along with their justification for adoption, as part of design within an annex to the Synthesis report. This is required to gain the Employer's Approval.

The format required for each departure application is presented in the table below:

PROJECT DETAILS	
Road Category & Type and No.	
Proposed Carriageway Cross Section	
Design Speed	
Future Traffic Flows & Composition	

DESCRIPTION OF DEPARTURE	
Location and chainage	
Departure type	
Standard or norm reference	
Required by standard	
Standard provided in the design	
Drawing No.	
JUSTIFICATION	
Detailed Justification	
Safety implications	
Structural Integrity	
ESSENTIAL COMPENSATORY MEASURES	

1.5.4.3 Structures and culverts and retaining walls

Eurocodes, which were formally implemented in Romania in 2010, shall apply to the new Feasibility Design. The typical cross section proposed for the dual two-lane structures shall comply with the TEM Standards and recommended practice, 3rd edition. Consideration shall be given to the typical cross section applicable in areas with climbing lanes, junctions and service and rest areas. The typical cross section should accommodate the installation of future ducting for both communication and power cables. As a minimum, the design shall include allowance for four communication ducts and three ducts for power cables.

The typical cross sections for all other categories of structure shall be presented by the Consultant within the Inception report.

The objectives at Feasibility Stage should be to provide information relating to the preliminary design of each structure. For each of the proposed structures, the following information shall be provided:

- Specification of the envisaged foundation level for spread foundations;
- Specification of number of piles, diameter and their disposal on the pile cap for piled foundations;
- Determination of rock and soil properties and mass characteristics based on the Ground Investigation data;
- State of weathering of rock;
- Definition of hydro-geological conditions including groundwater levels (especially for structures that have foundations near rivers or streams) and the presence of aquifers;
- Information of Seismicity;

- Identification of potential construction risks including access to site and transportation of abnormal loads. Special attention shall be paid to the interface between structures and tunnels;

- Information relating to the proposed types of precast beams dimensions and bearing capacity;

- Information relating to surface water drainage and arrangements at outfalls (gullies) on bridges was not presented in the existing Feasibility Study, dated 2008. It is recommend that the updated design allows for continuation of gully connection pipes to the bottom of piers, where special measures to enable treatment and infiltration of water can be adopted;

- Information relating to culverts and or other structures used for field accesses, including hydraulic calculations for culverts;

- The design will aim to adopt, as much as practically possible, standardisation of the type of structures to increase construction and maintenance efficiency.

A buildability review will be required in order to address aspects such as:

1. Procurement and transport of materials including, but not limited to, the need for temporary access roads for the transport of precast beams and routes required for abnormal loads (longest span proposed in the design is 120m);

2. Interface at transitions from tunnel to structure and vice versa, with possible alterations to tunnel portal locations and the inclusion of a section of embankment/ cutting between the two structures;

3. Analysis of possible allowance for the subsequent addition of a third traffic lane.

The Consultant shall assess the need for pedestrian bridges over the motorway at locations deemed necessary. Bridges and or underpasses for farm animals to cross the motorway shall also be provided, where required. Underpasses or other types of passageways for other habitats shall be correlated with the results of the biodiversity survey.

With regard to retaining structures, the Consultant shall carry out an analysis of the cost of land versus the cost of building and maintaining retaining structures to ensure that best value for money is achieved. It is acknowledged, however, that due to various constraints retaining structures will be required.

All structures longer than 100m shall be provided with public lighting. The lighting shall extend to a distance of 300m on approach to the structures. The Consultant shall give consideration to the health and safety and maintenance aspects relating to the potential provision of lighting columns within the central reservation of the motorway. Subsequent proposals shall be submitted to the RNCMNR for the location of lighting columns either within the verge or central reservation.

1.5.4.4 Earthworks

The Consultant shall carry out the design to ensure adequate measures for slope stability and for strengthening of the existing ground where required. The earthworks design shall take account of the information and recommendations included in the ground investigation report. Based on the classification of materials resulting from the excavations, the Consultant shall estimate required measures for the in-situ processing of materials and include within the land to be acquired provisions for such extensive processes. The earthworks design shall be carried out in accordance with Eurocode 7 and 8 and where appropriate complemented by relevant Romanian standards. The approach to earthworks design, including the applicable standards, shall be outlined by the Consultant within the Inception Report.

1.5.4.5 Hydro-technical works

Following the completion of the hydraulic and hydrologic study, the Consultant shall propose options for protection of motorway embankments in the vicinity of existing rivers or streams. Such works may include, but are not limited to:

- Lining of side slopes;
- Adoptions of various types of retaining structures;
- Stepped torrent arrangements on slopes;
- Special works at culverts.

Special attention shall be given to minimising the extent of river realignment work.

1.5.4.6 Tunnel Engineering Including Tunnel Ventilation and Fire Safety

This section comprises the Terms of Reference for the Feasibility Study with reference to tunnel engineering, including tunnel ventilation and fire safety (VFS).

Objectives

The feasibility study with reference to tunnel engineering, including VFS, is intended to confirm a preliminary design concept for the design of each tunnel, which is feasible and cost effective, and which:

- Gives confidence that the concepts are viable and meet the appropriate standards, levels of service and safety;
- Provides space proofing requirements for the detailed design of the tunnels;
- Provides sufficient information and drawings to support a cost estimate and preliminary programme, both of which are to be included in the study.

Scope

The study shall be undertaken to meet the objectives set out above and shall include, but will not necessarily be limited to, the following considerations:

Design objectives, codes and standards

The design objectives for tunnel design and VFS shall be proposed together with appropriate codes and standards.

It is recommended that the primary safety standard for tunnels will be the European Directive 2004/54/EC of the European Parliament and of the Council on Minimum Service Requirements for Tunnels in the Trans-European Road Network, but this should be confirmed by the study together with such other applicable standards, as may be identified.

Ventilation and fire safety strategy

An appropriate strategy for VFS shall be developed to establish the basis of design for the tunnels and tunnel systems. The strategy shall provide for, but will not necessarily be limited to, consideration of:

- Ventilation under normal operating conditions;
- Ventilation under emergency conditions;
- Management of vehicle breakdowns;
- Incident management;
- Emergency evacuation;
- Access for emergency services.

Tunnel system requirements

The study shall establish requirements for the following tunnel systems, and such others as may be considered necessary to implement the VFS strategy. The proposals shall be developed sufficiently to demonstrate feasibility and compliance with standards and levels of service, and to inform the cost estimate.

Structural requirements

The Consultant shall consider the following aspects as minimum:

- Maximum gradients;
- Carriageway widths, climbing lanes and lay-bys, as may be appropriate;
- Space proofing for equipment;
- Emergency walkways;

- Emergency exits;
- Cross-connections between tunnels for emergency exit and access of emergency services;
- Crossing of the central reserve outside each portal (carriageway interconnectors);
- Collection, drainage and removal of flammable and or toxic liquid spillages;
- Fire resistance of tunnel structures.

Lighting

- Normal lighting;
- Emergency lighting;
- Evacuation lighting.

Ventilation

- Natural ventilation as may be appropriate;
- Mechanical ventilation systems;
- Environmental impacts of ventilation discharge from tunnels under normal and emergency conditions.

Emergency stations in tunnels

- Distribution of and facilities for emergency stations within tunnels;
- Emergency exits to the ground surface or between the tunnel tubes.

Water supply

- Fire mains and hydrants.

Fixed fire suppression systems (FFSS)

- Justification for FFSS;
- Concept design for FFSS.

Tunnel control centre(s)

- Requirements/location(s) for tunnel control centre(s);
- Spatial requirements and facilities for tunnel control centre(s).

Monitoring

- Video/CCTV monitoring;
- Automatic incident detection and or fire detection.

Management of tunnel closure

- Traffic signals and or barriers at tunnel approaches and entrances;
- Traffic signals inside tunnel.

Communications

- Radio re-broadcasting for emergency services;
- Emergency radio messages for tunnel users;
- Loudspeakers in tunnels and cross passages etc.

Power supply and emergency power supply

- Power supply for normal operation and emergency conditions;
- Back-up power supply.

Fire resistance of systems

- Fire resistance of tunnel plant and equipment;
- Tunnel maintenance;
- Maintenance requirements, strategy and equipment proposals.

Tunnels civil design

The Feasibility Study shall establish the appropriate form of tunnel structure for each location, with due consideration of the following aspects of design and such others, as may be considered necessary:

- Geology and hydrogeology;
- Space proofing for VFS and tunnel systems;
- Waterproofing and drainage concepts;
- Temporary support design;
- Contingency measures for tunnelling through zones of weakness;
- Permanent lining (structural) design including durability and seismic considerations;

- Portal designs (temporary and permanent);
- Maintenance requirements;
- Construction methods and constructability including construction work sites and access, rates of tunnel excavations;
- Spoil management;
- Supply, transport and use of explosives, including blasting impact assessments;
- Review of requirements for temporary supports.

Drawings shall be prepared to demonstrate the proposals in sufficient detail to inform the cost estimate and preliminary programme.

A preliminary risk register for tunnel design and construction shall be included with the study.

1.5.4.7 Motorway Facilities

The location for the service areas, rest areas and motorway maintenance centres proposed as part of the existing Feasibility Study Volume 2.4, shall be reviewed in conjunction with the relevant interface with other works (e.g. interface with tunnels, structures or retaining walls) but also with the locations of the existing facilities on the adjoining motorway sections. The spacing between rest and or service areas, as well as, the minimum level of facilities to be provided within these areas, is detailed within the following piece of legislation:

- Ministry of Transport (MoT) order number 1506/2005 which modifies the MoT order number 2264/2004, titled Technical specifications for the design of parking, rest and services areas situated on public roads within rural areas.

This MoT order explains that the recommended distance between successive parking and or rest areas is between 15km to 25km. The order also clarifies that the selection of preferred location for such services should take account of:

- Terrain constraints;
- Horizontal and vertical geometry of the mainline;
- Enhancement of tourist attraction landmarks;
- Minimisation of environmental impacts including impacts on monuments or other listed buildings;
- Provisions for adequate visibility.

The three maintenance centres proposed as part of the existing Feasibility Study are located at a spacing of approximate 18 km and 28 km respectively, in order to provide easy access for maintenance and adequate coverage for the entire route.

Given the very difficult terrain traversed by the route and the complexity of proposed structures and tunnels it is considered that the proposal currently outlined within the 2008 Feasibility Study for the positioning of the maintenance centres would provide the opportunity for an enhanced and prompt response in case of accidents and or road blockages. The Consultant shall complete a detailed analysis on the constraints, as well as, advantages and disadvantages relating to the location of the three maintenance centres and propose alternative options.

All parking areas, rest areas, services areas and maintenance centres shall be provided with public lighting. The public lighting shall be provided from the start of diverge taper to the end of the merge taper.

The Consultant shall be responsible for the proposals and the design of all buildings and other equipments to be included within the parking, rest, service areas and the maintenance and coordination centres. The outline proposals for the buildings, including the importance category, footprint area, height regime, protection to fire, requirements for foundations, the resistance class, proposed internal and external finishes, shall be submitted by the Consultant.

1.5.4.8 General Cost Estimates

The cost estimates known in Romanian as *Deviz General* for the Sibiu–Pitesti motorway project shall be developed in accordance with the requirements of the Governmental Decision No. HG 28/2008. The Consultant shall prepare one general cost estimate for the entire project and a sub-cost estimate for each main category of works known in Romanian as *Deviz pe Obiect*. Both the *Deviz General* and *Deviz pe Obiect* shall cover the entire length of the Sibiu–Pitesti motorway.

In addition to the above, the Consultant shall prepare individual *Deviz General* and *Deviz pe Obiect* for each of the main five subsections of the motorway and for the DN73C should the rehabilitation of the national road be progressed within the scope of the new Feasibility Study.

The Consultant shall complete this task employing reasonable professional skills and care to a level expected for a project of this scale and importance.

1.5.4.9 Traffic Study

Introduction

The objectives of the traffic study are as follows:

- Assess the current traffic situation in the corridor;
- Assess the future traffic situation in the corridor without the project road;
- Assess the future traffic situation in the corridor with the project road under different scenarios, including alternative alignments;
- Provide inputs into the economic appraisal of the project road;
- Provide inputs into the environmental appraisal of the project road;

- Provide inputs into the operational assessment and final design of the project road.

The new traffic study shall be made available for review by the RNCMNR and JASPERS and the Consultant shall be required to update all relevant documents incorporating the comments received.

The study will require the following steps:

- Data collection;
- Development of a base year traffic model;
- Forecasts of future year traffic demand in the corridor;
- Development of future year models;
- Development of base case forecasts;
- Testing of alternative scenarios;
- Reporting and provision of traffic data/forecasts to other disciplines.

The study outputs will include:

- Inception Report
- Traffic model;
- Final Report;
- Traffic forecasts for several scenarios;
- Traffic inputs to:
  - Economic appraisal;
  - Environmental appraisal;
  - Operational assessment;
  - Final design.

Methodology

Data collection

The Consultant will be provided with and shall make use of the national traffic survey data collected by CESTRIN in 2010. This includes at least three roadside origin-destination surveys carried out in the corridor, travel time surveys and traffic counts.

The Consultant may also be provided with origin-destination data collected in the vicinity of Sibiu in 2012, as part of the development of the national transport model. Data will also be made available from CESTRIN permanent count stations in the corridor, of which there are at least four sites.

The Consultant will review the existing information made available, and make recommendations as to the necessity, or otherwise, for further traffic surveys in the corridor. As a minimum it is expected that the Consultant will undertake the following surveys (all to be undertaken in a Neutral month):

- Automatic Traffic Counts (ATC) at 3-4 key locations (7-day duration);
- Manual classified counts (MCC) at the same locations (1-day duration);
- Travel time surveys on key routes in the corridor (DN7, DN7C) (at least 3 observations per route in each direction).

These surveys will be used to verify the existing data, fill in any gaps which may exist, and to update the traffic model to a new base year of 2013. The data collection strategy is to be detailed in the Inception report for the traffic study and is to be agreed with the client in advance.

The Consultant may use vehicle tracking travel time data if it is available and if this is the case, a minimum number of "traditional" travel time surveys should be carried out to verify the data. The consultant will ensure that the travel time surveys are carried out during times that are compatible with modelled time periods.

At this stage, is it is considered that the origin-destination survey data collected in 2010 and 2012, will be sufficient for the purposes of this project. The Consultant will therefore be expected to present a convincing argument to justify any further origin-destination surveys.

The final survey programme will be agreed with the client at the time of the inception report.

Base year traffic model development

Overview

The Consultant will develop a traffic model for the project road corridor. The national transport model (developed in 2012/13) will be made available to the Consultant, in full, or cordoned sub-model networks and matrices from the model will be provided to the Consultant. These will form the basis of the corridor traffic model, with further enhancements and refinement made in the local area, as deemed necessary by the Consultant and agreed with the client. The model will be a roads assignment model only; mode-split analysis will not be required.

The national model was developed using the EMME software. The Consultant may suggest the use of an alternative modelling package if so desired. The modelling package used, however, must be an internationally recognised strategic modelling package (e.g. CUBE, VISUM) and the use of such an alternative package must be agreed with the Client in advance. The model network will be link-based only; there is no requirement to simulate junctions in detail.

The Consultant will be supplied with:

- Base Year & Future Year Networks;
- Base Year & Future Year Trip Matrices;
- Volume-Delay Functions;
- Traffic Assignment Routines;
- Model Operation Instructions.

Study area, zone system and model network

If a cordoned model is provided in place of the entire National Transport Model the Consultant will recommend the extent of the sub-model cordon required from the national transport model. Network and zone definition beyond the immediate project road study area, should be detailed enough to allow the analysis of strategic route choice decisions (e.g. Cluj to Bucharest via either the A1 or A3 corridors). The adopted network and zone system should also allow the analysis and presentation of corridor traffic by geographic category, i.e. international, national, regional or local.

Within the immediate project road study area, the model zone system and network should be at least as detailed as the national model. The Consultant will review the zone system in the project road corridor and recommend where zones need to be aggregated (if any) and disaggregated. The zone system should be detailed enough to reflect local traffic patterns, especially with respect to the analysis of optimal locations for project road access points. As a general rule, settlements in the corridor with 5,000 inhabitants or more should have their own dedicated zone. Separate zones may also be specified to represent any major development sites identified in the corridor – development sites that may in the future generate significant volumes of traffic on the project road.

Similarly, the Consultant shall recommend any necessary refinements to the model network within the immediate project road study area. Further network definition will be required to represent local roads in the corridor, especially where they provide access to newly defined zones, and potential project road access points.

Time periods, vehicles types and trip purposes

Given the inter-urban nature of the project, only a single model time period will be required, representing annual average daily traffic (AADT) or an average hour within an average day. It is preferable that the time period modelled, is identical to that used in the national transport highway assignment model. In the case of a daily traffic model being used, the volume-delay functions shall be adjusted accordingly. Peak hour volumes for dimensioning of junctions will be derived from typical hourly profile data.

Different vehicle classes should be represented by different user classes within the traffic model. These should match the classification system used in the national traffic model, namely cars, light goods vehicles (LGV) and heavy goods vehicles (HGV).

The car user class should also be broken into further sub-classes based on journey purpose. These should match the classification system used in the national traffic model (employers business, home-based work, home-based vacation and home based other). There is no need to disaggregate the goods vehicle trip matrices any further.

Route-choice parameters

As a default position, the traffic model should use the route-choice parameters (values-of-time, vehicle operating costs, volume-delay functions, motorway bonus etc.,) used in the national traffic model. The Consultant shall review these parameters and recommend any changes required to reflect local conditions (as a result of the model calibration process, for example).

Similarly, accident rate information should be applied to each model network link. As a default position, the traffic model should use the accident rate information used in the national traffic model network. The Consultant shall review local accident data and update the model network attributes, as appropriate.

Model calibration and validation

The base year model will be calibrated such that there is a good level of agreement between modelled and observed traffic flows on links, travel times on key routes in the corridor and observed trip patterns. For link flow validation, the validation measures which should be used are:

- the absolute and percentage differences between modelled flows and counts; and
- the GEH statistic, which is a form of the Chi-squared statistic that incorporates both relative and absolute errors, and is defined as follows:

$$GEH = \sqrt{\frac{2(M-C)^2}{M+C}}$$

where:

GEH is the GEH statistic;

M is the modelled (hourly) flow; and

C is the observed (hourly) flow.

Link flows that meet either criterion should be regarded as satisfactory. The validation criteria and acceptability guidelines for link flows are defined in the table below. The comparison should be made for light vehicles (cars and vans) and heavy vehicles separately.

Criteria	Description	Acceptability
1	Total screenline flows within 5% of counts	All screenlines
2	Individual flows within 100 veh/h of counts for flows less than 700 veh/h	> 85% of cases
	Individual flows within 15% of counts for flows from 700 to 2,700 veh/h	> 85% of cases
	Individual flows within 400 veh/h of counts for flows more than 2,700 veh/h	> 85% of cases
3	GEH < 5 for individual flows	> 85% of cases

For journey time validation, the measure which should be used is the percentage difference between modelled and observed journey times, subject to an absolute maximum difference. The validation criterion and acceptability guideline for journey times are defined in the table below.

Criteria	Description	Acceptability
1	Modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher)	> 85% of cases

If possible, the comparison should be made for light vehicles (cars and vans) and heavy vehicles separately, if travel time data is available for these different vehicle types (e.g. from vehicle tracking data sources).

With regards to trip patterns, the Consultant shall provide tabular and graphical comparisons of modelled and observed (i.e. from the roadside origin-destination surveys) trip patterns to demonstrate the reasonableness of the model trip matrices. Tabular and graphical representations of traffic demand in the corridor shall also be provided, showing the level of international, national, regional and local traffic in the corridor.

Future year demand

The Consultant will be provided with future year trip matrices from the national transport model, or cordoned sub-model trip matrices. These will be derived from certain future year scenarios with regard to socio-economic development and transport network developments. The Consultant will discuss and agree the national model future year scenarios to be adopted with the Client. It is not the intention of this study to model the impacts of any future mode shift due to improvement to the rail network, for example. The future year models will be motorway assignment models only. Any future changes in motorway demand, as a result of mode shift, will be incorporated in the future year matrices extracted from the relevant scenario of the national transport model.

