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LIST OF TERMINOLOGY

Abiotic	Non-living e.g. rocks or minerals.
Anthropogenic	Anthropogenic effects, processes, objects, or materials are those that are derived from human activities, as opposed to those occurring in natural environments without human influences.
Baseline (or Existing) Conditions	The 'baseline' essentially comprises the factual understanding and interpretation of existing environmental, social and health conditions of where the business activity is proposed. Understanding the baseline shall also include those trends present within it, and especially how changes could occur regardless of the presence of the project, i.e. the 'No-development Option'.
Baseline studies	Work done to collect and interpret information on the condition/trends of the existing environment.
Benefit-cost analysis	A method of comparing alternative actions according to the relative costs incurred (technical, environmental and economic) and the relative benefits gained. The analysis can incorporate discounting calculations to take into account the time value of money.
Bentonite	A naturally found absorbent clay. Relatively small quantities of bentonite suspended in water form a viscous, shear thinning material. It is used during Horizontal Directional Drilling
Berm	A narrow ledge or mound made from earth typically placed at the top or bottom of a slope
Biodiversity	Biodiversity encompasses the variety of life in all its forms, levels and combinations, and the ecological networks in which they occur. It is assessed at three levels: ecosystem diversity, species diversity, and genetic diversity
Biological Reinstatement	Harrowing, cultivation and seeding the ROW to encourage vegetation growth
Biota	All the organisms, including animals, plants, fungi and micro-organisms in a given area.
Biotic	Pertaining to living organisms or life.
Bulk Dewatering	Removal of the hydrotest water from the section after completion of hydrotesting the pipe
Climate Change	Climate change refers to the variation in the Earth's global climate or in regional climates over time. In recent usage, especially in the context of environmental policy, the term "climate change" often refers only to the ongoing changes in modern climate, including the rise in average surface temperature known as global warming.

Conformance	Acting according to certain accepted standards
Compensation	Trade-offs between different parties affected by proposals to the mutual satisfaction of all concerned. For biodiversity: Measures taken to offset/compensate for residual adverse effects which cannot be entirely mitigated. These usually take the form of replacing (or at least trying to) what will be lost (e.g. the relocation of important grassland or heathland habitats from the development site to another area identified as suitable (using techniques such as soil or turf transfer), or the creation of new habitats.
Compliance	A situation in which a party fully meets the requirements of laws, rules and regulations
Consequence	An event or chain of events that result from an action (which may include the release of a hazard).
Controls	A protective measure put in place to prevent threats from releasing a hazard or mitigate the consequence of a hazard being released.
Corridor	A strip of a particular type that differs from the adjacent land on both sides. Corridors have several important functions, including conduit, barrier and habitat.
Crossing	The point where the pipeline has to be installed under a Road, River, Railway or other utility. Usually requires extra protection for the pipe, a specific construction technique, and additional permissions
Cumulative effects assessment	The assessment of the impact on the environment which results from the incremental impact of an action when added to other past, present or reasonably foreseeable actions regardless of what agency or person undertakes such actions. Cumulative impact can result from individually minor but collectively significant actions taking place over a period of time.
Discharge	The release of fluid. The discharge rate of a river can be calculated using flow velocity and area.
Ditch	A long narrow trench or furrow dug in the ground, as for irrigation, drainage, or a boundary line
Drainage	The natural or artificial removal of surface and sub-surface water from an area.
Ecosystem	A dynamic complex of plant, animal, fungal and microorganism communities and associated non-living environment interacting as an ecological unit (examples include deserts, forests, mangroves, coral reefs etc).
Ecosystem functions	Beneficial functions that are performed by natural ecosystems, such as maintenance of hydrological systems, protection of the soil, breakdown of pollutants, recycling of wastes, support for economically important living resources and regulation of climate.
Effect	An adverse, or beneficial, impact on people, the environment, Nabucco's reputation, damage or loss of

	assets.
Emission	Emission is most often the giving off of gases from industrial processes and the engine exhausts of transport vehicles.
Endemic	Native to, and restricted to, a particular geographical region; highly endemic species are those with very restricted natural ranges and they are especially vulnerable to extinction if their natural habitat is eliminated or significantly disturbed.
Enhancement	The actions taken to maximise positive benefits.
Environment	An environment is a complex of surrounding circumstances, conditions, or influences in which a thing is situated or is developed. Scientifically it is the complex of physical, chemical, and biotic factors that surround and act upon an organism or ecosystem. There is no generally agreed definition of environment in EIA. Increasingly, it means the complex web of inter-relationships between abiotic and biotic components which sustain all life on earth, including the social/health aspects of human group existence.
Environmental Impact Assessment (EIA)	An instrument to identify and assess the potential environmental impacts of a proposed project, evaluate alternatives, and design appropriate mitigation, management, and monitoring measures.
Environmental management system	A structured approach for determining, implementing and reviewing environmental policy through the use of a system which includes organisational structure, responsibilities, practices, procedures, processes and resources. Often formally carried out to meet the requirements of the ISO 14000 series
Exotic species	A species introduced from one region from another geographical region – otherwise known as an alien species.
Fauna	All of the animals found in a given area.
Fertiliser	Plant nutrients (mainly nitrogen, phosphorus, and potassium) added into soil artificially. There are organic fertilizers (e.g., manure, peat compost, etc.) and mineral fertilizers (e.g., ammonium nitrate, ammonium phosphate, potassium chlorine, various commercial fertilizers etc.). Very often organic and mineral fertilizers are used together
Filter	A layer of granular material or geotextile laid beneath an armour layer, revetment or underlayer, to prevent the passage of fine material.
Flora	All of the plants found in a given area.
Fragmentation	The breaking up of a habitat, ecosystem or land-use type into smaller parcels.
Guideline	Documents that contain additional non-mandatory information on an activity or process.

Habitat	The physical and biological environment on which a given species depends for its survival; the place or type of site where an organism or population naturally occurs.
Hazard	The potential to harm people or the environment, cause damage to or loss of assets, or adversely impact the reputation of Nabucco
Health Impact Assessment	Component of integrated assessment which focuses on health impacts of development actions. Most attention is concentrated on morbidity and mortality, but increasingly, the World Health Organisation (WHO) definition of health as being a state of 'social, physical and psychological well-being and not just the absence of disease' is being used to guide this type of assessment work.
Horizontal Directional Drill (HDD)	Drilling at a shallow angle under a feature (watercourse or road for example) back to the surface. The borehole is systematically enlarged before finally pulling through a section of pipeline. Bentonite is used as a lubrication and hole supporting medium.
Human environment	Man-made systems and structures including social and economic systems, and cultural and heritage resources.
Hydrotest	A completed section of pipeline is filled with water, often with oxygen scavenger and corrosion inhibiter chemicals. The water is then pumped up to a higher pressure level than is normally used when transporting oil or gas, and held at that higher pressure for a period of time, generally eight to ten hours to test the strength of the pipe and welds. Long sections of pipe are tested on completion of installation, backfilling and reinstatement activities. After a successful hydrotest the pipeline is treated as 'live' and activites conducted over the pipe are heavily restricted.
Impact	See below
Incident	An unforeseen and unplanned occurrence that has actual or potential adverse impact on the Company's people, assets, reputation or the environment.
Integrity	The coherence of a site's ecological/geological structure and function across its whole area that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was designated.
Invasive species	Alien species are those that occur outside their natural range. Those alien species that threaten the existence of native plants and animals or other aspects of biodiversity are termed alien invasive species
IUCN Categories	A globally recognised system of categorising protected areas to reduce confusion over terminology, to promote internationally agreed standards of protection and management, to help global accounting and comparisons, to demonstrate full range of protected area values, and to encourage governments to create systems of protected areas.

Maximum permissible concentration (MPC)	The MPC value is the concentration of a pollutant or chemical in the environment at the edge of a designated mixing zone that will have no impact on the receiving water body. MPCs are allowable water quality concentration limits for specific substances in a receiving water body. MPC levels are set by Russian Federation regulators and established via toxicity testing.
Maximum permissible discharge MPD	Waste streams are modelled to determine the mixing of the stream in the mixing zone. By this method, Russian authorities are able to determine if the waste stream will mix enough to allow each pollutant in the waste stream to meet its MPC value.
Measuring	A systematic method for estimating, testing and otherwise evaluating key parameters and characteristics of a project's activities to determine conformance with a specific standard or other performance requirement
Mitigation	The purposeful implementation of decisions or activities that are designed to reduce the undesirable impacts of a proposed action on the affected environment.
Monitoring	A systematic process of watching, checking, observing, inspecting, keeping track of, regulating and otherwise controlling key parameters and characteristics of a project's activities to determine conformance with a specific standard or other performance requirement, or to measure progress towards pre-determined objectives and targets.
Natural resources	Features that have ecological, economic, recreational, educational or aesthetic value.
Network	An interconnected system of corridors.
Niche	The 'space' or 'ecological role' occupied by a species and the resources used by a species.
Non-Compliance	Planned or unplanned deviation from the requirements of the legislation.
Organisation	A description of the positions and lines of accountability within a company, typically in the form of a chart.
Physical environment	Everything in nature that is not living (climate, weather, noise, topography, hydrogeology, soils, etc).
Pig	A device, which tightly fits inside the pipe and is propelled using fluids such as compressed air or water. BI- Directional Pig - A pig capable of being propelled in either direction inside the pipe
Population	A collection of individuals (plants and animals), all of the same species and in a defined geographical area.
Population density	The numbers in a population per unit area.
Precautionary	A principle of sustainability that where there are threats of serious or irreversible damage, the lack of full

principle	scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
Proactive Target Setting	Challenging and achievable goals that are established in a consultative manner
Project Affected Communities	Communities that are affected by Project activities or are within 2 km of those activities.
Proposal	Any project, policy, program, plan or other activity.
Public consultation	A range of techniques that can be used to inform, consult or interact with stakeholders affected by a proposal.
Recovery Measures	Technical, operational and organisational measures that limit the chain of consequences arising from a top event.
Resources	The human, physical, financial and intellectual assets that is available to an organisation to carry out its tasks. A renewable resource can renew itself or be renewed at a constant level. A non-renewable resource is one whose consumption necessarily involves its depletion
Responsibilities	Assignments of control and accountability within an organization.
Review	A structured evaluation of the effectiveness and suitability of a system
Risk	A combination of the frequency of occurrence of an undesired event and the severity of the consequences of that event.
Risk analysis	Technique used to determine the likelihood or chance of hazardous events occurring (such as release of a certain quantity of a toxic gas) and the likely consequences. Originally developed for use in nuclear and chemical industry where certain possible events, of low probability, could have extremely serious results. Attempts are being made to use concepts from probabilistic risk analysis to characterise environmental impacts, whose occurrence and nature are not easy to predict with any degree of accuracy.
Run off	Water flow over the ground surface to the drainage system. This occurs if the ground is impermeable or if permeable ground is saturated
Schedule	A plan for carrying out construction stages or operations, giving lists of intended events and times
Scoping	An early and open activity to identify the impacts that are most likely to be significant and require investigation during the EIA work. Can also be used to identify alternative project designs/sites to be assessed, obtain local knowledge of site and surroundings; and prepare a plan for public involvement. The results of scoping are frequently used

	to prepare a Terms of Reference for the EIA.
Screening	Preliminary activity undertaken to classify proposals according to the level of assessment that should occur.
Sedimentation	Sediment is any particulate matter that can be transported by fluid flow and which eventually is deposited as a layer of solid particles on the bed or bottom of a body of water or other liquid. Sedimentation is the deposition by settling of a suspended material Many sediments in rivers, lakes, and oceans are contaminated by pollutants.
SIA	Social Impact Assessment
Soil Compaction	Act of compressing soil during backfill or contouring slopes to add stability and as a first line of defense against surface erosion
Species	A group of inter-breeding organisms that seldom or never interbreed with individuals in other such groups, under natural conditions; most species are made up of sub-species or populations.
Species richness	The number of species in an area or a sample.
Spoil Tips	Areas located outside the Right of Way where excess soil removed from the RoW is permanently stored
Stabilisation	The act of preventing material (spoil) moving laterally or vertically using hard or biological engineering techniques.
Stakeholders	all parties who may be affected by the project or take an interest in it. Stakeholders may be internal (i.e. part of Shell) and external.
Stakeholders	Those who may be potentially affected by a proposal e.g.: local people, the proponent, government agencies, NGOs, donors and others.
Standards	A document that provides mandatory minimum requirements of performance.
Steep Slopes	Gradients greater than 10º from horizontal Project criteria
Succession	The process by which a series of plants colonise a substrate over time, such as a change from open water, through swamp and scrub to woodland.
Target	A specific quantifiable endpoint that must be reached in order to meet an objective. These are expressed in terms of dates of completion of activities or quantifiable performance measures such as KPI's.
Technical reinstatement	Reforming the ROW after backfilling by grading and levelling the surface, installing drainage and hard engineering features. Must be completed prior to hydrotesting.
Threat	A possible cause that will potentially release a hazard and create a top event.

Total Dissolved Solids (TDS)	Total dissolved solids is an expression for the combined content of all inorganic and organic substances contained in a liquid which are present in a molecular, ionized or micro-granular (colloidal sol) suspended form. Generally the operational definition is that the solids (often abbreviated TDS) must be small enough to survive filtration through a sieve size of two micrometres.
Total Suspended Solids (TSS)	The weight of particles that are suspended in water. Suspended solids in water reduce light penetration in the water column, can clog the gills of fish and invertebrates, suffocate plants and are often associated with toxic contaminants because organics and metals tend to bind to particles.
Track walking	A bulldozer is used to track-walk (up and down) slopes to increase compaction of the earth and to provide small drainage lines from the track grouser bars. The parallel cleat indentations provide moisture retaining “mini-terraces” from which seed will germinate.
Turbidity	Cloudiness caused by the presence of suspended solids in water; solid particles suspended in water cause light rays shining through the water to scatter, thus turbidity makes the water cloudy or opaque. Turbidity is measured in nephelometric turbidity units (NTU). Turbidity is an indicator of water quality
Watercourse	Any channel - stream, river, canal, ditch, - which has the capacity to carry water from one point to another, irrespective of whether it is dry or wet.
Wet Cut	Excavation of trench through a water filled watercourse
Work Instruction	Mandatory documents describing how an activity or task is to be properly executed. Work instructions apply to a specific portion of an activity and provide a greater level of detail than a procedure.
IMPACTS	
ROEIA	Romanian Report for Environmental Impact Assessment
BGEIA	Bulgarian Report for Environmental Impact Assessment
Impact	A change in an aspect of the environment that would not have otherwise occurred had a human activity not taken place.
Impact Evaluation	Assessing the magnitude of change in the context of the sensitivity/value of the affected resource or receptor.
Impact Identification	The process (predominantly linked to scoping) of looking at the project activities and the environment, social and human receptors and resources that might be affected and identifying interactions between the

	two.
Impact Prediction	Describing the scale or magnitude of change induced by a project activity.
Impact Significance	Evaluating the impact against defined criteria to determine the acceptability of the residual impact and whether further mitigation is necessary. A significant impact is one that the IA should bring to the attention of project the design and decision-makers
Impact monitoring	Monitoring of environmental/social/health variables, which are expected to change after a project has been constructed and is operational, to test whether any observed changes are due to the project alone and not to any other external influences.
Negative Impact:	Negative change from the existing situation due to the project.
Positive Benefit:	Positive change from the existing situation due to the project.
Direct (or Primary)	Impact that results from a direct interaction between some feature of a planned action and the receiving environment (e.g. between an effluent discharge and receiving water quality).
Secondary	Impact that follows on from the primary interactions between the project and its environment as a result of subsequent interactions within the environment itself (e.g. loss of part of a habitat affects the viability of a species population over a wider area).
Indirect	Impact that results from other developments or activities that happen as a consequence of the original development (e.g. a new development stimulates a requirement for improved road access).
Cumulative	Impacts that act together to affect the same environmental resource or receptor. These can be:
Temporal	A series of impacts that occur over time that in themselves are not important but build up to the point that they become significant.
Accumulative	The overall effect of different types of impact (e.g. air pollution + noise + traffic + visual blight) on a single receptor (e.g. a community or a habitat) where each singly may not be important, but combine to achieve significance.
Additive	Where impact from the planned activity occurs at the same time as impact from activities being undertaken by other parties (these may be already occurring, committed developments for the future or developments that may happen in the foreseeable future).
Interactive	Where two different types of impact (which may not in themselves be important) react with each other to create a new and significant impact (e.g. changes in air quality with respect to two different pollutants).

Permanent	Impact that causes a permanent change in the affected receptor or resource (e.g. the felling of mature forest as a result of site land take, or the relocation of a community).
Short Term	Impact that is predicted to last only for a limited period (e.g. during construction, drilling or decommissioning) but will cease on completion of the activity, or as a result of mitigation/reinstatement measures and natural recovery.
Long Term	Impact that will continue over an extended period, (e.g. from operational discharges or emissions repeated seasonal disturbance of species). This includes impact that may be continuous or intermittent over an extended time period.
Residual Impact	The impact remaining following the application of mitigation.
Local	Impact that affects locally important environmental resources or a single habitat/biotope.
Regional	Regional: impact that affects regionally important environmental resources or are felt at a regional scale as determined by administrative boundaries, habitat type.
Transboundary impact	Any impact, not exclusively of a global nature, within an area under the jurisdiction of a Party caused by a proposed activity the physical origin of which is situated wholly or in part within the area under the jurisdiction of another Party. ie impact that is experienced in one country as a result of activities in another
Parties	Unless the text otherwise indicates, the Contracting Parties to the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention)
Party of origin	The Contracting Party or Parties to the Espoo Convention
Affected Party	The Party of origin and the affected Party of an environmental impact assessment pursuant to the Espoo Convention
Concerned Parties	The Party of origin and the affected Party of an environmental impact assessment pursuant to the Espoo Convention

ABBREVIATION LIST

NEPA	National Environmental Protection Agency of Romania
ANAR	National Administration “Apele Române” of Romania
REPA	Regional Environmental Protection Agency of Romania
APM	Environmental Protection Agency
AFDJ	Lower Danube River Administration, based in Galați
CNADNR	National Company for Motorways and National Roads of Romania
EIA	Environmental Impact Assessment
IFI	International Financial Institution
ICPA	National Research-Development Institute for Soil Science, Agricultural

	chemistry and Environmental Protection, Bucharest
INHGA	National Institute for Hydrology and Water Management, Bucharest, Romania
IUCN	International Union for Nature Conservation
LFE	Local Feed Engineering
NGPL	Nabucco natural gas transmission pipeline
GEO	Government Emergency Ordinance
OJ	Official Journal of Romania
OG	Official gazette of Bulgaria
SG	State Gazette of Bulgaria
MOEW	Ministry of Environment and Water of Bulgaria
RIoEW	Regional Inspection of Environment and Water, from Bulgaria
EEA	Executive Environment Agency of Bulgaria
MH	Ministry of Health of Bulgaria
RHI	Regional Health Inspection
BD	Basin Directorate
BDDR	Basin Directorate Danube Region from Bulgaria
EAEMD	Executive Agency for Exploration and Maintenance of Danube River , Bulgaria
MTITC	Ministry of Transport, Information Technology and Communications of Bulgaria
MAF	Ministry of Agriculture and Food of Bulgaria
EFA	Executive Forest Agency of Bulgaria
EARTA	Executive Agency Road Transport Administration of Bulgaria
RAEA	Railway Administration Executive Agency of Bulgaria
MC	Ministry of Culture of Bulgaria
NIMC	National Institute for the Monuments of Culture of Bulgaria
MRDPW	Ministry of Regional Development and Public Works of Bulgaria
GCCA	Geodesy, cartography and cadastre agency of Bulgaria
RIA	Road Infrastructure Agency of Bulgaria
NAIM	National Archaeological Institute with Museum of Bulgaria
BAS	Bulgarian Academy of Sciences
TFS	Technical Feasibility Study

AGIs	- Above Ground Installations
CDP	- Comprehensive Development Plan
CIW	- Construction and installation works
DH	- Habitats Directive
DN	- Nominal Diameter measured in millimetres
DP	- Design pressure
I/O	- Input/Output
Kp	- Kilometer Nabucco gas pipeline
Kmr	-River kilometre
NGO	- Non-Government Organizations
RI	- Red List

SCI	- Sites of Community Interest
SPA	- Special protected areas
UGS	- Underground Gas Storage
WBMP	- Water Basin Management Plan

1. INTRODUCTION

1.1. PURPOSE AND CONTENT OF THE DOCUMENT

Environmental threats do not respect national borders. Governments have realized that to avert this danger they must notify and consult each other on all major projects under consideration that might have adverse environmental impact across borders. The Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) is a key step to bringing together all stakeholders to prevent environmental damage before it occurs. The Espoo Convention was adopted in 1991 and entered into force on 10 September 1997.

The Espoo (EIA) Convention sets out the obligations of Parties to assess the environmental impact of certain activities at an early stage of planning. It also lays down the general obligation of States to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries

The Espoo Convention and the Rio Declaration on Environment and Development (1992):

- Principle 17: Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.
- Principle 19: States shall provide prior and timely notification and relevant information to potentially affected States on activities that may have a significant adverse transboundary environmental effect and shall consult with those States at an early stage and in good faith.

Nabucco natural gas pipeline (NGPL) is a dedicated pipeline for the gas transmission.

This pipeline will cross the Danube River and implicitly the Bulgarian-Romanian border at the river kilometre 685+300 (figure 1.1 below).

Along its course exiting Bulgaria and entering Romania, the Nabucco gas pipeline is connected with Danube river crossing. The Danube river crossing is part of the project for constructing the Romanian section of the gas pipeline.

The activities to be performed particularly at the section of the Danube River crossing during the construction, operation, maintenance and decommissioning of the gas pipeline will lead to trans-boundary impact on the environmental components and factors. The territorial range of the activities comprises the section of the land between the construction sites, located respectively on Bulgarian and Romanian territory and it depends on the selected crossing method (see Appendix 7). Trans-boundary effect exists also along the river course as its territorial range shall be determined for each environmental component by expert assessment.

The environmental impact has been assessed by considering the works proposed by the project, the original condition of the environmental features and the project's area of influence, as hereinafter defined in chap. 2.4.1

The purpose of this document refers to anticipated transboundary impacts from activities carried out for the Danube River crossing by Nabucco gas pipeline and to the impact mitigation measures

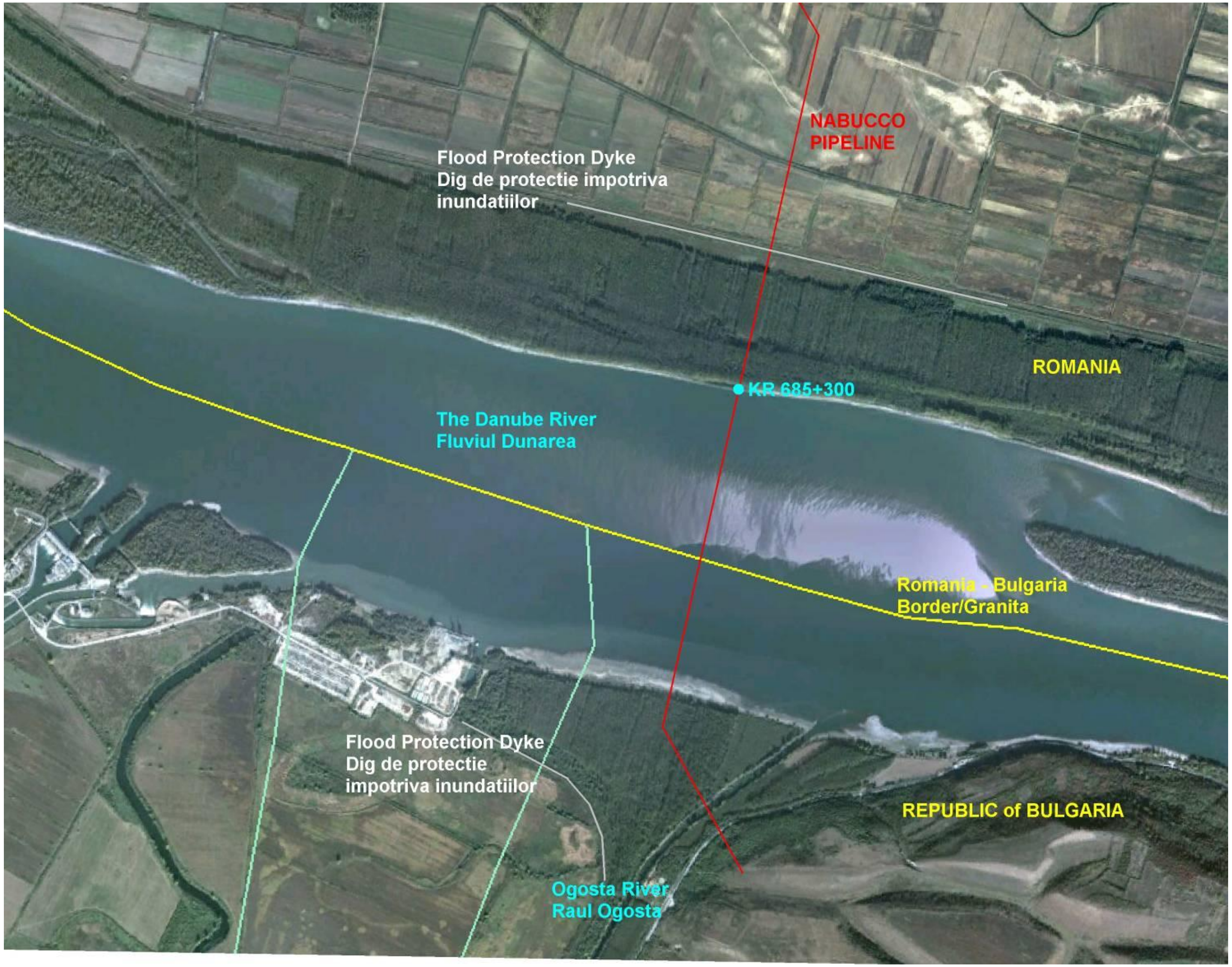

Figure 1.1.: Map of the Danube river crossing section

This document refers to the anticipated potential environmental and social impacts in Bulgaria resulting from construction and operation activities carried out in Romania. Considering the continuous nature of the investment proposal (construction of Nabucco transmission gas pipeline on the territories of both countries), this document also makes reference to the speculative process which is ongoing in Bulgaria to deal with transboundary impacts in Romania from activities carried out in Bulgaria.
This study informs the stakeholders in the two countries on the potential transboundary impact resulted from the activities performed.
The study shall be integrated into the documentation based on which the environmental consents needed for the project implementation will be obtained.

According to Espoo Convention and ToR, the structure of this document is the following:

1. Introduction
    - 1.1 Purpose and content of the document
    - 1.2 Legal framework on environmental impact assessment in a transboundary context
    - 1.3. The disclosure of Espoo related document in each affected country
    - 1.4. Information for contact with the Investor
2. Description of the proposed activity and its scope
    - 2.1. General information
    - 2.2. Investment schedule
    - 2.3. Route
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    - 2.4. Objectives (stations) located on the pipeline route
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        - 2.5.1. Construction
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5.4. Transboundary impacts resulting from unplanned events (consistent with risk assessment section)

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   6.1. Impact mitigation measures during construction

   6.2. Impact mitigation measures during gas pipeline operation

   6.3. Impact mitigation measures at the end of the life cycle

7. Inventory of gaps and uncertainties found when compiling the information

8. Non-technical summary including a visual presentation as appropriate (maps, graphs, etc.).

1.2 LEGAL FRAMEWORK ON ENVIRONMENTAL IMPACT ASSESSMENT IN A TRANSBOUNDARY CONTEXT

The project shall be mandatorily subject to the environmental impact assessment as set out in Annex I – to Directive 85/337/EEC, and in Annex 1 to the Convention on Environmental Impact Assessment in a Trans-boundary Context, signed in Espoo.

The Espoo Convention was ratified:

- by Romania, by Law no. 22/22.02.2001 and on the European legislation (Directive 85/337/EEC, as amended and updated by Directive 97/11/EC and Directive 2003/35/EC, including everything related to trans boundary impact).
- by Bulgaria with an Act dated 1995, it is effective as from 10.10.1997 and it was promulgated in SG in 1999

The aspects provided by the Water Framework Directive (Directive 2000/60/CE, as amended and updated), by appendices 5 and 6 and by Habitats Directive (Directive 92/43/CEE, as amended and updated) shall be included in the assessment.

Other legal documents, on which the environmental impact assessment in a trans-boundary context is based, are:

- Convention on Co-operation for the Protection and Sustainable Use of the Danube River (Convention for the Danube river protection). On the grounds of the quoted convention the negotiating countries, committed and with clear intention to strengthen their cooperation in the field of water management, preservation and usage concerned because of the presence and threat from short-term and long-term noxious effects, caused by changes in the conditions of the water currents in the Danube river basin on the environment, economies and the well-fare of the Danube countries; stressing on the immediate need for consolidating the national and international measures for avoidance, control and mitigation of the significant noxious impact caused by discharge of dangerous substances and biogenic elements in the aquatic environment of the Danube basin with the due attention also to the Black sea; recommending the measures already taken and concerning the national initiative of the Danube countries and also following the line of bilateral and multilateral level of cooperation as well as the efforts already made within the framework of the process for security and cooperation in Europe, by the Economic commission of the United Nations for Europe and by the European community for development of bilateral and multilateral cooperation for

avoidance and control over the trans-border pollution, sustainable water management, rational use and storage of the water resources; based in particular on the Convention on preservation and usage of trans-boundary water currents and international lakes from 17 March 1992 as well as the existing bilateral and multilateral cooperation between the Danube countries which will proceed and shall be duly taken into consideration in the cooperation between all the Danube countries as well as having in mind the Convention on the protection of the Black Sea from pollution from 21 April 1992; striving as to reach sustainable improvement and protection of the Danube river and the water from its catchment basin, in particular in trans-boundary context and striving to sustainable water management, duly keeping in mind the interests of the Danube countries in the field of water use and at the same time contributing to the protection of the marine environment in the Black Sea; agree to undertake the necessary measures for protection of the Danube river water from pollution.
The requirements and respectively the obligations of the countries under the convention are presented in detail in the mentioned Convention for Danube river protection.
This convention was ratified :

In Romania,	In Republic of Bulgaria
Law no.14/1995, published in OJ no.41 of 14.02.1995	With a Law, passed by XXXVIII national assembly on 24 March 1999 – SG issue 30 dated 1999, effective as from 6 April 1999, prom. in SG issue 49 dated 17 May 2002, amended in SG issue 53 dated 28 May 2002

- The development of the environmental impact assessment is also based on the Convention on Danube river navigation (Belgrade Convention);
- the International convention for prevention of pollution from ships (73/78);
- the Convention on the control on trans- boundary movement of hazardous wastes and their disposal (1989).

The provisions of the legislation in the Republic of Bulgaria on the Environmental impact assessment for investment proposals with trans-boundary impact

Environmental impact assessment for investment proposals with trans-boundary impact shall be made according to the requirements of the environmental protection Act (EPA), the Ordinance on the terms and conditions for carrying out Environmental impact assessments and the EIA Convention in trans-boundary context (ESPOO Convention) of UN’s Economic commission for Europe. The convention was ratified in Bulgaria with an Act dated 1995, it is effective as from 10.10.1997 and it was promulgated in SG in 1999. Competent authority for the EIA procedure in trans-boundary context appears the Minister of environment and water and the rest competent authorities by virtue of the EPA are obliged to render in due course the submitted information concerning the conducted procedures and to render the necessary cooperation to the Ministry of environment and water and to the Assigning authority. The regulation stipulates two procedures depending on the origin of the investment proposal:

- EIA procedure for investment proposals with trans-boundary impact, for which The Republic of Bulgaria appears „country of origin”;

- EIA procedure for investment proposals, which shall be realized on the territory of other countries, at which The Republic of Bulgaria appears an affected country.

The Regulation allows other opportunities too, in case there is an international contract between The Republic of Bulgaria and the affected country/countries, which contract provides otherwise

The EIA procedures in trans-boundary context are described in detail in the Ordinance on the terms and conditions for carrying out Environmental impact assessments.

The environmental impact assessment for investment proposals with trans-boundary impact, for which the Republic of Bulgaria appears country of origin, shall be made in the following order:

1. Notifying the competent authority and the affected public;

2. in case of assumption for significant environmental impact of another country or countries the Minister of environment and water shall notify the affected country or countries about their decision and shall determine a period for the respective (affected) country to answer whether it shall participate in the procedure; description of the investment proposal and the existing information for potential trans-boundary impact (which information does not appear secret according to the Law on protection of the classified information) should be applied to the notification, as well as information concerning the nature of the decision supposed to be made:

a) in case of negative answer on behalf of the affected country the further procedure shall completely follow the consistency according to the environmental protection Act and the Regulation for the conditions and way of EIA preparation, typical of the environmental impact assessment on the territory of The Republic of Bulgaria;

b) in case of positive answer on behalf of the affected country and its declared willing to participate in the procedure the further consistency of the EIA procedure shall be modified and adjusted in view of considering the trans-boundary aspects as it shall be considered also the public to be informed about application of a procedure for trans-boundary context;

3. consultations between both countries: whether the procedure, established by the national legislation shall be followed; if the proposal has not been included in Annex I to the EIA Convention in trans-boundary context, but it is included in Appendix № 2 to the EPA; submission of information regarding the main requirements of the legislation; the time for consultations shall be determined between the countries ad hoc;

4. Determining the scope of information, which the Assigning authority ought to include in the EIA report as special attention has to be given to the aspects with trans-boundary impact and to the measures for their prevention and restriction.

5. Development of EIA report; the Assigning authority is obliged to submit to the competent authority additional copy of the report, translation of the whole report or translation of a part of the report, in case this is agreed between the competent authorities of both countries as well as translation of the non-technical summary.

6. Quality assessment of the EIA report; further to all requirements, according to the requirements, concerning the national EIA procedure, the competent authority shall pay special attention to the trans-border impacts and the measures for their prevention/avoidance and restriction.

7. Sending the EIA report (its translation if agreed so) and the translation of the non-technical summary to the competent authority of the affected country and giving opportunity for conducting consultations regarding: the potential trans-border impacts and measures for avoidance or reduction of the impact; the possible proposed alternatives of the investment proposal; other issues of mutual interest.

8. Submission of the information from conducted consultations to the Assigning authority;

9. Public discussion on the EIA Report with an opportunity for participation of representative from the competent authority of the affected country and its public.

10. Making a decision on EIA by considering the notes and proposals, made by the affected country, participating in the EIA procedure;

11. Announcement of the EIA decision and communication of the decision to the affected country;

12. Control over the implementation of the decision; upon explicit preliminary agreement the competent authority of the country of origin shall notify the competent authority of the affected country for the implemented control measures and for the findings made.

The environmental impact assessment for investment proposal with trans-border impact, which shall be realized on the territory of other countries where Republic of Bulgaria appears affected country, shall be made following the next consistency:

1. upon receiving notification for the investment proposal which shall be realized on the territory of another country and for which it may be expected to have significant impact on the territory of Republic of Bulgaria, within the period mentioned in the notification the Minister of environment and water shall notify the country of origin for his decision to participate or not in the EIA procedure:

a) in case of expressed consent for participation it has to be followed the national procedure of the country of origin if not otherwise agreed in an international agreement;

b) The Minister of environment and water shall provide public access to the submitted information for EIA and in due course shall send all standpoints regarding the documentation before decisions to be taken by the competent authority of the other country;

2. in case there is no submitted notification by the country of origin about investment proposal under Annex I to the EIA convention in trans-boundary context, which might cause significant impact on the territory of Republic of Bulgaria, the Minister of environment and water shall make the necessary steps before the competent authority of the country of origin for consultations to be conducted for participation in the procedure.

Provisions of the legislation in Romania on the Environmental impact assessment for investment proposals with trans-boundary impact

The public consultation will take place in accordance with the specific legislation in the two countries, namely:

- Art.4 letter p): public training and awareness, as well as its participation in making and implementing the environmental decisions (GEO no. 195/2005 on environmental protection (published in the Romanian OJ no. 1196/30 Dec. 2005 and approved through Law no. 265/2006), with further amendments and requirements

- Decree no. 864/2002 of the Minister of Water and Environmental Protection on the approval of the Procedure for assessing the environmental impact in a transboundary context and for the public participation in decision-making in the case of the projects with a transboundary impact– published in O.J. no. 397/2003

- Decree 135/84/76/1.284/2010 of the Minister of Environment and Forestry, of the Minister of Administration and Interior, of the Minister of Agriculture and Rural Development and of the Minister of Regional Development and Tourism on the approval of the Environmental Impact Assessment implementation methodology for public and private projects – published in O.J. no. 274/24.04.2010

In Romania, the procedure on public participation is undertaken according to *Decree no. 864/2002 of the Minister of Water and Environmental Protection for the approval of the Procedure for* **environmental impact assessment in a transboundary context and for the public participation in decision-making in case of the project with transboundary impact**

In accordance with this order, the Minister of Environment and Forestry has sent to the Minister of Environment and Waters of Romania in the Republic of Bulgaria, as affected party, a notification (see appendix 1) regarding the works proposed on the Romanian territory and which are likely to have a transboundary impact. In the response to the notification (see appendix 1), the Ministry of Environment and Water in the Republic of Bulgaria informs that the Republic of Bulgaria will participate in the EIA procedure for the Nabucco project

The central public environmental protection authority ensures the implementation of the necessary measures for the affected parties to have the opportunity to be part of the procedural stages established by this decree.
In the case of the projects whose activities exceed the national territory, the central public environmental protection authority can invite the relevant affected party to prepare a joint environmental impact assessment for the proposed activity that may have a significant transboundary environmental impact.

The environmental impact assessment for investment proposals with trans-boundary impact, for which Romania appears country of origin, shall be made in the following order:
(1) Notifying the competent authority and the affected public, by specifying the time for requesting a response (6 weeks). The notification shall include: description of the investment proposal and the existing information for potential trans-boundary impact, as well as information concerning the nature of the decision supposed to be made:

(a) If the competent authority of the affected party shows that it does not want to participate in the environmental impact assessment procedure or if it does not respond within the timeframe specified in notification, the environmental impact assessment shall be performed according to the provisions of the Order no. 860/2002 of the Minister of Water and Environmental Protection.
(b) If the competent authority of an affected party shows the intention to participate in the procedure set up by this order, the central public authority for environmental protection invites the affected party to participate in discussions on the implication in the procedure, before commencing the environmental impact assessment.

(2). The central public authority for environmental protection:
- ensures the conditions needed to offer to the competent authority of the affected party and to the interested public members the possibility to submit in writing their comments on the information provided within a reasonable period, before establishing the environmental impact assessment field.
- informs the competent authority of the affected party, which ensures that the public in the areas likely to be affected is informed within two weeks from the reception of the notification and that the possibility to make comments or to raise objections is made available either directly to the competent authority of the party of origin or by the competent authority of the affected party, unless no other modality is provided in the bilateral agreements or as a result of the bilateral discussions held.

(3) Within 6 weeks from the reception of the notification, the affected party sends a clear summary in English of the public and competent authorities'

comments on the projects proposed, in conjunction with the requests of additional details identified in the individual comments of the public and authorities.

(4) The competent authority of the party of origin requests from the affected party information regarding the project's potential environmental impact, if this information is not already indicated in the response to notification; the time of response to such a request is 6 weeks from the reception of the notification, and the request shall be made in English language.

(5) – The information received from the affected party, in conjunction with the comments of this party's public shall be included by the central public authority for environmental protection into the guidance book prepared for defining the environmental impact assessment field. The environmental impact assessment study and the report to this study are prepared in accordance with the national legislation in force.

(6) If a party considers that it is likely to be affected by a significant negative transboundary impact due to a project mentioned in annex no. 1 to the Convention on environmental impact assessment in a transboundary context, ratified by Law no. 22/2001, and it has not been notified according to the provisions of Order 860/2002, it may request to the party of origin to perform a sufficient exchange of information, with a view to commencing consultations regarding the potential transboundary impact of the project.
If the parties involved in the above-mentioned situation:

- agree that a significant negative transboundary impact is likely to occur, the provisions of Order 860/2002 regarding the information and consultation of the affected party apply accordingly, unless another way of solving the difference is chosen.
- reach to no agreement, any party has the right to subject the problem to an investigation commission set up by bilateral or multilateral agreements, unless other way of solving the difference is chosen.

(7) The central public authority for environmental protection sends to the affected parties the report on environmental impact assessment in English in conjunction with the non-technical summary. The recommended response time shall consider a reasonable period, but no more than 8 weeks. The report to the environmental impact assessment study in a transboundary context shall include at least the information described in annex no. II to the Convention on environmental impact assessment in a transboundary context, ratified by Law no. 22/2001.

(8) The central public authority for environmental protection ensures the compliance of the legal provisions in force on the public participation in the quality review stage of the report to the environmental impact assessment study, by organizing public debates in the country of origin.
Within the same timeframe, the central public authority for environmental protection participates in conjunction with the project owner in the public debate of the report held on the territory of the parties affected, based on the provisions in the bilateral agreements or on discussions.

(9) After receiving from the owner the assessment of the comments of the affected parties' authorities, the competent environmental protection authority continues the quality review stage for the report to the environmental impact assessment study, according to the national legislation in force.

(10) During the report review stage the central public authority for environmental protection shall initiate the consultations with the competent authority of the affected party as regards the measures for mitigating or eliminating the potential transboundary impact of the proposed activity. The consultations shall consider:
a) possible alternatives to the proposed activity, including "zero" alternative when the project is not accomplished, and the possible measures for mitigating

the significant negative transboundary impact and/or for monitoring the effects of such measures;

b) other forms of possible mutual assistance for mitigating any significant negative transboundary impact of the proposed activity; and

c) any other appropriate issues regarding the proposed activity.

(11) In accordance with the affected parties, the central public authority for environmental protection sets at the beginning of the consultations a reasonable period of time, which cannot be longer than 8 weeks, unless otherwise stipulated by the bilateral agreements or by the discussions held.

(12) Both the result of the environmental impact assessment presented in the report to the environmental impact assessment study and the comments received regarding it and the result of the consultations are considered when making the final decision on the activity project.

(13) The central public authority for environmental protection sends to the competent authority of the affected party the final decision on the proposed activity, in conjunction with the reasons and considerations on which it was based, including:

a) the content of the decision and any conditions attached to it;

b) the main reasons and consideration based on which the decision was made; and

c) the description of the main measures for avoiding, mitigating and ,if possible, eliminating the major negative effects.

(14) If additional information on the significant transboundary impact of the proposed activity, which was not available when the decision on this activity was made and which could have materially affected the decision, becomes available for one of the parties affected before the commencement of that activity, that party shall immediately inform the party of origin. The party of origin shall decide on the possibility of other consultations with the affected party in order to establish if the review of the decision is necessary.

If Romania is an affected party:

(1) It responds to the notification sent by the party of origin within the timeframe specified by it

(2) The documentation received from the party of origin is provided to the authorities and public in the areas likely to be affected, by care of the competent authority of the affected party, which sends the comments and remarks received from public and authorities to the party of origin.

(2) The final decision is conveyed to the affected party's public by the competent authority of this party, within 7 days from its reception from the party of origin.

In accordance with this order, the Minister of Environment and Forestry has sent to the Minister of Environment and Waters of Romania in the Republic of Bulgaria, as affected party, a notification (see appendix 1) regarding the works proposed on the Romanian territory and which are likely to have a transboundary impact. In the response to the notification (see appendix 1), the Ministry of Environment and Water in the Republic of Bulgaria informs that the Republic of Bulgaria will participate in the EIA procedure for the Nabucco project

As a result of the bilateral Romanian-Bulgarian meetings that took place at Bucharest on 9.12.2010 and 22.12.2010, according to those conjunctly established with the Bulgarian party, the common sector of the gas pipeline in the Danube crossing zone shall be considered.

Considering the continuous nature of the investment proposal (construction of Nabucco transit gas pipeline on the territories of five countries) and considering the parity/uniformity of the expected impacts during realization of the investment proposal on the territories of The Republic of Bulgaria and Romania and in particular the section where the Danube river is to be crossed, the competent authorities from both countries have decided that the part of the national EIA reports of both countries, which part concerns the environmental impact in trans-boundary context, shall be joint.

The Terms of Reference for ESIA scope and content for the investment „Nabucco natural gas transmission pipeline" have been developed in accordance with the legislation of Bulgaria and Romania in the environmental protection field, namely:

Legal requirements in Bulgaria	Legal requirements in Romania
Art.95 of the Environmental Protection Act (EPA, promulgated in Official Journal 91/ 25.09.2002, as amended and updated in Official Journal 103/ 29.12.2009) and the requirements of Art. 10, par. 3 of the Ordinance on the terms and procedures for preparing an Environmental Impact Assessment (Official Journal 3/2006, as amended and updated in Official Journal 29/ 16.04.2010).	Art.11 of GEO no. 195/2005 on environmental protection (published in the Romanian OJ no. 1196/30 Dec. 2005 and approved through Law no. 265/2006), with further amendments and requirements of the Environmental Minister's Decree no. 135/84/76/1.284/2010 (published in the Romanian OJ no. 274/24.04.2010.
The investment proposal is subject to mandatory EIA as it falls under the provisions of :	
Annex 1 of Bulgarian Environmental Protection Act (EPA).	Appendix 1 to GD no.445/2009 (published in the Romanian OJ no. 481/13.07. 2009

The competent authorities in the two countries deciding on the necessity of developing the environmental impact assessment documentation are:

- ✓ in Bulgaria - the Ministry of Environment and Water
- ✓ in Romania – National Environmental Protection Agency, with the consultation of EPA Dolj, EPA Mehedinți, EPA Caraş-Severin, EPA Timiş and EPA Arad

As shown above, the legislation in the two countries establishes the need for environmental impact assessment, but LFE Bulgaria and LFE Romania also focus on the social significance of the gas pipeline, as well as on the best international practice (especially the requirements of the International Financial Corporation - IFC), supporting the Equator principles and the World Bank policy.

The Terms of Reference for determining the scope, the contents and the form of the EIA Report in transboundary context for investment proposal Nabucco Gas Pipeline have been developed based on the following:

Bulgaria:	Romania:
Answer of MOEW to the Notification of the project submitted by **NNC Bulgaria**, to the Ministry of Environment and Water (MOEW) (Letter Ref.No. НГПБ-04-00-12/03.06.2009 , entry Ref No. ОВОСУ-7720/04.06.2009) with additional information to the Notification with letter Ref.No. НГПБ-04-00-30/14.07.2009 and answers of the MOEW (Ref.No. ОВОСУ-7720/01.07.2009 and Ref.No. ОВОСУ-7720/02.09.2009).	Guideline sent to NEPA under no. 1/222/IN/18.01.2011 and registered in SC IPTANA SA under no. 227/19.01.2011 as a result of the submission to NEPA of the Notification and Project presentation Report by NNC Romania.

It should also make reference to the specular process which is ongoing in Bulgaria to deal with transboundary impacts in Romania from activities carried out in Bulgaria.

1.3 DISCLOSURE OF ESPOO RELATED DOCUMENT IN EACH AFFECTED COUNTRY

Competent authority for deciding on the ESIA in a transboundary context:

- in Bulgaria - the Minister of Environment and Water
- in Romania – the Minister of Environment and Forestry

According to the national legislation, the Romanian Minister of Environment and Forestry submitted the „NOTIFICATION TO AN AFFECTED PARTY OF A PROPOSED ACTIVITY UNDER ARTICLE 3 OF THE CONVENTION" to the Bulgarian Minister of Environment and Water on 22.11.2010 and received a response on 11.01.2011 on the participation of the Republic of Bulgaria in the EIA procedure for Nabucco project. (appendix 1).

Following previous arrangements, the national EIA report will include a separate chapter „Transboundary impacts" developed jointly with Bulgarian and Romanian EIA experts, in which the impact of the construction and operation of the Nabucco pipeline section crossing the Danube River to be considered and assessed in detail.

According to the national legislation in Republic of Bulgaria and Romania, this document will be published in both countries, by means of the competent environmental authorities and of the investor.

1.4 INFORMATION FOR CONTACT WITH THE INVESTOR

Data about the principal	
Company:	**Nabucco Gas Pipeline International GmbH**
Address:	Floridsdorfer Hauptstraße 1
City:	1210 Vienna
State:	Austria
E-mail:	info@nabucco-pipeline.com
Web page:	www.nabucco-pipeline.com
	Media & Press Contact
Contact person	
Phone:	Tel. +43 (1) 27777-240
Fax:	Fax +43 (1) 27777-5240
e-mail:	request@nabucco-pipeline.com
Data of the principal	
Company	**Nabucco gas pipeline Bulgaria EOOD**
Address:	15A Aksakov str., Floor-5, Office-3, Sofia 1000
Contact person	**Managing Director –** Marii Kossev
Phone/Fax:	+(359 2) 421 98 33
E-mail:	marii.kossev@nabucco-pipeline.com
Data of the principal	
Company	**S.C. NABUCCO GAS PIPELINE ROMÂNIA S.R.L. Mediaş**
Address:	4b Cristalului St., Mediaş, Sibiu county
Contact person	**Managing Director –** PhD. Eng. Vlad Pavlovschi
Phone/Fax:	Tel. (04) 0269806400 Fax: (04) 0269806401
E-mail:	romania@nabucco-pipeline.com

2 DESCRIPTION OF THE PROPOSED ACTIVITY AND ITS SCOPE

2.1 GENERAL INFORMATION

Over the next two decades, the natural gas required in the European Union and consequently the gas import will increase. For this reason, a special importance shall be paid to the development of the pipeline infrastructure that should ensure the natural gas transport in Europe.
The company **Nabucco Gas Pipeline International GmbH** was established in Vienna, on 24 June 2004 with a view to developing the transmission pipeline system, namely the natural gas transmission pipeline referred to as „Nabucco".
Nabucco pipeline shall be partially constructed with EU funds. In 2004, the project was considered to be of priority importance being classified as "TEN-E Priority project" (Trans-European Energy Networks). The project will be developed and constructed by stages until the supplied volume of 31 billionNm^3/year is reached.
The EU member states and Turkey signed an intergovernmental protocol at Ankara on 13 July 2009 in order to perform this project. This protocol establishes the legal and political framework for the natural gas transmission between the EU member states and Turkey.
The project support agreements between *Nabucco Gas Pipeline International GmbH* and the ministries involved in the five transit countries (Turkey,Bulgaria, Romania, Hungary and Austria) were signed on 8.06.2011.

The pipeline route was selected during the Technical Feasibility Study (TFS) undertaken in 2004 by CBI John Brown Limited in conjunction with the local consultants from Romania and Republic of Bulgaria.

Connection point at the Romanian-Bulgarian border with the Bulgarian sector of the gas pipeline: 6 km upstream of Bechet Port (at river kilometre 685+300)- (maps appendix 2).
The Danube River will be crossed at kmr 685+300, upstream Bechet Port located on the Romanian bank at kmr 679+000. On the Bulgarian bank, the undercrossing profile falls within the discharge mouth of Ogosta river and the ballast pit which is currently operational. The Bulgarian settlement Oriahovo lies opposite Bechet Port.
An agreement concerning STEREO coordinates of the crossing section has been signed between Bulgarian experts and Romanian experts (maps appendix 2).

The main technical data of the Nabucco pipeline are presented in table 2.1 below.

Table 2.1.: Main technical data of the Nabucco pipeline

Technical data	Value, feature
Diameter	1422 mm (56")
Pipe material	Steel pipe, according to API 5 L, material quality X 70
Pipe material protection	Cathodic protection pipe and PE passive insulation of the pipe
Wall thickness	20.36 mm – 28.88 mm
Location depth	1 m, in depth from the soil surface at the upper generator of the pipes (except the crossings of communication routes, watercourses, valleys, channels, irrigation channels etc.)
Working pressure	100 bar

The pipeline can be subject to pigging along the entire route.

In both countries, the pipeline route is considered within a 500 m wide corridor. The Right of Way is considered 36 m in farm lands, pastures, fallow lands and 30 m in the forest.

2.2 INVESTMENT SCHEDULE

The design activity started in 2009 and is to be completed in 2013. The project shall be performed according to the following table 2.2.

Table 2.2: Investment schedule

Stage	Period	Activity	Capacity (billion m3/year)
I.	2009 – 2013	Design, authorization	——
	2013 – 2016	construction	——
	2016 – 2017	commissioning, operation	8.5
II.	2017 – 2021	operation	15.7
III.	2021 – 2024	operation	25.5
IV.	2024	operation	31.0

2.3 ROUTE

The Bulgarian Nabucco gas pipeline section covers 422 km (figure 2.1 below), and the Romanian section 475+018 km. (figure 2.2. below)

The alternatives for the Bulgarian and Romanian territory are shown in RREIA and BGEIA.

2.3.1 PIPELINE ROUTE ON THE BULGARIAN TERRITORY

NGPL crosses the state border between Bulgaria and Turkey near the village of Strandzha. On the Bulgarian territory the gas pipeline follows a southeast-northwest direction to the Danube River (the border with Romania near Oryahovo) (figure 2.1 below),

The Nabucco Gas Pipeline crosses Danube river at the region between Oryahovo and Kozloduy.

The entire lower course of Ogosta river and the bank of Danube river at the gas pipeline crossing point fall within protected site „Ogosta river” (BG0000614) according to the Habitats Directive.

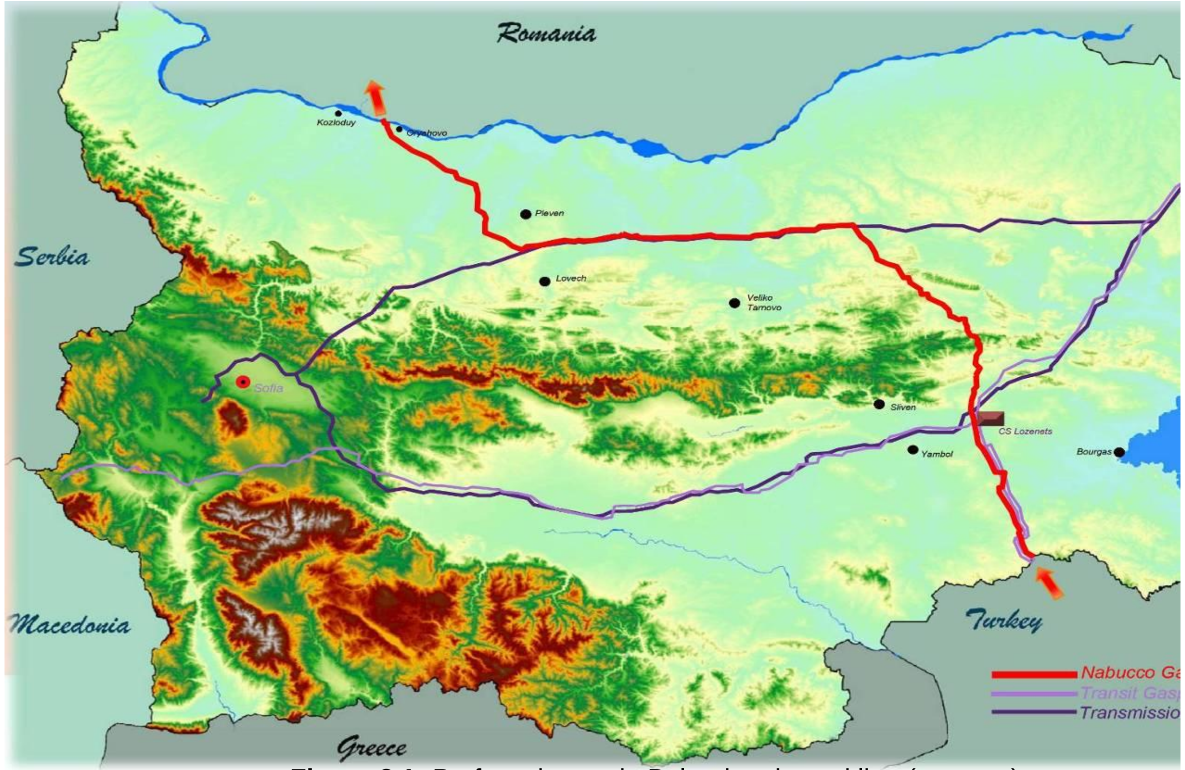


Figure 2.1: Preferred route in Bulgaria– the red line (▬).
(The light green lines show the routes of the existing gas pipelines – National northern ring and transit pipeline for Turkey

2.3.2 PIPELINE ROUTE ON THE ROMANIAN TERRITORY

On the Romanian territory, NGPL enters the country 6 km upstream the Bechet Port (at the river kilometre kmr 685+300) and is located in the administrative territories of Dolj, Mehedinți, Caraş Severin, Timiş and Arad counties, leaving the Romanian territory north of Nădlac settlement (figure 2.2. below). Between kp 0+099 and kp 10+572 NGPL crosses ROSPA0023 Jiu-Danube Confluence and ROSCI0045 Jiu Corridor (the two sites overlap).

Figure 2.2.: Nabucco pipeline location on the Romanian territory

2.4 OBJECTIVES (STATIONS) LOCATED IN THE TRANSBOUNDARY AREA OF INFLUENCE ON THE PIPELINE ROUTE

2.4.1 Definition of the transboundary area of influence on the pipeline route

In the case of Nabucco project, the project's area of influence includes:

- the area likely to be affected by the Nabucco Pipeline Project and Nabucco's activities, assets and related facilities that are directly owned, operated, or managed and that are a component of the Project. These facilities include related activities, assets and facilities owned or under the control of parties contracted for the operation of Nabucco Pipeline Project or for the completion of the project (such as Nabucco contractors);

- Associated facilities, which are facilities that are not funded by the Project Lenders as part of the Project, and whose viability and existence depend exclusively on the project and whose goods and services are essential for the successful operation of the Project;

- Area potentially affected by cumulative impacts[1] (i) from further planned development of the Nabucco Project, and (ii) that result from the incremental impact, on areas or resources used or directly impacted by the Project, from other existing, planned or reasonably defined developments at the time the Environmental and Social Impact Assessment is undertaken;

- Area where Nabucco Project activities may indirectly impact on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent; and

- Areas likely to be affected by impacts from unplanned but predictable developments caused by the Nabucco Project that may occur later or at a different location.