As a default position, the national model future year matrices, described above, will be used directly to represent future year demand in the corridor; or the growth rates implied in those future year matrices will be applied to the revised base year corridor model trip matrices to derive future year matrices. This recognises the fact that:

1. The zone system in the corridor may be more refined than the national model system;

2. The corridor model will have a more recent base year;

3. The horizon years will not necessarily match those of the national traffic model;

4. The base year corridor model trip matrices may be have been modified as a result of the local calibration process.

The Consultant will, however, review the future year trip matrices provided and the implied traffic growth rates against historic traffic growth in the corridor and changes to socio-economic indicators at the national, regional and local level. These indicators shall include, but will not be limited to:

- GDP;
- Population;
- Employment;
- Income;
- Car Ownership;
- Fuel Prices.

Following this review, the Consultant will recommend any proposed changes to the assumed traffic growth rates in the corridor, making use of the latest information available with regards to forecasted changes in national, regional and local socio-economic indicators.

As part of this exercise, the Consultant will review local land-use and developments plans (if available), including plans for any major development sites in the corridor, which may generate significant volumes of traffic. Any changes to the future year growth rates derived from the national transport model will need to be justified and agreed with the Client.

Since the national traffic model horizon years stretch only as far as 2030, the Consultant will be required to recommend a forecasting methodology for developing the final model year trip matrices (PROY + 40) which will be some time after 2030. The methodology and assumptions shall be agreed with the Client.

As another part of the demand forecasting process, the Consultant shall review and comment upon the level of induced (generated) traffic contained within future year trip matrices derived from the future year national model trip matrices, as a result of the opening of the project road itself and other motorway network developments. The Consultant shall provide comparisons of the assumed level of induced traffic with estimates provided by alternative methods of estimation, such as, simple elasticity approaches (change in demand to change in travel time).

Future year models

Model years

As a minimum, it is envisaged that future year models will be developed for the following years:

- 2015 (compatible with national model);
- Project Road Opening Year (PROY);
- 2020 (compatible with national model);
- 2030 (compatible with national model);
- PROY +40 years.

Additional model years may be required, depending on the likely opening schedule of the project road (whether it is phased or not) and the likely opening schedule of any new major feeder/competitor roads. The final number and selection of future year model years shall be discussed and agreed with the Client.

Future year networks

The highways schemes to be included in the future year base case networks shall be discussed and agreed upon with the Client and will be compatible with those used in the national model to derive the future year trip matrices. Two initial scenarios will be developed, namely:

- Without Project;
- With Project (Base Case).

The modelled characteristics of the project road (design speed, capacity etc.,) will reflect those of the preliminary design. A number of alternative (demand and supply) cases will also be modelled.

Route choice parameters

As a default position, the traffic model shall use the route-choice parameters (values-of-time, vehicle operating costs, volume-delay functions, motorway bonus etc.,) used in the national traffic model. The Consultant shall review these parameters for the study area, and recommend any changes required to reflect local conditions (as a result of the model calibration process, for example). The Consultant will also review and recommend any changes (if necessary) to the methodology for changing the value of parameters over time.

Similarly accident rate information should be applied to each model network link. As a default position, the traffic model should use the accident rate information used in the national traffic model network. The Consultant shall review local accident data and update the model network, as appropriate.

Forecasts

The Consultant will produce traffic forecasts for each year, for a period of 40 years after project road opening. Forecasts for years other than those explicitly modelled will be derived through interpolation. The Consultant shall recommend the appropriate interpolation methodology (straight-line or other), including assumptions regarding traffic ramp-up in the early years after project road opening.

The Consultant shall provide forecasts for the following initial scenarios:

- Without Project
- With Project (Base Case).

The Consultant will provide the results in tabular format, showing traffic volumes on links (project road and existing network) by vehicle class. Information shall also be provided on projected total network vehicle kilometres, total network vehicle hours, total accidents and travel times for key journeys in the corridor for the with and without project scenarios. In addition to tabular summaries, information shall also be provided in appropriate graphical formats (link flow plots, flow change plots etc) to aid understanding the results.

In addition to the two initial scenarios, the Consultant will be required to test alternative scenarios. These are discussed in the following sections. The forecasting assumptions associated with all scenarios shall be discussed and agreed with the Client.

Low and high growth scenarios

These will represent scenarios with lower and higher traffic growth assumptions:

Alternative project road alignment scenarios

The Consultant will be required to test a minimum of 4 alternative project road alignment (and link road) options. It is likely that these will be limited to testing alternative strategies for improving access to Ramnicu Valcea and the resulting impact on project road traffic volumes and economics.

Alternative access points

Similarly the Consultant may be asked to assess alternative access point arrangements (number and location) and report the resulting impact on project road traffic volumes and economics.

Tolling scenarios

The Consultant will be required to test scenarios in which the project road is tolled. These will only be preliminary investigations (more detailed analysis may be required at a later stage, if tolling is confirmed) and therefore it is proposed that only a scenario with a distance-based tolling regime is tested at various toll levels.

Network Development Scenarios

The Consultant may be required to test a limited number of alternative scenarios with respect to the timing of the development of the national motorway network. For example, the A3 motorway acts as a competing route to the A1 for trips between Cluj and Bucharest. The assumed opening schedule of the various sections of the A1 and A3 will govern which of the two routes is most advantageous for long-distance traffic and will therefore have an impact on project road traffic volumes.

Report and deliverables

The key project deliverables will include the following:

Traffic report

The final traffic report will include a detailed description of the methodology adopted for each stage of the study, making maximum use of tables and graphical representations, as appropriate. The report shall include the traffic forecasts for the various scenarios tested. The forecasting assumptions in each scenario will be clearly tabulated. As a minimum the report shall include the following chapters:

- Introduction;
- Data Collection;
- Base Year Model Development and Validation;
- Demand Forecasting;
- Future Year Model Development;
- Base Case Traffic Forecasts;
- Scenario & Sensitivity Testing.

If appropriate (to be discussed and agreed with the Client), the Consultant may provide intermediate reports covering data collection, base year model development and validation, and traffic forecasts.

Traffic model

At the end of the study, electronic copies of the traffic model files will be delivered to the Client, along with written instructions for operation of the model. These should be of sufficient detail to allow other consultants (familiar with the adopted software package) to operate the model and replicate model results.

Traffic Inputs to other feasibility study disciplines

Traffic information shall be supplied to other disciplines in the Feasibility Study, with the format and level of detail required by those disciplines. These will include traffic inputs into the:

- Economic appraisal;

- Environmental appraisal;
- Operational assessment;
- Final design.

A copy of the 2010 Traffic Census Data and Origin-Destination Surveys will be made available by the RNCMNR to the successful Consultant, free of charge.

1.5.4.10 Cost Benefit Analysis

Introduction

The purpose of this document is to present text that shall form the basis of the Cost-Benefit Analysis (CBA) sections of the Terms of Reference for the study of the Sibiu-Pitesti Motorway, which includes option identification, option selection and single option development to preliminary design.

The Terms of Reference have been developed on the basis that a range of options for transport between Sibiu and Pitesti will be sifted using MCA (without CBA), resulting in a short-list of options for further consideration and development. The short-list of options will then be subject to a refined MCA (including a CBA - economic analysis only), which will lead to the selection of a single option preliminary design. A full CBA (including financial analysis, economic analysis and a sensitivity and risk analysis) will be undertaken for the single option.

The new CBA shall be made available for review by the RNCMNR and by JASPERS and the Consultant shall be required to update all the relevant documents incorporating the comments received.

Cost benefit analysis

A cost-benefit analysis (CBA) comprising an economic analysis, shall be undertaken for each of the identified options. A further CBA comprising a financial analysis, an economic analysis and a sensitivity and risk analysis, shall be undertaken for the single option preliminary design.

The Consultant shall submit draft versions of all CBA deliverables to the MTI, RNCMNR and JASPERS, and shall be responsible for updating all documents based on the comments received.

CBA's shall be undertaken in line with EU and national guidelines relevant at the time of the study which may include, but are not limited to the following (and their respective updates if applicable):

- **New Programming Period** 2007-2013, Guidance on the Methodology for Carrying Out Cost-Benefit Analysis prepared by the Directorate General Regional Policy, European Commission (2006);
- **Guide to Cost Benefit Analysis of Investment Projects** prepared by the Directorate General Regional Policy, European Commission (July 2008);

- **Guidelines for Cost Benefit Analysis of Transport Projects to be supported by the Cohesion Fund and the European Regional Development Fund in 2007 – 2013** prepared under the co-ordination of Authority for the Co-ordination of Structural Instruments with JASPERS assistance (December 2008);

- **National Transport Master Plan.**

Whilst the CBA for the identified options is likely to be undertaken in accordance with current guidance, the Consultant should note that the CBA for the single option preliminary design may have to be appraised in line with the requirements set out in forthcoming regulations for the next programming period.

In the event of contradictory information between the available guidance, the Consultant shall seek clarification from the Client.

As part of the reporting process, the Consultant shall set out details of the investment options considered and the basis of the CBA, including assumptions made and parameter values used. The Consultant shall be responsible for ensuring that assumptions and parameters are appropriate and can be justified.

The Consultant shall provide sufficient details of the calculations undertaken to allow them to be verified by the Client. Where a calculation tool has been used, such as a spreadsheet, the Consultant shall provide both a hardcopy and electronic copy of the calculations, suitably annotated with comments and explanations.

The Consultant shall ensure that the Cost Benefit Analysis and Financing Plan information required for an application for assistance under articles 39 to 41 of Regulation (EC) No 1083/2006 (or equivalent as is relevant at the time of the study) is reported as part of the CBA.

Financial analysis

The Consultant shall assess the financial performance of the investment option as part of the CBA for the single option preliminary design, in line with relevant guidance at the time of the study. If the project is to be split into lots, with each lot progressing at different stages, the Financial Analysis shall be undertaken at Lot level, which can then be aggregated to fit the project being applied for.

The financial analysis shall be undertaken from the perspective of the Romanian National Company of Motorways and National Roads (RNCMNR).

As part of the financial analysis, the Consultant shall present a table on the financial sustainability of the project.

Economic analysis

The Consultant shall undertake an economic analysis as part of the CBA's, in line with relevant guidance at the time of the study, to establish the expected benefits of the investment options and whether these outweigh the expected costs, and to what extent.

The Economic Analysis is to be undertaken at two different stages:

Stage 1) at Phase 2 of the options analysis stage, where a consideration of the economic costs and benefits is undertaken for all options and used in the selection of the preferred alternative, and

Stage 2) after the completion of the preliminary design and prior to completion of the EC Application Form, the CBA for the preferred option should be revised based on the final alignment, design and cost estimate. The economic justification of the project shall be based on the results of the CBA for the entire corridor.

As part of the economic analysis, the Consultant shall take account of the following scenarios:

- A minimum investment scenario – including a minimum amount of investment costs for improvements to achieve minimum compliance with safety standards and a realistic level of maintenance costs to avoid or delay serious deterioration
- Maximum investment scenarios – the implementation of full investment options to achieve the intended objectives.

The Consultant shall liaise with the Client to confirm the committed infrastructure projects and development trips that are to be considered within the economic analysis.

The Consultant shall ensure that the full impact of the investment options on the transport infrastructure is taken into account within the economic analysis.

The Consultant shall ensure that the approach adopted for the economic analysis is suitable, taking cognisance of variable trip methodologies where appropriate.

The Consultant shall ensure that investment options considered as part of the economic analysis are compatible with those options analysed within the environmental impact assessment. Any costs for mitigation and compensatory measures highlighted within the environmental impact assessment should be incorporated within the economic analysis.

The forecast years used in the economic analysis shall correlate with the information generated by the traffic study.

The Consultant shall annualise the costs and benefits associated with the modelled time periods used in the traffic study, to provide a reasonable estimate of the economic impact of investment options for each year of the appraisal period.

As part of the economic analysis, the Consultant shall estimate the impact of investment options, expressing the following in monetary terms:

- Travel time;
- Vehicle operating;
- Accidents;
- Air pollution;
- Climate change;

- Noise pollution.

The Consultant shall consider the following (including anticipated spend profiles) for investment options within the economic analysis:

- Capital investment costs – including construction, land and management costs;
- Maintenance and operation costs;
- Residual value.

The Consultant shall present the results of the economic analysis using the key economic indicators:

- Economic Net Present Value (ENPV);
- Costs/Benefit Ratio (BCR);
- Economic Internal Rate of Return (EIRR).

Where the Client has provided guidance and appropriate tools for undertaking the economic analysis, the Consultant shall use these to assess the costs and benefits of investment options.

Should the results of the economic analysis be marginal in terms of value for money, an Economic Impact Analysis may be required to complement the CBA by assessing the wider economic impact of investment options.

Sensitivity and Risk Analysis

The Consultant shall undertake a sensitivity and risk analysis as part of the CBA for the single option preliminary design, in line with relevant guidance at the time of the study, to assess the uncertainty surrounding the implementation of the considered investment option.

The following key steps shall be undertaken, and reported on, as part of the sensitivity and risk analysis:

- Sensitivity testing / identification of critical variables;
- Scenario analysis;
- Calculation of switching values;
- Monte Carlo analysis.

A Monte Carlo analysis shall be carried out on those parameters identified as being critical as part of the sensitivity testing.

1.5.4.11 Multi-criteria Analysis

The Terms of Reference have been developed on the basis that a range of options for transport between Sibiu and Pitesti will be sifted using MCA (without CBA), resulting in a short-list of options for further consideration and development. The short-list of options will then be subject to a refined MCA (including a CBA with economic analysis only), which will lead to the selection of a single option preliminary design.

The new MCA shall be made available for review by the RNCMNR and JASPERS with the Consultant required to update all the relevant documents incorporating the comments received. An initial multi-criteria analysis (MCA) shall be undertaken on a range of options for transport between Sibiu and Pitesti considering technical, environmental, economic, financial, social and political factors – to be agreed with the Client. This shall lead to a short-list of options for further consideration and development.

The Consultant shall carry out a qualitative assessment for each of the factors considered in the initial multi-criteria analysis, drawing on the assessments and analysis undertaken as part of the study.

A refined MCA shall be undertaken on the short-listed options, which will lead to the selection of a single option. The Consultant shall agree the criteria to be considered in the refined multi-criteria analysis with the Client.

The Consultant shall carry out a qualitative and quantitative assessment (where possible) for each of the criteria considered in the refined MCA, drawing on the assessments and analysis undertaken as part of the study.

The weighting to be assigned to each of the factors or criteria considered in the multi-criteria analyses, shall be agreed with the Client.

The Consultant shall score each investment option against the factors or criteria considered using a 7 point scale from -3 to +3 (or as agreed with the Client). For each investment option, the scores against each criterion shall be multiplied by their respective weighting, and summed to establish the total impact of the option.

As part of the multi-criteria analyses, the Consultant shall describe to what extent each investment option is expected to meet the project objectives and shall take into account, and comment upon, the 'implementability' of the investment options, giving due consideration to the following:

- How straightforward the option will be to implement;
- Whether there are innovative techniques involved and what the associated risks are;
- Whether there are any factors which could result in major operational costs over the option's life;
- Whether the capital cost of the option can be funded and whether the on-going operating or maintenance costs can be met;

- How acceptable the option is to the public and to stakeholders.

The tasks that the Consultant shall complete as part of the CBA, MCA and Traffic Study are outlined in the summary table below:

Stage / Task type	Stage 1 analysis of wide range of options	Stage 2 analysis of shortlisted	Stage 3 analysis of final route
	-Outline traffic assessment -Route constraints -Multi criteria analysis	- Detailed traffic assessment - Multi criteria assessment -Economic analysis	-Detailed traffic assessment -Economic analysis - Financial analysis -Sensitivity and risk analysis

1.5.4.12 Environmental Impact Assessment and Appropriate Assessment

1.5.4.12.1 Environmental Impact Assessment and Environmental Decision

The terms of reference (ToR) presented in this section intend to define the main requirements that must be taken into account for the update of the EIA, in compliance with the revised Feasibility Study, observing the requirements of Ordinance no. 863/2002 and of the Sector Specific Guide for EIA (Construction projects for highways and roads) created by JASPERS.

Taking into account the complexity of the proposed project (the construction of seven tunnels, with a cumulated length of approximately 7500 m, more than 100 structures representing around 27% of the total length of the route) and also the difficult land conditions (the vicinity of the water courses Olt, Topolog, and Arges, and the crossing of nine protected areas), the Consultant must make sure that the final report includes sufficiently detailed information so that members of the public and the competent environment authorities can understand the dimension, the objectives and the particularities of the project. Special attention shall be given to the impact on the population, to the biodiversity elements and to the watercourses crossed by the final route of the motorway, assessing the effects of the project implementation on these environmental factors.

The terms of reference (ToR) shall be correlated with the Gap Analysis Report, dated June 2013, regarding the environmental impact assessment covering both the strong points and weak points of the existing EIA Report and shall include those documents previously identified as part of the environmental procedure.

The Consultant is responsible for the development of the procedure(s) of environmental impact assessment, according to the legal requirements in force, under the guidance of the competent environmental protection authorities. Moreover, the Consultant is bound to expand any and all speciality studies required by the competent environmental protection authorities, including the expansion of the Appropriate Assessment Study. The requests for the completion/modification of the studies made by the administrators/custodians of the protected areas shall be included in the Appropriate Assessment Study.

Taking into account the issues mentioned above, the following elements shall be considered as part of the update of the EIA Report:

a) The purpose of the environmental impact assessment

The legal framework and procedures imposed by national and European regulations must be adhered to;

To identify the activities with the potential for significant environmental impact, to predict the assessment of the environmental impact, taking into consideration the existing alternatives and the means used to reduce them through impact management.

b) Information detailing

The Consultant must make sure that the EIA Report includes complete information regarding all activities involved in the performance of the project, including the construction of roads, service areas, maintenance centres, site organisations, areas to be deforested, quarries to be opened to obtain raw materials, production bases, concrete and asphalt mixture stations, respectively, etc.;

The Environmental Impact Assessment must not be delayed for any of the project components citing reasons, such as, the determination of the locations for the site organisations. All available locations shall be assessed as any other component of the project, and in the EIA Report they must be described and the preferred solution presented.

A. Requirements regarding the revision of the EIA Report

The EIA Report shall include, at least, the following requirements:

1. General requirements on the EIA Report

The EIA Report shall analyse the revised version of the Feasibility Study, which shall include the Vestem-Sibiu section, as well as the proposed alternatives.

The Biodiversity chapter must be completed with the summary/final conclusions of the Appropriate Assessment Study.

The report shall also include a chapter regarding the interactions between the various forms of impact and the relations between the effects identified on the various categories of impact. It is recommended that this synthesis should be presented under the form of a table, so that it may provide an assembly image of the effects on each environmental factor corresponding to each project development stage. This approach must be differentiated for the different sections of the route depending on the areas neighbouring each section (e.g. protected area, residential area, watercourse, etc.).

The methods used for the assessment of the level and or amounts of pollutants and how they will be dealt with to comply with local regulations, shall be described and presented.

The final version of the report must be revised from the point of view of the references to the legislative acts, so that references are made to legislative acts in force at the date when the report is finalised.

The Consultant must include information regarding the considered alternatives and the selection of the preferred solution compared to the alternatives included in the feasibility study.

The analysis and the presentation of the various investigated alternatives must comprise descriptions of:

- The routes, alternative corridors and positions of the various road infrastructure elements (e.g. tunnels, aqueducts, viaducts, road intersections, etc.);
- Different design solutions considered;
- Different technology approaches where applicable.

The Consultant shall present in a special subchapter, a summary of the analysis used to compare the different solutions/alternatives technically identified for the selection of the preferred solution.

A detailed presentation of the initial conditions (water, air, soil, biodiversity, population, etc.,) is necessary so that the performance of the impact assessment and of the estimates regarding the effects on the environmental factors may be compared within a framework, which would be as specific as possible.

For the appropriate determination of the initial conditions in the area of the future highway, the execution of studies (chemical analyses) is necessary for the quality of surface and sub-surface water and soil conditions. In addition, a full air quality and noise assessment shall be carried out. This will ensure that the areas sensitive from the point of view of pollution prior to the project implementation may be identified, and the conclusions of these studies shall provide useful information for the analysis of the cumulated impact of the project.