2.4.2 . NGPL facilities in the area analyzed from the transboundary impact point of view

Table 2.3 below and designs from appendix 3 show the location of the NGPL facilities in the area analyzed from the transboundary impact point of view

Table 2.3.: NGPL facilities in the area analyzed from the transboundary impact point of view

No.	Facilities	Total number and location on the area of interest	
		Romanian territory	**Bulgarian territory**
1.	Gas metering stations (GMS)	-	in the area of Oryahovo municipality(see drawing 70223/BB/PL/03/01/0001/000,, appendix 5)
2.	Gas pipeline pigging stations (PS)	at kp 39+500 in the vicinity of the Segarcea town (see drawing , appendix)	in the area of Oryahovo municipality (70223/BB/PL/03/01/0001/000,, appendix 5)
3.	Off-take station (OS)	at kp 39+500 in the vicinity of the Segarcea town (see drawing , appendix)	-
4**.**	Block valve stations (BVS)	at kp 12+500, after crossing of Jiu river (see drawing 70223/RR/PL/00/01/8129, appendix 3)	At kp 419+787, at 2+459 km in relation to the border (see drawing 70223/BB/PL/03/01/0001/000,, appendix 3)
5.	Breathers, earth plates, direction markers etc.		
6.	Cathodic protection system.		

[1] Cumulative impacts are limited to those impacts generally recognized as important on the basis of scientific concerns and/or concerns from Affected Communities.

7.	Supervisory control and data acquisition system, telecommunication system, instrumentation

The block valve stations (BVS) are constructions located above-ground enabling the sectioning of the pipeline sector in case of failure and the execution of the periodical revisions (photo 1.1 below). They are compulsorily envisaged at: railway crossings, ramifications, interconnections, PIG launching/receiving stations. The project may envisage block valves at the crossings of some obstacles of special importance (waterways, motorways etc.) with a view to enhancing their safety. The block valves located on the pipeline centreline, on connections or interconnections, at the crossings must be provided with automatic shut down devices in case of failure upon beneficiary's request.

Photo 1.1: Valve station

The BVS are equipped with the stacks of 25m high, and the silencers about 6 m high.

2.4.3. CONSTRUCTION CAMPS AND PIPE STORAGE AREA

Construction camps that will accommodate workers during the execution of works, pipe dumps and construction camps in the works location will be arranged during construction.

Romanian bank

No construction camp or pipe dump will be located on the Romanian bank.
The nearest construction camp (where the personnel working on the construction site is accommodated) is located at kp 51+735 m in the area of Segarcea town and the nearest pipe dump is located at kp 19 in Gângiova village (see map from appendix 3). Its do not generatie any transboundary impacts
A mobile construction camp for offices equipped with ecological facilities (e.g.toilets, sanitary installations) will be located in the works area. This camp will be moved once with the construction site relocation.

If HDD method is used, the pipeline will be laid on the Romanian bank.
The additionally calculated area for the pipeline laid on the Romanian bank (approx. 2 km) covers ~ 87457 m^2 out of which: ~ 23632 m^2 outside the RoW (see figure .

Bulgarian bank

No construction camp or pipe dump will be located on the Bulgarian bank. The nearest camp is located near Staroseltsi village at 50 km from the crossing point – 250 persons. In Selanovtsi village, at 20 km from the crossing point, there is a pipe storage site provided. Its do not generate any transboundary impacts

A mobile construction camp for offices equipped with ecological facilities (e.g.toilets, sanitary installations) will be located in the works area.
If the open cut method is used for the Danube crossing, the area taken by temporary construction site will cover 150m/500m, and if HDD method is used, the area will cover 200m/200m (see appendix 4).

2.4.4. ACCESS ROADS

Romanian bank

The access roads in the area are represented by the existing earth roads and they are connected to county and national roads. The two alternatives are the connection to the county road from Ostroveni village, and one alternative with connection to the national road which is linked to the town of Bechet. The access road option will be chosen depending on the crossing method considering the heavy traffic, what the open cut method involves, large volumes of earth and concrete (see table 2.4, figures 2.3 and 2.4 below and appendix 4).

Table 2.4: Access roads to working corridor on the Romanian side

From kp	To kp	Road details	Lenghts (m)	Type	From to	Up to
0.55	1.1	Access on the pipeline corridor		-		
1.1	1.1	Access road over the dyke	50	DEX existing – to be rehabilitated	Corridor	Corridor
1.1	4	Access on the pipeline corridor		-		
4	4	Access road to the corridor	3900	DEX existing – to be rehabilitated	DN 55A	Corridor
4	10	Access on the pipeline corridor		-		

Operations that are necessary to reinforce the earth road are: stripping embankments with grader blade, execution of the road bed, mechanically stabilized earth layer with added ballast that is 20 cm thick after compaction, layer of crushed stone that is 10 cm thick after compaction. At the end of works the road bed will be demolished, and the land will be reinstated to its original use.The reinforce of the earth road does not generate any transboundary impacts.

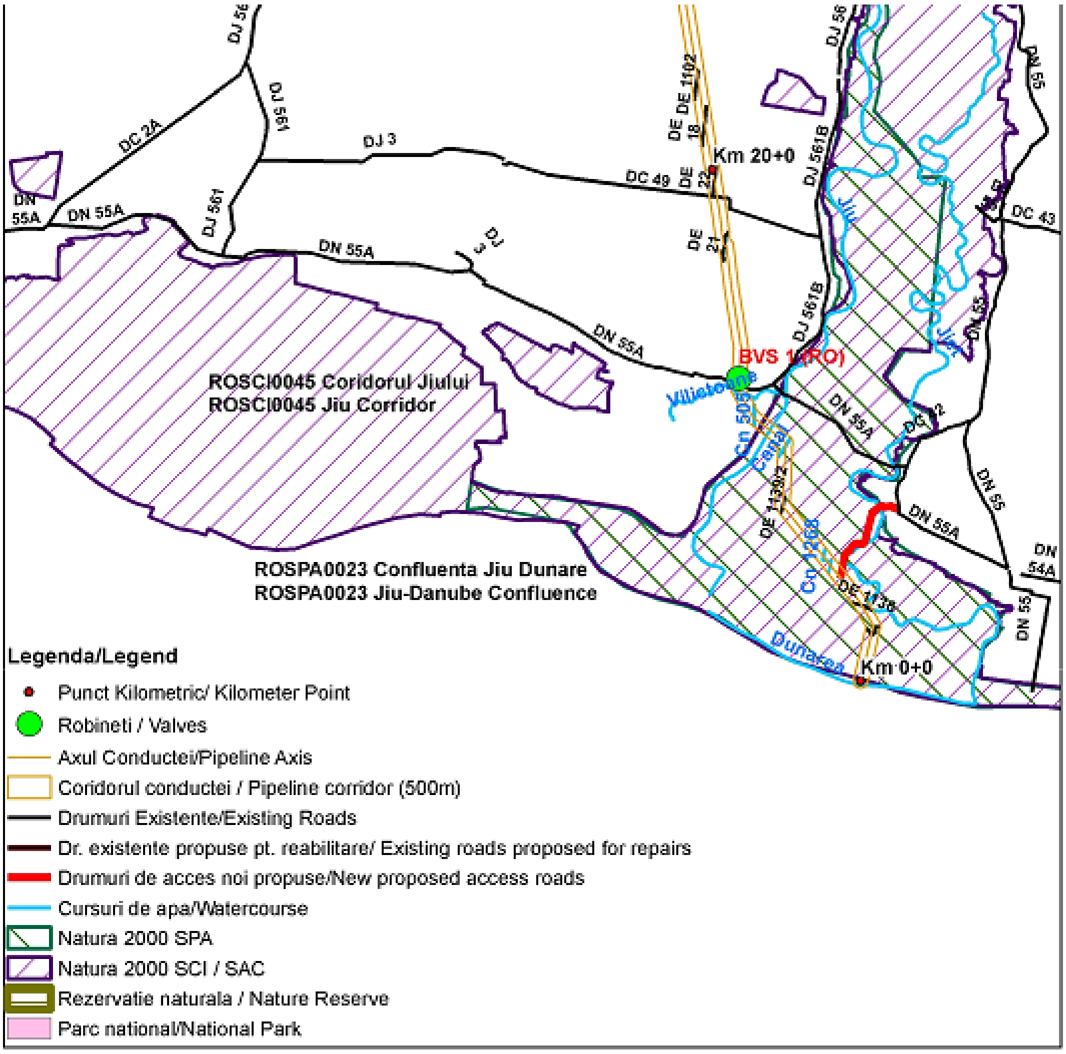


Figure 2.3: New access road on the Romanian side

Bulgarian bank

The acces road on the Bulgarian side is designed to approximately 700 m, is temporary and is connected to national road no. 15 to Oreahovo (see figures 2.4 below). The designed road is made of ballast and compacted crushed stone. The construction of the acces road does not generate any transboundary impacts. At the end of works the road bed will be demolished, and the land will be reinstated to its original use.

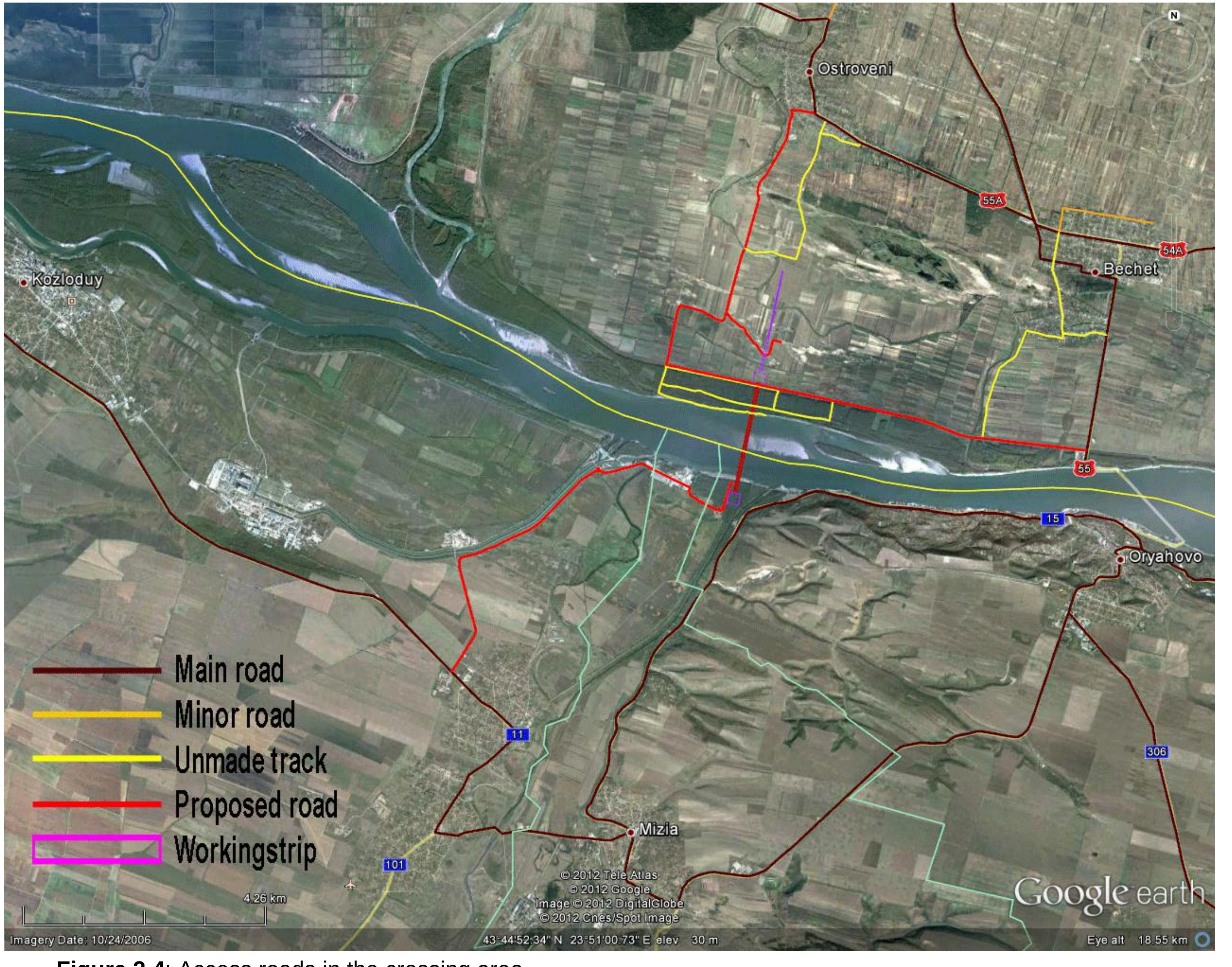


Figure 2.4: Access roads in the crossing area

2.4.5. PIPE TRANSPORT ROUTES AND PIPE SUPPLIER

The pipe will be laid on the Romanian bank both in the case of using the open cut method and in the case of using HDD method for the Danube crossing.
Pipe transport – for the Romanian border section, the pipes will arrive by the Danube and by railway

In **Romania**, the Danube ports where the pipes will be unloaded are represented by Bechet port for the sector from Bechet and by Drobeta Turnu-Severin port which has storage facilities (figure 2.5 below). These ports are connected to the rail and road infrastructure (figura 2.6 below)

The following shall be considered when selecting the route:

Pipe weight-56” pipe	Typical information
22.2 mm	770kg/m
27.0 mm	940 kg/m
Concrete coated	1800

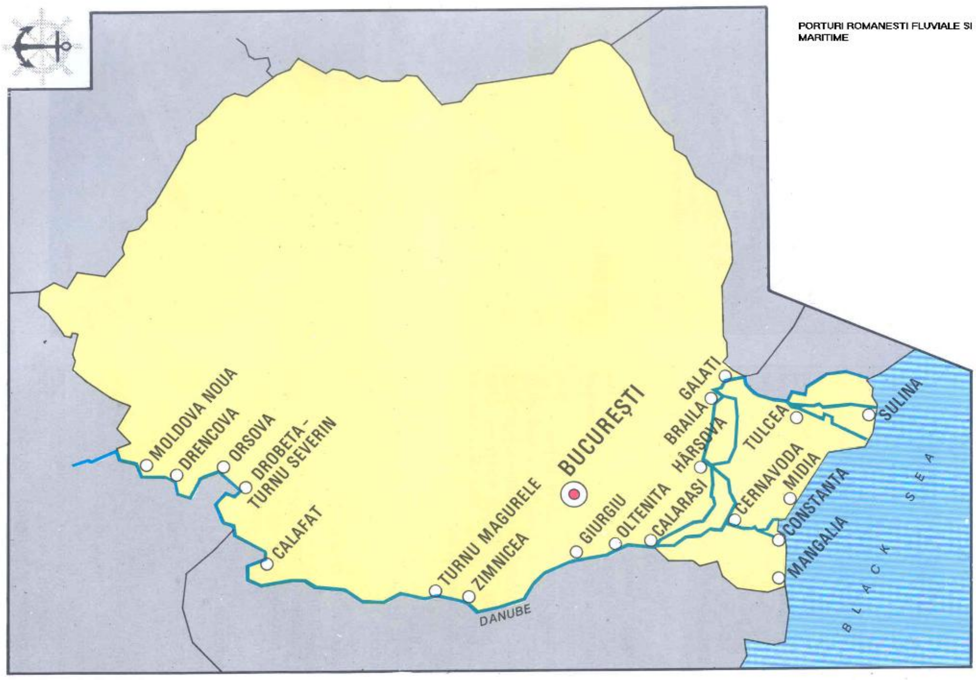


Figure 2.5.: Romania-maritime and river ports

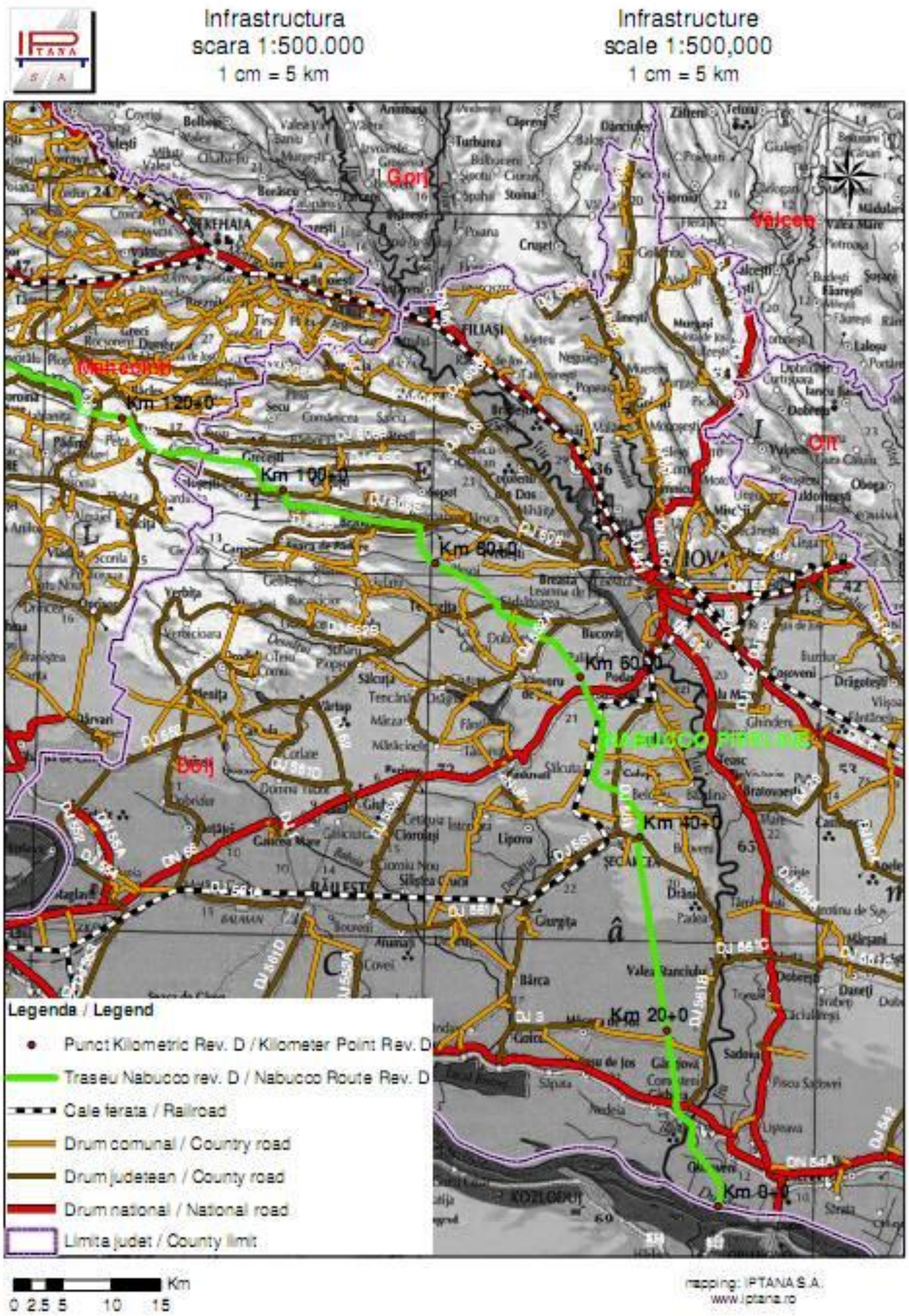


Figure 2.6: Transport infrastructure on the Romanian territory

2.4.6. TEMPORARY BRIDGE AT JIU RIVER CROSSING AND IRRIGATION CHANNELS ON ROMANIAN BANKS

Temporary bridges consist of joining tubes of compressed concrete used at water adductions with large diameter, covered with a thick layer of ballast; thickness is determined depending on traffic and diameter of tubes used. The riverbed bottom is ballasted before laying tubes. It is forbidden to cast concrete in these arrangements. At the end of works the riverbed will be reinstated to its original use.

2.4.7. STOCKPILING OF THE DREDGED MATERIAL AND PIPELINE COVER

The material resulted from dredging in open cut option is discharged into the Danube river (figure 2.7 below), near the Romanian bank.
The trench shall be covered with material resulted from the dredging activity for maintaining the navigable channel, section located in the area of the Jiu-Danube confluence (figure 4.2 below).

For HDD method on the Romanian bank it is necessary to create a working strip for pulling the pipe which will be placed on roller supports. Outside areas assigned the working strip will be 20 m wide and 2km long.

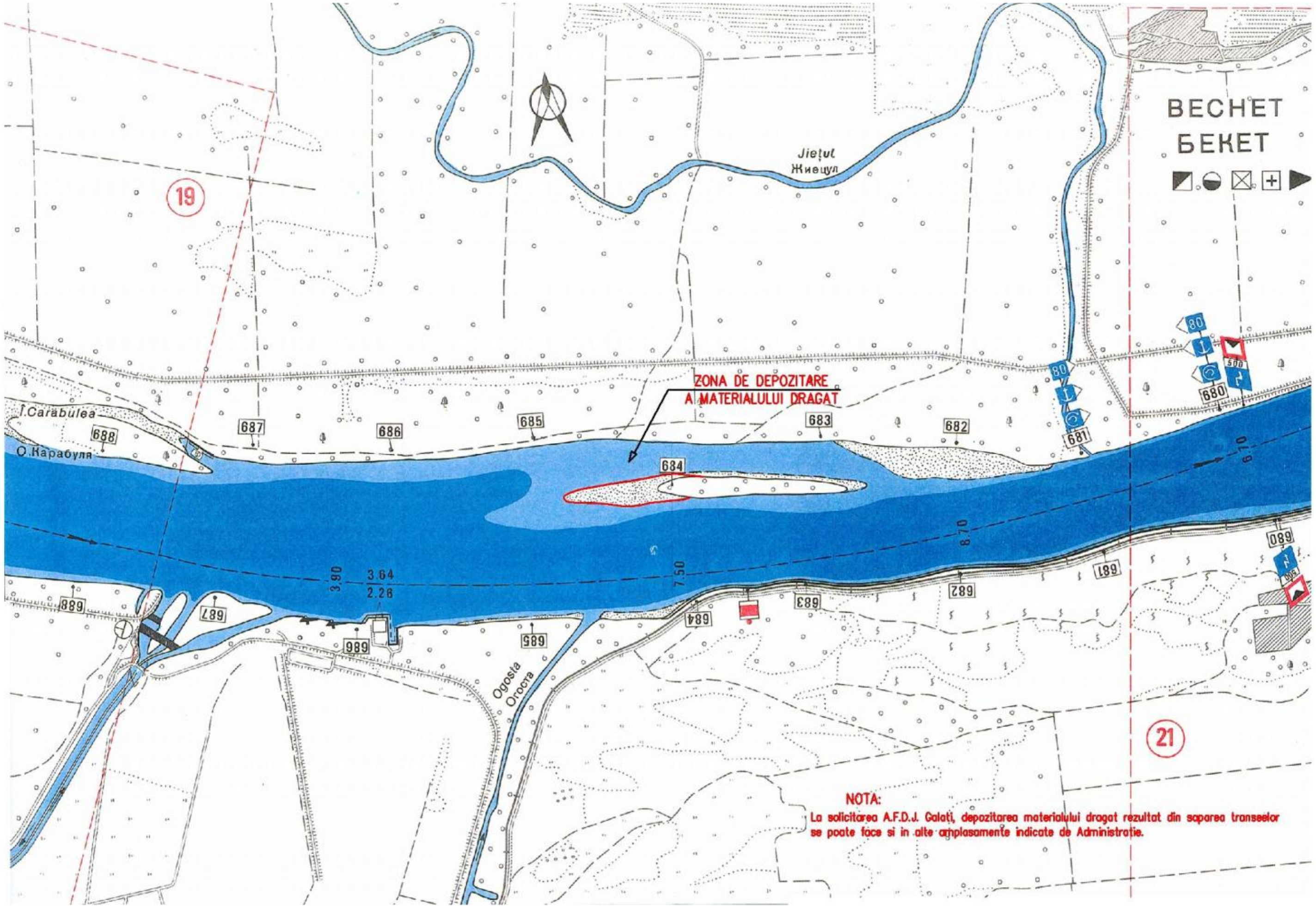


Figure 2.7: Storage area for the dredged materials

2.5. INVESTMENT-RELATED ACTIVITIES

This chapter analyzes the works needed for the implementation of Nabucco project and likely to have a transboundary impact, namely the crossing works for the Jiu, Danube and Ogosta rivers.
The assessment of the impact of all the activities in relation with Danube river crossing including all asociated activites and facilities (from crossing of Jiu river including sites, than crossing of Danube river including sites and until Ogosta river crossing including sites) are subject of this report.
Impact mitigation measures are proposed throughout all project implementation stages in order to mitigate the project's impact on the environmental characteristics and on the social factor.

2.5.1. CONSTRUCTION STAGE

In general, the in-stream crossing solutions (rivers, streams, valleys, channels) have been established depending on the field conditions, the results of the geotechnical surveys and technical possibility. The open-cut method and the trenchless method (horizontal directional drilling method) are two different technologies serving the same purpose, namely to lay the pipe under the riverbed and to ensure the continuity between the two banks.
A short presentation of these solutions is shown in table 2.5 below.

Table 2.5.: Methods for in-stream crossing

METHOD	DESCRIPTION OF METHOD
	OPEN CUT CROSSING
OPEN CUT	The open-cut option is a classical method consisting in dredging trenches where the pipeline is laid down . It is required the prior stripping of the surface on its entire width or by sections, according to the consent obtained from the authorities involved, and the execution of the excavation up to the pipeline laying mark. If protection tubes are needed, they must be supported on a stable foundation. More details are shown below in specific subchap.
	TRENCHLESS CROSSING
Horizontal Directional Drilling – HDD	A pilot drilling is executed from a hole; the drilling equipment executes a tunnel by means of a drilling fluid by high pressure jet. The drilling suspension (water mixture, bentonite and additives) dislodges the earth, carry the dislodged material, supports the microtunnel and reduces the friction. The head corresponding to the pipeline diameter shall be mounted after the drilling equipment reaches the exit hole.
	The drilling fluid has also the role of lubricant between the pipeline and the microtunnel walls. The three-dimensional location of the drilling head is based on the data emitted by a transmitter mounted in the drilling head to a data receiver; thus, the depth, the position in the longitudinal axis and the incline of the drilling head can be accurately determined**.** The pipelines mounted by horizontal directional drilling cannot be laid in protection casing due to the radius of curvature. More details are shown below in specific subchap.

Pipe Ramming – PR	This technique assumes the insertion of the protection tube from the drive pit where the ramming unit is installed, by means of dynamic energy developed by a percussive hammer attached to the pipeline end. This is a two stage process. It consists in the pushing of steel casing by means of a hydraulic installation. The technology assumes the excavation of an appropriate pit in which the equipment can be fitted, the installation of the hydraulic pushing device, the execution of the excavation in the shield foreside followed by advancing with presses, the installation of the protection tube for the pushing operation. The excavation can be executed either manually or mechanically.
Microtunneling – MTB	This is a pipeline installation method, without digging, executed by a computer-aided equipment. The guiding system consists of a laser which communicates with the boring head and the computer.
	A pilot drilling is executed from a hole; the drilling equipment executes a tunnel by means of a drilling fluid by high pressure jet. The drilling suspension (water mixture, bentonite and additives) dislodges the earth, carries the dislodged material, supports the microtunnel and reduces the friction. The head corresponding to the pipeline diameter shall be mounted after the drilling equipment reaches the exit hole.
Casing using Jack-and-Bore	The first step after ROW clearing is to dig a bore pit on one side and a receive pit on the other. These have to be about two feet deeper than the depth of the pipe. The bore pit will be about 3.5 to 5 meters wide at the bottom of the pit, and possibly wider at the top, depending upon the soil and slope conditions, and 17 meters long. The receive pit will not need to be larger than 3.5 by 3.5 meters at the bottom of the pit. The next step is to lower the boring equipment into the launch pit along with the first joint of pipe. The boring machine augers a hole and at the same time pushes the casing pipe through it, one length at a time. After the casing is in place, the pipe which is inserted into the casing. The pipe lengths will have the corrosion coating already in place before being installed. In order to reach a depth of at least 1.2 meters below the bottom of the river, the pits could each be up to 4 meters deep or deeper, depending upon the river depth. The maximum crossing distance that is feasible with the jack-and-bore method is approximately 100 meters. Jack-and-bore is not feasible in bedrock nor in large boulders.

2.5.1.1. CONSTRUCTION STAGE FOR THE OGOSTA RIVER CROSSING

The crossing of Ogosta river (∅1422 mm) shall be executed by trenchless method (casing), during the low waters of the river. According to the Hydrological Report this period is represented by the months August, September and October. The trenchless crossing method (casing) shall be used without water flow diversion (water flow diversion not needed).

The horizontal drilling will be executed with pipe ф1620 mm and length 62 m. Inside the pipe the gas pipeline ф1422 mm will be drawn.
According to the Hydrological Survey data the river is straight in the area of the crossing. The width of the main river bed during low waters is 28 m. The depth of the river during the low water period is approximately 1.90m. The depth of the

river at full river bed (high waters) is 6.5 – 7 m. The right terrace is 40 m wide followed by a slope. The left terrace is the right terrace of Danube river. Both terraces are flooded during high waters. The banks and terraces are densely vegetated (forested) with trees and shrubs.

According to the technical requirement set by the Project Manager, the upper cover of the pipe should be at least 2 m under the level of the expected erosion of the river bed. According to the Hydromorphological characteristic of the pressures of the river bed, the expected wash away is ~ 1,9 m.

During the elaboration of the river crossing design, the pipe wall thickness is estimated by complying with the 10% redundancy for high waters (ref. hydrological survey).

The pipeline is weighted with reinforced concrete weights for float protection during the high waters (according to the hydrological data).

The data for the designed crossing of Nabucco gas pipeline and Ogosta river at kp 421+321 are reflected in appendix 5 to this report and contains longitudinal and transfer sections of the crossing.

The designation of the river, of the gas pipeline KP of the crossing point and crossing coordinates are according to the attached Table of River crossing – Bulgarian Coordinate System 1970.
The crossing area is located in the protected site „Ogosta river" (BG0000614) according to the Habitats Directive.
The impact of works on the site is shown in the Appropriate Assessment according to the legal requirements in force in the Republic of Bulgaria.

2.5.1.2. CONSTRUCTION STAGE FOR THE DANUBE RIVER CROSSING

Both on the Romanian and on the Bulgarian territory, the main transboundary impact is recorded as a result of the Danube crossing-related activities, considering that the state border is in the middle of the water.

Under these circumstances, two solutions have been analyzed for the Danube river crossing:
- open-cut
- horizontal directional drilling (HDD)

The analysis of the topo-hydrographic study shows that, in the area of undercrossing, the navigable channel is very close to the Bulgarian bank. This has a negative influence on both options, increasing the undercrossing length, especially for horizontal directional drilling.

If the open cut method is used for the Danube crossing, the works will be performed from one bank to the other (figure 2.8 below.). The protection dikes on the Romanian bank shall be crossed by ramming.
As seen in the map in figure 2.8 below, the Bulgarian dike will not be affected.

If the trenchless method is used, the works will be performed outside the protection dike from the Romanian bank up to the Bulgarian bank. In this case, the dikes on the Romanian bank, the dike-bank area, the Danube banks and the riverbed will not be affected.

On the Bulgarian territory, the Danube riverbed and the dike-bank area up to the area for locating the HDD installation will not be affected (figure 2.9 below). Also, the Danube protection dike located on the Bulgarian bank will not be affected.

The technical execution possibilities, failure risks during execution, construction risks on the pipeline integrity, social and environmental considerations and cost assessment are the main issues to be taken into account for choosing the proper option of the Danube undercrossing.

Subchapter. 2.5.1.2.1 shows the Danube undercrossing in the open-cut option and subchap. 2.5.1.2.2. the Danube undercrossing in the trenchless option.

Subchapter 2.5.1.2.3, shows the dike undercrossing, subchapter 2.5.1.2.4. shows the time for the Danube undercrossing and subchapter 2.5.1.2.5. shows the navigation management.

Figure 2.8.: Layout plan - the Danube undercrossing by open cut method

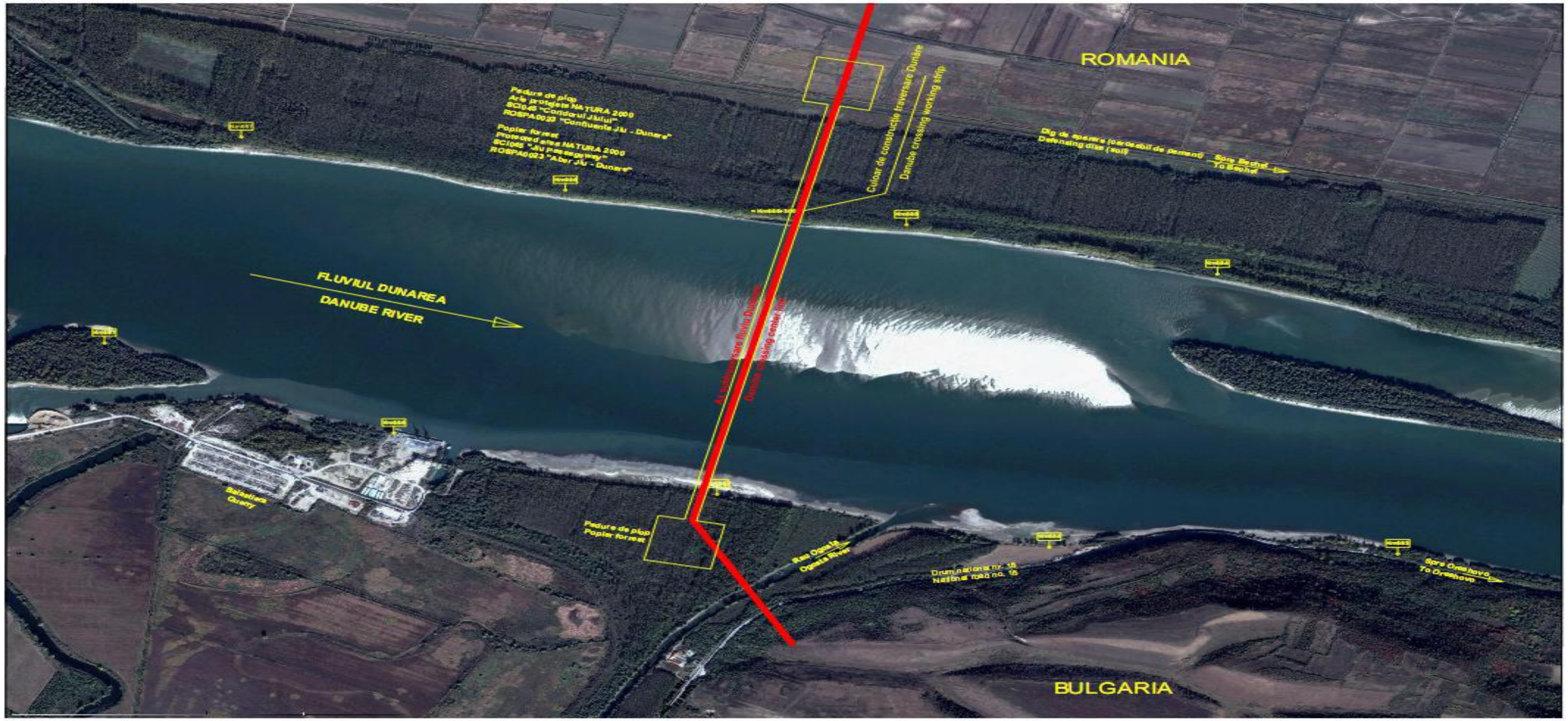


Figure 2.9.: Layout plan - the Danube crossing by trenchless method

2.5.1.2.1. THE DANUBE UNDERCROSSING IN THE OPEN-CUT OPTION

2.5.1.2.1.A General consideration

The Area of influence in the case of open- cut option is formed of: the access roads, the storage areas for the dredged material, the extraction areas for the material needed to cover the pipeline, the water of the Danube downstream of the crossing section.

The (concrete weight coated) steel pipeline to be laid in the Danube riverbed by open cut method will have the following characteristics, for Class location 3: pipe outside diameter 1422.00 mm × 30.0 mm, outside diameter including concrete weighting and coating: 1748.00 mm; maximum system pressure: 100 bar minimum, steel yield strength 483 N/mm^2, SR EN 10208-2, the minimum radius of curvature: 1578.00m.
For the protection of the telecommunication cables there are used two metal pipes with Dn = 100 mm fixed in "12 o'clock" position on the concrete coated pipe, fixed with chucks of 10 m to 10 m, the two metal pipes are self ballasted and will be protected against corrosion inside and outside.

The execution method is hereinafter shown.

Undercrossing geometry

The undercrossing geometry depends mainly on the technology. The minimum elastic curve of the pipeline of 1,530 m and the burial depth as determined in the previous paragraph shall be complied in either option.

Longitudinal profile

In the open-cut option, the longitudinal profile through the undercrossing (from the Romanian bank to the Bulgarian bank) is a sequence consisting of a 2,000 m radius curve with a length of ~ 155 m, an alignment of ~ 940 m and 1,800 m radius curve, having a length of approx. 276 m.

The undercrossing profile has resulted so that the excavation quantities should be minimal, according to the condition of eliminating the pipe inflexions (concavity/convexity alternation).
In the horizontal directional drilling option, the longitudinal profile will take the form of a curve. – see appendix ,6, figure A6.1.

Cross sections

In the open-cut option, the execution of the trench considers the fact that the excavations will be carried out in the water flow. For stability reasons, the trench slopes will be performed in the riverbed with a slope of 1:3. In the banks area, where the water velocity is lower and the excavations are carried out with on-shore equipment, the slope of 1:3 will be changed into 1:1.5.
The bottom width of the trench varies from 5 m in the banks area to 12 m in the riverbed. The bottom width has been established to ensure the trench linearity (there will be deviations to the left/right during the execution with the dredging equipment from the undercrossing centreline and therefore, it is required a greater width of the trench bottom to provide a continuous corridor in the undercrossing centreline for pulling the pipeline from one bank to the other); the ratio between the bottom width and the trench length is approx. 1/1,000.
The volumes of works to be performed in the Danube waterway are shown in table 2.6. below.

2.5.1.2.1.B Volume of material carried along to the critical points for navigation

In the open-cut option, part of the material excavated in the riverbed will settle out onto the critical points for navigation. The trench excavation and filling operations are performed in the water current and therefore a part of the material will be carried along downstream. A percent of this amount settles out onto the critical points where a minimum depth must be ensured.

The volumes of works to be performed in the Danube waterway in order to remove the material settled out onto the critical points for navigation are shown in table 2.5. above. They were determined based on the grading resulted from the geotechnical survey, from the studies conducted in the past for such situations and the experience from previous undercrossing. According to the data shown downstream the pipeline centreline– Bechet (kmr 684+100 – kmr 678+660) the riverbed morphological modifications are characterized by the degradation of the mobile riverbed. Due to this specific character, no additional aggradation evolutions are expected due to the volume of material dragged (see details in chap.5.2.1.2.2 below).

2.5.1.2.1.C. **Trench execution**

If this option is selected, the transboundary impact is analysed taking into consideration the following aspects:
- Dredging technology and timeline for implementation;
- Dredging equipment;
- Transport of the dredged spoil from the dredged location to the disposal site;
- Dredging spoil disposal technology;
- Environmental suitability of the dredged spoil disposal site (dumping site);
- Evaluation of the qualitative and quantitative characteristics of the river sediment, subject to dredging (total volume, grain size, mineral and chemical composition, eventual presence of contaminated sediments).

The pipeline will be placed in the Danube riverbed by the open-cut method with the following characteristics:
- ✓ diameter 1,422 x 28.6 mm for the location class I;
- ✓ mass: 983 kg/m;
- ✓ outside diameter, including the concrete lining:: 1,649 mm;
- ✓ max. regime pressure 90 bar;
- ✓ tubular material: X 70 PSL 2 API 5L/SR EN 10208/2;
- ✓ minimum flow limit: 483 N/mm^2;
- ✓ minimum curve radius: 1,530 m.

The excavated trench in the Danube riverbed will have the following characteristics
- Crossing length: 1,370.00 m;
- Minimum level of the bottom of the trench (minimum depth of excavation):
- + 5.91 mrMN;
- Minimum pipe cover, above the top of the pipeline: 2.00 m;
- Width at the base of the trench in the embankment area: 5.00 – 12.00 m;
- Width at the base of the trench in the river bed: 12.00 m
- Slope of the embankments in trench cross section in the river banks area:
1:1.5 – 1:3;
- Slope of the embankments in trench cross section in river bed: 1:3.

Table 2.6 : Volumes of hydrotechnical works

Sec-tion	Used distance (m)	Excavations										Backfillings	
		Above water level		Between 0 and -2.5 m below water level		Between -2.5 m and -6 m below water level		Between - 6 m and -14.5 m below water level		Below -14.5 m water depth		On-shore	Off-shore
		S (m2)	V (m3)	S (m2)	V (m3)	S (m2)	V (m3)	S (m2)	V (m3)	S (m2)	V (m3)	V (m2)	V (m3)
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1	84.5	108.0	9,126	56.6	4,783	21.4	1,809	-	-	-	-	15,717	-
2	100.0	-	-	71.7	7,170	99.0	9,900	14.3	1,430	-	-	18,500	-
3	200.0	-	-	-	-	74.0	14,800	61.8	12,360	-	-	-	26,680
4	260.0	-	-	-	-	132.3	34,398	177.2	46,072	-	-		73,970
5	211.6	-	-	-	-	-	-	322.9	68,326	5.5	1,164		69,490
6	158.4	-	-	-	-	-	-	293.4	46,475	42.0	6,653		42,547
7	120.0	-	-	-	-	-	-	-	-	83.8	10,056		10,056
8	80.0	-	-	-	-	67.8	5,424	482.5	38,600	69.5	5,560		49,584
9	78.7	-	-	39.2	3,086	231.9	18,251	247.0	19,439	-	-	40,775	
10	75.9	134.6	10,217	65.3	4,957	16.9	1,283	-	-	-	-	16,456	
Total	**1,369.1**		**19,343**		**19,996**		**85,865**		**232,702**		**23,433**	**91,448**	**272,327**

Total volume of on-shore excavations: = 19,343 m3
Total volume of off-shore excavations: = (19,996 + 85,865 + 232,702 + 23,433) m3 = 361,996 m3

Works quantities for the bank protections:
Geotextile in the bank protections (overlapping 20%): S = [(1,900 + 10,200) m2 + (190 + 430) m x 1.5 m] x 1.2 = 15,640 m2
Bank protection with crushed stone of 40÷65 mm grade: V = (1,900 + 10,200) m2 x 0.3 m = 3,630 m3
Bank protection with rubble stone 10÷50 kg/pc: V = (1,900 + 10,200) m2 x 0.3 m = 3,630 m3
Bank protection with stone blocks 50÷200 kg/pc: V = (1,900 + 10,200) m2 x 0.9 m = 10,890 m3

Note: The volume of fillings as above-mentioned refers to the material which is to be effectively placed. The volumes of excavations in the deposits for performing the fillings will be greater due to the fact that during the placing operations, a part of the material is carried along downstream by the water flow.
However, when establishing the *quantities of works and* within *the financial tender, it will* be *considered that some operations resulting from trench excavations and trench filling will be located in the critical points for navigation*, *wherefrom it will be removed.*

Based on the grading resulting from the geotechnical study, on the studies done in the past for such situations and on the experience of previous crossings, the above-mentioned quantities are approximated as follows:

The technological process of off-shore works includes the trench excavation operations, the excavated material unloading from the barge into the storage place, the material excavation from the storage place needed to cover the trench and the material unloading from the barge over the trench. The volume of material carried along by the water flow during the excavation process is about 10-20% and the volume carried along when unloading the barges about 20-30%, as follows:

Volume of excavations below water level: 361,996 m3 ~ 362,000 m^3
Volume of material placed from the barge: 272,327 m3 ~ 272,400 m^3

- Volume of material carried along in the excavation process:
362,000 m^3 x 15% = 54,300 m^3
- Volume of material carried along when unloading the barges from the storage place:
(362,000 – 54,300) m^3 x 25% = 77,000 m^3
- Volume of material carried along when unloading the excavated material into trenches from the storage place:

272,400 = V_d – 25%V_d $\Rightarrow$ $V_d = \frac{272.400mc}{0,75}$ = 363,200 m^3 $\Rightarrow$ V = 363,200 m3 x 25% = 90,800 m^3

- Volume of material carried along when excavating the material from the storage place in order to fill the trench:

363,200 m^3 = V_e – 15%V_e $\Rightarrow$ $V_e = \frac{363.200mc}{0,85}$ = 427,300 m^3 $\Rightarrow$ V = 427,300 m3 x 15% = 64,100 m^3

The above-mentioned shows a volume of material carried along by the water flow, of about 286,200 m^3 (54,300 m^3 + 77,000 m^3 + 90,800 m^3 + 64,100 m^3).
The above-mentioned studies show that out of the total volume of material carried along by the water flow to the critical points for navigation, about 5-10% will settle out, resulting a value of about (0.05÷0,1) x 286,200 m^3 = 14,300 ÷ 28,700 m^3.

Before the trench execution a cross section should be made through the undercrossing axis, which will be compared with the transverse profile resulting from the topo-hydrographic study.

The proposed working technology is:
- Above the average level of the Danube at Bechet (~ + 24.60 mrMN): excavation with reverse bucket excavator
- Between water elevation + 24.60 and + 22.60 mrMB: excavation with dragline excavator
- Between water elevation + 22.60 and + 10,10 mrMB: dredging with bucket-ladder dredger with the possibility of digging up to 14.50 m in depth;
- Between water elevation +10.10 and + 5.90 mrMB: dredging with bucket-ladder with the possibility of cutting up to 22.00 m in depth

The general Contractor is free to propose its own work technology with the obligation to comply with the construction dimensions and imposed quality conditions within the established deadline for work completion. The social and environmental impacts, constraints and mitigation measures are going to be taken into consideration during the decision making process.

2.5.1.2.1.D. **Dredging works in the river bed of the Danube**

The dredging and disposal activities trigger the possibility of trans-boundary environmental impacts.
Impacts from specific dredging technology refer to the impact on air generated by the operation of the dredging installations, of the engines of the self-propelled dredgers for the transport of the dredged material, as well as the impact generated on the aquatic environment as a result of the dredging, pipeline installation and trench covering works.

The Contractor will take into account that some of the solid material transported by water current shall be deposited in trenches throughout the execution and that volume will also be dredged.
Full compliance of the trench dimensions with the design is important to ensure the necessary thickness of protection above the pipeline, due to possible river bed erosions and accidental falls of objects. **Laying the pipeline at the designed levels (and not higher)** would ensure that this protection will be provided during the pipeline operation.
On completion of the dredging works the contractor will proceed to cleaning and levelling the trench bottom with airlift and remotely operated vehicle (ROV).
Before pulling the pipe from one bank to the other it is mandatory to check the trench bottom with ROV and make a cross section through the trench to check dimensions. Cross section will be conducted by an independent unit
Allowable tolerances of the dimensions at the trench bottom should be ±10 cm for 95% of the values and ±15 cm for the remaining 5%.

Dredging works will be executed by using a self-propelled dredger with a capacity of 750.00 m3/h. The machine can be used at depths greater than 2.00 m. In cross section, slope excavation will run with slopes of 1:3, in 1.00 m deep and 3.00 m wide steps, each step representing an independent strip of dredging. Along the trench, excavation will be done in steps of 0.50 m. The length of the trench dredged section will be about 1,248.00 m, due to the inability to use equipment at depths less than 2.50 m.
Dredged material will be loaded into self-propelled barges and will be transported at the points indicated by the Romanian navigation authority AFDJ Galati, where it will be unloaded.

Three solutions have been analyzed for storing the dredged material, namely:

- According to the initial discussions held with the Romanian navigation authority AFDJ Galati, the dredged spoil disposal site (dumping site) is an islet, floodable in high waters (see figure 2.6 above). The difficulty consists in the fact that the islet is a shelter site for many bird species.
- An other proposed solution was for storing the dredged material on the Eomanian bank, outside of Natura 2000. The difficulty consists in the fact that the material must be unloaded dry from the barge, and then stored, which requires a very expensive construction camp, wide land areas, etc.

-As a result of the discussions held with the Romanian navigation authority AFDJ Galati and Bulgarian Executive Agency for Exploration and Maintenance of Danube River, the dredged material should be stockpiled in front of the islet, towards the Romanian bank.

Total volume of on-shore excavations: = 19,343 m^3

Total volume of off-shore excavations: = 361,996 m^3

The geotechnical surveys carried out in the Danube riverbed (Nabucco document 70223-RR-RPT-PL-0044) have highlighted a non-cohesive complex formed of sand and gravel with various grain sizes, mainly grey, sometimes with lens of silty clays, clayey silts or intercalations of sandstones and cobbles.
The existence of no contaminated sediments has been highlighted from the available data.
After laying the pipeline into the trench, the material dredged from the navigable channel, section located in the area of the Jiu-Danube confluence shall be used for filling the trench.

2.5.1.2.1.E River bank excavations

The river bank excavations will be done with excavators that will be equipped with dragline for working under the water level.
Topsoil on the banks will be collected and transported in a special storage site, to be reused on completion.
The material will be loaded into dumpers and transported to storage sites on the Danube banks. Material from the excavations below the water level will be stockpiled on the waterfront, in an intermediate storage, to allow water to drain, and then it will be transported to the same storage sites, from where it will be recovered for filling the trench.
In areas with eroded lands, as well as in areas with inclined slopes, consolidation fences and compaction and thorough grass seeding of soil shall be executed after covering the pipeline in order to avoid the occurrence of landslides.
When executing the diggings within the working strip, the topsoil shall be separately stored in the same area in order to be recovered and brought back when reinstating the land to its agricultural use (figure 2.10 below).

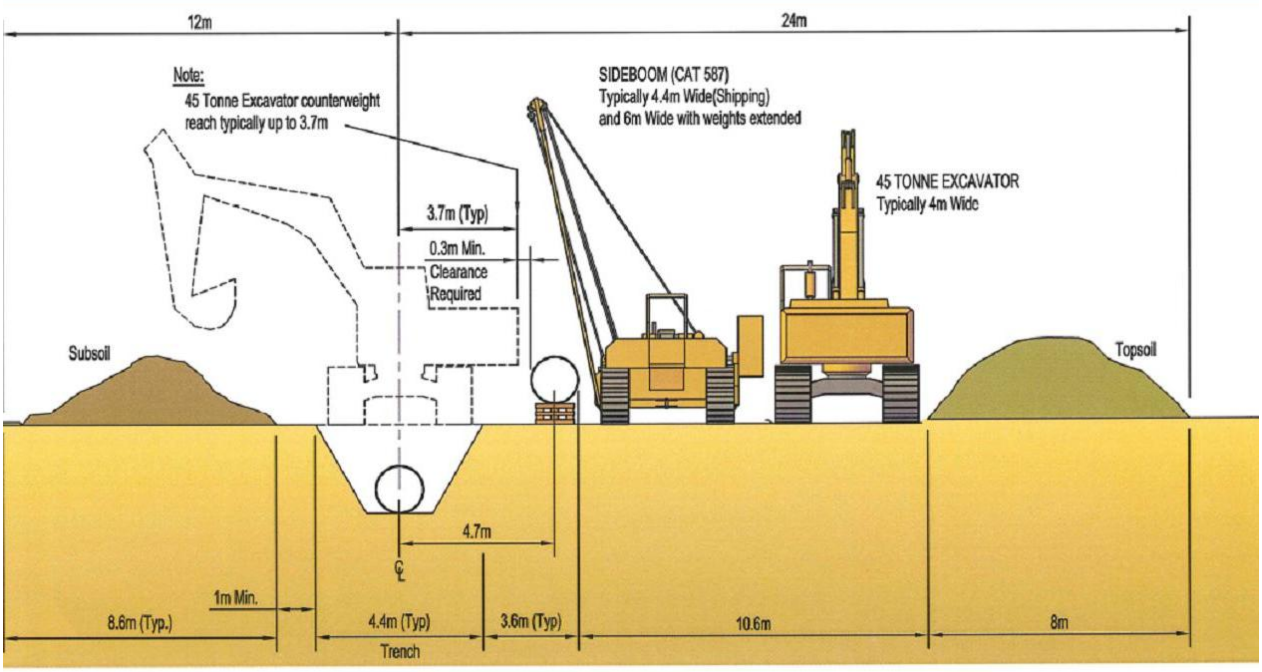


Figure 2.10 : Typical drawings for execution of the trench.

After covering the pipeline, the topsoil shall be reinstated so that the land should be at its initial profile after compaction.

Also, in the open-cut option, it is considered necessary to provide the stone protection of both banks in the water level variation area, due to the fact that the local material placed to cover the trench is looser than before the excavation and it can be carried along easier by the water flow. Another important advantage brought by the banks protection to the riverbed stability is damping the tensions in the riverbanks due to ice floes and ice bridges (see appendix 14).

2.5.1.2.1.F. Laying the pipeline into the Danube river bed - dragging from one bank to another

Sections are formed on the left bank of the Danube, in major river bed (where pipes concreting takes place) and are drawn successively in minor river bed with horizontal-mounted equipment that is used to hoist, crown, crane engines, gearboxes and torque converters.

2.5.1.2.1.G. Filling the trench

After placing the pipeline in the trench in accordance with the geometry set in the design, the open-cut will be filled.

To this effect, the filling material will be dredged in the area agreed by AFDJ Galati, and then it will be carried with barges and unloaded in the trenches. Backfilling the trench will be executed so as to ensure an appropriate layer thickness above the pipeline, determined from the erosion and protection condition against the mechanical action.

In the banks area, after backfilling the ditch with the material resulted from excavations, the bank protection will be executed in accordance with the drawings. The backfills will be compacted in layers of 15-20 cm above the water level.

The bank protections will be executed in the variation area of the water level, on about 3 m above and below the average water level.

On completing the trench backfill operation and bank protection, A.F.D.J. Galați will make a cross section to check the backfill levels.

The surface area of the expected landtake on the Bulgarian bank for the execution of the Danube crossing works is shown in appendix 8 (drawing no. 70223-BB_PL-03-02-0157, and drawing no. 70223-RR-PL-8155).

2.5.1.2.2. TECHNOLOGICAL OPERATION IN THE CASE OF OPEN-CUT METHOD

The construction stages for Nabucco gas pipeline are the following:

- Working strip preparation
- Trench excavation
- Pipeline laying – to the surface
- Pipeline launching into the trench
- Pipeline cover
- Pressure test (hydrostatic)
- Land reinstatement works

2.5.1.2.2.A. Construction corridor clearing

The first stage of the construction works consists in the preparation of the land for the working strip: route identification in point of the topography, marking, detecting and removing any unexploded ordnance, archaeological excavations where archaeological finds are present, construction of pipe storage yards and access roads, if necessary.

The working strip on **both territories** has the following widths:

- In the field, farm lands, pastures, agricultural road junction: 36 m
- In forest areas: 30 m
- At intersections with asphalt roads, railways, watercourses, irrigation channels: the width depends on the type of obstacle crossed

2.5.1.2.2.B. Trench excavation

The topsoil shall be removed from the entire surface of the working strip in accordance with those envisaged by the soil analysis study (photo 2-1 below). The topsoil shall be stockpiled. When completing the construction works, the topsoil shall be reinstated.

Photo 2-1 : Example of trenching

2.5.1.2.2.C. Pipeline laying- at the surface

The pipeline shall be laid according to photo. 2.2 below.

Photo. 2.2. : **Example of pipeline installation**

2.5.1.2.2.D. Pipeline launching into the trench

The pipes shall be welded after opening the trench by mechanized excavation and stockpiling the subsoil in the working strip. After welding, the pipes shall be laid onto the trench.

2.5.1.2.2.E. Pipeline cover

The pipeline shall be covered once the pressure resistance test and the tightness test have been conducted. The land shall be reinstated in accordance with the provisions of the soil protection and Reinstaitment plan (see appendix15).

2.5.1.2.2.F. Pressure (hydrostatic) test

The pipeline shall be tested according to the procedure developed within the project. Prior to commencement of hydrostatic testing the Construction Contractor must submit detailed procedures to NIC for approval.

The general methods to be used to perform hydrostatic pressure testing and pre-commissioning of the gas pipeline includes the following activities:

- Pipeline cleaning.
  Prior to commencement of hydrostatic testing each pipeline section shall be cleaned of construction debris using trains of pigs fitted with brushes and magnets. The Construction Contractor will submit for NIC approval, a cleaning procedure stating the volumes of water to be used in front and between the pigs and the proposed discharge method and location. To reduce total water requirements, the cleaning pigs will be propelled by air and separated by slugs of fresh water.
  Water used for cleaning and proposed discharge locations will be selected to avoid areas in close proximity to residential areas and locations of environmental sensitivity.

- Pipeline gauging.
  Prior to hydrostatic testing, either after the cleaning activities or during line filling, the pipeline test sections will be checked for any buckles, dents and similar irregularities using a gauging plate attached to a pig. In the event a received plate is damaged, the pipeline defect location will be identified and the section repaired. When the cleaning and gauging activities have been completed satisfactorily the pipeline section is ready for pressurising.