The report shall appropriately define the locations and period for monitoring the environmental factors, surface and subsurface water, soil, noise and vibrations, both during the construction period and during the operation period.

The impact on the environmental factors shall include specific references to the sensitive areas (e.g. residential areas, protected areas, etc.) and an approach based on sections of the envisaged route is necessary for a full assessment of the possible impacts. Moreover, the assessment of the impacts shall be characterised depending on the stages of project implementation:

- the construction period;
- the operation period.

The prevention/reduction/compensation measures corresponding to each type of effect must have a particular feature corresponding to the effects of the forecasted specific impact. Thus, there must be presented features, including but not limited to, the exact location along the route, the elements that must be protected, estimates of the reduction in impact, etc., for each mentioned measure to mitigate the impact. The specified prevention/reduction /compensation measures must be identifiable in the material estimate of the project.

The specific/local impact (water, air, soil, biodiversity, etc.,) of proposed site organisations, temporary trenches, etc., and the specific diminution measures for the environmental impact, shall be taken into account for each location.

Moreover, the impact and mitigation measures for generated transport, including transport of construction materials from source to the required location of the site organisation, must be included.

The report shall be completed with information relating to the number of persons affected by demolitions, the impact on the population due to expropriations/relocations and their mitigation measures, estimates of the number of created workplaces and the number of workplaces to be lost after the project implementation.

2. Requirements specific to each chapter

i. Requirements for Chapter General Information and Chapter Technological Processes

The Consultant is required to prepare a general description of the road route designed, with reference to maps / charts on which the area studied shall be clearly identified. The project description must be prepared for each sector / section and for each structural component. Tabular formats are recommended to be used whenever possible for the best possible summarising of the information presented, thereby facilitating easy review from the competent authorities.

Special attention should be paid to the number and location of the proposed site organisations. A description of the best locations identified for setting up the site organisations will be included, indicating areas where their location is not possible and providing justification.

Description of the general characteristics of the project must include the following as a minimum:

- The main structural components of the road (the road itself, connections and intersections with other roads, tunnels, viaducts, bridges, over / under-crossing of roads, railway overpasses, etc.);
- Facilities for safety of the population and environmental protection (protective road guards, fencing/safety nets, shelter belts, snow fences, bio-corridors/passages for animals, noise barriers);
- Facilities for operation of the road (maintenance centres, parking lots, service areas) and details of the specific activities required for operation of the motorway (e.g. maintenance and repair works);
- Relocation / modification / protection of the civil engineering works (public utility networks such as telecommunication cables, over or underground electricity transmission lines, gas or water pipelines, etc.);
- Deviations / reconstruction of roads of different categories;

- Displacement / Demolition / Restoration / Protection of public or private buildings;
- Slope construction, embankments, drainage, regulations or other changes of the surface water bodies (works for riverbed recalibration, hydro-technical arrangements to the culverts, arrangement of torrents) and any interventions on groundwater aquifers;
- Information on the locations for drainage of rainwater from the road structures;
- Restoring the vegetation and roadside landscaping;
- Changes in the route of railways (including service buildings);
- Off-site arrangements (transport, energy and utilities infrastructure) determined directly or indirectly by investment operation.

For each of the above characteristics, data identification shall be provided (e.g. names of localities, rivers, valleys, bridges, railway stations, etc.) and other relevant particulars such as the number, length, exact location (e.g. distance, kilometre of motorway, etc.) and the technical characteristics of each installation / object / work.

For each structural component, the following shall be presented:

- The techniques / methods of construction adopted, including the nature of the construction works (excavations, fillings, etc.) and the size range of the equipment that will be used;
- The areas occupied permanently and temporarily on categories of land (forest, agricultural, industrial, commercial, residential, recreational lands, protected areas);
- The quantities of materials excavated and or necessary for fill;
- The method of removing the excess material, types and quantities of materials to be removed from the site;
- Other resources / quantities of materials needed (construction aggregates and minerals, water, energy including electricity and fuels, wood material, etc.) and the source of supply, the number of shipments / time intervals for supply, the methods of handling, etc.;
- The total resources required;
- Information on the effective use of the raw materials.

The report shall include updated estimates of the number of vehicles used during the construction (relative to the emissions of pollutants into the atmosphere), as well as, of the number of vehicles during operation.

The distances (in metres) between the proposed alignments and the sensitive areas (residential areas, natural areas, Natura 2000 sites, water courses), as well as, the exact areas affected within the protected areas shall be included.

Descriptions of the main technological processes shall be prepared for the two periods of the project implementation and shall include:

- Construction period:
  - Site preparation works: removal of vegetation from the existing land (referring to the areas included in the Natura 2000 sites), topsoil removal (excavation to reach the foundation height and preparing the ground for construction), demolition works, relocation of the utilities networks, excavations / detonation / fillings (the estimated volume shall be indicated), closing, diverting or restricting the transport routes or existing routes of infrastructure, catchments or transfer of water from underground or surface sources, temporary/permanent diversions of the watercourses, etc;
  - The number of persons / workers required during the construction, including arrangements for transportation / accommodation of persons or equipment / machinery, goods or materials required;
  - The use of potentially toxic substances or materials, or which pose risks to human health or the environment (flora, fauna, water supplies), type, quantity, purpose, methods of handling, storage, protection measures, etc.;
  - Site organisations and production bases, indicating the proposed locations, the area occupied temporarily, structures and installations which will be erected / assembled on-site, (domestic and technological) water supply arrangements, liquid effluent treatment plants, etc.
- Operating period:
  - Predicted proportions of heavy goods vehicles and public and private transport;
  - Planned routine maintenance programs, including those of planting and maintenance of the systems for collection and evacuation of waters drained from the carriageway, emergency response measures provided, antifreeze / non-slip materials to be used in the winter, etc.;
  - Lighting;
  - Drainage.

The tables presented in this chapter which show a summary of the potential impact, nature and extent of the environmental impact estimated for the period of operation of the motorway, must also identify the negative environmental impact.

ii. Requirements for the chapter on Noise and Vibrations

The information presented regarding the noise and vibrations must be structured for project implementation stages and shall include details concerning:

- Construction period:
  - Circulation of motorised vehicles, traffic and activity of construction equipment;
  - Vibrations generated in the construction phase from activities such as detonation, excavation, extraction of rocks, foundation of various structures, planting of pillars, heavy traffic and especially on uneven surfaces.
- Operating period:
  - Road noise generated by the motorised traffic;
  - Maintenance and repair works.

The Consultant shall include details of the positive impact of the project (e.g. positive impact due to traffic diversion from residential areas).

The Consultant shall include measures for mitigation of residual impacts during operation of the objective.

iii. Requirements for the Chapter on Waste and information on the emissions generated

The information presented regarding waste and the emissions generated, must be structured for project implementation stages and shall include details concerning:

- Construction period:
  - Waste and emissions (including the volume / quantities estimates thereof) that will be generated during construction of the works, actions, equipment, materials, climate / seasonal weather conditions, construction methods and measures for prevention / mitigation / compensation expected to be adopted or applied. The Consultant shall base the report on the anticipated waste and emissions from this project and not rely on generic statements;
  - The main types of waste that may be generated during the construction are, but will not be limited to, the following: materials resulting from excavation / detonation / dredging not used as

filling materials, fertile layer, soil or other contaminated materials (if applicable), household waste, hazardous or toxic waste, sludge from wastewater treatment plants, residues from the petroleum products separators, waste resulting from activities of construction or demolition, machinery or equipment in excess or which can no longer be used, technological waste (waste tyres, batteries, lubricants, packaging, etc.).

- Operating period:
  - Specification of the main air pollutants (CO2, NOx, SO2, particulates) resulting from the forecasted traffic analysis (structure of goods and passengers transportation);
  - Detailed description of other emissions resulting from routine activities (traffic and maintenance), as well as, from emergency response;
  - Description of the types and estimated quantities of waste resulting from operation of the motorway.

iv. Requirements for the Chapter on Environmental factor - Water

The information presented here must be structured for project implementation stages and shall include details concerning:

- Construction period:
  - Temporarily redirecting water courses, temporary disturbance of other morphological elements and or flow characteristics (velocity, level) and possible temporary influences on underground water (especially in the area of hydro-technical structures, such as, bridges, culverts, viaducts, etc.);
  - Pollution of surface waters and underground water contamination along with changing the physical, chemical and biological properties due to uncontrolled or accidental discharge of hydrocarbons, deposition of potentially contaminated particulates on the soil, transfer of polluting substances (SO2, NOX and heavy metals) through rainfall, from the atmospheric to aquatic environment, accidental spills from sewage networks, etc.
- Operating period:
  - Permanently diverting the watercourse bed, permanent change of other morphological elements and or flow characteristics (velocity, level) and possible influences on underground water;
  - Pollution of surface and underground waters due to surface water runoff from the carriageway surface;
  - Accidental, incidental and seasonal pollution of surface water and groundwater due to polluting substances resulting from road

accidents or malfunctions, incidental leakage of substances used for road maintenance, melted snow loaded with anti-freeze chemical products or sand, deposition of polluting substances from traffic (heavy metals) after rainfall events.

The chapter shall be completed with specific information on the possibility for providing the necessary volumes of water from the available sources:

- In the construction phase (industrial water);
- During the operating phase (specific activities of road maintenance and supply of service areas).

Regarding the sources of water, the Consultant shall include information on the justification of the modality to supply water (e.g. water supply from surface waters, from underground waters or from existing networks).

The sub-chapter concerning wastewater management must be completed with information on the quantities and physico-chemical characteristics of wastewater discharge (concentrations of pollutants), wastewater collection systems, the place of discharging the untreated/treated waste waters, pre-treatment and or treatment facilities, the receiver of the waste waters coming from the wastewater treatment plants or on those untreated and discharged directly.

It is necessary to determine the need for assessing the impact of the hydro-technical arrangements on surface water bodies, as well as, their cumulated impact. An assessment of the necessity for applying Article 4 (7) of the Water Framework Directive shall be conducted.

The separate and cumulative impact of the hydro-technical works for each surface water course (e.g. Olt River, Arges River, etc.) and appropriate specific measures to reduce the impact, shall also be presented.

v. Requirements for the chapter on Environmental factor - Air

The information presented here must be structured for project implementation stages and shall include details concerning:

- Construction period:
  - The particulates potentially contaminated with air pollutants resulting from excavations, transportation traffic, asphalt plants, concrete mixers, loading and unloading of raw materials, etc;
  - Emissions of air pollutants resulting from transport and motorised construction equipment (particulate emissions from diesel engines, NOX, volatile organic compounds, carbon monoxide, etc.).

- Operating period:
  - The positive effects (e.g. traffic diversion outside the built-up areas) and negative effects (due to emissions from vehicles and the dust entrained by vehicles' wheels) resulting from project implementation;
  - The impact of atmospheric pollution on the environmental factors and human health (effects on respiratory diseases including allergic reactions), vegetation (through exposure to NOX), built environment (through the increased aggressiveness of an atmosphere loaded with acid gases), etc.

vi. Requirements for the chapter on Environmental factor - Soil

The information here must be structured on project implementation stages and shall include details concerning:

- Construction period:
  - Temporary change of land use and any subsequent effects, such as, damage to the soil profile;
  - Soil degradation in the area of excavations due to exposure and topsoil removal, soil compaction, soil erosion and landslides;
  - Soil pollution and further changes in soil quality under the action of pollutants, due to spreading on the soil or infiltration of polluting substances as a result of uncontrolled or accidental discharge of hydrocarbons, deposition of particulates potentially contaminated with air pollutants on the soil, transfer of the polluting substances (heavy metals) from the atmospheric environment into the soil, through rainfall.
- Operating period:
  - Permanent changes of land use;
  - Erosion and pollution of the soil on the road route, due to storm water runoff on the road slopes;
  - Soil degradation on the route due to slope maintenance works;
  - Accidental, incidental and seasonal pollution of the soils due to spreading on the soil of polluting substances resulting from road accidents or incidental leakage of substances used for road maintenance, melted snow loaded with anti-freeze chemical products or sand;
  - Transfer of the polluting substances (heavy metals) from the atmospheric environment into the soil, through rainfall.

The chapter shall include estimates of the quantities / concentrations of pollutants (specific to construction activities and traffic generated by operation of the motorway) and especially quantities resulting from sedimentation of air pollutants (SO2, NOX and heavy metals).

Details shall be included on the surface, thickness and volume of the topsoil which is stripped during the various stages of project implementation.

vii. Requirements for the chapter on Geology - Subsoil

Special attention shall be given to the geological conditions with regard to the construction of tunnels, including specific details in the impact areas thereof.

Information must be included regarding the redistribution of the geological stress, change of massifs' stress, activation of landslides and erosion of slopes.

The chapter shall include specific details regarding the impact on the subsoil geology and impact mitigation measures. Information shall also be included relating to the direct impact on the underground – geological components, the impact of changes in the geological environment on environmental elements and on the hydro-geological conditions (e.g., after construction of tunnels).

viii. Requirements for Biodiversity chapter

Information on biodiversity must include at least the following details:

- For Fauna:
  - The irreversible disappearance of sedentary fauna or those that move slowly from the area of the new road and from all access areas, construction site areas, areas of operation of the heavy equipment used in construction and excavation, temporary storages of materials generated from excavation, etc.;
  - Disturbances due to general activities, lighting at night time, noise and vibrations that can disturb the mammals, birds and reptiles in the vicinity of the construction site areas;
  - Fragmentation of habitats with its subsequent effects;
  - Change in the aquatic and or terrestrial habitats due to effects of pollution or morphological changes and changes in water resources and their quality;
  - Behavioural changes (e.g., some species will no longer cross the open areas near the road because of the threat of predators);
  - The stress caused by increased levels of noise and vibrations on birds, bats and other small mammals, which can leave the areas close to the road.

- For Flora:
  - The irreversible disappearance of the vegetation from the area of the new road and from all the access road areas, construction sites, etc;
  - The potential partial or total destruction of the vegetation from the site of the new road through soil stripping, cutting and clearing of vegetation;
  - Indirect effects caused by deposition of particulates on the soil and plants, exposure to NOX contamination, change in the quality of soil and or underground water, changes in the groundwater level, accidental leakage of pollutants, accidental leakage of fuel, accidents that could cause damage to the trees planted on the roadside.

The information regarding Natura 2000 sites shall be completed after termination of the Appropriate Assessment procedure, incorporating the summary/conclusions from the Appropriate Assessment study.

The chapter must be completed with detailed information regarding mammals (especially large mammals) resulting from field investigations, for the entire route of the future motorway.

Information shall be included on the number and density of the populations, the degree of isolation, the age class structure, the dynamics of habitats and of the species within the protected areas affected by the project.

ix. Requirements for the Landscape chapter

Special attention shall be given to aspects regarding the landscape, particularly in the protected natural areas crossed by the proposed route.

Details shall be presented regarding effects on the physical structure and landscape aesthetics in the context of changes caused by the project implementation.

The study shall be complete with effects on the visual value of the landscape for different receptors (e.g. people who live in neighbouring settlements or future users of the road).

The impact on the landscape shall be assessed for different sections of the project in relation to the initial characteristics of the landscape and the probable presence of sensitive receptors.

x. Requirements for the chapter on Social and Economic Environment

The information on the social and economic environment shall include, but will not be limited to, the following details concerning:

- The demographic disruption in localities traversed by the future motorway;

- Disruptions, discomfort and increased risk of developing respiratory diseases for the general population and workers in the construction and operation phases due to noise, vibration and air pollution;

- Increased risk of traffic accidents relating to the improvement of conditions for high speed circulation;

- The positive effects on human health due to improved air quality and reduced pollution in residential areas where traffic shall diminish;

- The positive social effects, through improved transport conditions which can further influence the economic development of the area, new opportunities for investment and social development in the more quiet and less polluted areas of localities relieved of traffic;

- The direct effects from accidents during the construction and operation phases leading to destruction or damage to property;

- The indirect effects on individual sources of water supply (which may be affected by the changes in the level or quality of groundwater), on material resources for agricultural activities (reduction of water resources, deterioration of irrigation networks), on the built environment (damages caused by vibrations, chemical atmospheric aggressiveness, degradation of the facades due to the dust deposits).

xi. Requirements for the Chapter on Environmental Monitoring

The Consultant will be responsible for developing an Environmental Management Plan (EMP), which shall ensure compliance with the provisions and guidelines formulated by the regulatory authorities. The EMP must ensure monitoring of the environmental performances through information of the impact, upon its occurrence, and to highlight the risks that require mitigation and compensation measures.

EMP shall include at least the description of the detailed actions necessary to achieve the objective, including the modality to perform them, the persons responsible for types of actions, implementation deadlines, the resources that will be used, the monitoring / checking and the level of performance or quality target. The mechanisms through which changes in project implementation, emergency situations and unanticipated events shall be responded to and any appropriate approval processes required, shall also be provided.

The level of detail for information contained in the Environmental Management Plan shall be substantial due to the project being a complex and large-scale undertaking, with significant potential risks to the environment allied to the differences between the various stages of its implementation.

The EMP shall include distinct chapters in the Plan for monitoring the effects on environmental factors to demonstrate compliance with the legal conditions for each environmental factor and proposals for intervention where there is a case of accidental pollution.

The EMP shall provide procedures describing the means of rapid and effective intervention for minimising effects and remedying possible damage to the environment.

The Consultant shall be responsible for the content and conclusions of the EMP. The EMP shall be incorporated in the Awarding Documentation for the Works Execution Contract.

The chapter shall include specific details on the locations for sampling/observation and the frequency for monitoring the environmental factors (noise, water, air, soil and biodiversity) during construction and operation of the motorway.

xii. Requirements for Chapter Risk situations

Special attention shall be given to aspects relating to situations of risk resulting from the handling and use of substances with high risk of explosion and fire (explosives and fuels).

It is recommended to complete the chapter with a potential accident risk analysis, plans for risk situations, the method of response to accidents, as well as, a comparative summary from analysis of risk situations for each project alternative.

xiii. Requirements for the Non-Technical Summary

The summary shall be conceived in a format similar to that of the EIA Report, but condensed, i.e. describing the project, the existing environment, the (negative and positive) impacts and prevention / mitigation / compensation measures. It will use easy to understand language, avoiding scientific and technical terms, where possible.

It is recommended to also include in the summary, an overview of the evaluation process, some explanations on the process of issuing the development approval for the project and the role of EIA in this process.

1.5.4.12.2 Appropriate Assessment (AA)

1. Introduction

The Terms of Reference (ToR) presented in this section are intended to show the principal requirements to ensure updates to the feasibility study comply with the European Habitats Directive (92/43/EEC) and Birds Directive (79/409/EEC). The ToR should be read in conjunction with the preceding Gap Analysis Report, i.e. the Gap Analysis of the Sibiu-Pitesti motorway Feasibility Study Habitats Directive Assessment (HDA), dated June 2013. The key stages, in Romania, to ensure compliance with Articles 6 (3) and 6 (4) of the Habitats Directive are as follows;

- Stage A: Initial Assessment (Notification);
- Stage B: Screening;

- Stage C: Appropriate Assessment;
- Stage D1: Alternative solutions stage;
- Stage D2: Assessment where no alternative solutions exist and where adverse impacts remain.

The ToR refers to these stages in the sections below. All stages of future HDA shall incorporate the minimum ToR requirements described in these sections.

2. Consultation

Although not a requirement of Romanian legislation, as best practice, a summary description and written records of all consultation with the EPA/ Technical Approval Committee shall be provided to show that the EPA has agreed with the list of Natura 2000 sites to be included in the screening, the stages of the AA and are content with the general scope and methodology of the assessments.

3. Stages A and B: Initial Assessment and Screening

These stages have already been completed but the screening stage needs to be revisited to ensure all Natura 2000 sites that could be impacted by the motorway construction, are correctly identified.

4. Stage C: AA

Introduction

The scope of data collection for the AA shall follow the exact requirements of the Ministry of Environment and Forests Order no. 19/2010, provided as Appendix 1.

Links with other assessments

EIA procedures apply to the project. The environment competent authority shall determine whether it is subject to Government Decision no. 445/2009 regarding the impact assessment of some public and private projects on the environment.

The study on biodiversity and protected natural areas shall be prepared for at least a one year period (to collect data from all four seasons) and shall be carried out in parallel with the preparation of the EIA, in compliance with the provisions of Order no. 19/2010. For efficiency of resources and time, data collection on biodiversity or protected areas shall be shared between the EIA and the AA. The interim and final conclusions of the AA shall feed into the EIA assessment of potential impacts from the project on biodiversity and also be summarised in the final Environmental Statement of the EIA.

Sites to include

The Appropriate Assessment shall consider, as a minimum, the following supporting habitats and Natura 2000 sites;

a) Sites that may offer supporting habitat for the qualifying interest species of Natura 2000 sites shall be included in a detailed analysis of direct and indirect impacts from the route and its options. These sites shall include, as a minimum:

- Cozia National Park and the areas indirectly affected by the project (areas situated in the vicinity of the original route and options);
- Lotrioara Reservation;
- Padurea Calinesti-Brezoi Reservation;
- Bascov Lake (declared a natural protected area by Arges County Council Decision no. 30 from 26.02.2004).

The survey, however, should not only be limited to the above mentioned sites.

b) Natura 2000 sites. The Consultant shall prepare a list of Natura 2000 sites intersected by the route and its options. The Consultant shall also include any Natura 2000 sites which may be affected directly or indirectly by the project. For these sites, the data collection for biological records shall follow the requirements from Ministry Order no. 19 (2010) regarding the analysis of habitats, the community interest species mentioned in the Natura 2000 standard form issued through Ministry Order no. 2387 in 2011 and the bird species mentioned in the Natura 2000 standard form issued through Government Decision no. 971 in 2011.

The Consultant shall discuss upon, as a minimum, the sites considered to be directly affected by the project. These include, but are not limited to, the following:

- ROSCI0354 Platforma Cotmeana;
- ROSCI0046 Cozia (for the 1st and 2nd option);
- ROSPA0098 Piemontul Fagaras;
- ROSPA0043 Frumoasa;
- ROSCI0085 Frumoasa.

The Consultant shall also analyse the sites considered to be indirectly affected by the project. These include, but are not limited to, the following:

- ROSCI0122 Muntii Fagaras;
- ROSCI0132 Oltul Mijlociu-Cibin-Hartibaciu;

- ROSCI0304 Hartibaciu Sud–Vest;
- ROSPA0062 Water reservoirs on the Arges River (Important Bird Area (IBA) and currently under an application to be designated as a Ramsar wetland site).

c) Other natural protected areas or flora and fauna species that may be affected by the initial route or by its options or whose accidental presence is recorded on the route or in its immediate vicinity.

Mapping

As a recommendation of best practice, and for ease of illustration, maps showing the different route alignment options, in relation to all Natura 2000 sites within 5km of the road, shall be provided. This distance is not described in HDA guidance but maps showing the Natura 2000 sites within this distance are likely to show the Natura 2000 sites most likely to be impacted by the project. It should be noted in the AA, that some impact distances can exceed 5km, for example hydrological impacts, water pollution impacts or impacts on bat species and their foraging habitat.

The Consultant of the AA shall also include maps of buried services cables, overhead power lines, bridges, viaducts, tunnels and any other construction works associated with the different route options. The mapping shall clearly show the location of all construction works and route options in relation to all water courses.

Description of proposals

The Consultant shall describe the project in sufficient detail for members of the public to understand its size, scale and objectives. This shall include a description of all key facets of construction according to the information requirements set out in the Ministry of Environment and Forests Order 19 (2010). This shall also include estimates of construction vehicle numbers (in relation to atmospheric dust emissions) and vehicle numbers during operation (e.g. CESTRIN modelling data) in relation to the collision risk and barrier effect on Natura 2000 mammal species and the deposition of oxides of nitrogen on Natura 2000 habitats. The expected phases of activity shall be described, including the proposed timing of each phase (construction, operation and decommissioning, plus sub-phases of these, as required). Typical 'on-the-ground' activities relating to each construction phase shall also be described. Distances (in metres) between the proposed route alignments and all Natura 2000 sites shall be provided. The precise area of any land-take required from any Natura 2000 site or supporting habitat shall also be specified.

Details of construction works required for service cables, overhead power lines and any other ancillary works shall be included in the HDA.

The Consultant shall also refer to the Gap Analysis report of June 2013, for potential alternative alignment proposals, which may be considered for further assessment.

Influencing design and route alignment

The potential impacts from construction, operation and decommissioning of all of these aspects shall be considered in the AA.

The Consultant of the AA shall seek to influence the design and alignment of all options at the earliest stage possible. For example, the following design aspects need to be considered and discussed with the wider project team:

- any options that involved construction within or near to the Arges or Olt rivers, including river bed re-alignment shall be avoided where possible. Such works would likely cause significant challenges in terms of Habitats Directive and Water Framework Directive compliance. Volume 2.1 of the Gap Analysis report includes a section entitled 'Hydro-technical works', which describes such considerations. Section 1.5.4.12 of this ToR also describes the need for understanding hydrological connectivity to determine potential impacts on Natura 2000 sites;

- any options that include construction on marshland may affect Natura 2000 habitat used by wetland bird species, amphibians, invertebrates and other qualifying interest species;

- the advantages and disadvantages of overhead power lines and buried cables shall be considered in terms of their respective potential impacts on Natura 2000 habitats and species;

- route alignment options that maximise the distance between the route options and the designated Natura 2000 areas are, generally speaking, less likely to cause adverse impacts on these sites – for example, the greater the distance, the more the air and noise pollution will be reduced. Direct land take of any Natura 2000 designated land in the construction footprint should be avoided; and

- route alignment options shall aim to avoid disruption to migration routes of Natura 2000 designated species by using ecological survey data to inform alignment and design. For this reason, ecological surveys need to begin as soon as practically possible

Baseline conditions

The existing conditions of the Natura 2000 sites shall be described, i.e. trends in distribution, migration and abundance of qualifying interest habitats and species, including current conservation status. The most up-to-date conservation objectives and site management plans shall be obtained to help identify impacts.

Methodology

There shall be a description of the process of the HDA, including the results of the first stage – screening for likely significant effects. The methodology shall refer to the relevant articles and appendices of the Habitats and Birds Directives and shall follow the key methodological guidance on HDA, e.g. Romanian HDA procedures, 'EC (2001).

Assessment of plans and projects significantly affecting Natura 2000 sites' and also HDA guidance specific to roads shall be provided. Evidence of early avoidance measures through design guidance and specifications shall also be provided. A wider list of other development plans and projects along the Sibiu-Pitesti corridor shall be considered to better predict cumulative effects. A detailed description of impact types and pathways shall be included and a rationale provided for all impacts and Natura 2000 sites screened out from further assessment. Additional information regarding any hydrological or ecological links and migration routes between the different Natura 2000 sites and other areas of supporting habitat, shall be provided.

The first part of the assessment shall include an inventory of the qualifying interest species and habitats present in the initial route corridor and its options (the corridor can be defined on the entire length of the route as having a width of around 100m). The inventory is intended to make recommendations, impact mitigation measures and, eventually, to compensate any biodiversity loss, if loss is predicted. The impact assessment shall be specifically relevant to the qualifying interest habitats and species of the Natura 2000 sites and their conservation objectives. The AA stage shall summarily identify the adverse effects of the project on the integrity of individual Natura 2000 sites or the ecological coherence of the Natura 2000 network, by specifically referring to direct or indirect impacts on the qualifying interests of the Natura 2000 sites. In duly substantiated cases the presence of stable species populations or of priority habitats for protection, can lead to route changes.

5. Establishing hydrological connections between route and Natura 2000 sites

Introduction

It is essential for the Consultant to establish these hydrological connections as this will help determine the source, pathway and receptor of potential impacts on Natura 2000 designated habitats and species. The Habitats Directive specialist shall liaise closely with hydrological specialists. The Consultant shall review the status of all available data in terms of topography (topographic maps, aerial mapping), storm duration, rain statistics, upper soil characteristics, vegetation, etc., to assess the catchment areas and the hydraulic parameters for all existing provisions and surface water drainage proposals.

The Consultant shall review the information regarding maximum flood levels, the minimum low levels, flow velocity, etc., from existing records, local research and the visible marks, if any, on structural components and earthworks.

The Consultant shall consider the hydrological impacts from constructing the road or any ancillary structures. In particular, the impacts of bridge construction and use of new structures in rivers shall be considered in terms of effects on flow volumes, flow speed, turbidity and potential for water pollution. Impacts during construction, maintenance, operation and decommissioning shall also be considered.

Hydrological analysis and determination of sections crossing water courses (especially for the Olt River and its tributary streams)

The study shall consist of the following, as a minimum:

- Morpho-hydrological analysis of the minor and major river beds and of the platform in the crossing section;
- Analysis of bank stability, river erosion phenomena and flow trends and corresponding data collection regarding flood risk from all water bodies;
- Analysis of historic maximum river flood levels, analysis of the surface lithology from the river bed and banks, analysis of the water flow speed and a global assessment of scouring phenomena;
- Description of the river volume levels and flow pathways required to support the conservation objectives of the Natura 2000 species and habitats;
- Description of any direct or indirect influences from route alignments on the flow pathways required, including location and description of road drainage and field drains.

Hydrological analysis and determination of the lakes and surrounding areas situated next to the initial route and the alternative routes, including marshland habitat.

The study shall consist of the following, as a minimum:

- Description of the lake or wetland habitat elevation, current water levels and flow pathways required to support the conservation objectives of the Natura 2000 species and habitats;
- Description of any direct or indirect influences from route alignments on the flow pathways required, including location and description of road drainage and field drains.

6. Mitigation measures

The report shall set out a timescale and identify the mechanisms through which the mitigation measures will be secured, implemented and monitored. This shall include a detailed description of the timing requirements for the proposed mitigation measures (e.g. outside of bird breeding seasons etc). All mitigation measures shall be targeted to the qualifying interest habitats and species for which adverse impacts were predicted. Any residual impacts after mitigation measures have been applied shall be recorded and assessed to determine if, in combination, there are likely to be cumulative impacts on site integrity.

7. Stage D1: Assessment of alternative solutions

If the AA objectively concludes that adverse impacts on the integrity of Natura 2000 sites remain, even after mitigation measures are applied, the AA report shall describe the next stages to be followed in the HDA process, i.e. consideration of alternative solutions. This shall include identification of any aspects of the project that require alternative solutions to avoid adverse impacts, including alternative routes, alignments, carriageway widths and single and dual-carriageway options. The Habitats Directive requires that in this phase, 'other assessment criteria, such as economic criteria, cannot be seen as overruling ecological criteria'. The examination of alternative solutions requires, therefore, that the conservation objectives and status of the relevant Natura 2000 sites shall outweigh any consideration of financial costs, delays or other aspects of an alternative solution. A description of the existing route alignment options is provided in the IPTANA Feasibility Study of 2008.

8. Stage D2: Compensatory measures

General considerations

If it can be demonstrated that the project must be carried out due to imperative reasons of overriding public interest and adverse effects on Natura 2000 sites cannot be avoided, then compensatory measures, including compensatory habitat, may be required. The identification of compensatory measures is required to maintain the coherence of the Natura 2000 network and comply with Article 6 (4) of the Habitats Directive. The Habitats Directive makes clear that compensatory measures are only a last resort attempt to maintain the overall coherence of the Natura 2000 network as a whole. Compensatory measures shall be assessed to ensure that they:

- Are appropriate to the site and the loss caused by the project or plan;
- Have the ability to maintain or enhance the overall coherence of Natura 2000;
- Are feasible; and
- Can be operational by the time the damage to the site comes into effect (unless this can be proved unnecessary in the circumstances of the case).

9. European Regional Development/Cohesion Funding Requirements

If it is demonstrated that this project is likely to adversely affect a site included or intended to be included in the Natura 2000 network and compensation measures are deemed necessary in accordance with Article 6(4), it will be necessary to provide a copy of the form "Information on projects likely to have significant negative effect on Natura 2000 sites"

. This shall include a map indicating the location of the project (including the route alignment options) and the Natura 2000 sites.

10. Next steps

The AA shall include a detailed description of any further ecological survey and consultation requirements for all Natura 2000 qualifying interest habitats and species. In particular, the requirements for undertaking surveys for Canis lupus, Lutra lutra, Lynx lynx, Ursus arctos, Castor fiber, and all bat, reptile, amphibian, invertebrate and SPA bird species, shall be described. This description shall include the length of survey period required (e.g. four season), when it will need to be repeated in terms of monitoring, the technical expertise required for survey staff and a description of the most robust survey methodology applicable to these specific species. The surveys shall aim to show the abundance and distribution of qualifying interest flora species and the abundance, distribution, short term behaviour patterns (e.g. daily movements) and seasonal migration routes of qualifying interest fauna species, including SPA designated bird species.

In order to avoid delays to construction, ecological surveys need to begin as soon as practically possible to influence final design and route alignment.

Extract from the Order 19 (Ministry of Environment and Forests)

According to the national legislation, the regulation applying to the preparation of the impact assessment studies on bio-diversity is **ORDER no. 19, dated 13th of January 2010, regarding the approval of the methodological Guide to Appropriate Assessment of potential effects from plans or projects upon the community interest protected natural areas.**

Issue authority: Ministry of Environment and Forests

Published in: Official Gazette, no. 82, dated 8th of February 2010

Art. 2.2, Appropriate Assessment study stage

The appropriate assessment stage includes:

a) Information on Plan/Project, subject to approval:

1. Information on Plan/Project: name, description, its objectives, information on production to be achieved, information on raw materials, used chemical agents or materials;

2. Geographical and administrative location, mentioning the Stereo 70 coordinates;

3. Physical modifications deriving from the Plan/Project (from excavations, consolidations, dredging) and occurring during the different stages of implementing the plan/project;

4. Natural resources necessary to implement the Plan/project (water takeover, renewable resources, non-renewable resources);

5. Natural resources that will be exploited within the community interest protected natural area to be used for the implementation of the Plan/project;

6. Emissions and wastes generated by the Plan/Project (in water, in air, on surface where wastes are stored) and modality to eliminate them;

7. Requirements on land use, necessary to execute the Plan/Project (land use category with land surfaces to be temporarily/permanently used by Plan/Project i.e. access roads, operating roads, road reservation, ditches and retaining walls, drainage devices, etc.);

8. Additional services necessary to implement the Plan/Project (decommissioning/relocating pipes, high voltage lines, etc., and their necessary construction means) and the way accessing these additional services may affect the integrity of the community interest natural area;

9. Duration for execution and operation, project decommissioning and scheduling the implementation period of the Plan/Project, etc;

10. Activities generated as a result of the Plan/Project implementation;

11. Description of the project technological processes (in case the competent authority responsible with the environment protection requires it);

12. Features of the existing Plan/Project, proposed or approved, which may generate a cumulative impact with a Plan/Project, which is under the evaluation procedure and may affect the community interest protected natural area;

13. Other information required by the competent authority responsible with the environment protection;

b) Information on the community interest protected natural area affected by the implementation of the Plan/Project:

1. Data regarding the community interest protected natural area: surface, types of ecosystems, types of habitats and species which may be affected by the implementation of the Plan/Project;

2. Data regarding the presence, location, population and ecology of the community interest species and or habitats situated within the surface area and or in the near neighbourhood of the Plan/Project, which are mentioned within the standard form of the community interest protected natural area;

3. Description of the ecologic functions of the affected community interest species and habitats (surface, location, characteristic species) and description of their connection/relation with the neighbouring community interest protected natural areas and their distribution;

4. Conservation status of the community interest species and habitats;

5. Data regarding the structure and the dynamics of the affected species populations (population numeric evolution within the community interest protected natural area, estimate percentage of a species population,

affected by the implementation of the Plan/Project and whether the habitat surface is large enough to maintain the species in the long term);

6. Structural and functional relations which create and maintain the integrity of the community interest protected natural area;

7. Conservation objectives of the community interest protected natural area, where enforced by the management plans;

8. Description of the current conservation status of the community interest protected natural area, including development/changes that may occur in future;

9. Other relevant information regarding the conservation of the community interest protected natural area, including possible changes to the natural evolution of the community interest protected natural area;

10. Other relevant aspects for the community interest protected natural area.

The Appropriate Assessment study shall evaluate, in a proper manner, the impact on each community interest species and habitat from each community interest protected natural area, which is potentially affected by the implementation of the Plan/Project, to ensure its conservation objectives and integrity of the Natura 2000 network.

1.5.4.13 Motorway Communication, Intelligent Traffic System and Traffic Control

The Feasibility Study shall include details relating to motorway communication installations. As a minimum, the Consultant shall propose:

- Variable message signs to be installed near junctions and tunnels;
- Matrix signs providing live data on traffic, weather, sensors for vehicle counting, weighting, classification, speed etc;
- Weather stations with all the required infrastructure, sensors etc;
- Traffic loops acting as automatic traffic counters, generally provided every 500m and near grade separated junctions;
- CCTV equipment including the number of CCTV units proposed based on coverage;
- Automatic plate recognition systems;
- Emergency phone systems including typical details for access platforms near the equipment;
- The cost estimates shall include unit rates used;
- Radio communication including radio coverage maps for the route;
- Typical drawings showing the number of ducts required to be included for motorway communication systems. As a minimum, the Consultant

shall allow for four longitudinal communication ducts and three ducts for power cables. The design shall enable physical segregation of the communication ducting and power ducting, which is a requirement for health & safety reasons. The design shall allow for separate inspection chamber for communication and power ducting;

- The schedule of motorway communication equipment and intelligent traffic systems shall be developed and correlated with all other works proposed as part of the design.

The Consultant shall ensure that the provisions for motorway communications are agreed with the RNCMNR to ensure consistency with other on-going motorway projects.

The RNCMNR shall clarify whether provisions for a tolling plaza are required.

1.5.4.14 Maintenance and Operation Plan

The Consultant shall assess the maintenance strategy options with the view to ensure the optimal long-term maintenance of road infrastructure to the highest economic effectiveness. The Consultant shall outline the possible options and develop a comparison of options based on costs, risks and site constraints. The maintenance plan (considering both normal and periodic maintenance over a period of time longer than 40 years) shall include, but is not limited to, the following:

- Identification of optimal locations for maintenance centres;
- Organisation of maintenance centres;
- Identification of necessary maintenance operations, as well as, their required frequency;
- Cost of the initial investment (improvements on centres, equipment procurement, etc.);
- Cost of annual maintenance works for 40 (forty) years.

The maintenance plan shall provide outline requirements for the provision of inspection and maintenance for the main categories of work, in line with the most recent Romanian standards.

The decision relating to the maintenance strategy for Sibiu–Pitesti motorway will require further consideration by the RNCMNR, as well as, Ministry of Transport and Infrastructure in order to ensure a nationwide consistent approach.

1.5.4.15 Carbon Footprint and Whole Life Cost Estimates

Whole life costs are the costs associated with owning or managing an asset that occur throughout its lifecycle. Included in a whole life cost analysis are capital costs, operational costs and maintenance costs (including operational maintenance and capital maintenance). When estimating the whole life costs, the Consultant shall use the relevant and valid maintenance norms applicable in Romania. The whole life costs form an integral part of any cohesion fund application and therefore must be investigated and estimated as part of the updated Feasibility Study.

To be able to undertake a whole life cost analysis, the Consultant shall be required to collect the following data:

- Capital cost, i.e. cost of construction;
- Operation and maintenance costs, including:
  - Annual maintenance;
  - Planned periodic maintenance;
  - An estimate of reactive maintenance;
  - Refurbishment costs, sometimes referred to as capital maintenance costs.

An estimate for the years of the maintenance requirements is also required.

These future costs shall be discounted, to determine their present value for inclusion in such an analysis. The discount rate to be used shall be decided in conjunction with the RNCMNR and will be in line with the latest Romanian guidance.

According to Romanian practice, the discount rate for the calculation of the present value of all costs and benefits for economic appraisal is 5.5%, while the discount rate for financial appraisal is 5%.

The annual discount factor is calculated as follows:

$$\mathrm{Pr}\,esentValue = FutureValue \times \frac{1}{(1+r)\text{^}n}$$

Where:

r = discount rate

n = year of cost

The number of years for the analysis shall also be decided in conjunction with the RNCMNR.

The tool should be flexible enough to allow for changes, for example, if the analysis period or the discount rate is changed, the whole life cost will automatically be updated.