- Pipeline filling
  The water quality at abstraction sources will be analysed prior to the commencement of the filling activities. The decision to use chemical treatment will depend on the water analysis and on how long the water will remain in the pipeline. The need for chemical treatment will be challenged, however should treatment be necessary the use of inhibitors and chemicals will be subject to NIC approval. The Contractor shall obtain samples from all water sources proposed for analysis by a testing laboratory approved by NIC. The analysis shall show:
    - Sulphate concentration
    - Fatty acid concentrations, if the total dissolved organic carbon is above 15 ppm;
    - Ammonium concentration;
    - pH values;
    - Biological growth.

  The fill water will be of a quality that protects the pipeline test section from ingress of foreign matter, sedimentation, biological contamination and internal metal corrosion. The water will be filtered and passed through vented break tanks before entering the test section of the pipeline. Flow meter arrangements will be incorporated into the fill spread for monitoring the water volume.
  Where pipeline test sections are not located near potential water sources, the hydrotest water will be transferred between test sections.

- Hydrostatic testing
  Following completion of filling activities the pipeline test section will be left for 24 hours to allow the temperature to stabilise. The pressure will be raised in a controlled manner until the correct test pressure is reached. Upon reaching the required test pressure, the pressurising pump will be isolated and the pressure allowed stabilising for a period of 2 hours. The

test pressure will then be held for a minimum of 24 hours and a log of pipeline temperature, ground temperature and ambient temperature will be maintained at regular intervals throughout the hold period. The test will be considered successful if there are no changes, which cannot be attributable to temperature variation.

- Dewatering and Final Cleaning

  Immediately following successful completion of the pressure test the pipeline section will be dewatered by using air propelled swabbing pigs. The displaced water may be transferred to another section or discharged to an approved discharge location. The procedure will detail the water analysis limits, monitoring requirements and ensure energy stored in the displaced water is dissipated to prevent erosion at the discharge location. Water will be discharged in a manner not to cause damage, pollution or flooding to the area.
  Following completion of dewatering activities, the tested pipeline sections will be welded together ready for final cleaning. This will be carried out using trains of cleaning pigs

After finishing all tests and preparatory activities, the gas pipeline is secured, the fences of all block valve stations and facilities are locked and marked with warning signs and the gas pipeline is in a state of readiness for commissioning.
All valves along the gas pipeline route are left in closed position.

Permits for all water intakes and discharges from and into water bodies shall be obtained in advance from the respective Basin Directorates. The water released from the hydrotest is “conditionally pure”, i.e. it will not lead to violation of the standards for water quantity. The gas pipeline pipes have an internal epoxy coating, there will not be corrosion and presence of a loose oxide layer or release of other harmful substances. The processed water is not toxic for the domesticated and wild animals and is safe for the environment.
No groundwater will be abstracted for hydrostatic test use. Water will be abstracted from the Danube river and river flows are not affected.

An example of installation for hydrotest is presented in photo 2.3. below.

Photo 2.3: Example of installation for hydrotest

The landform and topsoil shall be reinstated after finishing the water settlement and disposal.

The water needed for hydrotest will be abstracted from the Danube river. After treatment, the water will be discharged into the Danube River, by complying with NTPA 001[2] conditions.

2.5.1.2.2.G. Land reinstatement works

The constructor must reinstate the affected land to its original condition before the work execution.
When executing the diggings within the working strip, the topsoil shall be separately stored in order to be recovered and brought back when reinstating the land to its agricultural use.

The following shall be reinstated according to the procedures developed within the project: cropped land or grassed areas, hedges, affected ditches. Where roads or footpaths have been damaged by Contractor's plant or vehicles outside the trench line the base course and wearing course shall be reinstated over the full extent of the damaged area.

Where a pre-construction drainage scheme is installed this should be maintained and protected by the Contractor throughout the works.

In case of **forest clearings**, the trees can be replanted in the same area, except the surface of the pipeline protection zone.
According to the regulations in the two countries, the Nabucco pipeline protection area covers:
- 12 m (6m left/right in relation to the pipeline centreline) for the Romanian bank
- 30 m (15 m left/right in relation to the pipeline centreline) for the Bulgarian bank.

The forest area that cannot be replanted in the same place shall be replanted within Natura 2000 site in the zones indicated by the administrator/curator of the area or by the forest administrator.

2.5.1.2.3. THE DANUBE RIVER CROSSING USING THE HDD METHOD

2.5.1.2.3.A. General consideration

In terms of banks height, the horizontal directional drilling option is possible (appendix 7).
This option would have become impossible if the undercrossing profile had been established with a few hundred meters downstream, where the Bulgarian bank is high and steep.
Given the banks configuration, the drilling rig can be located on either side, but in terms of accuracy in execution and of the risk that the drilling rig cannot ensure safe pipeline installation at a depth below the riverbed, the drilling head should be placed on the Bulgarian bank (the distance between the Bulgarian bank and valley floor is lower, the cumulative errors of drilling rig in the valley floor, which is the most sensitive area of undercrossing are smaller).
This option has the advantage that the undercrossing does not affect the river bed, the banks, plants and aquatic organisms, the environmental factors in general.

[2] Government Decision no. 188/2002 for the approval of Standards on the conditions of wastewater discharge into the aquatic environment, as amended by GD no. 352/2005

Work will be performed in a way that the negative impact of activity on the environment is minimized.

Area of influence in the case of HDD method includes: temporary construction site, access roads and localities near crossing location or crossed by access roads

Similarly to the open cut option where some difficulties might arise when placing the pulling equipment onto the bank, some difficulties may also occur when placing the drilling rig onto the bank.
Also, the risk of laying the pipeline on a profile different from the designed one is higher; in this case, the pipeline may be installed closer to the riverbed bottom (higher than the designed levels).

2.5.1.2.3.B. Drilling tunnel execution

Two separate/different drillings will be carried out.

The steel pipe for the gas pipeline will have the following characteristics, for Class location 4: pipe outside diameter 1422.00 mm × 36.65 mm, maximum system pressure: 100 bar minimum, steel yield strength 483 N/mm^2, SR EN 10208-2.
For protection of telecommunication cables 1 drilling is performed with steel casing Dn 250 mm. The undercrossing length for the two drillings is 2,000.00 m.
The drilling tunnel is done by cutting and injection of the drilling fluid under pressure and assumes the following steps:

The distance between the two tunnels is minimum 20 m. This distance may increase depending on the constructor's equipment.
<u>Pilot drilling</u>: From a starting hole it is drilled with a power drill head through the ground. The controlled drilling head drills a tunnel with a high pressure jet drilling suspension. Displaced material is partially incorporated in the tunnel, and fine particles are carried by the drilling suspension in the starting pit.

<u>Expanding drilling</u>: After the drill head reaches the target precisely into the pit, the expanding head corresponding to pipeline diameter is installed. By rotating and pulling the head back through the pilot tunnel, this will expand to the desired size. The diameter of the drilling tunnel must be 30% greater than the diameter of the pipeline to be laid. If necessary, successive enlargements, with increasingly larger expanding diameters are used.

<u>The drilling rig will be located on the Bulgarian bank.(see fig.2.11.below)</u>
<u>The soil resulted from drilling shall be stored on the Bulgarian bank, in the rig location zone and shall be used after the execution of the project.</u>

Figure 2.11: Layout of rig site

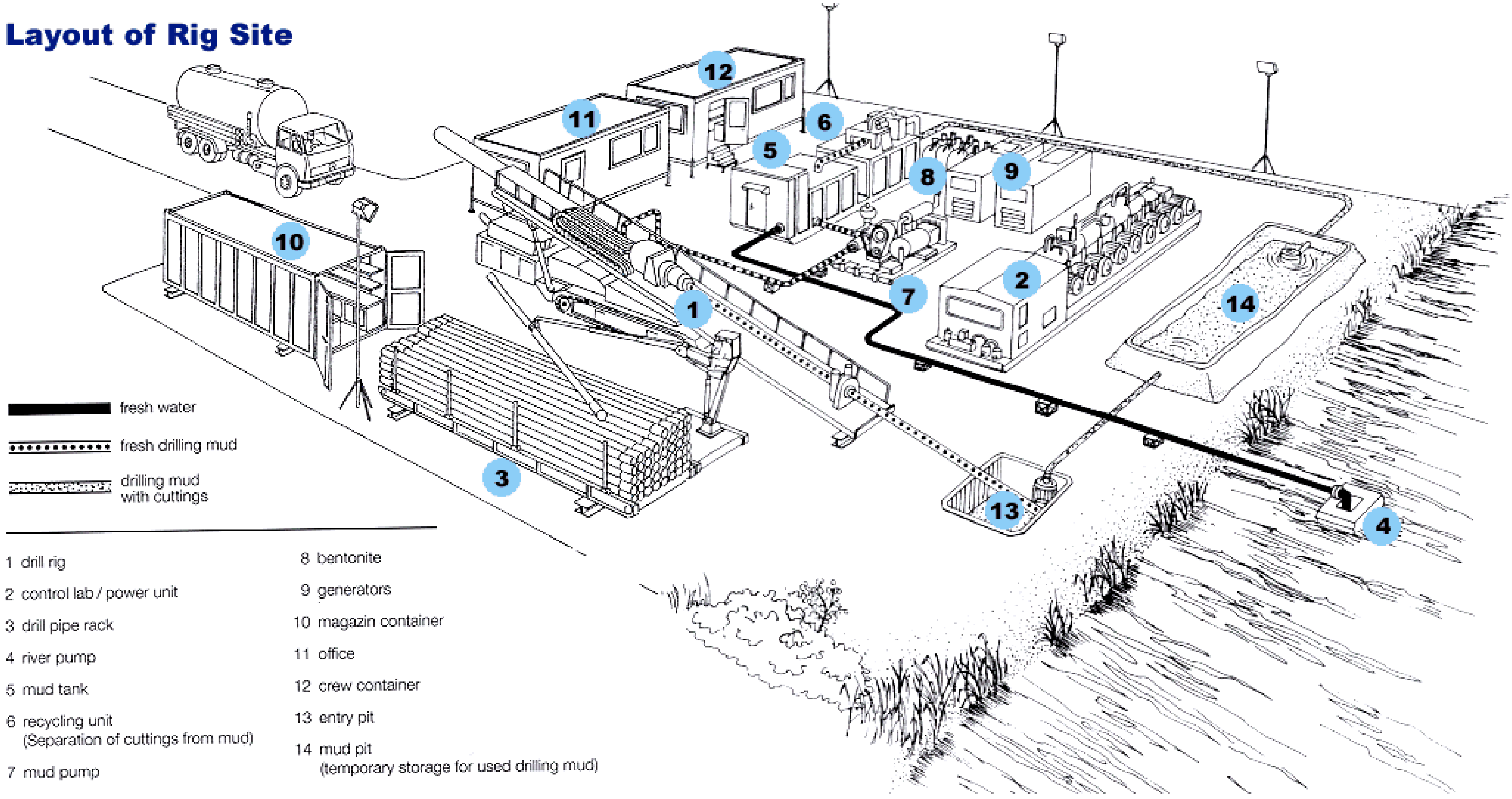


Image downloaded from site http://www.lmrdrilling.co.uk/organisation.html

Figure 2.12: Layout of pipe site

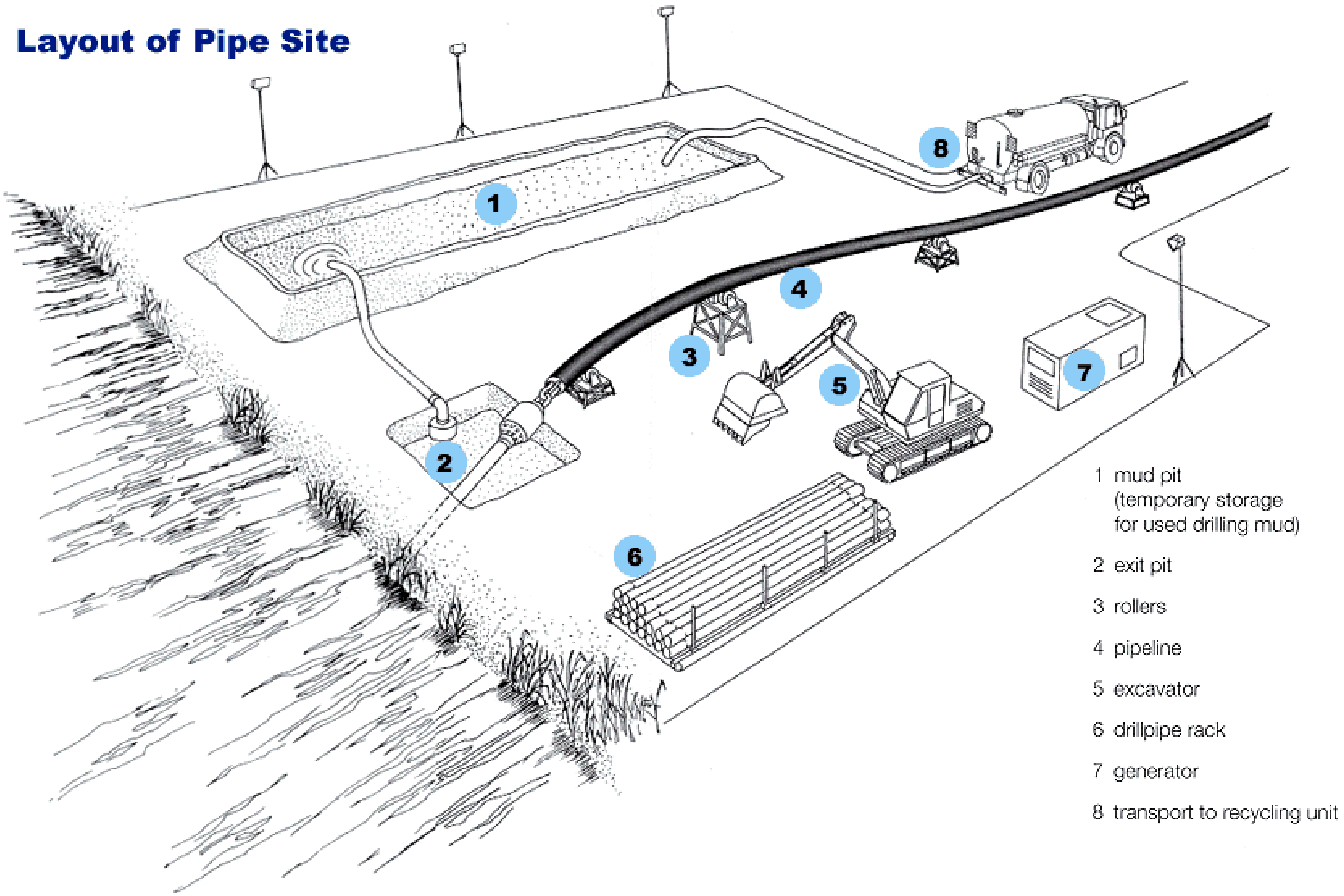


Image downloaded from site http://www.lmrdrilling.co.uk/organisation.html

2.5.1.2.4 TIMELINE FOR THE DANUBE RIVER CROSSING

2.5.1.2.4.A. Timeline for the Danube river crossing using open cut method

The designer recommends an execution time of 6 calendar months, which will include all operations of land preparation, excavation in the riverbed and banks, verifications, formation of pipe segments, placement of the winch, pulling the pipe from one shore to the other, on-shore and off-shore filling, the execution of bank protection, land reinstatement after decommissioning.
Work period is recommended from June 15 to December 15 and will comply with the fish prohibition period (spawning) and breeding period for other aquatic species.
Prohibition period for each bank is announced every year, by ministries in Romania and Bulgaria and lasts about 45 days, being placed, depending on weather conditions in late spring / early summer.
Considering the duration of the similar works in Isaccea area (Danube crossing with gas pipeline between Ukraina and Romania), an estimation varying **from 6 to 8 calendar months** depending on the contractor's floating equipment can be made.

2.5.1.2.4.B. Timeline for the Danube river crossing using HDD method

The designer recommends an execution time of **4 calendar months**, which will include all operations. The duration of execution is long because the Danube undercrossing is represented by two separate drillings, one for gas pipeline and one for telecommunications.

2.5.1.2.5. NAVIGATION MANAGEMENT

Open-cut method

The trench excavation and backfilling works will be performed while keeping open the traffic of vessels on the Danube. The traffic will be suspended only during the time when the pipeline is pulled from one bank to the other. A.F.D.J. Galați as the authority that ensures the navigation conditions on this sector of the Danube will be informed in advance when the navigation on the Danube should be closed for the pipe stringing operations. In order to ensure the safety of navigation on the Danube during the gas pipeline construction and operation, there will be required signs and traffic lights in the work area in accordance with the following:

- "Regulation of Navigation on the Danube in the Romanian Sector" published by the State Inspectorate of Civil Navigation in 1993;
- CEVNI (The European Code for Inland Waterways);
- the Danube Commission recommendations;
- the recommendations of the International Commission on Lighting;
- the requirements and regulations of the Romanian Naval Authority;
  the requirements of AFDJ Galati – Romania and of the Executive Agency Exploration and Maintenance of the Danube River – Republic of Bulgaria

HDD method

The works are performed underground, without affecting the surface of the watercourse and the navigation on the Danube. No measures are needed for the regulation of navigation during construction.

2.5.1.2.5.A. Signalling of works in the undercrossing area during construction

The traffic in the undercrossing sector takes place both by day and by night with individual river vessels or convoys formed of river barges with a maximum capacity of 3000 t and a pusher. The convoys usually consist of 2 to 6 barges of 2,000 tons and a pusher of maximum 2400 HP. The traffic of 10,000 convoys/year is anticipated.

The signalling works during construction using open-cut
The signalling works during construction consist in:

- Location of non-luminous signals for interdiction, obligation, restriction and recommendation (coastal signalling) on the banks ;
- Floating signals: keeping technical and assistance ships in the area 24h/24h;

For the open cut option the trench excavation and cover works will be performed by keeping open the ships' and convoys' traffic on the Danube. Moreover, the constructor shall take all the measures for drawing back to the bank the floating equipment when the work zone is transited by ships/convoys. The floating equipment shall be appropriately signalled.

The traffic shall be disrupted only when the pipeline is dragged from one bank to another, by previously informing A.F.D.J. Galați- Romania and the Executive Agency for Exploration and Maintenance of the Danube River – Republic of Bulgaria, on the time when the navigation is closed in the crossing area. The duration of disruption (estimated at 3-4 days) and the exact time when this will happen shall be established by mutual agreement between the constructor, beneficiary and authorities with responsibilities in ensuring the conditions of navigation on the Danube in Romania (AFDJ Galați) and in Bulgaria (Executive Agency for Exploration and Maintenance of the Danube River). The authorities in the water transport field shall establish the places/ ports where the ships shall wait and shall ensure the issuance of the permits to the navigator.

The signalling works during construction using HDD method
The Danube traffic is not disturbed if the Danube is crossed by HDD method. The installations for pulling the pipeline are located onshore, far from water.

2.5.1.2.5.B. Permanent signalling of the pipeline in the undercrossing area

Irrespective of the crossing method (open-cut or HDD), the presence of the pipeline in the Danube riverbed must be signalled.
During Nabucco pipeline operation, its presence in the Danube riverbed shall be signalled according to the "General conditions for sailing on the Danube", to the "Instruction for signs allocation according to the navigation situation of Danube" , to the Danube Commission for National regulation in navigation, respectively by placing signals (interdiction to anchor, to drag anchors, chains or hawsers) on both banks both upstream and downstream the undercrossing profile.

Signalling shall be done based on a study approved by the Executive Agency for Exploration and Maintenance of the Danube River, for Bulgarian Danube section and by the Romanian Naval Authority and AFDJ Galati, for Romanian Danube section

2.5.1.2.6. PROTECTION DIKE CROSSING

If the Danube river is crossed by the open cut method, the ramming method shall be used for crossing the protection dike on the Romanian bank. This way, the protection line is not affected.

As seen in appendix 7, the Danube protection dike on the Bulgarian bank will not be crossed.

The technique Pipe Ramming (PR) assumes the insertion of the protection tube from the drive pit where the ramming unit is installed, by means of dynamic energy developed by a percussive hammer attached to the pipeline end. This is a two stage process. It consists in the pushing of steel casing by means of a hydraulic installation. The technology assumes the excavation of an appropriate pit in which the equipment can be fitted, the installation of the hydraulic pushing device, the execution of the underground excavation in the shield foreside followed by advancing with presses, the installation of the protection tube for the pushing operation. The works can be executed either manually or mechanically.

If the Danube river is crossed by HDD method, the protection dike shall be crossed by microtunneling. .
This is a pipeline installation method, without digging, executed by a computer-aided equipment. The guiding system consists of a laser which communicates with the boring head and the computer.
A pilot drilling is executed from a hole; the drilling equipment executes a tunnel by means of a drilling fluid by high pressure jet.
The drilling suspension (water mixture, bentonite and additives) dislodges the earth, carries the dislodged material, supports the microtunnel and reduces the friction. The head corresponding to the pipeline diameter shall be mounted after the drilling equipment reaches the exit hole.

2.5.1.2.7. DEMOBILISATION AND LAND REINSTATMENT

After work completion, will be taken to demolish the camp site and remove any obstacles from the location. Contractor shall dismantle the platforms, roads, buildings and facilities of their own camp site and also ensure cleaning of any obstructions (waste materials, concrete blocks, rocks, piles of earth, etc .) of the location of works performed both on land and in riverbed.
All waste will be taken to an authorized dumping ground.
Under no circumstances the waste will be left on site or will be thrown into the Danube. On this occasion, necessary measures will be taken to restore the land to its previous use to conditions existing before erecting the camp site and trees of the same type as those existing in the area will be planted.

When executing the diggings within the working strip, the thick topsoil (0.3 m in the case of the Romanian bank and 0.5m for the Bulgarian bank) shall be separately stored in order to be recovered and brought back when reinstating the land to its agricultural use.
The constructor must reinstate the affected land to its original condition on the bases of Reinstaitment Plan (appendix 16) . More details about reinstatement are given in RR EIA and BBEIA documents.

2.5.1.3. CONSTRUCTION STAGE FOR THE JIU RIVER CROSSING

Two crossing methods have been analyzed (figure 1.6 below):

- open cut method (Appendix 14., figures A14.1 and A14.2), the works being performed from one bank to another;
- trenchless method (Appendix.14., figure A14.3), the drilling works are executed in points located outside the Jiu protection dyke.

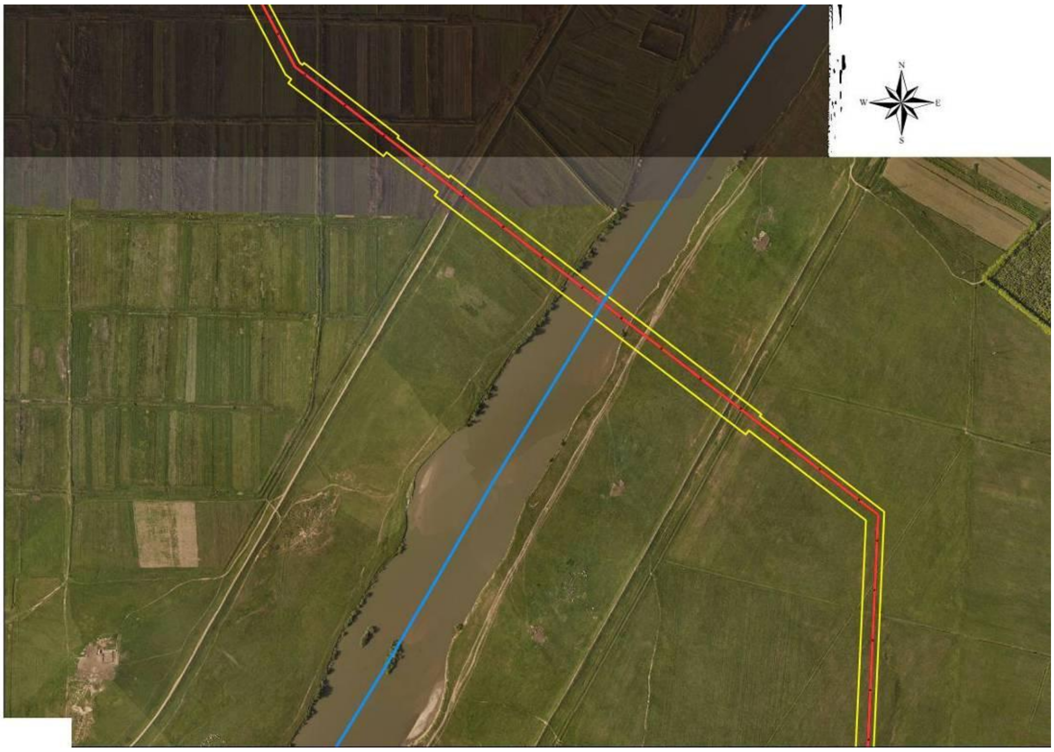


Figure 2.13. : Crossing of Jiu River

2.5.1.3.1. Option of undercrossing river Jiu by open cut method

The undercrossing of River Jiu by open cut method Appendix 14., figures A.14.7 and A.14.8), will be achieved with concrete weighted pipeline on a length of 184.00 m, the dikes for protection against floods will be crossed by pipe ramming method using casings, with attached spacers, sealing devices, cathodic protection test facilities and vent device.

Undercrossing length in horizontal projection is about 220.00 meters and total length (developed) in this variant is about 224.00 meters. This variant of undercrossing would have the advantage of lesser length than the variant of undercrossing by horizontal directional drilling but has the disadvantage that the environment is greatly affected.

Trench execution

Trench that will be constructed in the Jiu riverbed will have the following characteristics:

- Undercrossing length: 184.00 m for concrete coated pipe, 220.00 m undercrossing length in horizontal projection, 224.00 m developed length of undercrossing
- Minimum pipe cover, above the top of the pipeline: 1.50 m;
- Width at the base of the trench: 4.00 – 6.00 m;
- Slope of the embankment in the cross section of trench: 1:1.5 – 1:3;

Before the execution of the trench it is recommended to make a cross section through the undercrossing axis, which will be compared with transverse profile resulting from the topohydrographic study.

The general Contractor is free to propose its own work technology with the obligation to observe the construction dimensions and the imposed quality conditions, within the established deadline for completing the works

Dredging works in the river bed of Jiu

Dredging works will be executed using a reverse bucket excavator and a dragline; for depths greater than 2.00 m the dragline shall be used.

The Contractor will take into account that some of the solid material transported by running water shall be deposited in trenches throughout the execution and that volume will be dredged.

Achieving foundation levels is important to ensure the necessary thickness protection above the pipeline, due to possible riverbed scorings. Laying the pipeline at the project levels (not above) would ensure that in the operational period of the pipeline, this protection will be provided.

The volume of dreging material is about 3600 m^3.

On completion of dredging works, the Contractor will proceed to cleaning and levelling the trench bottom with airlift.

Before pulling the pipe from one side to the other it is mandatory to check the bottom of the trenches with divers and make a cross section through the trenches to check dimensions. Cross section will be conducted by an independent unit.

Allowable tolerances of the dimensions at the trench bottom should be ± 10 cm for 95% of the values and ± 15 cm for the remaining 5%.

Excavation works in the banks area

Excavations on the banks will be done with excavators that will be equipped with dragline for working under the water level.

Topsoil on the banks will be collected and transported in a special deposit, to be reused on completion.

The material will be loaded into dumpers and transported on the Jiu bank deposits. Earth from the excavations beneath the water level will be deposited on the waterfront, in an intermediate storage to allow water to drain, then will be transported in the same deposits, from where it will be recovered for filling the trench.

Laying the pipe in the Jiu riverbed - dragging from one shore to another

Sections are formed on the Jiu river bank, in the major river bed (where pipes concreting takes place) and are drawn successively in minor river bed with horizontal-mounted equipment that is used to hoist, crown, crane engines, gearboxes and torque converters.

Filling the trench

After installing the pipe into the trench respecting the project geometry, the trench will be filled on the water and on the banks.

Technological risks

The failure risks during execution include the impossibility of reaching the design rates of the trench due mainly to possible floods that might occur in the final period of excavations with consequences on the extension of construction period in the winter, when it would be very difficult to pull the pipe from one bank to another. This situation depends mainly on the constructor's management who can avoid such a situation by scheduling the construction on a shorter time.
The risks to the pipeline integrity during the execution can be summed-up by forcing the minimum radius of curvature in case when the designed trench rates would not be observed. To avoid this risk it is necessary, before pulling the pipe from one bank to another, to clean the solid material deposited on the bottom of the trench, and to verify by topographic measurements on a profile along the undercrossing if the final designed rates were reached.
Steel pipe (concrete weight coated) will be laid in the river bed of Jiu by open trench method will have the following characteristics: pipe outside diameter 1422 mm × 36.65 mm, outside diameter including concrete weighting and coating: 1743 mm; maximum system pressure: 100 bar, minimum yield strength 485 N/mm^2, line pipe in accordance with SR EN 10208-2, the minimum radius of curvature: 1077.00 m.
For the protection of telecommunication cables is used one steel tube Ø 114 mm concrete weight coated placed in the same trench, along with natural gas pipeline DN 1400 mm.

2.5.1.3.2. Jiu river crossing by horizontal directional drilling method

Given the configuration of the terrain after the dykes, drilling equipment can be placed on either of the two sides. Distances between axes of dykes are about 680.00 meters: respectively from the left bank is about 270.00 meters and from the right bank is about 250.00 meters, the width of the river cross section being about 160.00 meters. Undercrossing length in this variant is about 866.00 m in horizontal projection and the developed length of undercrossing is about 868.00 meters. This variant of undercrossing has the advantage that the river bed, the banks, plants and aquatic creatures, environmental factors in general are not affected.
Similarly to the variant of open cut method where it might be some difficulties, also this version might raise some other difficulties in placing the drilling equipment on the bank. Also, the risk of pipeline laying on a different profile from the designed one is higher; in his case, the pipeline may be installed closer to the riverbed bottom (higher than the designed levels).
Two separate/different drillings will be carried out, one for the gas pipeline Ø 1400 mm and one for the steel protective tube Ø100 mm of telecommunication cables.
For the gas pipeline is used the same type of pipe as for the open cut variant, the outside diameter 1422 mm × 36.65 mm wall thickness; maximum system pressure: 100 bar, minimum yield strength 485 N/mm^2, line pipe in accordance with SR EN 10208-2, the minimum radius of curvature: 1580.00 m.
For the protection of telecommunication cables one drilling is performed with steel protective tube Ø114.00 mm.
Undercrossing length for the two drillings is 866.00 m in horizontal projection, developed length of undercrossing is 868.00 m.
Making the drilling tunnel is done by cutting and injection of the drilling fluid under pressure and assumes the following steps:
Pilot drilling: From a hole is drilled with a power drill head through the ground. The controlled drilling head drills a tunnel with a high pressure jet drilling suspension. Displaced material is partially incorporated in the tunnel, and fine particles are carried by the suspension of drilling in the starting pit.
Expanding drilling: After the drill head reaches the target precisely into the pit, the expanding head corresponding to pipe diameter is installed. By rotating and pulling the head back through the pilot tunnel, this will expand to the desired size.

The diameter of the drilling tunnel must be 30% greater than the diameter of the pipe to be laid. If necessary, successive enlargements with increasingly larger expanding diameters are used.
Laying the product: Immediately after expanding head, it will be attached the pipe or cable to be drawn. This operation is done very gently because the suspension of drilling, which contains bentonite, is acting now as a lubricant of the drilled tunnel.
Drilling technique under high pressure injection: The suspension of drilling is an important component of the system. It displaces the soil, it transports dislocated material in pits, and it supports the micro tunnel and reduces friction between it and the product (pipes or cables). The suspension of drilling is made of a mixture of water and bentonite (natural clay water soluble) and is specific to each type of soil. The mixture of water and bentonite is related to soil physical parameters, the parameters being established by geological research. The pipeline is installed (without being subject to additional tension) in the so-called filter cake surrounding the product. Only products which present no environmental hazard are used for drilling suspension.
Location technique: Through the three-dimensional location of the drilling head, data about the position of the drill head are available thus avoiding different underground obstacles. The location is based on the transmission of data (modulated broadcast signal) by a transmitter mounted on the drilling head. A data receiver receives signals from the transmitter. Information is remotely transmitted to the display of the data receiver handset. As a result it can locate the exact depth, position and inclination the longitudinal axis of drilling head.

2.5.1.3.3 Timeline for the Jiu river crossing

2.5.1.3.1.1 Timeline for the Jiu river crossing using open cut method

This duration considers the complexity of the operations, the length of the pipeline, the land nature, the in-stream work, the time for preparing the pipeline sectors etc. The designer recommends a duration of 4 calendar months that will include all the land preparation operations, excavations in riverbed and on banks, checks, the pipeline pulling from one bank to another, onshore and offshore fillings, bank protections, land reinstatement after decommissioning the construction site. The constructor shall establish the equipment required in compliance with the quality and safety requirements lest the duration of execution might be exceeded.
An estimate varying **between 4 to 6 calendar months** depending on the floating equipment of the contractor equipment can be made.

2.5.1.3.1.2. Timeline for the Jiu river crossing using HDD method

The designer recommends an execution time of **2 calendar months**, which will include all operations. The Jiu undercrossing is represented by two separate drillings, one for gas pipeline and one for telecommunications.

2.5.2. OPERATION OF NABUCCO GAS PIPELINE

The gas pipeline operation involves four countries.
The pipeline is remotely operated on the basis of SCADA system. In Romania, the two stations of Segarcea and Nădlac will have about 10 service people. The control centre for the entire country will be in Mediaş.

Maintenance
The supervision is scheduled at intervals determined by the pipeline operator and by the undercrossing method..

In the case of crossing by Open-cut method, maintenance activities are numerous, committed to the objective and therefore expensive Besides inspection operations with intelligent PIG, produced every five years, which are absolutely necessary in this option the following are still needed as maintenance activities:
- signalling with buoys and coastal signals must be permanent;
- watercourse bottom inspection in the crossing area and checking the position of the pipeline centreline in the undercrossing area (with divers) should be done annually;
- visual surveillance of the integrity of the banks in the crossing area and detection of possible leakage of gas pipeline should be done monthly;
- surveillance of the watercourse bed in the undercrossing area in order to detect potential migration processes of the pipeline, in order to schedule the operative interventions in the banks, of the pipeline and the crossing route is recommended daily, from the events described and up to the stabilization of the area;
- checking the condition of insulation and corrosion protection of steel pipes in the area of the banks of the watercourse crossed through the execution of intervention pits is recommended three times per year.

Maintenance activities in horizontal directional drilling operations is defined only by inspection of the pipeline / undercrossing with intelligent PIG, operations that should be done every 8 years to determine the technical condition and operation of the pipeline that crosses the watercourse. Crossing inspection operation with intelligent PIG is not an activity dedicated to that objective (crossing). It is done in the section of inspection between the launching and receiving facilities upstream and downstream of the crossing

Potential risk

During the maintenance works, certain pipeline sections (BVS) may need to be emptied at the fixed objectives for corrosion repair works. In such cases, the gas pressure is reduced in that section up to the normal operating pressure, and then the quantity left in the pipeline is burnt by complying with the thermal effect zone. The BVS are equipped with the stacks of 25m high, and the silencers about 6 m high. This hardly ever happens, based on the experience in the operation of the existing gas pipelines, maybe once in 15-20 years. In these cases, burning lasts for a relatively short time and the venting gas quantity does not generate significant air pollution Gas venting should be safely done in order to avoid explosions and flaring to mitigate the impact on air. In order to carry out repair works, the upstream and downstream valves of the network section being discharged shall be closed and the natural gas may be completely released into the atmosphere or may be recovered.
In the case of NGPL, on the Romanian territory, vents are provided to the two stations of Segarcea and Nădlac.

On the Bulagrian territory, in the most remote point (km 373.5), there is valve facility located just downstream the deviation to Chiren Accumulating Facility.

The Internet and media offer a lot of information about accidents, explosions and fires during operation of transmission gas pipelines. In the same time, most of announcements lack details on causes which have led to accidents and respectiveconsequences. Technical characteristics of pipeline are also frequently missing –diameters, gas pressure, etcMost accidents occurred on gas pipelines being in operation for more than ten years, not equipped with up-to-date safety devices and do not correspond to the contemporary security requirements.

Components of safety and security system of the NGPL could be divided to two groups – passive and active ones- and is the same for the entire NGPL route.
The description of the components of safety and security system of the NGPL is given in RREIA and BBEIA.
For the operation period, a Emergency Plan will applied.

The new methods and technologies enable the recovery of the gas from the pipeline subject to a certain action.
The gas recovery solution will be chosen as a result of a technical-economic analysis for each given situation.
The natural gas leaks will be reduced and the methane emissions to atmosphere will be diminished by applying new technologies to the gas transmission pipelines.

The experience proves that the pipeline sections are emptied once in 15-20 years, they last for a very little while and the quantity of flared gas has no significant environmental impact.

Gas venting should be safely done in order to avoid explosions and flaring to mitigate the impact on air.

Studies carried out in USA[3] or by the International Association of Oil & Gas Producers (OGP)[4] have proven that the venting operations contribute significantly more methane than flaring operations.

Figure 2.14 below shows contributions of carbon dioxide emissions (1%) from flaring to anthropogenic carbon dioxide emissions, at the level of 1994

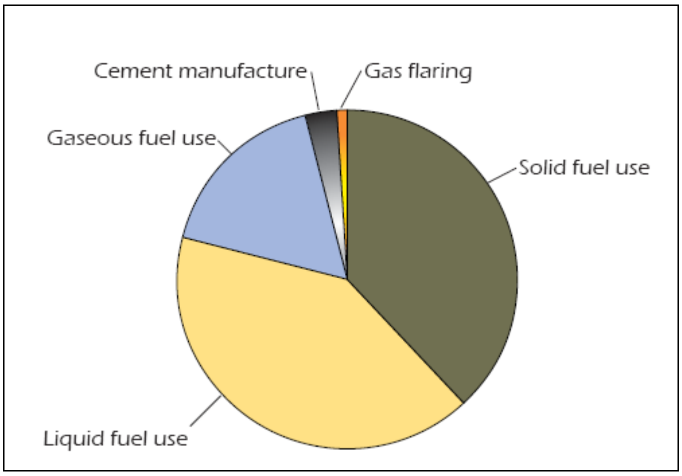


Figure 2.14: Contribution to anthropogenic carbon dioxide emissions, 1994

As regards the methane emissions from flaring and venting, figure 1.4 below shows the contributions of methane emissions(4%) from flaring &venting to global methane emissions, at the level of 1994

[3] Stern, D. I. and R. K. Kaufmann, *Estimates of Global Anthropogenic methane Emissions:1860-1994.* Trends Online: A Compendium of Data on Global Change. Carbon Dioxide Information Analysis Centre, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn, USA, 1988
[4] OGP Report No.2 66/216 (Dec. 1994), *Atmospheric Emissions from the Offshore Oil and Gas Industry in Western Europe.*

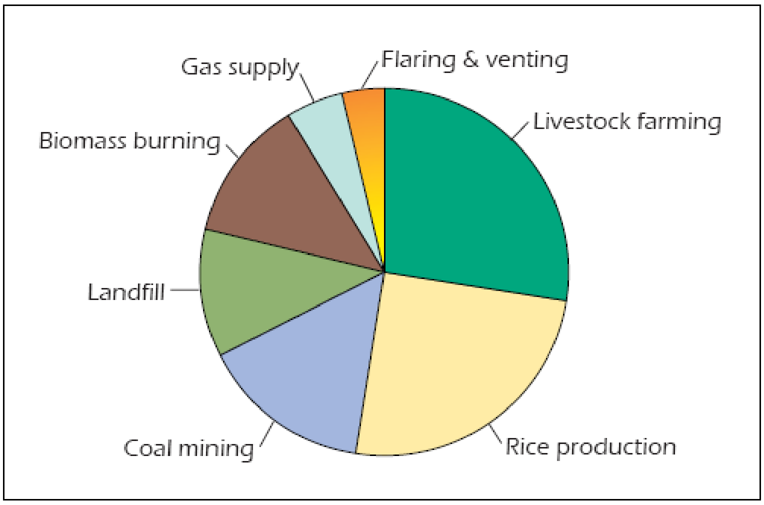


Figure 2.15: Contribution to total methane emissions, 1994

Cleaning the impurities from the the gas pipelines and filling them with gas
Before performing the connection to the natural gas pipelines, the pipeline section prepared for connection shall be washed by a compressed air current.
After performing the connection works, the impurities (solid particles such as slag, dust etc) from the pipelines must be cleaned by purging a pressure gas current into the pipelines until the air and the impurities are completely eliminated from the pipeline, whereas the vent discharges clean gas. A frequent case encountered in the operation of the natural gas transmission pipelines is the cleaning of liquid particles in the natural gas. These particles may be collected in droplet separators and released into the atmosphere under the pressure of the natural gas through a vent or purged directly through the vent with no collection in the separator.

Operation of NGPL and of its associated installations
The operation of NGPL involves 4 countries crossed by it. The pipeline shall be remotely operated.
The main control centre is in Turkey, and the secondary control centre in Austria. In Romania, the control centre will be located in Mediaş.
The natural gas metering station Segarcea shall be automatically operated, with a remote monitoring. During the pipeline operation, the operator will be in the station only periodically for the established maintenance works.
The border metering station of the natural gas transited to Hungary from Nadlac will have several service persons.

In the case of emergency, an emergency response plan will be applied.

In the case of the Danube river crossing, BVSs needed for blocking this pipeline section shall be located as follows:

- on the Bulgarian bank, the last BVS will be located at kp 419+787 (2+500 km border)
- on the Romanian bank, the first BVS will be located at kp 12+500, after crossing the Jiu river.

2.5.3. DECOMMISSIONING AND ABANDONMENT

It is anticipated that the operations could last about 40 years (~ until 2050).
After the cessation of the gas transmission, the pipeline will be cleaned by pigging and the connection with the natural gas system shall be stopped. According to the decommissioning plan and to the authorities' provisions, the pipeline will be filled (with inert gas or air) and shall be closed, filled with cement in places or shall be removed from ground. The connections of the objectives with the systems shall be closed. The equipment, fittings in the block valve stations and the branch points shall be dismounted. The buildings, service spaces and the other surface objects shall be demolished. The environment shall be reinstated and the soil shall be cropped.

3. CONSIDERATION OF ALTERNATIVES

The alternative solutions of a project are assessed by considering the species and/or habitats of community interest for which the natural protected area of community interest has been designated, the costs, the delays or other aspects of the alternative solution. The alternative solutions identified in this stage shall be separately assessed, by using the same criteria as in the assessment of the original version of Project Proposal (PP). The alternative solutions, including "alternative zero" (i.e. no intervention performed) are identified.

The assessment of alternative solutions consists in:

a) Description of the alternative solution/solutions or the mitigation of the significant impact on the natural protected area of community importance. It entails the PP review according to the criteria used for the second stage of this methodological guide. The alternative solutions must be examined in comparison with the original proposal, according to the same scientific criteria and the same standard;

b) Each alternative solution identified shall be separately assessed to select the alternative with the lowest impact on the natural protected area of community interest; arguments for the decision to propose an alternative PP by highlighting the additional positive aspects in relation to the other alternative solutions. In this stage, the economic criteria or other assessment criteria cannot prevail against the ecological criteria.

When having selected Nabucco Gas Pipeline (NGPL) route, special attention was paid to the conditions discussed during the negotiations with the competent authorities. As a result, a route with the lowest environmental and social effect was determined.

The crossing area has been selected in 2004 by the Bulgarian and Romanian shareholders. The crossing area was determined in a bilateral agreement between Bulgaria and Romania.
As part of this project since 2009 no other crossing locations have been studied and assessed. Only an exact crossing point was selected in an 80km area, form the geotechnical and engineering point of view considering the geotechnical conditions.
When assessing the environmental impact, 3 alternatives have been defined:

- Null alternative (no development), namely the one in which no development would be performed and that space would keep its current uses and features;
- Alternative "1" that may have an effect on the environmental features

- Alternative “2” generating the lowest environmental impact

3.1 NULL ALTERNATIVE (NO CONSTRUCTION)

The purpose of Alternative 0 review is to assess how Nabucco project addresses the needs and requirements of the environmental condition in the project implementation zone and of its evolution trends.
The alternative with no development (Alternative 0) is the alternative in which no development would be performed; therefore Nabucco pipeline would not be performed. Under these circumstances, the respective space would keep its current uses and features.

The energy crisis, pollution and global warming are among the main problems the mankind is faced with.
In both countries, the population uses the natural gas, Diesel fuel, wood and coal for food preparation and heating. The use of wood for heating results annually in losses of wooded areas with an effect on the climate, especially at the local and regional level.
The generation of electricity and thermal power is also based on the use of coal, gas and Diesel fuel. The coal burning generates besides the greenhouse gas emissions, very high quantities of slag and soot. The exploitation, processing and distribution of coal may also create other environmental problems. The coal exploitation methods, especially the exploitation in surface quarries creates many problems as a result of clearing large areas, taking the lands with the refuse dumps, practically changing the landscape with effects on all the environmental features. The coal transport requires Diesel engines using fossil fuels. The supplementation of the gas quantities available in the two countries as a result of performing Nabucco pipeline results in the increase in the number of natural gas users and implicitly in the reduction of the use of wood and coal for the above-mentioned purposes, with a beneficial environmental effect.

Besides not achieving the positive aspect above, not performing Nabucco pipeline, it will have the following negative aspects pointed out below:

- It is maintained the situation regarding the prevention and limitation of the economic losses, as well as the situation of industrial accidents as a result of the interruption of the gas supplies to the in-country industrial consumers, with negative effects on the environmental features.
- It decreases the population’s degree of protection from risks associated with the disruption in the natural gas supply.
- It is reduced the possibility of developing new industrial units with effect on the socio-economic situation of an area.
- As a result of the increase in population and in the requirements on the fuel for heating and for preparing food and hot water, the wood areas cleared for ensuring the heating of the settlements that are not connected to natural gas, will annually increase. This has a strong negative impact on air quality, as well as on climate.

Not performing Nabucco pipeline has also the following positive aspects:

- The impact typical of the construction period will not occur. Air, soil and water pollution, temporary or permanent removal of lands from the agricultural or forest use, negative impact on infrastructure and natural resources used, negative impacts on the communities in the project’s zone of influence are recorded with various intensities during construction.

- About 1.36 ha of forest in the Romanian Danube floodplain (only if the open cut method is used) will not be cleared.
- The forest is already cleared on the Bulgarian bank.

Nabucco pipeline has a negative impact during operation as a result of the fact that the underground existence of the natural gas transmission pipeline near settlements will narrow the possibility of extending the build-up area or of executing new works in the pipeline safety zone. Moreover, planting trees with roots deeper than 0.50 m is forbidden on the 6 m corridor to the left/right of the centreline, in the case of Romanian bank and on the 15 m corridor to the left/right of the centreline, in the case of Bulgarian bank. This has a negative effect on the potential benefits of the landowners as a result of tree plantation in this corridor.
As the Danube crossing area is located in a Natura 2000 site, the option for the null alternative can only be due to the identification of some protected species in the location site, for which the specific legislation in force forbids:
- Any form of collection, capture, killing, destruction or injury of the individuals being in their natural environment, in any of the stages of their biological cycle;
- Deliberate disturbance during the breeding, hibernation and migration period;
- Deterioration, destruction and/or deliberate collection of the nests and/or eggs in the wild;
- Deterioration and/or destruction of the breeding or rest sites.

This case may be taken into account for ROSPA0045 Jiu-Danube Confluence on the Romanian bank, when species listed in the annexes no. 4A (species of community interest) and 4B (species of national interest) in GEO 57/2007, as well as species listed in the national red list are found in the location site.
In the case of ROSPA0045 Jiu-Danube Confluence, the species *Pelecanus crispus* was observed flying over the Danube. No significant impact on the species will be recorded due to the impact mitigation measures proposed.
The field surveys (baseline studies for establishing the baseline or existing conditions), have not highlighted the existence of habitats of community interest in the pipeline corridor.

3.2. LOCATION ALTERNATIVES AND TECHNOLOGICAL PARTICULARITIES OF THE INVESTMENT PROPOSAL

3.2.1. Location alternatives on the Bulgarian territory

No alternatives are reviewed and addressed for the crossing of Ogosta river in the BG EIA Report. Only the casing method has been found feasible.
The fish species for which the Natura 2000 site Reka Ogosta has been designated are not affected.

3.2.2. Alternatives for the Danube river crossing

In 2004 and 2009 the crossing point of the Danube (maps in appendix 2) was agreed between the Republic of Bulgaria and Romania.
The Danube crossing point and the connection point at the Romanian-Bulgarian border were established in conjunction with representatives from CHIMCOMPLECT ENGINEERING AD -Bulgaria and TRANSGAZ Romania (Minutes of meetings from 18th - 19th May 2009 and November 2nd 2010).

As shown in chapter 2.5.1, two options were analyzed for the Danube crossing:

- open cut

- horizontal directional drilling (HDD).

The two solutions are technically and economically analyzed in the Nabucco document 70223-RR-RPT-PL-0017 “Danube Crossing: Technical Economic Study. Undercrossing Options ».

The analysis was undertaken by considering:

- Open cut option: 1,370.00 m the actual undercrossing plus 630.00 m in major riverbed.
- Horizontal directional drilling option: 2,000.00 m crossing the Danube protection dyke located on the Romanian bank, as well.

The analysis from the technical and environmental protection point of view is shown in table 3.1. below.

It is worth mentioning that the crossing solution by open cut was proposed in the Technical Feasibility Study.

The areas of the temporary landtake for construction site are much smaller in comparison with the open cut crossing option.

Conclusion:
The analysis conducted considering the morphological, geological and geotechnical conditions, the weather and hydrological conditions, the technical and economic aspects shows that the crossing option proposed is HDD.
This method affects the land to a smaller extent, in surface and in depth. Using this technique, the perimeter of vegetation is less affected by the opening trajectory. The aquatic ecosystem is not affected.

The fish species for which the Natura 2000 site ROSCI0045 Jiu Corridor has been designated are not affected.

Table 3.1.: Analysis of alternatives on the Danube river crossing

		Open -cut alternatives	HDD alternatives
	Field Conditions and their influence on the crossing options		
	Morphological Conditions	The analysis of the topo-hydrographic survey shows that in the undercrossing area the navigable channel is very close to the Bulgarian bank. This has a negative influence on both options due to the increase in the undercrossing length, especially for the controlled horizontal directional drilling	
		In the open-cut crossing method, the navigable channel approach to the right bank has little influence on the undercrossing length. Additionally, where it is considered that the minimization of undercrossing length is beneficial in the banks area in this option, the pipeline may be brought closer to the ground level by welding some pipe sections in the form of "S "(swan neck) at the ends - this method has been applied to other undercrossing works (see Appendix B - welding of some pipe sections at the ends of the laid pipe). Considering that the distance between the river bank at average flows and the flood protection dike is approx. 530 m on the Romanian bank, and approx. 650 m on the Bulgarian bank, the pipe sections may be formed on either banks (3 sections on the Romanian bank and 2 or 3 sections on the Bulgarian bank could result), the pulling winch being placed on the opposite bank.	In terms of banks height, the horizontal directional drilling option is possible. This option would have become impractical if the undercrossing profile had been determined by several hundred meters downstream, where the Bulgarian bank is high and steep. Given the configuration of banks, the drilling equipment can be located on either sides, but in terms of execution accuracy and the risk that the drilling equipment cannot ensure the safe pipeline laying at the depth established below the level of the riverbed, it is recommended to place the drilling head on the Bulgarian bank (distance between the Bulgarian bank and the waterway is lower; the cumulative errors of the drilling equipment in the waterway area - which is the most sensitive area of the undercrossing are smaller).
	Geological and geotechnical conditions	Given the land stratification, dredging works in the Danube riverbed can be performed. The sea dredgers performing such work can dig in all types of land, and some problems may exist only for very soft or very hard land, but not present on the undercrossing site. Also the excavations in the banks area can be made without any problems. There are no technical impairments to perform the off-shore and on-shore fillings in order to fill-up the trench after laying the pipeline.	From geological and geotechnical point of view, the area of undercrossing is compatible with execution of the work in horizontal directional drilling method.

		Geologically and geo-technically, the land of the undercrossing site is fully compatible with the work execution in the open-cut option.	
	Meteorological and hydrological conditions	Usually, the meteorological and hydrological conditions allow the normal execution of works during spring – autumn season, if the flow rates are within relatively normal values. Whichever solution is chosen, in terms of efficient management and meteorological and hydrological conditions of no extreme weather, the works can be performed within a maximum period of 9-10 calendar months (three seasons, avoiding the winter, low temperatures, blizzards, freezing, the ice flows, etc).	
		In this option, the normal execution of the works on the banks, especially the pipe sections forming operations may be affected by high flows, which may cause flooding of the riverbed in the area between the riverbank at average flows and the flood protection dike. In these situations, the equipment must be removed from the site, and the work can be resumed only after water withdrawal, with possible consequences (depending on the duration of flooding and the period when it occurred) on the timely completion of work. The floods which may occur during the construction works may also affect (to a lesser extent than on the banks) the excavations in the riverbed, knowing that at the floods, the water carries much more suspended solids than on the average, which involves a greater clogging of the trench than expected. The very low flow rates may also cause the extension of the time schedule of the excavation works in the riverbed, whereas the areas of lower depths (from the Romanian bank) could be put to dry, or there would be no minimum navigation depth to work with floating equipment. In this case, the excavations would be made with ground equipment, which have much lower productivity than those of the sea dredger, or waiting for a rise of water levels should be considered.	This option is much less dependent on the hydrological conditions. The increase or decrease in water level has no influence on the work and the high-waters flooding of the bank with the drilling equipment may remain without negative consequences, if a closed peripheral embankment consisting of local compacted material would be raised around the drilling machine. Providing shelter for the drilling equipment by executing the embankment would be temporary as the embankment will be disposed.

	Technical consideration	The open-cut option is a classical method and has been tested until now in Romania. In this option, there can be some difficulties to fix the pulling winch on the bank and these difficulties can be overcome if the field conditions are taken into account. The failure risks during construction include the impossibility of reaching the design rates of the trench due mainly to possible floods that might occur in the final period of excavations with consequences on extending the execution period in the winter, when it would be very difficult to pull the pipe from one bank to another. This situation depends mainly on the constructor's management who can avoid such a situation by scheduling the construction on a shorter time. The risks to the pipeline integrity during the execution can be summed-up by forcing the minimum radius of curvature if the designed trench sizes are not observed. To avoid this risk it is necessary, before pulling the pipe from one bank to another, to clean the solid material deposited on the bottom of the trench, and to verify by topographic surveys on a profile along the undercrossing if the final designed dimensions were reached. The project will consider the necessary thickness of the protection over the pipeline, due to possible riverbed erosion and accidental falls of objects, and the pipeline laying at the project levels (and not higher) should ensure that this protection will be provided for the calculated thickness during the operation period of the pipeline. Steel pipeline (concrete weight coated) to be laid in the Danube riverbed by open trench method will have the following characteristics, for Class location 4: pipe outside diameter 1422.00 mm × 36.65 mm, outside diameter including concrete weighting and coating: 1743.00 mm; maximum system pressure: 100 bar minimum, steel yield strength 483 N/mm^2, SR EN	Similarly to the open cut method where some difficulties might arise when placing the dragging equipment on the bank, in this alternative some difficulties may also appear in placing the drilling equipment on the bank. Also, the risk of laying the pipeline on a different profile from the designed one is higher; in this case, the pipeline may be installed closer to the riverbed bottom (higher than the designed levels).