It is preferable that the whole life cost analysis is developed in an editable tabular electronic format.

Carbon management

The calculation of carbon emissions has become increasingly important worldwide, with climate change and the effect on the environment being a major issue.

Throughout the design, the Consultant shall seek technical solutions which minimise cost over the entire life of the project, through application of sustainable design solutions which provide for the optimal trade-off between initial construction cost and the lifetime cost of operating, maintaining and renewing the infrastructure. Similarly, the Consultant shall seek technical solutions which minimise carbon emissions over the lifecycle of the project (i.e. covering both construction and operational stages).

There are recognised sources in the UK for carbon emissions, such as Defra, ICE, CESSM3, which give, for example, the carbon emissions per litre of petrol, or the carbon emissions per cubic metre for soil or rock excavation. It is advised that these sources, or similar, are used when developing the carbon management system.

Relevant details are also located on the European Commission webpage at the following link:

http://ec.europa.eu/clima/policies/transport/index_en.htm

1.5.4.16 Land Acquisition

The Consultant shall provide full support and services required for the completion of Phase 1 of the land acquisition process:

- Phase 1 is required for the issuance of the Governmental Decision in accordance with Law 255/2010. This phase is to be completed as part of the Feasibility Study stage as detailed within the Reporting section of this ToR.

Phase 2 of the land acquisition, required following the published Governmental Decision in accordance with Law 255/2010, is to be completed prior to the award of the Construction Contract and shall be administrated by the RNCMNR. Phase 2 of the Land Acquisition does not form part of the Consultant's scope of works.

Phase 1, required for the issuance of the Governmental Decision in accordance with Law 255/2010

Land owners, as well as, owners of the buildings affected by the development of the Feasibility Study on the expropriation corridor must, after a previous notification, allow access for topographical surveys, geotechnical and archaeological investigations and any operations necessary for the Feasibility Study.

The Consultant shall carry out all activities relating to the completion of all necessary documents required for issuing the Government Decision in accordance with Law no. 255/2010.

The activities relating to Phase 1, shall be carried out in accordance with the following requirements:

a) Identification on plan of the properties to be expropriated, including land in public ownership/administration;

b) Contacting the local authorities and collecting the relative information concerning the ownership of the properties to be expropriated;

c) Contacting the landowners affected by the Project to obtain copies of the relevant cadastral documents;

d) Collecting copies of the ownership documents and the cadastral plans from the County Cadastral Offices, real estate offices, notary offices and any other relevant sources;

e) Obtaining agreement from the appropriate representatives for lands which are the property of the state;

f) Checking the legal status of properties to be expropriated and carrying out, if necessary, legal action to clarify their status;

g) Identification, where necessary, of buildings and improvements affected by expropriation;

h) Undertaking all legal actions necessary to prepare documentation for the promotion of the Governmental Decision regarding expropriation, in accordance with Law 255/2010;

i) Undertaking any necessary topographic surveys, determination of STEREO 1970 coordinates, preparing descriptions of topographical points and identification on a drawing of the properties to be expropriated;

j) Compiling and obtaining agreement of the cadastral technical documentation (three copies to be produced);

k) Preparation and checking of documentation, in accordance with Law no. 7/1996, together with endorsement of the documentation by an authorised verifier;

l) Submission of documentation to the Cadastral Office and Real Estate advertising together with lodgement and award of the cadastral number;

m) Preparation of any documents that may be required for the free of charge transfer from other entities and state owned land areas;

n) Pedological studies and obtaining necessary approvals from the relevant authorities for removal of such areas from the agricultural regime;

o) Preparation of the annex to the Governmental Decision, including the administrative territorial unit, the cadastral number, the land surface resulting from documents and measurements, the surface description and the name of owners according to the technical-cadastral documentation;

p) Preparation of evaluation reports for those properties to be expropriated, according to administrative-territorial units and categories of use, by a National Association of Evaluators in Romania (ANEVAR) licensed expert, approved by the Employer, of assessment reports . The assessment reports shall establish the value of compensation for each individual building or plot of land, according to the provisions of Law no. 255/2010 on the basis of expropriation for public utilisation causes, necessary to achieve certain national, county, and local interest objectives;

q) Providing any other assistance, consulting and legal representation specific to this phase, as requested by the RNCMNR.

The Consultant shall provide regular communication to the RNCMNR with regard to progress achieved in relation to Phase 1 of the land acquisition process.

1.5.4.17 Urbanisation Certificates, Permits, Approvals, and Authorisations

The Consultant shall provide, in compliance with the legal provisions in force, the documentation necessary to obtain the Urbanisation Certificates. The Consultant shall submit the documentation to all local and county administrations, whose territories shall be traversed by the route of the project and they shall obtain, on behalf of the Beneficiary, the necessary Urbanisation Certificates.

The Consultant shall carefully verify all the conditions imposed in the Urbanisation Certificates, especially the conditions referring to restrictions imposed by territorial development plans already approved, as well as, the conditions mentioned in the approvals and notices they shall obtain.

The Consultant is responsible for the development, or update, of general/zonal/local urban plans in the development area of the project route, where required by the authorities of the local, county, regional administrations whose territories are occupied by the route of the project.

After obtaining the Urbanisation Certificates, the Consultant shall be responsible for the immediate development of any specialised documentation required, in compliance with the provisions of the Romanian legislation in force, and they shall obtain, on behalf of the Beneficiary, all notices, approvals, permits, and authorisations necessary to perform the project.

The legal period for comments and or endorsements by third parties is 30 days and this must be observed by the Consultant.

The Consultant is solely responsible for obtaining, on behalf of the Beneficiary, all approvals, permits, agreements, and authorisations stipulated by the Romanian legislation in force, and for obtaining other similar documents required by any other authorities and or institutions involved.

An outline list of expected third party permits is included below:

- The approval of the Ministry of Transport and Infrastructure regarding the need and appropriateness of the investment;
- The approval of the Inter-ministerial Council for noticing Public Works;

- The Urbanisation Certificate(s) for the highway, issued by the local and county administrations that have authority over the territories where the sectors of the future motorway shall be built, accompanied by all necessary approvals from the authorised territorial institutions;

- Approvals/Notices from all owners of facilities (such as: thermal and electric energy, methane, water, sewerage, telecommunications, oil, etc.), which are registered in the Town Planning Certificates and or which are affected by or present within the project development area;

- The EIA Decision and Water licence;

- Other specific permits, approvals and endorsements established according to the provisions of the legislation in force, issued by the competent institutions (County Council, Local Council, Public Health Directorate, Sanitary-Veterinary Directorate, Water Management, National Agency of Mineral Resources, Ministry of Agriculture and Rural Development, Ministry of National Defence, State Inspectorate for Construction, General Inspectorate for Civil Protection, the Romanian Information Service, Ministry of the Administration and Interior, County Police Inspectorate, County Culture Directorates, etc.) and established according to the provisions of the legislation in force.

The Consultant shall be fully familiar with the necessary approvals and procedures and shall take into account the fact that, depending on the complexity of the required applications, the Ministries or the central authorities can issue approvals directly and or with conditions regarding the procurement of the previous approvals from the directions and or agencies in their suborder.

The Consultant shall take into account that they will be responsible for the fact that certain institutions and authorities initially issue preliminary approvals, notices, authorisations, with final approvals, notices, and authorisations only being issued if certain conditions or addendum are met.

The Consultant shall be aware of the interdependency between various permits or approvals and shall ensure that all conditions imposed through such permits are implemented in the design.

During the performance of the Feasibility Study services, the Consultant shall take all reasonable measures to protect the environment (both on and off Site), limit damage and nuisance to people and property resulting from pollution, noise and other operations, and shall observe all relevant provisions of environment laws and regulations. To this extent, the Consultant shall be solely liable for any damages caused to population, buildings, environment, natural resources or other assets.

The Consultant undertakes to have valid authorizations issued by competent authorities for the performance of the services related to the Sibiu – Pitesti Feasibility Study. S.

The Consultant shall be responsible for any notice, approval, permit, agreement, and or authorisation necessary to be obtained for their team and equipment for the entire contract implementation period, for the period of measurement execution for studies, and for any field investigations within the project area, whenever necessary. Thus, any damages or deterioration produced by the Consultant which affects the population,

buildings belonging to the State and or private domain, environment, natural resources and similar, shall be supported unconditionally, irrevocably, and entirely by the Consultant.

The Consultant is responsible for the reception, on behalf of the Beneficiary, of all notices, approvals, permits, agreements, and authorisations necessary for the promotion of the investment. The costs of all permits and approvals shall be reimbursed by the RNCMNR, based on the invoices and receipts provided by the Consultant. The reimbursed costs shall exclude the costs related to the preparation of any presentation or design documentation that might be required by the Authorities, as part of the application for a permit, approval or authorisation. These costs are to be supported by the Consultant.

The invoices associated with the fees or equivalent cost for obtaining the approvals and permits regarding this project must be issued on behalf of the RNCMNR SA, with the mention "payable by means of Consultant" to avoid the re-invoicing of VAT. These costs shall be reimbursed by the RNCMNR, based on the receipt of the original invoices and evidence of payment of permit fees by the Consultant.

As soon as a notice, approval, permit, agreement, and or authorisation is issued, the Consultant shall be responsible for the detailed analysis of the content of any document provided, in order to promptly notify the conditions, restrictions, or other aspects imposed by the authorities issuing the notices/approvals, agreements and authorisations, and they shall promptly propose, in writing, resolution/clarification/solutions for all encountered aspects.

The Consultant is responsible for notifying the Beneficiary within the first five days of each month or as required or as necessary, about the status of the procurement of notices, approvals, permits, agreements and any authorisations.

Within the notification, the Consultant shall annex the documents requesting the issue of the notices, approvals, agreements and authorisations already issued (as copies) and they shall present their analysis of the encountered situations, as specified in the previous paragraph.

The Consultant shall also detail any advantages which have occurred to the benefit of the project or any conditions and restrictions or other imposed aspects, clearly specifying their implications on the general context of the project fulfilment, and if the aspects encountered shall have effects on certain notices, approvals, permits, agreements, and any authorisations already obtained or on other notices, which shall be issued.

The Consultant is responsible for the maintenance within the terms of validity of any notice, approval, permit, and authorisation issued during the implementation period of the Contract/Project. The Consultant shall request all third parties to issue permits with validity set to the duration of the construction contract, which would be in compliance with the requirements of Law 255/2010.

The Consultant shall not be responsible for delays caused in the issuance of any permits or approvals, due to reasons out with the Consultants control.

Before performing the final payment(s) relating to the services supplied within the contract, the Consultant shall present in one or more volumes/files the following:

- Detailed content in the form of a table, with all notices, approvals, permits, agreements, and or authorisations obtained, specifying the date of issue and the date of potential expiry, if applicable, or other remarks considered necessary;

- Original copies of all notices, approvals, permits, agreements, and or authorisations obtained;

- Each notice, approval, permit, agreement, and or authorisation must be accompanied by:

  – The address or, as the case may be, the proof of submission to the Consultant of documentation or, as the case may be, the specialty reports requesting the issue of the approval, agreement, authorisation, etc;

  – Proof of the Consultant having paid the taxes/fees or equivalent costs for the procurement of each approval, agreement, authorisation, etc;

  – The documentation or, as the case may be, the specialty reports having been submitted for the issue of the approval, agreement, authorisation, etc., documentation and reports being the basis for the procurement, accompanied by the endorsement of the Consultant or, as the case may be, a proof that the Consultant had analysed the submitted documentations;

  – If applicable, any signed protocol or minutes of meetings between the Consultant and the institutions and or authorities issuing the approvals.

The Consultant shall be responsible for the update of all design drawings and reports, implementing all of the requirements included within the permits, approvals and licences issued by third parties or by the RNCMNR.

1.5.4.18 The Relocation and Protection of Public Utilities

The Consultant shall apply for and obtain all relevant third party permits relating to the proposed protection and relocation of public utilities.

The Consultant shall identify facility owners/holders which have networks located in the area where works for the objective shall be performed and they shall send to the Beneficiary, the data required to notify facilities holders of their obligation to clear the location, in accordance with Law 255/2010.

The Romanian legislation requires that relocation projects for utility networks (including gas, water, telecommunications and power) shall be developed by specialised and authorised designers. For this purpose, the Consultant is required to carry out detailed checks of public utility networks affected by the road works.

The Consultant shall contact the owners of utility networks in order to obtain information about over ground and underground networks or other infrastructures that could be affected by the construction works.

The Consultant shall be responsible for the development of the Technical Project, to a level of execution detail, for all the necessary relocation/protection works relating to utility networks for the motorway.

With the approval of the RNCMNR and in compliance with Romanian legislation, the Consultant will subcontract to authorised companies in the field of design services, any necessary relocation work, to develop the Technical Project and execution details for the relocation/protection works relating to facilities networks and technical specifications (including the confidential estimate).

By means of authorised and specialised design companies, the Consultant shall be responsible for obtaining the endorsement of technical projects by the owners of facilities networks and obtaining from them estimates regarding the costs of relocation works.

At the same time, the Consultant shall ensure a project verifier, authorised for the respective field, will stamp and check the Technical Projects for the Relocation/Protection of Utilities.

Considering the diversity and specialisation of utilities, and their networks, requiring relocation/protection works, the Consultant shall appoint a professional utility designer who will coordinate the utility projects to avoid any possible conflicts between proposed relocation positions and where necessary, to ensure optimisation of land areas requiring expropriation (for the relocation of network facilities).

The Consultant shall assess and include in the design any works relating to land reclamation, known in Romanian as *lucrari de imbunatari funciare*.

The Consultant shall develop a master plan that will include all public utilities, including existing and proposed relocations, for the Sibiu–Pitesti motorway. In addition to the public utilities information, the master plan will include the topographical mapping and proposed motorway alignments including all side roads and access tracks. The master plan shall be used to check for any clashes between various categories of works, clashes which the Consultant will be required to design out / resolve.

The development of the Technical Projects for the relocation / protection of utilities and for the execution details must be initiated as soon as possible to allow the identification of landowners affected by the relocation of utilities.

1.5.4.19 Assistance with the preparation of the Application for Structural Funds

a) Assistance with the application for structural funds

The Consultant shall support the RNCMNR with the preparation of the application for funding of the construction of the Sibiu – Pitesti motorway in line with the relevant regulations in force. The Consultant will assist the RNCMNR in developing the application until the issuance of the financing decision by AM POST, respectively EC.

The application will be completed based on data collected from:

- Feasibility Study and its annexes;
- Cost-benefit analysis;
- Institutional analysis;
- Environmental impact assessment;
- Procurement policy;
- Information collected from the Contracting Authority.

In completing the application form, the Consultant shall provide assistance to the Employer in order to ensure compliance with the applicable relevant requirements and instructions in force that are to be developed for the 2014-2020 programming period.

b) Assistance during the evaluation of the funding application

Following the submission of supporting documents and the preliminary assessment grant application, in accordance with the procedures SOP-Transport, the Consultant shall provide all necessary assistance to the Employer during the evaluation stage of the European Commission and or SOP-T Managing Authority and JASPERS, and shall assist with any requests for clarification or review of grant applications and or its annexes (or parts of documents). The Consultant shall make such revisions to any parts of the documents and shall submit the revised version for final approval.

1.5.4.20 Development of Prequalification, Tender and Contract Documents for the Award of the Construction Contract

In accordance with Romanian national legislation, the Consultant shall develop a complete set of procurement documents for the award of prequalification and construction contracts on five lots as follows:

- Lot I: Sibiu – Boita;
- Lot II: Boita – Racovita;
- Lot III: Racovita – Valeni;
- Lot IV: Valeni – Curtea de Arges;
- Lot V: Curtea de Arges – Pitesti.

A sixth Lot (DN73C Tigveni – Ramnicu Valcea) may be added to the above list subject to the outcome of the traffic study and cost benefit analysis and with approval by the RNCMNR.

In collaboration with the RNCMNR, the Consultant shall develop the Data Sheet, qualification criteria and evaluation factors for both the prequalification stage and tender stage.

In collaboration with the RNCMNR, the Consultant shall prepare a public works procurement and implementation programme with an associated cash flow analysis to establish the optimal use of available financing from the Government and by means of Structural Instruments. The form of contract will be Design & Build based on the International Federation of Engineering Council – Yellow FIDIC.

Romania became an EU member state and consequently, the works and service contracts concluded after accession observe Romanian procurement rules. The Awarding Documentation will be prepared in English accompanied by the Romanian translation, for information purposes.

Moreover, the Awarding Documentation must be clear, legible and correctly written in English. The Consultant must ensure the appropriate and consistent use of terminology in all documents.

An indicative structure for the contents of the Awarding Documentation for works to be developed by the Consultant is presented below. It shall be noted, that the final form of the Awarding Documentation for works will be established in compliance with the provisions of Romanian legislation and project specifications.

Volume 1

Instructions to Tenderers

Volume 2

The Contract

Volume 3

Employers Requirements

Volume 4

Illustrative Design (FS)

Volume 5

Schedules and Specifications

Volume 6

Additional Supporting Documentation and Data

The Application and Contracting conditions shall be discussed and agreed with the RNCMNR, in compliance with the legal provisions in force.

1.5.4.21 Road Safety Audit

The verification of road safety represents systematic verification of the aspects relating to safety for the new motorway and any associated traffic management schemes. The main goal is to identify the safety issues at early stages of the project and implement robust mitigation measures.

The RNCMNR shall commission and organise the roads safety audit. The Consultant shall make all drawings, reports and calculations available to the RNCMNR to enable the completion of the road safety audit. The Consultant shall also provide information relating to accident data along the existing road network situated within the motorways zone of influence.

The road safety audit, which will be commissioned by the RNCMNR, will comply with Ordinance 6, dated January 29, 2010, and the modification and completion of Law no. 265/2008, published in the Official Journal 70 on January 30, 2010 (OJ. 70/2010).

1.5.5 Project Management

1.5.5.1 Responsible Institution

The project will be coordinated by the Directorate for Projects with External Financing, within the RNCMNR, and they shall appoint a Project Manager responsible for supervising the implementation and approval of the Consultant's recommendations.

1.5.5.2 Facilities Ensured by the Contracting Authority

RNCMNR grants special attention to the successful completion of the task and considers implementation to be a common responsibility. It will therefore have an active approach in supporting the Consultant to carry out the activities under contract.

RNCMNR will focus especially on:

- Collecting and sending all existing data and studies relating to the project, in both electronic format and hard copy, to the Consultant, following the awarding of the contract;
- Ensuring access to other relevant data reasonably requested by the Consultant;
- Supporting and assisting the Consultant in obtaining all permits and approvals necessary for the successful completion of the contractual tasks;
- Ensuring a connection with other governmental agencies and ministries;
- In addition, the RNCMNR will make available to the Consultant any other relevant information reasonably requested by the latter;
- The Romanian Tax Code was subject to amendments as of January 1st, 2007. Therefore, this contract will not be granted an exemption from the payment of VAT and other fees. The amount of VAT and other fees will be covered by the Budget of Romania, representing non-eligible expenses stipulated in the Financing Contract.

1.5.5.3 Quality Assurance

The Quality Plan will be submitted together with the Inception Report. The Quality Plan will be based on the Consultant's Quality Management System. The Quality Plan will include:

- Team organogram and descriptions of key staff involved in the project;
- A detailed procedure relating to the review and analysis of the RNCMNR requirements and protocols for internal communication of agreed changes to the project;
- Risk register, which will include risks related to project implementation;
- Procedures relating to the analysis and validation of the documents received from the Client;
- Project implementation programme and procedures relating to project progress monitoring;
- Procedures relating to internal allocation of tasks;
- Protocols for internal and external communication;
- Details relating to the sub-contractors, main deadlines and procedures for the verification of deliverables received from the subcontractors (note: the appointment of subcontractors requires the prior approval of the RNCMNR);
- Procedures for the internal verification of all deliverables including the forms used to evidence the check and approval process;
- Drawings and document management systems including the proposed numbering system;
- Procedures for dealing with non-conformance issues relating to the design package and parts thereof, including drawings and reports;
- Internal audit procedures and project internal audit plan.

1.6 Logistics and Planning

1.6.1 Location

The Consultant is required to establish a project office in Bucharest that will be the main basis for operations to facilitate regular connection with the Project Management team within the RNCMNR. The cost of providing the office will be included under the lump sum items of the project budget.

1.6.2 Inception Date and Execution period

The Consultant shall begin its activity 15 (fifteen) calendar days after the signing of the Contract date. At the end of this 15 day period, the Consultant is deemed to be fully mobilised, with an operational office in Bucharest complete with all necessary equipment and IT.

The duration of the contract is 30 months.

During the mobilization period of 15 days, the Consultant shall develop a quality assurance manual specific to this project and prepare a detailed programme for the implementation of their task. These documents shall be submitted to the RNCMNR as part of the Inception Report.

1.7 Requirements Regarding the Staff

The Consultant shall provide the key experts listed below.

1. Project Manager – Sef de Proiect Complex;
2. Road Engineer;
3. Bridge Engineer;
4. Tunnels Engineer;
5. Engineer specialised in tunnels;
6. Road pavement Engineer;
7. Geotechnical Engineer;
8. Hydrologist Engineer;
9. Traffic Planner;
10. Cost – Benefit Analysis and Multi Criteria Analysis Expert;
11. Environment Expert;
12. Appropriate Assessment Expert;
13. Quantity Surveyor.

The Consultant shall include, in its tender, the names and CVs for key experts only. The Consultant is not required to provide CVs for any other non-key support staff.

The team shall be lead by a Project Manager who shall have the overall responsibility for the co-ordination of the design and shall report directly to the RNCMNR.

The key experts have to satisfy the minimum requirements outlined in the Data Fiche.

All key experts shall undertake to spend a minimum 70% of their time in Romania.

The resources (inputs) necessary for each expert shall be established by the Consultant.

The Consultant is free to employ any non-key expert considered necessary for the job but no CV shall be provided for these experts.

1.7.1 Consultants place of work

Consultants' main design team and design office shall be in Bucharest, Romania.

Consultants' key experts, listed in 1.7, shall deliver at least 70% of their resource input working from Bucharest, Romania. Moreover, the Consultants' Project Manager, Roads Expert, Bridges Expert and Geotechnical Expert shall be available to attend progress meetings with the RNCMNR representatives at a frequency of every two weeks throughout the duration of the contract.

1.7.2 Facilities to be provided by the Consultant

The Consultant shall provide support and equipment necessary for the experts to appropriately perform their tasks. In particular, the Consultant shall provide sufficient administrative, secretarial and interpretation staff, thus allowing the experts to concentrate on their main responsibilities.

Throughout the entire performance of the Contract, the Consultant shall be responsible for normal performance activities required to fulfil contractual obligations, such as:

- Ensuring the accommodation of their staff;
- Ensuring the transport of their staff;
- Establishing an office in Romania to perform the requested services in good conditions;
- Bearing all costs for the multiplication of documents, printing and binding of reports, etc.

The Consultant shall undertake the fitting of its office (including the pieces of furniture), its maintenance and all utilities during the performance of the contract. These costs shall be covered from the Global Price.

Equipment

No equipment shall be purchased and transferred upon the conclusion of the contract to the Contracting Authority/beneficiary country, as part of this service contract.

1.7.3 Reporting Requirements

The Consultant shall draft the progress reports at three months intervals. The first progress report is to be delivered three months after the submission of the Inception Report. All progress reports shall have an informative purpose, their approval not being required.

The Progress Reports shall refer to the entire task, but they shall also contain the detailed progress of all tasks and shall highlight any risks of delays, reasons for such delays and the mitigations measures proposed by the Consultant to minimise the impact of such delays. The appendix to the Progress Reports shall contain the minutes of the progress meetings. The Consultant shall present an outline structure for the future Progress Reports as an annex to the Inception Report. The Progress Reports shall be drafted in Romanian.

The Inception Report shall be delivered one and a half months from the Inception Date.

The Inception Report shall provide an overview of the development of the tasks to be undertaken and shall present the methodology suggested for the implementation of the Feasibility Study, including any foreseen risk, with recommendations for mitigation and risk management. The Inception Report shall also include as a minimum the following:

- traffic modelling software to be used (for approval/ratification by the Client);
- traffic surveys to be completed (for approval by the Client);
- traffic modelling methodology (for approval by the Client).
- Methodology proposed for the multi-criteria analysis
- Methodology proposed for the cost-benefit analysis
- Approach proposed for the ground investigations
- Approach proposed for the EIA and AA
- List of all standards proposed for being used as part of the design

A copy of the proposed projects Quality Management Plan shall be included within the Inception Report. The Report shall also discuss any ambiguity or modification to the Terms of Reference and shall identify any perceived risks or potential constraints for the timely completion of the services. The Inception Report shall be drafted in Romanian and in English.

The Reports to be delivered by the Consultant are listed within the following table:

Report name	**Deadline for delivery to RNCMNR**	**Payment Milestone**
Inception Report	1.5 months from the Inception Date	10%
Route Options Report	4 months from the Inception Date	10%
Report on Permits and Approvals required for access to site for GI, Archaeology and other site investigations. The Report shall include the Specification for all ground and site investigations	4 months from the Inception Date	2.5%
Noise Surveys	6 months from the Inception Date	2.5%
Prequalification Documents for the Construction Works Contracts	10 months from the Inception Date	4.5%
Hydraulic and Hydrologic Report	14 months from the Inception Date	2.5%
Seismic Study Report	14 months from the Inception Date	2.5%
Archaeological Investigations Report	20 months from the Inception Date	8.5%
Biodiversity Surveys	16 months from the Inception Date	2.5%
Ground Investigation Report Phase 1	12 months from the Inception Date	10%
Ground Investigation Report Phase 2	20 months from the Inception Date	15%
Soil, Material, Construction Processes and Health & Safety Report	20 months from the Inception Date	2.5%
Motorway facilities (rest areas, service areas, maintenance and coordination centres) outline proposals	16 months from the Inception Date	2.5%
Maintenance and Operation Plan Report	20 months from the Inception Date	2.5%

Report name	Deadline for delivery to RNCMNR	Payment Milestone
DRAFT For Comments Feasibility Study including the EU Funding Application, Traffic Study, CBA, EIA & AA, Cost Estimate & Confidential Estimate	20 months from the Inception Date	2.5%
DRAFT For Comments Tender and Contract Documents for the Construction Works Contracts	20 months from the Inception Date	2.5%
DRAFT For Comments Technical Projects for the Relocation and Protection of Public Utilities including the public utilities co-ordination master plan and the approval of the utility owners or administrators.	20 months from the Inception Date	2.5%
DRAFT For Comments Land acquisition documentation Phase 1	20 months from the Inception Date	2.5%
Final Feasibility Study including the EU Funding Application, Traffic Study, CBA, EIA & AA, Cost Estimate & Confidential Estimate	23 months from the Inception Date	2.5%
Permits and Agreements	23 months from the Inception Date	1%
Final Land acquisition documentation Phase 1	23 months from the Inception Date	2.5%
Technical Projects for the Relocation and Protection of Public Utilities including the master public utilities co-ordinator plan and the approval of the utilities owners or administrator.	23 months from the Inception Date	2%
Tender and Contract Documents for the Construction Works Contracts	23 months from the Inception Date	2%
Completion Report	23 months from the Inception Date	2%

The content of the Feasibility Study shall comply with HG 28/2008 and the requirements of this Terms of Reference. The Consultant shall arrange meetings with the RNCMNR shortly after the submission of the above reports to discuss, and agree on the RNCMNR comments and recommendations on these reports. The RNCMNR reserves the right to request the addition of various key topics to any of the above reports.

1.7.4 Submission and Approval of the Reports

All reports and documents to be submitted shall be drafted in Romanian and translated into English. All reports shall be submitted in both hard copy and editable electronic format and shall be distributed as follows:

- RNCMNR: The Inception Report and the Progress Reports shall be delivered in one hard copy and one electronic (editable format) copy. Final version of the reports: two hard copies in Romanian and one hard copy in English; in editable electronic format one copy in Romanian and one in English. All Draft for comments submissions shall be delivered in electronic copies only.

- MTI: The Inception Report and the monthly progress reports shall be delivered in one hard copy and one electronic copy. Final version of the reports: two hard copies in Romanian and one hard copy in English. All Draft for comments submissions shall be delivered in electronic copies only.

- JASPERS: one electronic copy in Romanian and one electronic copy in English of the Inception Report and all other draft and final reports.

The electronic copies shall be submitted by email or, in case of large files, on CD/DVD. In the case of very large electronic files the Consultant shall use external hard drive or similar media for delivery of electronic copies.

The approval procedures for the reports are defined under the Special Conditions of the Contract.

All reports shall also be submitted in a preliminary format first, which shall then be commented on by the RNCMNR SA and MTI within 10 calendar days.

It should, however, be noted that official approval for the Route Options Report and the Final Feasibility Study from the Technical-Economic Committee of the RNCMNR (TEC RNCMNR) shall also be required.

Additionally, other parts of the feasibility study including the designs for road markings and signs, all layouts for grade separated and at-grade junctions and relevant traffic capacity analysis shall be subject to approval by the road safety panel of TEC RNCMNR, known in Romanian as *CTE restrans*.

The Consultant shall keep an archive of documents, drawings, site notes and correspondence, which shall be uploaded in electronic format to CD/DVD and shall be submitted to the RNCMNR at the end of the contract, thus becoming its property.

If the Consultant receives requests for copies of the documents or in relation to other information on this project, these requests shall be addressed to the RNCMNR, who shall give the appropriate instructions to the Consultant. The Consultant shall not submit any documents without specific approval of the RNCMNR.

1.7.5 Publicity Measures

In this contract, the Consultant shall produce requirements for the development of an Action Plan for Promotion of the *[Project*], technical specifications and budget for the information and advertising activities, and print and distribute information and advertising materials for the promotion of this technical assistance contract, highlighting the financial contribution of the European Union.

The publicity measures are required to:

- Inform the stakeholders with regard to the importance of the project, costs, benefits and the project implementation status;
- Provide transparency for the utilisation of EU funds.

I The Action Plan for the promotion of the [Objective]

For the investment objectives, representing the object of the contract, the Consultant must present the requirements for the elaboration of an *Action plan for the promotion of the [Project*], complying with the provisions of the Visual Identity Manual for the Transport Sectoral Operational Programme (www.ampost.ro section Documentation, subsection Advertising) or of the Visual Identity Manual in force at the date when the contract was signed.

The action plan for the promotion of the [Project] describes all measures for the information and advertising that shall be taken by the parties involved in the development of that objective.

The team of experts will define and lead activities conducted according to law and the terms set out in the contract SOP-Transport, deadlines, resources required (number of experts, training, and experience necessary to carry business equipment, etc.) and expected deliverables (quantity, quality, specific conditions).

The minimum compulsory activities that must be found in the Action plan for the promotion of the [Project], are as follows:

- Activities performed within the Supervising contract;
- Elaboration and implementation of the Action plan for the promotion of the objective;
- Elaboration of printed informative/advertising materials and dissemination towards the target public;
- Elaboration of audio-video informative/advertising materials and dissemination towards the target public;
- Organisation of events;
- Photos taken to illustrate the progress of the works in images;

- Activities performed within the works contract;
- Mounting and display of exterior advertising boards (temporary boards and commemorative plates);
- Common requirements: use of obligatory graphic symbols (according to MIV) on all documents performed within the objective (contractual correspondence exclusively).

II Technical and budget specification

For each activity proposed in the Action Plan to promote the objective, the Consultant shall develop tender books, implementation schedules, and price estimates.

The budget shall be established depending on the size and importance of the project and allotted to certain types of activities, as shall be found in the Action plan for the promotion of the [Project].

The costs relating to implementation of the activities included in the plan for the promotion of the [Project] shall be found, depending on the activities proposed, in the budgets of the supervision contract and of the works execution contract.

The total estimated budget relating to the information and advertising measures shall be distinctly registered in the financing application (the FEDR application).

III Informative and advertising measures that must be carried out by the Consultant

All informative and advertising measures carried out by the Consultant shall comply with the provisions of the Visual Identity Manual for the Transport Sectoral Operational Programme (www.ampost.ro under the Documentation section and then the subsection on Advertising) or from the Visual Identity Manual in force at the date when they are carried out.

III.1 Development and distribution of informative materials relating to the Project

In order to ensure accurate information and advertising, the Consultant shall ensure the printing and distribution of informative materials.

All informative and advertising materials produced by the Consultant shall highlight the financial contribution of the European Union (co-financing of the technical assistance contract).

The Consultant shall submit, for approval by the RNCMNR, all informative and advertising materials before their printing and distribution.

a) Brochures - minimum requirements:

- Open format A4 (297 x 210mm);
- Closed format 99 x 210mm;

- Support: matt paper, plasticised for exterior and 200g/m² and interior 150g/m² with a glossy selective varnish applied on texts/images;
- Maximum 12 pages, including the cover;
- The brochures shall be stapled;
- Run minimum 50 pieces.

b) Posters - minimum requirements:

- Dimension: 50 x 70cm;
- Matt paper 200 g/m²;
- Polychromic;
- Matt plasticisation;
- Run minimum 30 pieces.

c) Folders - minimum requirements:

- Dimension: A5 close – 2 scores;
- Matt paper minimum 150 g/m²;
- Polychromic;
- Run minimum 50 pieces.

d) Catalogues - minimum requirements:

- Finite format A4 (220 x 305mm) with double score (5mm);
- Matt plasticised cardboards with 300-350g/m², glossy selective varnish applied on texts/images;
- Polychromic;
- A pressed patch pocket with a socket for CD/DVD;
- Run minimum 50 pieces.

The materials will be distributed and displayed at the premises of the Consultant, the RNCMNR and during events organised by the central and local beneficiary and or local authorities.

Deadlines shall be agreed in accordance with the requirements of the financing contract agreement with the RNCMNR.

III.2 Documents developed within the contract

All documents developed within the contract by the Consultant (Reports, technical and economic reports, deliverable under any form and type – except for the contractual correspondence) shall comply with the specific visual identity measures (e.g. in scripted logos, the text "Project financed through EFRD") specified in the Visual Identity Manual for the Transport Sectoral Operational Programme (www.ampost.ro under the Documentation section and then the subsection on Advertising) or from the Visual Identity Manual in force at the date when the contract is signed.

1.7.6 Training to be provided by the Consultant

The Consultant shall provide specialised training to the RNCMNR that will cover the following main categories:

- Project and contract management;
- Specific software used as part of the design and made available to the RNCMNR as fully functional licences;
- Risk Management
- Quality Assurance
- Cost benefit analysis
- Environmental impact assessment and appropriate assessment
- The planning of ground investigations
- Contract management
- Conditions of contract, advantages and disadvantages relating to the use of various forms of contract (FIDIC red, FIDIC yellow, PPP etc)

The exact number of training sessions, their duration and timing shall be proposed by the Consultant and agreed with the RNCMNR. The duration for one training session shall be 1 – 2 days and the anticipated number of participants from the RNCMNT will be 10 to 15 staff.

The budget allocated for the activities relating to training shall be 200,000.00 RON. This sum must be included without modification in the Consultants financial offer.

1.7.7 Software licences to be made available by the Consultant

The Consultant shall make available to the RNCMNR, software licences for the main software products utilised by the Consultant as part of the design. This may include as minimum:

- Software used for the highways design and 3D modelling – 1 licence
- Software used for the traffic study – 1 licence

- Software used for the cost benefit analysis – 1 licence
- Software used for the cost estimates

All software licences shall be provided with a four years maintenance period. All software licences along with an editable electronic copy of all project deliverables shall be installed on a desktop computer with system configuration adequate for the processing of the data made available by the Consultant. The cost relating to licences and the desktop computer shall be supported by the Consultant and be delivered to the RNCMNR at Completion Report stage.

1.8 Monitoring and Assessment

1.8.1 The definition of the Performance Indicators

The performance of the contract shall be monitored by the Project Manager, within the 'Directorate for Projects with External Financing' of RNCMNR and by the Management Authority SOP-T within MTI, in compliance with all documents to be provided listed in Chapter 7 - REPORTS of the Tender Book. The key indicators (Objectively Verifiable Indicators) for the monitoring and assessment of the Consultants activities are as follows:

- A new Feasibility Study as detailed in these TORs;
- Roads operation & maintenance strategy;
- An application for EU funds based on the findings of the Feasibility Study;
- Detailed Design for the re-location/protection of utilities;
- Tender documents for procurement of works contracts for the execution of the Sibiu-Pitesti motorway.

1.8.2 Special requirements

The Consultant shall comply with the provisions of Law 10/1995 as subsequently amended and supplemented.

Annex A

Summary of existing ground investigation data

Annex A – Existing Ground Investigation Information and requirements for additional boreholes

Contents:

Table 1 - Summary of Ground Investigations Information at Structures

Section I – Vestem - Cornetu

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S1	Offline	20	Over bridge	FR1@Ch 000	Phase 1: 1 Phase 2: 2 Phase 3: 2
S2	1040-1560	520	13 span bridge	SR3@Ch 1300 FR3@Ch 1400 GI is inadequate for preliminary design since only 2 boreholes have been identified for this 525m long structure and these do not adequately define the ground model. It is not possible to determine feasibility of either deep or shallow foundations.	Phase 1: 4 Phase 2: 13 Phase 3: 13 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S3	2890-2910	20	Single span bridge	FR4@Ch 2920 A borehole at each abutment is required to establish the ground model. At present the model has been inferred to 5m depth from adjacent boreholes and is therefore inadequate.	Phase 1: 1 Phase 2: 2 Phase 3: 2 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S4	5280-6100	820	23 span bridge	FR5@Ch 5310 FR6@Ch 5750 SR14@Ch 5470 Borehole spacing is too great. SR14 is of inadequate depth.	Phase 1: 6 Phase 2: 21 Phase 3: 21 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S5	6220-6320	100	3 span viaduct	FR7@Ch 6250 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S6	7080-7280	200	3 span viaduct	FR8@Ch 7100 The borehole allows definition of the north abutment, but ground model at the other foundations is not properly defined. Further GI required for preliminary design.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S7	8120-8800	680	21 span bridge	FR9@Ch 8120 SR19@Ch 8510 FR10@Ch 8750 Adequate for preliminary design, however, it is recommended the ground model is updated as there is enough information to refine it.	Phase 1: 6 Phase 2: 20 Phase 3: 20 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S8	9800-10000	200	9 span viaduct	FR11@Ch 9810 GI is inadequate for preliminary design since only one borehole is available to cover a 390m span. The ground model has been inferred from this single borehole (and other adjacent boreholes). Further GI required.	Phase 1: 3 Phase 2: 9 Phase 3: 9 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S9	10300-10460	160	3 span bridge	SR21@Ch 10320 FR12@Ch 10460 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S10	11130-11630	500	6 span bridge over River Olt	FR13@Ch 11130 FR14@Ch 11530 Bedrock has not been identified at the north abutment and therefore the ground model is incomplete. Further GI required to complete ground model and enable preliminary design. At detailed design stage, in-stream GI will be required to design pier foundations.	Phase 1: 2 Phase 2: 7 Phase 3: 7 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S11	11950-12100	150	Single span bridge	SR22@Ch 11950 FR15@Ch 12100 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 2 Phase 3: 2 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S12	12260-12600	340	3 span viaduct	FR16@Ch 12610 Borehole required at north abutment to enable preliminary design.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S13	12760-12880	120	Single span viaduct	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 2 Phase 3: 2

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S14	13280-13700	420	3 span bridge	SR24@Ch 13250 FR17@Ch 13710 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S15	14040-14260	220	4 span viaduct	FR18@Ch 14040 SR24bis@Ch14300 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 2 Phase 2: 5 Phase 3: 5 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S16	14600-14740	140	3 span viaduct	FR19@Ch 14560 Borehole required at south abutment to enable preliminary design. Ground model appears to have been heavily inferred from adjacent boreholes.	Phase 1: 1 Phase 2: 4 Phase 3: 4
S17	14920-15060	140	4 span viaduct	None. GI needed to enable preliminary design.	Phase 1: 2 Phase 2: 5 Phase 3: 5