		10208-2, the minimum radius of curvature: 1077.00m. For the protection of telecommunication cables are used two steel tubes Ø 168 mm, concrete weight coated placed in the same trench, along with natural gas pipeline DN 1400 mm.	
	Environmental impact	- Impact on the Danube water quality (increased turbidity of water, water pollution potential risk due to fuel and oil leaks from construction equipment and ships; - Impact on ambient air because gas and dust emissions generated by the construction equipment and ships; - Impact on aquatic biocenosis, disruption of fish migration, disturbance of terrestrial flora and fauna connected with aquatic flora and fauna etc. - Impact on ROSPA0023 Jiu-Danube confluence - Impact on ROSCI0045 Jiu Corridor - Impact on Ogosta river Potential restriction of construction corridor in the wooded areas and Natura 2000 sites: ROSPA 0023 Jiu-Danube Confluence ROSCI0045 Jiu Corridor BG0000614 Ogosta River Temporary land use (including the storage area): Bulgarian bank: 75682m^2 Romanian bank: 224286 m^2, from wich 12000.000 m^2 for storage area Deforestation is needed. (480 m × 150 m on the Romanian bank and 500 m × 150 m on the Bulgarian bank) The permanent servitude strip : 12 m along the route	**- Impact on the Danube River water quality - low risk of water pollution due to fuel leaks from equipment and machinery used;** **- Impact on ambient air due to emissions generated by the drilling rigs and equipment** **-Low impact on terrestrial flora and fauna due to relatively small areas occupied on the Danube river banks;** **- Potential impact on fish in the case of deterioration of the drilling head and accidental pollution of water by drilling fluid.** - Low impact on ROSPA0023 Jiu-Danube confluence - Low impact on ROSCI0045 Jiu Corridor - Impact on Ogosta river Potential restriction of construction corridor in the wooded areas and Natura 2000 sites BG0000614 Ogosta River Temporary land use: Bulgarian bank: 40000 m^2 Romanian bank: 87457. m^2, from wich 23632. m^2 outside from working strip The permanent servitude strip – not necessary

	Equipment and machinery present at work	- self-propelled dredger, in the minor riverbed of the Danube; 1 pc. - self-propelled barge; 2 pc. - excavators with dragline, on both sides; 3 pc. on the Romanian bank and 2 pc. on the Bulgarian bank; - excavators with turned spoon, on both sides; 4 pc. on the Romanian bank and 2 pc. on the Bulgarian bank - Heavy dumpers, on both sides; 10 pc. on the Romanian bank and 5 pc. on the Bulgarian bank; - pulling equipment, on the Bulgarian bank; 1 pc. - pipeline launchers, on the Romanian bank; 12 pc. - metal trolleys for the pulling of the concreting pipeline, on the Romanian bank; 50 pc. - concrete mixers, on the Romanian bank; 6 pc. - pipeline transport trailers, on the Romanian bank; 4 pc.	- drilling equipment, on both sides; 1 pc. on the Romanian bank and 1 pc. on the Bulgarian bank; - excavators with dragline, on both sides; 2 pc. on the Romanian bank and 2 pc. on the Bulgarian bank; - excavators with turned spoon, on both sides; 2 pc. on the Romanian bank and 2 pc. on the Bulgarian bank - Heavy dumpers, on the Bulgarian bank; 4 pc. - rolling equipment for the pipeline positioned for pulling; 100 pc. - pipeline launchers, on the Romanian bank;14 pc. - pipeline transport trailers, on the Romanian bank; 4 pc.
	Crossing time	6-8 months	4 months
	Social and socio-economic consideration	- Impact on socio-economic conditions because of difficulties that occur in water transport both during and after execution. Fishermen Given the location of the nearest administrative-territorial units in relation to the location site, the works on the Romanian territory, including the construction site-related transport will generate no negative transboundary impact on population in the border zone. The situation is similar in the case of the works performed on the Bulgarian territory.	- Low impact on socio-economic conditions because of difficulties that occur in water transport after execution. No impact Given the location of the nearest administrative-territorial units in relation to the location site, the works on the Romanian territory, including the construction site-related transport will generate no negative transboundary impact on population in the border zone. The situation is similar in the case of the works performed on the Bulgarian territory
	Archaeological constraints	Potential for stray find in case of open cut	No archaeological constraints

	Economic viability		
	Evaluation of overall cost	- More expensive than option HDD	- This option is far less expensive both during construction and during operation
	Schedule-induced cost increases	- High potential of inducing delays as a result of the high water level of the Danube river, risk of high floods	- Low potential of inducing delays

3.2.3. Location alternatives on the Romanian territory

Two options have been analyzed for the Jiu crossing (figure 2.13 above):

- open cut

- horizontal directional drilling (HDD).

The analysis has been undertaken by considering:

- Open cut option: crossing length in horizontal projection is about 220.00 meters and total length (developed) in this option is about 224.00 meters
- Horizontal directional drilling option: crossing length in this option is about 866.00 m in horizontal projection and the developed length of undercrossing is about 868.00 meters.

Table 3.2 below shows the analysis of both alternatives for the Jiu river crossing.

Conclusion:
The analysis conducted considering the morphological, geological and geotechnical conditions, the weather and hydrological conditions, the technical and economic aspects shows that the crossing option proposed is o. This method affects the land to a smaller extent, in surface and in depth. Using this technique, the perimeter of vegetation is less affected by the opening trajectory. The aquatic ecosystem is not affected.

Regarding the transboundary impact:

- No transboundary impact concerning air pollution;
- No transboundary impact in the case of using HDD method for Jiu River crossing
- Transboundary impact in the case of using open-cut method for the Jiu River crossing related to the fish located into the Danube-Jiu Confluence.

3.2.4. Alternatives depending on the technological particularities of the construction

No alternatives were considered for the *technological particularities*, as it is mandatory to implement European and international standards and methods when building the NABUCCO gas pipeline.

Table 3.2.: Analysis of Jiu river crossing

No.		**Open - cut alternatives**	**HDD alternatives**
Field Conditions and their influence on the crossing Options			
1.	Morphological Conditions	The Jiu river crossing by open cut method will be achieved with concrete weighted pipeline on a length of 184.00 m, the dikes for protection against floods will be crossed by pipe ramming method using casings, with attached spacers, sealing devices, cathodic protection test facilities and vent device. Undercrossing length in horizontal projection is about 220.00 meters and total length (developed) in this option is about 224.00 meters. This undercrossing option would have the advantage of lesser length than the undercrossing option by horizontal directional drilling but has the disadvantage that the environment is greatly affected.	Given the configuration of the land behind the dykes, the drilling equipment can be placed on either of the two sides. Distances between the axis of dykes are about 680.00 meters: respectively from the left bank is about 270.00 meters and from the right bank is about 250.00 meters, the width of the river cross section is about 160.00 meters. The undercrossing length in this option is about 866.00 m in horizontal projection and the developed length of undercrossing is about 868.00 meters. This undercrossing option has the advantage that the river bed, the banks, plants and aquatic organisms, environmental factors in general are not affected.
2.	Geological and geotechnical conditions	This crossing option is performed by using the bucket dredger to execute the trench in the Jiu riverbed, also the excavations in the banks area can be executed without problems. There are no technical impediments to perform onshore and offshore fillings to fill up the trench, after laying the pipeline.	On the right and left banks of the Jiu river, geotechnical drillings were made to determine soil lithology (drilling no. 20 and 21, carried up to depths of 29.00 to 30.00 meters and highlighted as such in the Factual Geotechnical Report doc. no. 70223-RR-RPT-PL-0014); after drilling boreholes, sands and gravels were intercepted.
3.	Meteorological and hydrological	Usually, the meteorological and hydrological conditions allow the normal execution of works during spring – autumn season, if the flow rates are within relatively normal values. Whichever the solution is chosen, in terms of efficient management and meteorological and hydrological conditions of no extreme weather, the works can be performed within a maximum period of 9-10 calendar months (three seasons, avoiding the winter, low temperatures, blizzards, freezing, the ice flows, etc).	

No.		Open - cut alternatives	HDD alternatives
	conditions		
	Meteorological and hydrological conditions	In this option, the normal execution of the works on the banks, especially the pipe sections forming operations may be affected by high flows, which may cause flooding of the riverbed in the area between the riverbank at average flows and the flood protection dike. In these situations, the equipment must be removed from the site, and the work can be resumed only after water withdrawal, with possible consequences (depending on the duration of flooding and the period when it occurred) on the timely completion of work. The floods likely to occur during the construction works may also affect (to a lesser extent than on the banks) the excavations in the riverbed, knowing that at the floods, the water carries much more suspended solids than on the average, which involves a greater clogging of the trench than expected. The very low flow rates may also cause the extension of the time schedule of excavation works in the riverbed, whereas the areas of lower depths (from the Romanian bank) could be put to dry, or there would be no minimum navigation depth to work with floating equipment. In this case, the excavations would be made with onshore equipment, which have much lower productivity than those of the sea dredger, or they shall wait for a rise of water levels.	This option is much less dependent on the hydrological conditions. The increase or decrease of water level has no influence on the work and the high-water flooding of the bank with the drilling equipment may remain without negative consequences, if a closed peripheral embankment consisting of local compacted material is raised around the drilling machine. Providing shelter for the drilling equipment by executing the embankment would be temporary as the embankment will be disposed.
4.	Technical consideration	The failure risks during execution include the impossibility of reaching the design rates of the trench due mainly to possible floods that might occur in the final period of excavations with consequences on the extension of construction period in the winter, when it would be very difficult to pull the pipe from one bank to another. This situation depends mainly on the constructor's management who can avoid such a situation by scheduling the construction on a shorter	Similarly to the open cut option where some difficulties may occur, this option might raise some other difficulties in placing the drilling equipment on the bank. Also, the risk of pipeline laying on a different profile from the designed one is higher; in this case, the pipeline may be installed closer to the riverbed bottom (higher than the designed levels). Two separate/different drillings will be carried

No.		Open - cut alternatives	HDD alternatives
	Technical consideration	time. The risks to the pipeline integrity during the execution can be summed-up by forcing the minimum radius of curvature if the designed trench rates are not observed. To avoid this risk it is necessary, before pulling the pipe from one bank to another, to clean the solid material deposited on the bottom of the trench, and to verify by topographic measurements on a profile along the undercrossing if the final designed rates were reached. <u>Trench execution</u> Trench that will be constructed in the Jiu riverbed will have the following characteristics: - Undercrossing length: 184.00 m for concrete coated pipe, 220.00 m undercrossing length in horizontal projection, 224.00 m developed length of undercrossing - Minimum pipe cover, above the top of the pipeline: 1.50 m; - Width at the base of the trench: 4.00 – 6.00 m; - Slope of the embankment in the cross section of trench: 1:1.5 – 1:3; Before the execution of the trench it is recommended to make a cross section through the undercrossing axis, which will be compared with the transverse profile resulting from the topohydrographic study. The general Contractor is free to propose its own work technology with the obligation to observe the construction dimensions and the imposed quality conditions, within the established deadline for completing the works. <u>Dredging works in the Jiu riverbed</u> Dredging works will be executed using a reverse bucket excavator and a dragline; the dragline shall be	out, one for the gas pipeline Ø 1400 mm and one for the steel protective tube Ø100 mm of the telecommunication cables. The same type of pipe as for the open cut option is used for the gas pipeline, the outside diameter 1422 mm × 36.65 mm wall thickness; maximum system pressure: 100 bar, minimum yield strength 485 N/mm^2, line pipe in accordance with SR EN 10208-2, the minimum radius of curvature: 1580.00 m. For the protection of telecommunication cables one drilling is performed with steel protective tube Ø114.00 mm. Undercrossing length for the two drillings is 866.00 m in horizontal projection, the developed length of undercrossing is 868.00 m. The drilling tunnel is performed by cutting and injection of the drilling fluid under pressure and assumes the following steps: <u>Pilot drilling</u>: From a hole is drilled with a power drill head through the ground. The controlled drilling head drills a tunnel with a high pressure jet drilling suspension. Displaced material is partially incorporated in the tunnel, and fine particles are carried by the suspension of drilling in the starting pit. <u>Expanding drilling:</u> After the drill head reaches the target precisely into the pit, the expanding head corresponding to pipe diameter is installed. By rotating and pulling the head back through the pilot tunnel, this will expand to the desired size. The diameter of the drilling tunnel must be 30% greater than the diameter of the pipe to be laid. If necessary, successive enlargements with increasingly larger expanding diameters are used. <u>Laying the product:</u> Immediately after

No.		Open - cut alternatives	HDD alternatives
	Technical consideration	used for depths greater than 2.00 m. The Contractor will take into account that some of the solid material transported by running water shall be deposited in trenches throughout the execution and that volume will be dredged. Achieving foundation levels is important to ensure the necessary thickness protection above the pipeline, due to possible riverbed erosions. Laying the pipeline at the project levels (not above) would ensure that during the operation of the pipeline, this protection will be provided. On completion of dredging works, the Contractor will proceed to cleaning and levelling the trench bottom with airlift. Before pulling the pipe from one side to the other it is mandatory to check the bottom of the trenches with divers and make a cross section through the trenches to check dimensions. Cross section will be conducted by an independent unit. Allowable tolerances of the dimensions at the trench bottom should be ± 10 cm for 95% of the values and ± 15 cm for the remaining 5%. Excavation works in the banks area Excavations on the banks will be done with excavators that will be equipped with dragline for working under the water level. Topsoil on the banks will be collected and transported in a special storage site, to be reused on completion. The material will be loaded into dumpers and transported on the Jiu bank deposits. Earth from the excavations beneath the water level will be deposited on the waterfront, in an intermediate storage to allow water to drain, then will be transported to the same storage sites, from where it will be recovered for filling the trench.	expanding the head, the pipe or cable to be drawn will be attached. This operation is done very gently because the suspension of drilling, which contains bentonite is acting now as a lubricant of the drilled tunnel. Drilling technique under high pressure injection: The suspension of drilling is an important component of the system. It displaces the soil, it transports dislocated material in pits, and it supports the micro tunnel and reduces friction between it and the product (pipes or cables). The suspension of drilling is made of a mixture of water and bentonite (natural clay water soluble) and is specific to each type of soil. The mixture of water and bentonite is related to soil physical parameters, the parameters being established by geological research. The pipeline is installed (without being subject to additional tension) in the so-called filter cake surrounding the product. Only products which present no environmental hazard are used for drilling suspension. Location technique: Through the three-dimensional location of the drilling head, data about the position of the drill head are available thus avoiding different underground obstacles. The location is based on the transmission of data (modulated broadcast signal) by a transmitter mounted on the drilling head. A data receiver receives signals from the transmitter. Information is remotely transmitted to the display of the data receiver handset. As a result it can locate the exact depth, position and inclination the longitudinal axis of the drilling head.

No.		Open - cut alternatives	HDD alternatives
		<u>Laying the pipe in the Jiu riverbed - dragging from one shore to another</u> Sections are formed on the bank of the Jiu, in major river bed (where pipes concreting takes place) and are drawn successively in minor river bed with horizontal-mounted equipment that is used to hoist, crown, crane engines, gearboxes and torque converters. <u>Filling the trench</u> After installing the pipe into the trench respecting the project geometry, the trench will be filled onshore and offshore.	
5.	Impact on environment	- Impact on the Jiu water quality (increased turbidity of water, water pollution potential risk due to fuel and oil leaks from construction equipment and ships; - Impact on ambient air because gas and dust emissions generated by the construction equipment and ships; - Impact on aquatic biocenosis, disruption of fish migration, disturbance of terrestrial flora and fauna connected with aquatic flora and fauna etc. - Impact on ROSPA0023 Jiu-Danube confluence - Impact on ROSCI0045 Jiu Corridor	**-Impact on ambient air due to emissions generated by the drilling rigs and equipment** **-Low impact on terrestrial flora and fauna due to relatively small areas occupied on the Jiu river banks;** **- Potential impact on fish in the case of non-routine event** - Low impact on ROSPA0023 Jiu-Danube confluence - Low impact on ROSCI0045 Jiu Corridor
6.	Social and socio-economic consideration	- Impact on fishermen : only local impact, no transboundary impact	**No impact**
7.	Archaeological constraints	Potential for stray find in case of open cut	**No archaeological constraints**
8.	Economic viability		

No.		Open - cut alternatives	HDD alternatives
	Evaluation of overall cost	- More expensive than option HDD	- This option is far less expensive both during construction and during operation
	Schedule-induced cost increases	- High potential of inducing delays as a result of the high water level of the Jiu river, risk of high floods	- Low potential of inducing delays

4 DESCRIPTION OF THE ENVIRONMENT LIKELY TO BE SIGNIFICANTLY AFFECTED BY THE PROPOSED ACTIVITY AND ITS ALTERNATIVES

On the Bulgarian territory, at kp 421+323, NGPL crosses Ogosta river, by using the HDD method. At kp 421+803 the route reaches the Danube River bank at an average water level; kp 423+408 is at the border with Romania, in the middle of the river.

The environment likely to be affected in the border zone is represented by the physical environment, water quality and aquatic ecosystem of the Danube River and riverbank flora and fauna.

On the Romanian territory, NGPL crosses the Danube river starting with kp 0+000, at the border with the Republic of Bulgaria, in the middle of the river. Starting with kp 0+500, NGPL crosses the Danube river bank, the flood protection dike and at kp 9+500 crosses the Jiu river.

4.1 PHYSICAL ENVIRONMENT

4.1.1. CLIMATE & ATMOSPHERE

4.1.1.1. BULGARIAN BANK (RIGHT BANK)

The Nabucco Gas Pipeline crosses the Danube river in the region between Oryahovo and Kozloduy. Physically, the region belongs to the West Danube valley (elevation above sea level from 50m up to 300m).
The climate in the region of Oryahovo is mild-continental with prevailing atmospheric circulation from west to east. During winter time there are strong temperature inversions with relatively cold air. The average annual air temperature is around 11.5° up to 12.2°C, with maximum in July – around and over 23°C and minimum in January – around 0°C.
The average monthly and annual wind speed is from 2 up to 2.5 m/s with maximum during spring time (March-May) and minimum during the summer and autumn. The prevailing wind speed is on the north-west direction.
The average relative humidity in the Danube lowland is 73% with maximum in December (up to 90%) and minimum in August (50-60%). The average annual rainfalls are round 600 mm with maximum values in spring-summer and minimum values in winter.

Quality of air - current condition

The gas pipeline route crosses mainly open countries, away from big settlements or industrial regions. Therefore, the atmospheric air in the crossing region is fresh. The levels of pollution by main or specific pollutants such as sulphur and nitrogen oxides, methane, non-methane volatile organic compounds, ammonia etc. are very low. Sources of such emissions seem to be the road and river transport and tree and coal burning in the nearby settlements during the cold season.
As a whole the levels of pollution (emissions and concentrations) in the areas along the Danube river valley seem to be below the average values of pollution in Bulgaria.
Details are shown in BB EIA Report.

4.1.1.2. ROMANIAN BANK (LEFT BANK)

Geomorphologically, the Danube Meadow is a lowland, with many islets (elevation above sea level from 30m up to 300m). There are numerous marshes which have their origin in the fluvial accumulation and show a parallel arrangement to the Danube, being mostly dammed and drained.

Overall, the climate is temperate continental with Mediterranean influences that are felt due to both warmer and more humid air currents of western Mediterranean origin, and to the tropical air currents from SW.

Thus, the air temperature regime is moderate, with frequent warm periods in winter and early spring. The medium annual temperature is 11.5 ^{o}C. The medium annual amounts of global solar radiation are between 100 and 115 kcal/cm^2 year.
The winters are mild and moderately moist. The summers kept the character of relatively dry and warm periods, the rainfalls being more frequent in late autumn. The value of medium temperature of the coldest month varies between 0^{0}C and -1°C and the warmest month between 21^{0}C and - 23°C.
There are times when cold air masses penetrate, due to the eastern circulation, and in combination with strong winds in the same direction, produce the snowstorm phenomenon. Thus, there can be minimum temperatures of -110C ÷ - 13°C that can reach up to -25°C. The first frost is likely to occur in the first decade of November, sometimes even later. The last frost in spring occurs in late March.
The frost phenomena (flow of ice jams, ice bridge) occur in about 75% of winters. Ice bridges are rarely, about once every 5-10 years, with a mean of 20-30 days. The maximum and minimum durations were 60 days and respectively, 3 days. According to the Romanian standard STAS 6054-84, the maximum depth of frost in the region is 80 cm at Bechet
The distribution of rainfalls throughout a year is different from the rest of the country. The sub-Mediterranean influence is felt. Due to the region location under the incidence of air masses of W and SW circulation, there are relatively high amounts of precipitation (800-900 mm / year), with two maximum rainfalls, one in April and May, and one in November and December. The least precipitations occur in late summer and early autumn (August-September) and late winter (February-March).
There are also irregular variations in rainfalls. In the case of intensive cyclonic activity of the Mediterranean cyclones, there are excessive amounts of precipitation of over 1,300 mm / year, while during the years when the anticyclone regime persists, droughts can occur.
The liquid precipitations are dominant; the solid ones under the form of snow are relatively low. A greater frequency during winter has the sleet. The number of days with snow is less than 20 days per year. The snow layer lasts between 30 and 40 days, and rarely reaches 50-60 cm in thickness.
The wind has some peculiarities under the influence of general atmospheric circulation and landscape, and the movement in the western sector is dominant. The medium wind velocities are between 2.3 and 4.6 m / s. The wind speed increases in spring and early summer.
The maximum wind velocities exceeded 20 m/s each year. The seasonal changes of the general air circulation have caused significant modifications in the local system of frequency and wind speed. Some modifications are also induced by the topography surface and the vegetation.

Quality of air - current condition

The gas pipeline is located outside the built-up area of the settlements or industrial centres or at the boundary of the built-up area, where no stationary pollution sources are located and no industrial activities with emissions of heavy metals or persistent organic pollutants are carried out. Sources of such emissions seem to be the road and river transport. Therefore, the atmospheric air in the crossing region is fresh.

The bank- floodbank area is affected by anthropogenic low effects as a result of human activities (such as grazing, etc).
Details are shown in RR EIAReport

4.1.2. SURFACE WATER

4.1.2.1. HYDROLOGICAL CHARACTERISTIC OF DANUBE RIVER – CURRENT CONDITION OF THE WATER BODY

The main hydrological data needed for the study were elaborated by the National Institute for Hydrology and Water Management (INHGA), a specialized institution in Romania,
The hydrological calculations were elaborated for a wide range of frequencies and annual exceeding probabilities of maximum flows and various values of medium flows analyzed (Table 4.1. below)

To analyze the morphological changes of the riverbed at the hydrometric stations, the specific cross sections were studied (acc. to INHGA data) to determine the values of the following parameters: drainage area, maximum depth and width of the riverbed at low-water line for the period of 1981-2010 at the hydrometric stations of Calafat, Corabia, Turnu Magurele, Zimnicea, Giurgiu, Oltenita and Silistra.
The analysis of the above mentioned parameters, in conjunction with the liquid and solid flow values, indicates that on the Danube there is a trend of erosion in both depth and width (gradient of 20m2/year for the area under the low-water line, and 0.5 m / year for the low-water line width).
The sections of Turnu Magurele, Corabia Calafat and Bechet show a relative stability on the left side and riverbed bottom and the erosion trend is particularly apparent on the right side under low-water line and the connection areas with the bed bottom.

The following conclusions can be drawn from the analysis of the existing studies on the morphological phenomena in the Danube riverbed during this period in the studied sector:
- The Confluence Zone with the Jiu River (km 712 - 690) indicates that this area has been under a predominant process of erosion that has emerged through more prominent erosions of the Bulgarian bank.
- The Downstream Confluence with the Jiu River between km 689 - 686 has an erosion tendency of the Bulgarian bank and deposits on the Romanian bank.
- The Bechet Zone between Km. 685 - 662, in the same period, is characterized by a predominant sedimentation phenomenon over erosion due to the occurrence and development of the islets present in the riverbed.

Due to the fact that the Bechet Hydrometric Station is only 6 km downstream of the crossing area and that there are no significant changes on this section of the Danube, the continuity of water flows and sediments between the two sections can be taken into consideration.
Since 1963-1964, the floods in the Danube major riverbed along the Romanian sector have been avoided by dams. The multiannual average flow rate of the river at Bechet is 5,650 m3/s. The maximum values by seasons are recorded in spring (March-May) when the flow is about 34% of the yearly volume, and the minimum values occur in autumn (August- October) when the flow is about 18% of the yearly volume.

Table 4.1: Hydrological calculations elaborated for a wide range of frequencies and annual exceeding probabilities of maximum flows and various values of medium flows analyzed for the Danube river

Max. flows

Probability	1%	Qmax. 2006	2%	5%	10% (2010)	20%	30%	50%	80%
Qmax.(m^3/s)	16250	15900	15370	14290	13370	12320	11500	10530	9020

Medium flows

Probability	1%	10%	45%	50%	75%	97%	99.9%	Qmin low water
Qmed.(m^3/s)	8000	7000	6000	5590	5000	4000	3000	2500

The (annual) minimum daily average flow rates with 80% likelihood have values of 1,820 m3/s on this sector, and those corresponding to the same likelihoods but calculated throughout June - August when the demands of the various uses are maximum have values of 2,650 m^3/s. Minimum flow rates of 1600 m^3/s were recorded at Bechet in August-September in 2003.
The variation of the Danube levels is low, except the zone of influence of the Iron Gates hydroelectric power station which is felt up to downstream of Calafat. The average speed of the water front is about 2 km/hour. Generally, the slopes remain the same both for high values and for low values of the levels, which shows the parallelism of the free water surfaces corresponding to various typical situations.
The data for the medium water flows were obtained from the measurements of flows and levels and from the discharge rating curves determined for the years: 2004, 2005, 2006, 2007, 2008, 2009, 2010.
The analysis and comparison of the annual discharge rating curves pointed out their good stability. In these conditions it was possible to trace a multi-annual medium discharge rating curve for the period of 1994 - 2003, when the recorded flows were between 2300 m^3/s and 13 400 m^3/s. During this period, the deviations of measurements points from the multi-annual medium discharge rating curve were less than 5%. The occurrence of special hydrological events (flood recorded in 2006), required substantial changes and corrections in particular in the area of great flows with low frequency 10,000 m^3/s – 16,000 m^3/s where the levels recorded in 2006 are lower than about 50 cm.
Regarding the multi-annual medium solid flow for the period of 1931 - 1962 (under natural conditions) in the Orsova section (km 955), the value was 1080 kg/s (34 million t/year) and during 1971-1999 it decreased to 769 kg/s (24 million t /year) due the hydro technical developments upstream.
In order to highlight the volume differences of sediments transported on the Danube, during the hydrological extremes (year with fluid deficit and year with fluid excess), the analysis has shown that during the hydrological drought period of 2003 (record year with minimal water in the last hundred years), the transit did not exceed the value of 25% of that resulted when the water levels were high (2006). Also, comparing the volume of sediments since the ~ 119 days with low water in 2003 with the medium volume of that year resulted the percent of 20.1%.
The share of volumes transported during floods is almost equal as compared to the annual mean (Figure 4.1 below). This large share defines the erosion power.

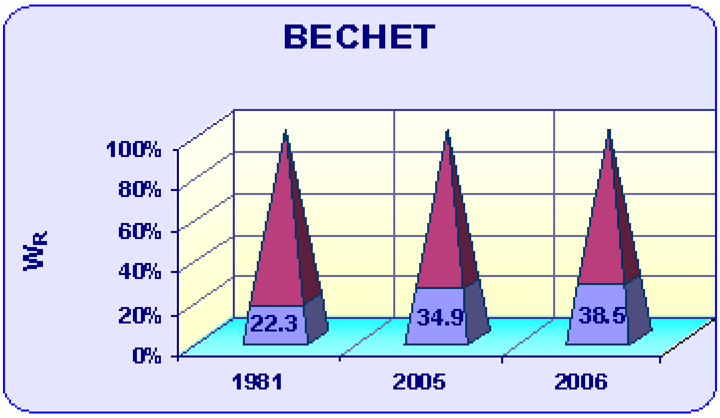


Figure 4.1: Percentage size of the volumes of suspended sediments carried by flood during the years 1981, 2005 and 2006 compared with the mean of the corresponding years

Regarding the chemical composition of sediments, generally this slightly varies - in other words, different grains of sand are predominant (i.e. silicon dioxide), and then silts and clay (minority oxides).

The water chemistry shows interest due to its action on material. Natural or treated water in contact with various materials can cause their degradation, under certain circumstances. In the case of metals, the process is known as corrosion, in the case of concrete, the process is called aggression.

The series of medium annual values between 1977 – 2009 show that the indices of pH, HCO^{3-} , have an increasing trend and the indices of O. D., Mg^{2+}, SO_4^{2-} and mineralization have a decreasing trend.

Roughly, (except for accidental situations), we can conclude that the values of indices pH, O.D., Mg^{2+}, SO_4^{2-} are not large enough to contribute to metal corrosion or aggression for concrete (these phenomena occur after a long time). It is worth mentioning that HCO^{3-} and mineralization could contribute to the acceleration of this aggression.

Regarding the water quality, according to the Water Directive, on the main course of the Danube river, administrated by the Water Basin Administration Bodies, two water bodies were identified and evaluated, namely:

- Bazias – Iron Gate I (RORW14.1_B1) – typological category RO 12
- Iron Gate I- Iron Gate II (RORW14.1_B2) – typological category RO 13
- Iron Gate II - Chiciu (RORW14.1_B3)- – typological category RO 13

Because of the evaluation, it was found out that these water bodies, which are strongly modified because of Iron Gate dams, have a good ecological potential.

After leaving the Iron Gate gorge, the Danube valley shows a number of morphological features caused by the tectonic structural conditions of the foundation, and also the riverbed paleo-evolution under certain morphogenetic conditions. The Danube course is rectilinear and has a relatively good stability between km 690 (upstream Bechet) and km 672. The major riverbed has a clearly asymmetric aspect with the left bank consisting of low plains (1-2 m above the sea level) and the right side much higher (about 5 m above the sea level) and steep in places.

In the undercrossing area, the Danube flows from W-NW to E-SE, and the bed is unique. As shown in the topo-hydrographical study, the navigable channel moves to the Bulgarian bank, the central area depths are lower, increasing again towards the Romanian bank. A wooded island lies between km 683 and 684 in the Danube riverbed, in the central area.

Structurally, downstream Iron Gates gorge, the Danube valley cuts across the Great Depression of the Romanian Plain between the Carpathians and the Balkans, with a complex archaic-Hercynian complex foundation filled with Mesozoic hard deposits (limestones, conglomerates) overlapped by a heterogeneous sedimentary (Quaternary) bedding consisting of clays, sandy clays, sands and gravels, increasing in thickness from south to north.

The morphological unit crossed by the Danube in the undercrossing area is the Danube Plain, which can be described as a low area, relatively flat, with a large number of small islands of low expand and numerous ponds of river storage origin in a parallel arrangement with the Danube; currently they are mostly dammed and drained. On the Calafat-Bechet-Corabia, sector, the sedimentary processes are dominant due to the reduced flow slope. The alluvial bedding thickness can exceed 10 m in the area of banks. The sediments that make up this alluvial layer of the riverbed may have shifting tendencies both across (from the convex bank to the concave bank) and especially along the watercourse, depending on the hydrologic regime.