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S18	15220-15340	120	3 span bridge	FR20@Ch 15190 SR25@Ch 15350 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S19	15610-15680	70	2 span bridge	FR21@Ch 15710 Borehole required at north end to enable preliminary design. Ground model appears to have been heavily inferred from adjacent boreholes.	Phase 1: 1 Phase 2: 2 Phase 3: 2 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S20	15920-16340	420	6 span viaduct	SR26@Ch 16050 Minimum of 2 boreholes required for preliminary design, since SR26 only identifies superficial deposits at one location of this 400m structure.	Phase 1: 3 Phase 2: 6 Phase 3: 6 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S21	16640-16960	320	3 span viaduct	SR27@CH 16750 Minimum of 2 boreholes required for preliminary design, since SR27 only identifies superficial deposits at one location of this 150m structure.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S22	17000-17060	60	Single span bridge	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 2 Phase 3: 2
S23	17440-17850	410	6 span bridge	FR23@Ch 17400 SR28@Ch 17820 Additional borehole needed at south abutment to define bedrock and complete ground model.	Phase 1: 3 Phase 2: 6 Phase 3: 6 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S24	18480-18820	340	7 span bridge	FR24@Ch 18510 SR29@Ch 18810 Additional borehole needed at south abutment to define bedrock and complete ground model. At detailed design stage, in-stream boreholes required to investigate River Olt bed deposits.	Phase 1: 3 Phase 2: 7 Phase 3: 7 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S25	19060-19170	110	4 span bridge	FR25@Ch 19100 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 2 Phase 2: 5 Phase 3: 5 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S26	20240-20360	120	3 span bridge	FR26@Ch 20300 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S27	20700-21000	300	7 span bridge	FR27@Ch 20780 Additional borehole needed at south abutment to define bedrock and complete ground model. At detailed design stage, in-stream boreholes required to investigate River Olt bed deposits.	Phase 1: 3 Phase 2: 7 Phase 3: 7 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S28	21150-21170	20	Single span bridge	SR30@Ch 21170 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 2 Phase 3: 2 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S29	21280-21340	60	Single span bridge	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 2 Phase 3: 2
S30	21840-22140	300	7 span bridge	FR28@Ch 21930 Additional borehole required at south abutment to define ground model and allow preliminary design.	Phase 1: 3 Phase 2: 7 Phase 3: 7 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S31	22770-22900	130	3 span viaduct	SR32@Ch 22910 At least 2 boreholes required to adequately define ground model for preliminary design. SR32 is only to a depth of 5m and is considered inadequate for foundation design.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S32	23280-23340	60	2 span viaduct	FR30@Ch 23300 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 3 Phase 3: 3 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S33	23720-23960	240	3 span viaduct	FR31@Ch 23850 Additional borehole required to define ground model and enable preliminary design.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S34	24180-24300	120	3 span viaduct	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 4 Phase 3: 4
S35	24440-24480	40	Single span viaduct	FR32@Ch 24450 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 2 Phase 3: 2 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S36	24540-24600	60	Single span viaduct	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 2 Phase 3: 2
S37	24720-24800	80	2 span viaduct	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 3 Phase 3: 3
S38	24980-25300	320	5 span bridge	FR34@Ch 25300 Additional borehole required at north abutment. FR33 considered too distant to define ground model.	Phase 1: 1 Phase 2: 6 Phase 3: 6 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S39	26000-26400	400	6 span bridge crossing River Olt	FR34b@Ch 26040 FR35@Ch 26390 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 2 Phase 2: 7 Phase 3: 7 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S40	27980-28580	600	7 span bridge crossing River Olt	FR36@Ch 28010 SR34@Ch 28430 Further GI required to define bedrock for preliminary design.	Phase 1: 3 Phase 2: 7 Phase 3: 7 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S41	28810-29560	750	23 span viaduct	SR35@Ch 29050 FR37@Ch 29350 SR36@Ch 29550 Inadequate number of boreholes and bedrock not defined. Suggest additional four boreholes including rotary core to enable preliminary design.	Phase 1: 7 Phase 2: 22 Phase 3: 22 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S42	31630-31650	20	Single span viaduct	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 2 Phase 3: 2
S43	32050-32250	200	3 span bridge	FR42@Ch 32090 Further GI required to define bedrock for preliminary design	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S44	32380-32530	150	3 span viaduct	FR43@Ch 32600 Additional borehole required at north abutment.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S45	33420-32580	160	3 span bridge	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 4 Phase 3: 4
S46	34240-34460	220	3 span viaduct	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 4 Phase 3: 4
S47	35190-35230	40	Single span viaduct	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 2 Phase 3: 2
S48	35340-35650	310	4 span viaduct	None GI needed to enable preliminary design.	Phase 1: 2 Phase 2: 5 Phase 3: 5

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S49	36200-36900	700	15 span viaduct	FR48@Ch 36230 FR49@Ch 36850 GI inadequate for length of structure. Also FR49 does not define bedrock and model is therefore incomplete.	Phase 1: 6 Phase 2: 14 Phase 3: 14 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S50	37730-38620	890	17 span bridge	SR44@Ch 37800 FR51@Ch 38110 GI inadequate for length of structure. Also FR51 does not define bedrock and model is therefore incomplete.	Phase 1: 5 Phase 2: 17 Phase 3: 17 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.

Section II – Cornetu – Tigveni

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S51	40630-40750	120	3 span bridge	FR56@Ch 40+590 SR45@Ch 40+750 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S52	41580-41740	160	4 span bridge	None GI needed to enable preliminary design.	Phase 1: 2 Phase 2: 5 Phase 3: 5
S53	41800-41900	100	2 span bridge	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 3 Phase 3: 3
S54	42200-42250	50	Single span bridge	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 2 Phase 3: 2
S55	43800-44380	580	11 span bridge	FR57@Ch 44+110 FR58@Ch 44+400 Adequate for preliminary design	Phase 1: 4 Phase 2: 11 Phase 3: 11 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S56	44470-44570	100	2 span bridge	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 2 Phase 3: 2
S57	44620-44800	180	4 span bridge	SR52@Ch 44+680 FR59@Ch 44+770 Additional borehole required at north abutment to define bedrock and complete ground model.	Phase 1: 2 Phase 2: 5 Phase 3: 5 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S58	44950-45150	200	5 span bridge	FR61@Ch 45+000 FR62@Ch 45+200 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 2 Phase 2: 6 Phase 3: 6 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S59	45330-45420	90	3 span viaduct	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 4 Phase 3: 4

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S60	45860-46270	410	6 span viaduct	SR54@Ch 45+950 FR63@Ch 46+280 Additional borehole required at north abutment to define bedrock and complete ground model.	Phase 1: 2 Phase 2: 7 Phase 3: 7 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S61	47300-47740	440	9 span viaduct	SR57@Ch 47+500 FR64@Ch 47+700 Additional borehole required at north abutment to define bedrock and complete ground model.	Phase 1: 3 Phase 2: 9 Phase 3: 9 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S62	47880-48930	1140, 340 & 340	17 span semi-viaduct, 6 span semi-viaduct, 6 span semi-viaduct	SR58@Ch 48+250 FR65@Ch 48+600 FR66@Ch 48+900 GI inadequate for length of structure. Also SR 58 is of insufficient depth to define the ground model.	Phase 1: 6 Phase 2: 16 Phase 3: 16 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S63	49120-49280	160	3 span Viaduct	FR67@Ch 49+210 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S64	49370-49520	150	3 span Viaduct	FR68@Ch 49+510 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S65	49840-50280	440	6 span Viaduct	FR70@Ch 50+200 Additional borehole required at north abutment to define bedrock and complete ground model. FR69 considered too distant from structure.	Phase 1: 2 Phase 2: 6 Phase 3: 6 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S66	50470-50580	110	3 span Viaduct	FR71@Ch 50+600 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S67	51180-51530	350	9 span Viaduct	SR59@Ch 51+350 FR73@Ch 51+500 GI inadequate for length of structure. Also SR59 is of insufficient depth to define the ground model.	Phase 1: 3 Phase 2: 9 Phase 3: 9 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S68	53320-53500	180	4 span Viaduct	SR64@Ch 53+500 Additional borehole required to define bedrock and complete preliminary ground model.	Phase 1: 2 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S69	54920-54940	20	Single span structure	SR68@Ch 54+950 Additional borehole required to define bedrock and complete preliminary ground model.	Phase 1: 1 Phase 2: 1 Phase 3: 1 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S70	57740-58230	490	6 span Viaduct	SR71@Ch 57+800 FR77@Ch 58+030 Additional borehole required at north abutment to define bedrock and complete ground model.	Phase 1: 2 Phase 2: 6 Phase 3: 6 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S71	58290-58470	180	3 span Viaduct	SR72@Ch 58+410 Additional borehole required to define bedrock and complete preliminary ground model.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S72	58710-58870	160	3 span viaduct	SR73@Ch 58+670 FR78@Ch 58+810 Additional borehole required at north abutment to define bedrock and complete ground model.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S73	58960-59110	150	3 span viaduct	SR74@Ch 58+970 Additional borehole required to define bedrock and complete preliminary ground model.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S74	59220-59420	200	3 span viaduct	SR75@Ch 59+200 SR76@Ch 59+310 SR77@Ch 59+410 Additional borehole required to define bedrock and complete preliminary ground model.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S75	59570-60010	440	9 span viaduct	FR79@Ch 59+610 FR80@Ch 59+860 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 3 Phase 2: 9 Phase 3: 9 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S76	60210-60650	440	6 span viaduct	SR78@60+370 FR81@60+650 Additional borehole required at north abutment to define bedrock and complete ground model.	Phase 1: 2 Phase 2: 6 Phase 3: 6 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S77	60780-60930	150	3 span viaduct	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 4 Phase 3: 4
S78	61280-61330	50	3 span viaduct	FR82@Ch 61+350 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S79	61770-62100	330	6 span viaduct	FR83@Ch 61+820 Additional borehole required at south abutment to define bedrock and complete ground model.	Phase 1: 2 Phase 2: 6 Phase 3: 6 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S80	62160-62340	170, 100, 40	3 span viaduct, 3 span viaduct, single span viaduct	None GI needed to enable preliminary design.	Phase 1: 3 Phase 2: 7 Phase 3: 7
S81	63800-64040	240	4 span viaduct	SR84@Ch 63+870 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 2 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S82	64260-64720	460	6 span bridge	None GI needed to enable preliminary design. Borehole FR86 considered too distant from structure.	Phase 1: 2 Phase 2: 6 Phase 3: 6

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S83	65380-65970	590	9 span bridge	FR87@Ch 65+510 SR86@Ch 65+900 Additional borehole required at south abutment to define bedrock and complete ground model.	Phase 1: 3 Phase 2: 9 Phase 3: 9 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S84	67560-67710	150	3 span bridge	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 4 Phase 3: 4
S85	68900-69080	180	3 span bridge	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 4 Phase 3: 4
S86	69220-69240	20	Over bridge	FR91@Ch 69+220 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 1 Phase 3: 1 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S87	69760-69930	170	3 span bridge	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 4 Phase 3: 4

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S88	70700-70920	220	3 span viaduct	FR94@Ch 70+860 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S89	71520-72380	860	12 span viaduct	SR96@Ch 71+560 SR97@Ch 71+900 FR95@Ch 72+230 GI inadequate for length of structure. Also SR96 and SR97 are of insufficient depth to define the ground model.	Phase 1: 4 Phase 2: 11 Phase 3: 11 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S90	74120-74320	200	5 span bridge	SR102@Ch 74+260 GI needed to enable preliminary design.	Phase 1: 2 Phase 2: 5 Phase 3: 5 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S91	75470-75600	130	3 span bridge	FR98@Ch 75+570 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S92	76240-76470	230	6 span bridge	SR107@Ch76+340 Additional borehole required to define bedrock and complete preliminary ground model.	Phase 1: 2 Phase 2: 6 Phase 3: 6 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S93	76800-76940	140	3 span bridge	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 4 Phase 3: 4
S94	77240-77600	360	6 span viaduct	SR109@Ch77+250 FR100A@Ch77+560 Additional borehole required at north abutment to define bedrock and complete ground model.	Phase 1: 2 Phase 2: 6 Phase 3: 6 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.

Section III – Tigveni - Pitesti

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S95	79860-78980	120	3 span viaduct	SR104bis@Ch 78+890 Additional borehole required to define bedrock and complete preliminary ground model.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S96	79120-79800	630	7 span viaduct	FR100bis@Ch79+180 SR105B@Ch 79+420 FR101B@Ch 79+570 SR106B@Ch 79+710 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 3 Phase 2: 7 Phase 3: 7 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S97	82830-83230	420	6 span bridge	SR108B @ Ch 82+900 Additional borehole required to greater depth to complete preliminary ground model.	Phase 1: 2 Phase 2: 6 Phase 3: 6 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S98	83940-84040	100	3 span viaduct	SR111@Ch 83+960 Additional borehole required to greater depth to complete preliminary ground model.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S99	84100-84270	170	4 span viaduct	FR105B@Ch 84+160 Laboratory investigations needed in order to determine foundation design parameters.	Phase 1: 2 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S100	85850-86550	700	12 span viaduct	SR114@Ch85+900 SR115@Ch86+000 SR116@Ch86+250 FR108B@86+500 Deeper boreholes required towards north end of structure as SR114, SR115 and SR166 considered inadequate.	Phase 1: 4 Phase 2: 12 Phase 3: 12 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S101	87000-87570	570	9 span viaduct	FR109@Ch87+250 SR117@CH87+450 Additional borehole required on north bank of river.	Phase 1: 3 Phase 2: 9 Phase 3: 9 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S102	88100-88200	100	3 span viaduct	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 4 Phase 3: 4
S103	91150-91580	430	9 span viaduct	FR112@Ch91+450 Additional borehole required on north bank of river.	Phase 1: 3 Phase 2: 8 Phase 3: 8 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S104	92720-92740	20	Single span viaduct	FR113@Ch92+700 Laboratory investigations needed to determine foundation design parameters.	Phase 1: 1 Phase 2: 1 Phase 3: 1 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S105	94640-94690	50	Single span viaduct	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 1 Phase 3: 1
S106	95050-95550	510	9 span viaduct	None GI needed to enable preliminary design.	Phase 1: 3 Phase 2: 8 Phase 3: 8
S107	98250-100070	1820	14 span bridge	SR133@Ch 98+350 SR134@Ch 98+600 FR116@Ch 98+850 SR135@Ch 99+000 SR136@Ch 99+450 FR117@Ch 99+800 SR136bis@Ch 100+100 Further GI required to complete the preliminary ground model: suggest a further 5 boreholes similar to the "FR" series which go to sufficient depth to define the model.	Phase 1: 6 Phase 2: 13 Phase 3: 13 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S108	104000-104510	510	9 span viaduct	FR121@Ch104+250 Additional 2 boreholes required to define preliminary ground model.	Phase 1: 3 Phase 2: 8 Phase 3: 8 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S109	104680-104710	30	Single span bridge	None GI needed to enable preliminary design.	Phase 1: 1 Phase 2: 1 Phase 3: 1

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S110	105400-105600	200	6 span bridge	FR122@Ch105+600 Additional borehole required at north abutment to define bedrock and complete ground model.	Phase 1: 2 Phase 2: 6 Phase 3: 6 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.
S111	105750-106870	1120	10 span viaduct	SR141@105+830 SR142@106+080 FR123@106+300 SR143@106+500 FR124@107+100 Further GI required to complete the preliminary ground model: suggest a further 3 boreholes similar to the "FR" series which go to sufficient depth to define the model.	Phase 1: 4 Phase 2: 10 Phase 3: 10 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S112	108200-108300	100	3 span viaduct	SR145@108+200 Additional borehole required to define bedrock and complete ground model.	Phase 1: 1 Phase 2: 4 Phase 3: 4 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Structure No.	Ch	Length (m)	Description	GI info available	Additional boreholes required
S113	108750-109200	450	9 span viaduct	FR125@108+700 SR146@108+900 Additional borehole required at south abutment to define bedrock and complete ground model.	Phase 1: 3 Phase 2: 8 Phase 3: 8 If the existing boreholes have the same stratification like the new ones and reach bedrock, then they can be considered valid.
S114	109750-109980	230	6 span viaduct	FR126@ 109+840	Phase 1: 2 Phase 2: 6 Phase 3: 6 If the existing borehole has the same stratification, like the new ones and reach bedrock, then it can be considered valid.

Table 2 - Summary of Ground Investigations Information at Tunnels

Tunnel	Chainage	Length (m)	Approx. Maximum Depth (m)	Approx. Minimum Cover <20m	Additional Boreholes Required
Lazaret Nord	19180 to 20240	1060	250	-	Phase 1: 10 Phase 2: 10
Lazaret Sud	20370 to 20700	330	60	-	Phase 1: 4 Phase 2: 4
Caineni A (north)	26390 to 26940	550	175	-	Phase 1: 6 Phase 2: 6
Caineni B (cut and cover)	26940 to 27080	140	Cut and Cover	Min 2m	Phase 1: 2 Phase 2: 2
Caineni C (south)	27080 to 27980	900	240	-	Phase 1: 9 Phase 2: 9
Robesti	30550 to 31450	900	60	<20	Phase 1: 10 Phase 2: 10
Balota	35745 to 36200	455	50	<15m	Phase 1: 4 Phase 2: 4
Poiana	55135 to 56835	1700	110	-	Phase 1: 17 Phase 2: 17
Curtea de Arges	80800 to 82150	1350	85	-	Phase 1: 13 Phase 2: 13

Table 3: Register of Ground Investigations Information for Embankments

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E1	0-440	440	3.3	FR1@Ch 0 FR2@Ch 440	Phase 1: 2 Phase 2: 4 Phase 3: 4 Adequate for preliminary design only.
E2	440-600	160	1.0	FR2@Ch 440	Phase 1: 1 Phase 2: 2 Phase 3: 2 Adequate for preliminary design only.
E3	880-1040	160	6.7	SR2	Phase 1: 1 Phase 2: 2 Phase 3: 2 Depth of SR2 is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E4	1560-2660	1100	5.7	SR4, SR5, SR6, SR7	Phase 1: 5 Phase 2: 10 Phase 3: 10 Depth of boreholes is inadequate for preliminary embankment design. Borehole spacing is >200m. Ground model is not fully defined at this location.
E5	3490-5280	1790	6.3	SR10, SR11, SR12, SR13	Phase 1: 6 Phase 2: 18 Phase 3: 18 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E6	6540-7080	540	4.1	SR16, SR16B	Phase 1: 3 Phase 2: 5 Phase 3: 5 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E7	7280-7780	500	7.8	SR17, SR18	Phase 1: 2 Phase 2: 5 Phase 3: 5 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E8	8080-8120	40	3.4	FR9	Phase 1: 1 Phase 2: 0 Phase 3: 0 Adequate for preliminary design only.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E9	8800-9800	1000	7.6	SR20	Phase 1: 4 Phase 2: 10 Phase 3: 10 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E10	10000-10300	300	2.8	SR21, FR11	Phase 1: 1 Phase 2: 3 Phase 3: 3 Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E11	10460-11130	670	7.6	FR12, FR13	Phase 1: 3 Phase 2: 6 Phase 3: 6 Additional boreholes required as spacing is too great to define preliminary ground model. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E12	12600-12760	160	2.0	FR16	Phase 1: 1 Phase 2: 2 Phase 3: 2 Adequate for preliminary design only.
E13	13100-13280	180	4.4	SR24	Phase 1: 1 Phase 2: 2 Phase 3: 2 Adequate for preliminary design only.
E14	14740-14920	180	3.8	None	Phase 1: 1 Phase 2: 2 Phase 3: 2 GI needed to enable preliminary design.
E15	15060-15220	160	5.1	FR20	Phase 1: 1 Phase 2: 2 Phase 3: 2 Adequate for preliminary design only.
E16	17100-17240	140	4.6	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E17	21000-21150	150	6.2	SR30	Phase 1: 1 Phase 2: 1 Phase 3: 1 Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E18	21170-21280	110	4.1	SR30	Phase 1: 1 Phase 2: 1 Phase 3: 1 Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E19	21740-21840	100	4.9	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
E20	23960-24180	220	4.8	None	Phase 1: 1 Phase 2: 2 Phase 3: 2 GI needed to enable preliminary design.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E21	24300-24440	140	2.6	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
E22	24480-24540	60	5.2	None	Phase 1: 1 Phase 2: 0 Phase 3: 0 GI needed to enable preliminary design.
E23	24600-24720	120	1.0	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
E24	24800-24980	180	7.6	FR41	Phase 1: 1 Phase 2: 1 Phase 3: 1 Adequate for preliminary design only.
E25	31650-31820	170	1.0	FR33	Phase 1: 1 Phase 2: 1 Phase 3: 1 Adequate for preliminary design only.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E26	32250-32380	130	5.7	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
E27	35230-35340	110	3.2	SR43	Phase 1: 1 Phase 2: 1 Phase 3: 1 Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E28	35650-35750	100	7.8	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
E29	36900-37730	830	6.8	FR50	Phase 1: 4 Phase 2: 8 Phase 3: 8 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E30	37350-37420 (within structure)	70	5.0	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
E31	38620-39340	720	5.5	FR52, FR53, FR54	Phase 1: 3 Phase 2: 7 Phase 3: 7 Adequate for preliminary design only.
E32	39650-40580	930	6.0	FR55, FR56	Phase 1: 4 Phase 2: 9 Phase 3: 9 Additional boreholes required as spacing is too great to define preliminary ground model.
E33	40750-41600	850	6.1	SR45, SR46, SR47	Phase 1: 4 Phase 2: 8 Phase 3: 8 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E34	41700-41800	100	1.7	None	Phase 1: 0 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
E35	41900-42200	300	4.7	SR48	Phase 1: 1 Phase 2: 3 Phase 3: 3 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E36	42250-43800	1550	6.2	SR49, SR50, SR51	Phase 1: 3 Phase 2: 15 Phase 3: 15 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E37	47200-47300	100	4.9	SR56	Phase 1: 1 Phase 2: 1 Phase 3: 1 Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E38	52700-53320	620	6.1	SR63	Phase 1: 3 Phase 2: 6 Phase 3: 6 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E39	53500-53860	360	10.5	SR64, FR74, SR65	Phase 1: 2 Phase 2: 3 Phase 3: 3 Adequate for preliminary design only.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E40	56930-57040	110	2.5	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
E41	62100-62150	50	2.9	None	Phase 1: 1 Phase 2: 0 Phase 3: 0 GI needed to enable preliminary design.
E42	62360-62520	160	6.7	SR80	Phase 1: 1 Phase 2: 1 Phase 3: 1 Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E43	63330-63440	110	3.3	SR82	Phase 1: 1 Phase 2: 1 Phase 3: 1 Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E44	63740-63800	60	4.2	None	Phase 1: 1 Phase 2: 0 Phase 3: 0 GI needed to enable preliminary design.
E45	64720-64900	180	5.3	FR86	Phase 1: 1 Phase 2: 1 Phase 3: 1 Adequate for preliminary design only.
E46	65100-65360	260	7.4	SR85	Phase 1: 2 Phase 2: 2 Phase 3: 2 Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E47	65970-67560	1590	7.0	FR88, FR89	Phase 1: 5 Phase 2: 16 Phase 3: 16 Additional boreholes required as spacing is too great to define preliminary ground model. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E48	67710-68900	1190	5.5	FR90	Phase 1: 4 Phase 2: 12 Phase 3: 12 Additional boreholes required as spacing is too great to define preliminary ground model.
E49	69080-69780	700	5.7	FR91, FR92	Phase 1: 4 Phase 2: 6 Phase 3: 6 Additional boreholes required as spacing is too great to define preliminary ground model.
E50	69930-70700	770	5.5	SR93, FR93, SR94	Phase 1: 4 Phase 2: 7 Phase 3: 7 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E51	70920-71520	600	6.0	SR95, SR96	Phase 1: 2 Phase 2: 6 Phase 3: 6 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E52	72380-74120	1740	5.1	SR98, SR99, SR100, SR101, FR96	Phase 1: 5 Phase 2: 18 Phase 3: 18 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E53	74320-75470	1150	5.9	SR103, FR97, SR104, SR105	Phase 1: 5 Phase 2: 11 Phase 3: 11 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E54	75600-76240	640	7.0	SR106	Phase 1: 3 Phase 2: 6 Phase 3: 6 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E55	76470-76820	350	8.4	FR99	Phase 1: 2 Phase 2: 3 Phase 3: 3 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E56	77600-78480	880	2.7	SR110, FR101A	Phase 1: 3 Phase 2: 9 Phase 3: 9 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E57	78640-78860	220	7.9	SR103bis, SR104bis	Phase 1: 1 Phase 2: 2 Phase 3: 2 Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E58	78860-79140	280	7.4	none	Phase 1: 1 Phase 2: 3 Phase 3: 3 GI needed to enable preliminary design.
E59	82320-82450	130	6.5	FR104	Phase 1: 1 Phase 2: 1 Phase 3: 1 Adequate for preliminary design only.
E60	82600-82830	230	4.9	none	Phase 1: 1 Phase 2: 2 Phase 3: 2 GI needed to enable preliminary design.
E61	83230-83320	90	3.5	none	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E62	84000-84100	100	1.4	none	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
E63	84270-84340	70	3.9	SR112	Phase 1: 1 Phase 2: 1 Phase 3: 1 Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E64	84800-84940	140	5.8	none	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
E65	85280-85850	570	7.5	SR113	Phase 1: 3 Phase 2: 5 Phase 3: 5 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E66	86550-87000	450	4.3	none	Phase 1: 2 Phase 2: 4 Phase 3: 4 GI needed to enable preliminary design.
E67	87570-88100	530	4.2	SR118, SR118bis	Phase 1: 2 Phase 2: 5 Phase 3: 5 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E68	88100-91150	3050	6.9	SR119, FR110, Sr120, SR121, FR111, Sr122, Sr123	Phase 1: 10 Phase 2: 31 Phase 3: 31 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E69	91580-92680	1100	6.3	SR124, SR125	Phase 1: 4 Phase 2: 11 Phase 3: 11 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E70	92760-94680	1920	5.3	SR126, SR127, SR129bis	Phase 1: 9 Phase 2: 18 Phase 3: 18 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E71	94700-95050	350	5.7	FR114	Phase 1: 2 Phase 2: 3 Phase 3: 3 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E72	95550-98250	2700	6.3	SR130, FR115, Sr131, SR132, FR115B	Phase 1: 11 Phase 2: 26 Phase 3: 26 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E73	100070-101600	1530	5.5	SR136bis, FR118, Sr137	Phase 1: 6 Phase 2: 15 Phase 3: 15 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E74	101600-104100	2500	6.5	SR138, FR120, SR139, SR139B	Phase 1: 10 Phase 2: 25 Phase 3: 25 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E75	104500-104690	190	6.2	none	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E76	104720-105400	680	5.0	FR121B, SR140	Phase 1: 2 Phase 2: 7 Phase 3: 7 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E77	105600-105750	150	6.4	none	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
E78	106870-108200	1330	6.4	FR124, SR144, SR145	Phase 1: 5 Phase 2: 13 Phase 3: 13 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Embankment No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
E79	108300-108750	450	4.7	none	Phase 1: 2 Phase 2: 4 Phase 3: 4 GI needed to enable preliminary design.
E80	109200-109750	550	6.9	SR147	Phase 1: 2 Phase 2: 5 Phase 3: 5 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.
E81	109980-116650	6670	3.8	SR148, SR149, SR150, Fr127, SR151, FR128, SR152, Sr153, SR154, SR155, FR129, Sr156, SR157, SR158, FR129, FR130	Phase 1: 25 Phase 2: 66 Phase 3: 66 Additional boreholes required as spacing is too great to define preliminary ground model. Depth of boreholes is inadequate for preliminary embankment design. Ground model is not fully defined at this location.

Table 4: Register of Ground Investigations Information for Cuttings

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C1	600-880	280	2.0	SR1	Phase 1: 1 Phase 2: 3 Phase 3: 3 Adequate for preliminary design only.
C2	2660-2920	260	4.0	SR8, FR4	Phase 1: 1 Phase 2: 3 Phase 3: 3 Adequate for preliminary design only.
C3	2920-3490	570	2.9	FR4, SR9, SR10	Phase 1: 2 Phase 2: 5 Phase 3: 5 Adequate for preliminary design only.
C4	6100-6220	120	10.0	SR15	Phase 1: 1 Phase 2: 1 Phase 3: 1 A deeper borehole is required to extend below base of proposed cutting and enable definition of ground model.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C5	6320-6540	220	1	SR16	Phase 1: 1 Phase 2: 2 Phase 3: 2 A second borehole is required at the north end to enable definition of the ground model.
C6	7780-8080	300	7.6	SR12, FR9	Phase 1: 1 Phase 2: 3 Phase 3: 3 Both boreholes lie outwith the footprint of the cutting – a further borehole is required within cutting footprint.
C7	11630-11950	320	19m rock cutting with anchors. Reinforced earth structure.	SR22	Phase 1: 1 Phase 2: 3 Phase 3: 3 A second borehole is required at the north end to enable definition of the ground model.
C8	12100-12260	160	13.4 (TBC)	FR15	Phase 1: 1 Phase 2: 2 Phase 3: 2 A second borehole is required at the south end to enable definition of the ground model.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C9	12880-13100	220	7.0	None	Phase 1: 1 Phase 2: 2 Phase 3: 2 GI needed to enable preliminary design.
C10	13700-14040	340	TBC	FR17, FR18	Phase 1: 1 Phase 2: 3 Phase 3: 3 Adequate for preliminary design only.
C11	14260-14600	340	TBC	SR24bis, FR19	Phase 1: 1 Phase 2: 3 Phase 3: 3 A deeper borehole is required at north end to extend below base of proposed cutting and enable definition of ground model.
C12	15340-15610	270	3.9	SR25	Phase 1: 1 Phase 2: 2 Phase 3: 2 A second borehole is required at the south end to enable definition of the ground model.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C13	15680-15920	240	1.0	FR21	Phase 1: 1 Phase 2: 3 Phase 3: 3 A second borehole is required at the north end to enable definition of the ground model.
C14	16340-16640	300	7.6	FR22	Phase 1: 1 Phase 2: 3 Phase 3: 3 A second borehole is required at the north end to enable definition of the ground model.
C15	16960-17000	40	1.0	None	Phase 1: 1 Phase 2: 0 Phase 3: 0 GI needed to enable preliminary design.
C16	17060-17100	40	2.5	None	Phase 1: 1 Phase 2: 0 Phase 3: 0 GI needed to enable preliminary design.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C17	17240-17440	200	6	FR23	Phase 1: 1 Phase 2: 2 Phase 3: 2 Adequate for preliminary design only.
C18	17850-18480	630	TBC	SR28, FR24	Phase 1: 1 Phase 2: 6 Phase 3: 6 Both boreholes lie outwith the footprint of the cutting – a further borehole 2 boreholes are required within cutting footprint.
C19	18820-19060	240	TBC	SR29, FR25	Phase 1: 1 Phase 2: 3 Phase 3: 3 Both boreholes lie outwith the footprint of the cutting – a further borehole is required within cutting footprint.
C20	21280-21740	460	5.4	None	Phase 1: 1 Phase 2: 5 Phase 3: 5 GI needed to enable preliminary design.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C21	22140-22770	630	TBC	SR31, FR29	Phase 1: 2 Phase 2: 7 Phase 3: 7 Spacing of boreholes is too great and a further borehole is required to determine preliminary ground model.
C22	22900-23280	380	TBC	None	Phase 1: 1 Phase 2: 4 Phase 3: 4 GI needed to enable preliminary design.
C23	23340-23720	380	TBC	None	Phase 1: 1 Phase 2: 4 Phase 3: 4 GI needed to enable preliminary design.
C24	25300-26000	700	TBC	SR33	Phase 1: 2 Phase 2: 7 Phase 3: 7 Spacing of boreholes is too great and further 3 boreholes of adequate depth are required to determine preliminary ground model.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C25	28580-28810	230	TBC	None	Phase 1: 1 Phase 2: 2 Phase 3: 2 GI needed to enable preliminary design.
C26	29560-29950	390	TBC	FR38	Phase 1: 1 Phase 2: 4 Phase 3: 4 A second borehole is required at the north end to enable definition of the ground model.
C27	29960-30150	190	7.8	SR37	Phase 1: 1 Phase 2: 2 Phase 3: 2 A deeper borehole is required to extend below base of proposed cutting and enable definition of ground model.
C28	30160-30220	60	7.5	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C29	30230-30540	310	TBC	SR38, FR39	Phase 1: 1 Phase 2: 3 Phase 3: 3 A deeper borehole is required at north end to extend below base of proposed cutting and enable definition of ground model.
C30	31460-31630	170	8.0	FR40	Phase 1: 1 Phase 2: 2 Phase 3: 2 Adequate for preliminary design only.
C31	31380-32050	220	1.0	None	Phase 1: 1 Phase 2: 2 Phase 3: 2 GI needed to enable preliminary design.
C32	32560-32920	360	TBC	FR43, SR39	Phase 1: 1 Phase 2: 3 Phase 3: 3 Adequate for preliminary design, if FR43 is included.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C33	32930-33420	490	6.7	SR40	Phase 1: 1 Phase 2: 5 Phase 3: 5 A deeper borehole is required at north end to extend below base of proposed cutting and enable definition of ground model.
C34	33580-34240	660	7.9	FR44, SR41	Phase 1: 2 Phase 2: 7 Phase 3: 7 A deeper borehole is required at south end to extend below base of proposed cutting and enable definition of ground model.
C35	34540-34860	320	TBC	SR42	Phase 1: 1 Phase 2: 3 Phase 3: 3 A deeper borehole is required at south end to extend below base of proposed cutting and enable definition of ground model.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C36	34880-35190	310	6.6	FR46	Phase 1: 1 Phase 2: 3 Phase 3: 3 An additional borehole to the north of FR46 is required to allow determination of preliminary ground model.
C37	39340-39630	290	TBC	None	Phase 1: 1 Phase 2: 3 Phase 3: 3 GI needed to enable preliminary design.
C38	44380-44470	90	8.2	FR58	Phase 1: 1 Phase 2: 1 Phase 3: 1 Adequate for preliminary design only.
C39	44570-44620	50	TBC	None	Phase 1: 1 Phase 2: 0 Phase 3: 0 GI needed to enable preliminary design.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C40	44800-44950	150	1.0	FR60	Phase 1: 1 Phase 2: 1 Phase 3: 1 Adequate for preliminary design only.
C41	45150-45330	180	TBC	FR62	Phase 1: 1 Phase 2: 2 Phase 3: 2 Adequate for preliminary design only.
C42	45420-45860	440	6.6	SR53	Phase 1: 1 Phase 2: 5 Phase 3: 5 A deeper borehole is required at south end to extend below base of proposed cutting and enable definition of ground model.
C43	46270-47200	930	9.2	SR55, SR56	Phase 1: 2 Phase 2: 9 Phase 3: 9 A further 5 boreholes of adequate depth are required to allow determination of the preliminary ground model.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C44	47740-47880	140	1.0	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
C45	48320-48520	200	TBC	None	Phase 1: 1 Phase 2: 2 Phase 3: 2 GI needed to enable preliminary design.
C46	48930-49120	190	TBC	None	Phase 1: 1 Phase 2: 2 Phase 3: 2 GI needed to enable preliminary design.
C47	49280-49370	90	TBC	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
C48	49520-49840	320	6.1	FR68, FR69	Phase 1: 1 Phase 2: 3 Phase 3: 3 Adequate for preliminary design

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C49	50280-50470	190	TBC	None	Phase 1: 1 Phase 2: 2 Phase 3: 2 GI needed to enable preliminary design.
C50	50580-51180	600	TBC	FR71, FR72	Phase 1: 2 Phase 2: 6 Phase 3: 6 A deeper borehole is required at south end to extend below base of proposed cutting and enable definition of ground model.
C51	51180-52700	1520	TBC	SR60, SR61, SR62	Phase 1: 3 Phase 2: 15 Phase 3: 15 A further 8 boreholes of adequate depth are required to allow determination of the preliminary ground model.
C52	53860-55100	1240	TBC	SR65, SR66, SR67, SR68, FR75	Phase 1: 3 Phase 2: 13 Phase 3: 13 Adequate for preliminary design only.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C53	56830-56930	100	TBC	FR76	Phase 1: 1 Phase 2: 1 Phase 3: 1 Adequate for preliminary design only.
C54	57040-57740	700	2.4	SR69, SR70	Phase 1: 2 Phase 2: 7 Phase 3: 7 Spacing of boreholes is too great and a further borehole is required to determine preliminary ground model.
C55	58230-58290	60	5.5	None	Phase 1: 1 Phase 2: 0 Phase 3: 0 GI needed to enable preliminary design.
C56	58470-58710	240	TBC	SR73	Phase 1: 1 Phase 2: 2 Phase 3: 2 Spacing of boreholes is too great and a further borehole is required to determine preliminary ground model.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C57	58870-58960	90	TBC	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
C58	59110-59220	110	6.5	SR75	Phase 1: 1 Phase 2: 1 Phase 3: 1 Adequate for preliminary design only.
C59	59420-59570	150	TBC	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
C60	60010-60230	220	6.6	None	Phase 1: 1 Phase 2: 2 Phase 3: 2 GI needed to enable preliminary design.
C61	60650-60780	130	1.0	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C62	60930-61280	350	TBC	SR79	Phase 1: 1 Phase 2: 3 Phase 3: 3 A deeper borehole is required at south end to extend below base of proposed cutting and enable definition of ground model.
C63	61330-61770	440	TBC	None	Phase 1: 1 Phase 2: 4 Phase 3: 4 GI needed to enable preliminary design.
C64	62320-32360	40	2.7	None	Phase 1: 1 Phase 2: 0 Phase 3: 0 GI needed to enable preliminary design.
C65	62520-63300	780	TBC	SR81, FR84	Phase 1: 2 Phase 2: 8 Phase 3: 8 A deeper borehole is required at south end to extend below base of proposed cutting and enable definition of ground model.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C66	63440-63740	300	7	SR83	Phase 1: 1 Phase 2: 3 Phase 3: 3 Additional 2 boreholes required at to define ground model.
C67	64020-64260	240	4.1	FR85	Phase 1: 1 Phase 2: 3 Phase 3: 3 Additional borehole required at south end to define ground model.
C68	64900-65120	220	2.3	None	Phase 1: 1 Phase 2: 2 Phase 3: 2 GI needed to enable preliminary design.
C69	76940-77240	300	1.9	SR108, SR109	Phase 1: 1 Phase 2: 3 Phase 3: 3 Adequate for preliminary design only.
C70	78480-78640	160	3.5	SR103bis	Phase 1: 1 Phase 2: 2 Phase 3: 2 Adequate for preliminary design only.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C71	79800-80800	1000	TBC	FR102, SR107B, FR103	Phase 1: 2 Phase 2: 10 Phase 3: 10 A further 3 boreholes within the centre of the cutting are required to adequately determine the preliminary ground model.
C72	82140-82320	180	TBC	None	Phase 1: 1 Phase 2: 2 Phase 3: 2 GI needed to enable preliminary design.
C73	82460-82600	140	TBC	None	Phase 1: 1 Phase 2: 1 Phase 3: 1 GI needed to enable preliminary design.
C74	83320-83930	610	TBC	FR105, SR109B	Phase 1: 2 Phase 2: 6 Phase 3: 6 Additional borehole required at south end to define ground model.

Cutting No.	Chainages	Length (m)	Hmax (m)	GI info	Additional boreholes required
C75	84340-84800	460	6.5	FR106, FR107	Phase 1: 1 Phase 2: 5 Phase 3: 5 Adequate for preliminary design
C76	84940-85280	340	9.8	FR108	Phase 1: 1 Phase 2: 3 Phase 3: 3 Additional borehole required at south end to define ground model.

Based on the existing Feasibility Study, dated 2008, a total of 81 culverts have been proposed and it is considered that a single borehole per culvert would be appropriate. The final number of boreholes will depend on the number of culverts proposed by the Consultant.

It shall be noted that the data relating to the existing Geotechnical Study, dated 2008, presented within the Tables 1, 2, 3 and 4 is for information only. The inclusion of this data as annex to the Terms of Reference does not imply that the information presented can be used in the design or in the development of the tenderers financial offers. As outlined within section 4.5.3.2.1, the data presented herein was not validated and no guarantee can be provided for its accuracy.

The number of additional boreholes relating to each element of the scheme given in Tables 1, 2, 3 and 4 must be adhered to by the Consultant.