Geologically and structurally, the area corresponding to the Danube Floodplain belongs to the tertiary sedimentary bedding of the Moesian Platform consisting of formations with a great thickness (> 100 m), of which the Sarmatian-age ones consist of marls and limestone outcropping on the right bank of the Danube. On the Romanian bank, these are covered with Quaternary terrace deposits, represented by alluvial accumulations: sands, loamy sands and gravels, with tens of meters in thickness. The newest deposits, belonging to the floodplain, are related to the higher Holocene and consist of gravels, sands and loamy sands with a thickness ranging between 10 to 15 m.
In terms of seismicity, the work site falls under SR 11100/1993 in the macrozone of seismic intensity "7_1", and according to the norm P100-1/2006, in the seismic hazard zone with a design value of land acceleration a_g = 0,16g for earthquakes with the average recurrence interval of SMR = 100 years and a corner period of Tc = 1.0 s.

River characteristics and water quality of the Danube River in the Jiu-Danube Confluence

The Danube is about 1000 km long on the Romanian territory between Drobeta Turnu Severin and its discharge into the Black Sea. This sector is described as the lower section of the Danube where the hydrographical and hydro-biological features differ from the middle and upper sections. In this sector, the longitudinal slope of the riverbed ranges from 34 cm/km in the defile to 2.8 cm/km in the area of Braila town.

The main tributary of the Danube in the Jiu –Danube Confluence is the Jiu river with an average water intake estimated at 92 m^3/s (figure 4.2. below).

Figure 4.2. : Map of the Jiu River discharge zone into the Danube

In this sector, the biotope typical of the Danube is the navigable channel (minor riverbed). The floodplain is reduced from several kms to only a few hundred meters.

The water flow regime shows significant seasonal and annual variations depending on the amounts of rainfall recorded in the middle and upper sector of the Danube. The highest flow rates are recorded in spring and at the beginning of summer. The multiannual average flow rate of the Danube is estimated at 6290 m^3/s in this sector.

The water temperature values recorded throughout a calendar year range from 1-2 degrees Celsius in winter to 25-26 degrees Celsius in summer. The multiannual minimum values (2-3 degrees Celsius) are recorded in January-February, and the multiannual maximum values (25-26 degrees Celsius) are recorded in August. In general, the Danube waters are characterized by a relatively high thermal inertia given the high water volume (the diurnal variations of the water temperatures are 3-4 degrees Celsius). The multiannual average temperature was estimated at 13 degrees Celsius. The water current ranges from 0.2-0.3 m/s in some areas near banks to 1.5-2 m/s in the middle course area. The water surface frost phenomenon manifests throughout 30-45 days.

Depending on the quantity of suspended solids, the water transparency is estimated at 10 cm during high floods and 70-80 cm when water is clear.

The solid flow rate (total amount of suspended solids carried along) ranges depending on the volume of precipitations in the sectors upstream the Danube, being generally estimated at 2.2 tons/s (average value), with a density between 90 and 325 mg/l suspended particles.

The dissolved oxygen concentration ranges from 5 to 10 mg oxygen / l of water. The maximum values are recorded in winter.
The water pH records annual values ranging from 7 to 8. In winter, the pH is usually 7-7.5.

The average water hardness is 9 ^{o} dH (German degrees). The concentrations of Ca and Mg ions are 40-50 mg/l, and the chlorides have concentrations of 14-21 mg/l. The values recorded for the phosphates concentration range from 0.05 to 0.5 mg/l.

As regards the water chemical quality of the Danube river identified with a Merck field kit « Compact laboratory for determining the water quality» in March 2011, the aspects shown in table 4.2 were highlighted below.

Table 4.2.: Water chemical quality of the Danube river in March 2011

No.	Indicators	Range of values
1.	water transparency	20-30 cm
2.	water temperature	4-6 degrees Celsius
3.	nitrites (NO_2-)	from 0.075 to 0.1 mg/l
4.	nitrates (NO_3-)	from 50 and 75 mg/l
5.	ammonium (NH 4+)	from 0.4 to 0.6 mg/l
6.	phosphates (PO4 3-)	from 0.5-0.75 mg/l
7.	pH	7-7.5 mg/l
8.	dissolved oxygen concentration	8-8.5 mg/l

4.1.2.2 BULGARIAN BANK- CHARACTERISTICS OF OGOSTA RIVER- CURRENT CONDITION

The route crosses the Danube river above the place where Ogosta river flows, at kmr 685+300. The crossing site is located on the general fluvial terrace of the Danube river and Ogosta river, behind the protection dyke (appendix 5). The pipeline crosses also Ogosta river itself, approximately 550m before it flows into the Danube river.

Ogosta river (with code of the water body at the outflow 'Ogosta and Skut' – BG1OG100R01) may be characterized with spring high water and summer-fall dryness. The average water quantity at the town of Mizya is 18.273 m^3/sec, catchment – 3112 km^2 and intensity – 7940 l/s.km^2.

According to WBMP the surface and ground waters in the region for basin management are divided into water bodies, which appear independent and significant elements of the waters and areas for their protection have been determined.

The route crossing the Danube River falls within the catchment area of the following surface water bodies:

- Surface water body, which appears deeply modified, category "river" from the Danube river valley, named Danube RWB01 and code BG1DU000R001. The ecological status of the water body is moderate; the chemical condition is assessed as being bad.
- Surface water body, which appears deeply modified, category "river" from the river valley Ogosta, named Ogosta RWB14, with code BG10G100R014. The ecological status of the water body is moderate; the chemical condition is assessed as being good.

The route falls within an area for water protection according to Art.119a, para 1, item 5 from the Water Act- the protected territories and areas, declared for protection of habitats and biological species, in which the maintenance and improvement of the water condition appear as important factors for their protection - "Ogosta river" with code BG0000614.

4.1.2.3 ROMANIAN BANK- CHARACTERISTICS OF JIU RIVER

The Jiu River is a I[st] order tributary of the Danube. Its confluence with the Danube river is at 692 km upstream the Danube outlet into the Black Sea in the Pontic Eco-region.
The Jiu River is 339 km long; the average slope is 5 %, a sinuosity coefficient of 1.85 and a basin of 10080 km^2. The hydrographical network covers 3876 km. The density of the hydrographical network is 0.38 km/km^2 being above the country average value (0.33 km/km^2).
The average multi-annual flow of the Jiu River in Zaval section from the confluence with the Danube is 2762.5 mil. m^3 (87.7 m^3/s) and is shown in table 4.3 below.

Table 4.3: Average multi-annual flow of the Jiu River in section Zaval from the confluence with the Danube river

River	Hydrometric Station	River length from confluence (km)	Area (km^2)	Altitude (mdM)	Multi-annual average flow (m^3/s)	Monthly min average flow (m^3/s)		QM / QM *
						80%	90%	
1	2	3	4	5	6	7	8	10
Jiu	Zaval	331.0	10073	417	87.7	16.8	12.4	1/222

According to WBMP, the ecological condition of the Jiu River in the flowing area is good.

Geomorphologically, the crossing area of the Jiu River is located in Oltenia Plain with Jiu Meadow subunit. This represents the newest morphological element of the Jiu Valley. The crossing area develops evenly in terms of width (4 – 5 km on an average). The unit area is relatively plain, with a big number of eyots with reduced extension and many swamps of fluvial origin.
The Jiu Meadow is dominated, either by the small heights of the 5 – 10 m terraces between Malu Mic and Toceni, either by those of the 15 – 20 m terrace between Listeava – Ostroveni, Barza – Zavalu and Damian – Listeava or of the bigger height of the 50 – 60 m terrace between Dobresti – Damian and Padea – Barza or the height of the field Salcuta – Dranic between Podari – Padea.
The meadow heights are between 70 and 30 m. The Jiu River watercourse presents a trend to construct a meadow on the left side, the same as the Olt River, and to erode the left river bank, through lateral erosion (in some parts even regressive).

4.1.3. GROUNDWATER

4.1.3.1 BULGARIAN BANK

According to the hydrological zoning of Bulgaria, the site of the Danube river crossing is located in the Lower Danube artesian area. This area is a typical artesian basin with broad spread of aquiferous horizons, located on floors and in depth and which sink to the north. During the construction of the gas pipeline the horizons located the highest in the hydrogeological section and which form two water bodies will be affected:

- BG1G0000QAL005 has been determined as an area of protection for drinking water with code BG1DGW0000QAL005[5].– Pore water(s) in Quaternary-Kozloduy lowland – represented by the alluvial precipitations/sediments of Danube, which have high depth of water. The site falls within the eastern part of this water body. According to WBMP, the chemical condition of the groundwater body is assessed as being good. The quantitative condition is assessed as being bad.
- BG1G000N1BP036 –Cavern water(s) in the Lomsko-Plevenska depression – located just under the water body BG1G0000Qal005 - Pore water(s) in Quaternary-Kozloduy lowland. Ground water under pressure have been formed in the sandpits, the sandy limestone and gravel. According to WBMP, the chemical condition of the groundwater body is assessed as being bad. The quantitative condition is being assessed as good.

The route falls within an area for water protection according to Art.119a, para 1, item 5 from the Water Act- the protected territories and areas, designated for the protection of habitats and biological species, in which the maintenance and improvement of the the water condition seem like an important factor for their protection - “Ogosta river” with code BG0000614.

4.1.3.2. ROMANIAN BANK

According to the provisions of the Framework Directive 60 /2000 /EC and WBMP for Jiu River, in the wetland and terrace areas of the Jiu and Danube rivers, two underground water bodies were delineated (ROJI05 and ROJIO6), being developed in porous-permeable alluvial deposits of quaternary age. Situated near the ground surface, they represent the free level.

The chemical analysis of the groundwater in the Danube wetland and terraces generally indicates drinkable waters.

Body ROJI05- the Jiu wetland and terrace and its tributaries

In 2007 the underground water quality ROJI05 was monitored by 46 monitoring boreholes. In 9 boreholes, the threshold values were exceeded NH_4, NO_3 and PO_4.

The boreholes with exceedance are about 20 % of the monitoring points, and their distribution is relatively even in the lower part of the water body, where the possible pollution sources are represented by farming activities.

Under these conditions it was considered that this groundwater body is under poor chemical condition as regards the quality in comparison with the specific indicators NH_4, NO_3 and with local exceedance at NO_2 and PO_4.

[5] Areas for water protection according to Art.119a, para 1 from the Water Act (WA) (prom. in SG, issue 67/27.07.2012, last amended in SG issue 61/06.08.2010)

Areas for protection of drinking waters –water bodies as well as sanitary-protection areas according to Art.119a, para 1, item 1 from the Water Act;

4.1.4. GEOLOGICAL BASE

4.1.4.1 BULGARIAN BANK

The precipitations of Quaternary are located in the region of the Danube river crossing. It is built from alluvial formations, represented by gravel, sand and clay.
Under the quaternary is Neogene period, represented by the marine sediments of Pre-Carpathian basin, which consist of sandpits, sandy limestone, sands and gravel.
As far as Tectone is concerned, the site is located in the Moesian platform.
Seismicity According to the map for seismic zoning of Republic of Bulgaria for period of 1000 years, the region belongs to zone with VII degree of intensity (I) under the scale of Medvedev-Sponheuer-Karnik scale and it has a coefficient of seismicity (Kc) – 0,10.

4.1.4.2. ROMANIAN BANK

The morphological unit Danube Meadow has a low altitude like an alluvial plain; the piesometric water level is 2.10 – 5.50 m.
The surface of the unit is relatively flat, with many lakes of Aeolian accumulation origin, 3 – 5 m high local terraces, abandoned meanders, dunes, etc. At present the lakes are dried. Along the pipeline route we found a poplar forest, floodbanks, many irrigation/dried channels of 1.5 – 2.5 m in depth, areas with dunes, arable lands, small lakes, pasture areas, swamp areas. The Danube Meadow is crossed by the Jiu water course.
We mention that the hydrostatic level can rise in the rainy seasons to 1.0 – 2.5 m.
Along the pipeline route, the performed surveys intercepted poorly cohesive deposits such as silts, sandy silts, argillaceous silts, fine sands, silty sands and cohesive deposits such as silty clays and sandy clayey silts.

4.1.4.3 DANUBE RIVER

From the hydro-geological point of view and analyzing the specialized documentation and maps near the pipeline route, it appears that the groundwater seepage level is variable, being found at depths ranging from 2.0 to 9.0 m. It is noted that the hydrostatic level can rise to higher rates, ranging from 1.0 to 2.5.
Tectonically, besides the network of faults that the literature assigns to the foundation, the gravity and seismic geophysical surveys have highlighted along the Danube some sectors with positive neotectonic movements alternating with areas of subsidence (sinking).
The Danube course is rectilinear and has a relatively good stability between kp 690 (upstream Bechet) and kp 672. The major riverbed has a clearly asymmetric aspect with the left bank consisting of low plains (1-2 m above the sea level) and the right side much higher (about 5 m above the sea level) and steep in places.
For Nabucco project, the geological and geotechnical studies have been prepared[6] in the crossing area of the Danube river.
In the undercrossing area, the Danube flows from W-NW to E-SE, and the bed is unique. As shown in the topo-hydrographical study, the navigable channel

[6] Nabucco Project 2011, *Geological Survey Report* (Document 70223-RR-RPT-PL-0014) and *Geotechnical study on the Danube River Ubdercrossing* (document 70223-RR-RPT-PL-0044)

moves to the Bulgarian bank, the central area depths are lower, increasing again towards the Romanian bank. A wooded island lies between kp 683 and 684 in the Danube riverbed, in the central area.

Structurally, downstream Iron Gates gorge, the Danube valley cuts across the Great Depression of the Romanian Plain between the Carpathians and the Balkans, with an archaic-Hercynian complex foundation filled with Mesozoic hard deposits (limestones, conglomerates) overlapped by a heterogeneous sedimentary (Quaternary) bedding consisting of clays, sandy clays, sands and gravels, increasing in thickness from south to north.

The morphological unit crossed by the Danube in the undercrossing area is the Danube Plain, which can be described as a low area, relatively flat, with a large number of small islands of low expand and numerous ponds of river storage origin in a parallel arrangement with the Danube; currently they are mostly dammed and drained. On the Calafat-Bechet-Corabia, sector, the sedimentary processes are dominant due to the reduced flow slope. The alluvial bedding thickness can exceed 10 m in the area of the banks. The sediments that make up this alluvial layer of the riverbed may have shifting tendencies both across (from the convex bank to the concave bank) and especially along the watercourse, depending on the hydrologic regime.

Geologically and structurally, the area corresponding to the Danube Floodplain belongs to the tertiary sedimentary bedding of the Moesian Platform consisting of formations with a great thickness (> 100 m), of which the Sarmatian-age ones consist of marls and limestone outcropping on the right bank of the Danube. On the Romanian bank, these are covered with Quaternary terrace deposits, represented by alluvial accumulations: sands, loamy sands and gravels, with tens of meters in thickness. The newest deposits, belonging to the floodplain, are related to the higher Holocene and consist of gravels, sands and loamy sands with a thickness ranging between 10 to 15 m.

4.1.5. SOILS

4.1.5.1. BULGARIAN BANK

The soil coverage in the region between the Danube river and Ogosta river includes alluvia, alluvial and alluvial-meadow soils (sandy and sandy-clay), to the north-east of Ogosta river – it includes vigorous soils, bordered by eroded carbonate and typical black earth (beyond the outlines of the investment intention). According to the permanent use these lands are artificially forested woodlands (Poplars), created with anti-erosive/ anti-abrasive purpose – stabilization/strengthening of the river bank.

4.1.5.2 ROMANIAN BANK

On the lower terrace and in the Danube wetland, affected by the sand accumulations, on the Calafat-Rast and Bechet-Dăbuleni sector, there are various soils, the sandy chernozem soil being dominant.

The immature soil class existing in the large wetland of the Danube and Jiu is grouped into alluvial soils that, in many areas matured to alluvial chernozem.

In the Danube wetland, the presence of sandy alluvium and of sands blown by wind determined the predominance of sandy soils and unsophisticated sands.

4.1.6. LANDSCAPE

4.1.6.1 BULGARIAN BANK

The main factor for landscape differentiation of the territory of a certain region is in the interaction between the location, climate and vegetation, as the topography has priority. This concerns mostly the natural complexes, which are considered to be conditionally unmodified by anthropogenic activity. The

various industrial and non-industrial human activities cause significant anthropogenic impacts on the natural landscapes. In the mentioned territories the biggest changes were caused by the agricultural activity.
Publications of the Bulgarian Academy of Science (BAS) on geography of Bulgaria, maps and publications in the specialized literature are used in describing the current condition of the landscape in the affected territories.
According to the landscape zoning of the territory of Bulgaria (1989) the site falls within the boundaries of:

Northern-Bulgarian zoning area of the Danube plain

I. Northern Danube- plain sub-area

4. Zlatiiski region

According to the typological classification system of the landscapes in Bulgaria, developed on the grounds of geo-morphological, mezzo-climate and phyto-geographic features/signs, within the site the landscapes belong to class Plain – landscapes of the meadow-steppe alluvial lowlands with an average rate of agricultural reclamation.
A part of the natural landscapes have been transformed as a result of the industrial human activity. The natural landscapes in the region of the settlements are now anthropogenic. The construction of the infrastructure network also contributes to the landscapes to become anthropogenic. The development of agriculture changes these regions into agricultural ones.

4.1.6.2 ROMANIAN BANK

The Danube Floodplain morphological unit will be crossed along about 11.5 km, from the Danube river crossing point considered as kp 0 of the pipeline, located approx. 5 km west of Bechet and up to Zavalu settlement. It is a meadow of Holocene age, formed over the last 10000-15000 years by alleviation, its height increases from upstream to downstream, from 3-4 km at Drobeta Tr. Severin to 16-17 km at Calaraşi. In longitudinal and cross section, the meadow shows a micro relief formed of strips:

- banks' strip (silts)
- (low) moors, lakes and marshes' strip.

Morphologically, the Danube Floodplain appears like relatively flat lowland, with a large number of islets. There are numerous marches which have their origin in the fluvial accumulation and show a parallel arrangement with the Danube, being mostly dammed and drained. The area is low lying with high water table and is crossed by several large drainage ditches. The Meadow Vegetation, between the bank and river is a dense plantation of Euro-American poplar (Populsus. populus eurocanadensis) with aquatic and lacustrine herbal plants. The area supports a large number of Common Kestrels (*Falco tinnunculus*) which have been seen hunting, so obviously the small mammal population and the amphibian population are high.
The flood bank is built at least 500 m far from the river bank.
The vegetation of the flood bank is a mosaic of aquatic emergent, tall herbs, dune grassland, relict arable grassland.
Along its route, the pipeline crosses a number of farm lands and grasslands. The grasslands are intensely exploited, the pasture area is too small as compared to the number of animals. The pastures are represented by secondary grasslands, the productivity being low due to over-exploitation.
The area is part of the Important Bird Area ROSPA0023 the Jiu-Danube Confluence, therefore it can support populations of protected species or can be important during the migration period of some birds.

4.1.7. NOISE

4.1.7.1 BULGARIAN BANK

The noise levels are those typical of the natural background noise in the region. The closest territories with fixed noise regime are:

- Saraveo village which is located round 3.5 km to the south-west direction and
- Oryahovo – located at 5 km to the east direction

4.1.7.2 ROMANIAN BANK AND WATER BODY

The noise levels are those typical of the natural background noise in the region. The closest territories with fixed noise regime are:

- Bechet Port is located 6 km far
- Ostroveni village is located round 1.970 km to the east direction

4.1.7.3 DANUBE RIVER

The type of ships that sail the Danube River in the area of the pipeline crossing are: Pushers (2400 HP) with 6 barges, passenger ships, Pushers with barges, Tugboats (1200 HP) with 4-6 lighters and pushed lighters (1000HP).
The engines on passenger ships are silent, and pusher engines are noisy.

4.1.8. CULTURAL HERITAGE

4.1.8.1.. BULGARIAN BANK

There are no data about the historical site along the pipeline route within the ZoI of the Danube river crossing. No archaeological sites are identified during the total archaeological survey.

4.1.8.2. ROMANIAN BANK

The archaeological sites in the Historical Landmark List of Dolj county are found at a certain distance from the Danube (more than 10 km far from the minor riverbed of the Danube, considered most of the times as the current Danube) and none of them on the Danube line. The explanation[7] could be that the floodplain of the historical Danube was narrow between Cetatea and Calafat, followed by the sands of Ciuperceni, then by a 4 km wide strip that was even wider in Dessa and Rastu. The floodplain became more than 10 km wide from Bistreț to Gura Jiului and covered a 20000 ha area with the ponds Bistrețul, Cârna- Măceşul and Nedeia.
Along the pipeline route, in the Danube river crossing no archaeological sites were identified during the archaeological survey.

4.1.8.3. DANUBE RIVER

The possible presence of a shipwreck in the river bed, buried into the sediments of archaeological artefacts will be discussed and assessed.

[7] Information extracted from: *emiliacorbu.ro/2009/09/**dunarea**-istorica*

4.1.9 SOCIAL AND HEALTH & SAFETY

Based on the International best practices the Area of Influence (AoI) of the project was defined as the area along the pipeline route of 4 km – 2 km in width (4km Buffer zone- 4km BZ) on each side of the planned centreline of the gas pipeline.

The baseline information (health conditions of the population, living near to the crossing point of Danube River (AoI)) are presented in RREIA and BBEIA.

4.1.9.1 BULGARIAN BANK

As seen in appendix 3, figure 3.2, the crossing area of the Danube river and Ogosta river is located on the administrative territory of Oryahovo locality. Over 80% of the total municipal territory is farmland, out of which 50%-70% is arable land.
According to the Social baseline report, about 86.9% of the total population is affected by the project as result of traffic on acces roads .

4.1.9.2 ROMANIAN BANK

On the Romanian bank, the port of Bechet (km 679) is about 6 km downstream of the undercrossing section.
The crossing area of the Danube River is located on the administrative territory of Ostroveni village. Nabucco pipeline passes near Ostroveni hamlet.

Ostroveni village includes a number of 4767 inhabitants (2011 census). The access road is the national road DN 55 A. The village territory belongs to the agricultural profile.
Agriculture, as the basic economic activity is supported by the two branches: crops (cereals, industrial plants) and livestock husbandry: sheep, swine, goats. The villagers own bee hives mainly for honey used as a food and as a remedy in certain diseases.
Fish-farming, commerce and services are other activity fields of the inhabitants in this village.
The farm lands are protected from floods by the Danube flood bank.
The hamlets belonging to Ostroveni village are not supplied by water. The drinking water is ensured by individual wells.

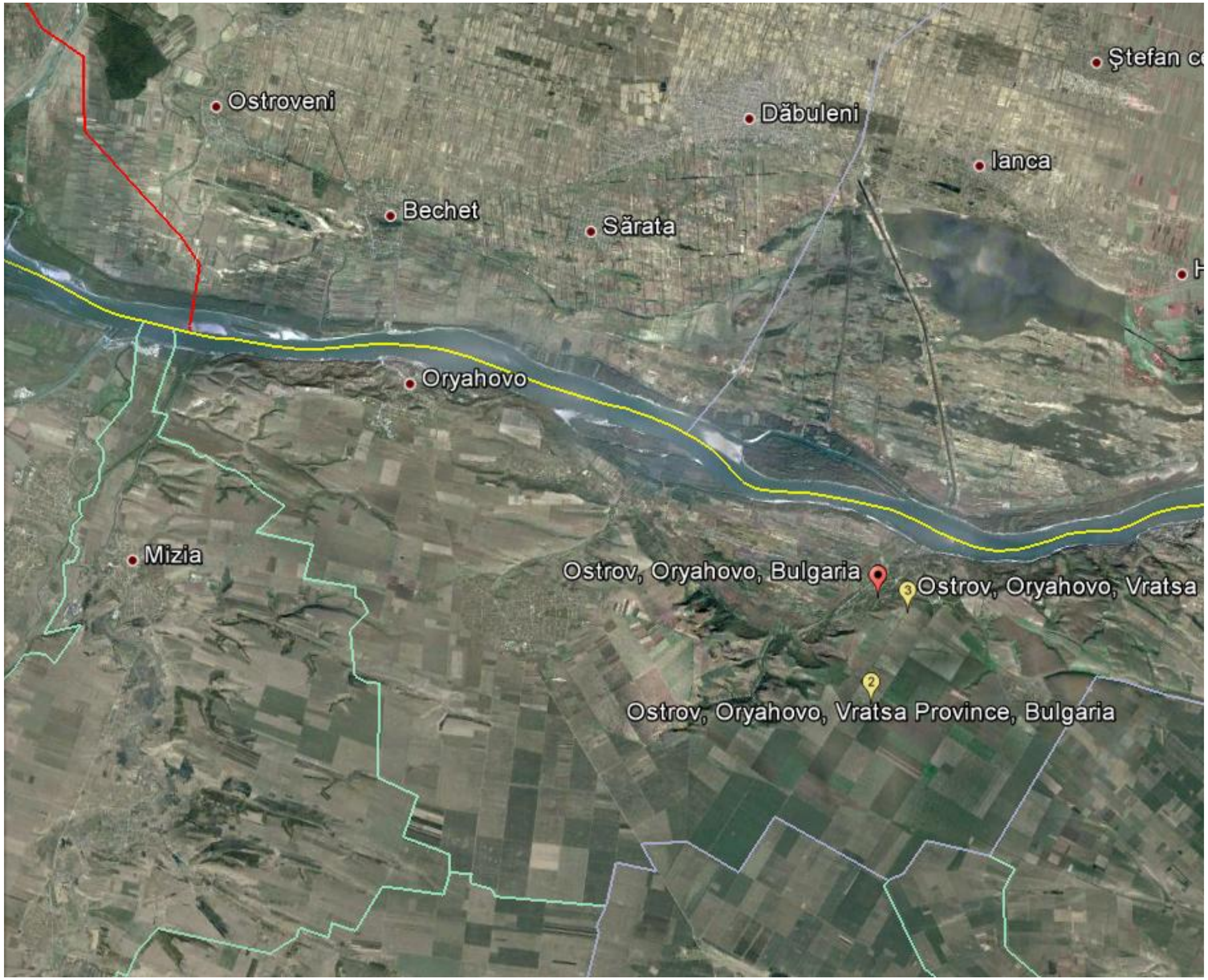


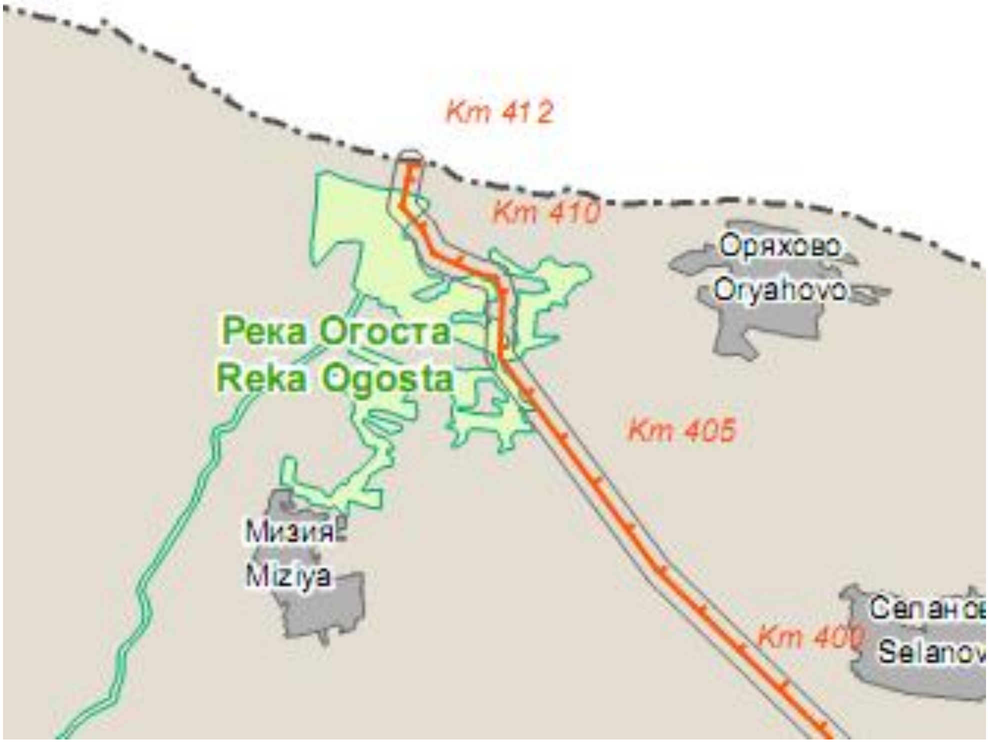
Figure 4.3: Localities near border

4.2. BIODIVERSITY

4.2.1 BULGARIAN BANK

4.2.1.A. General consideration

The entire lower course of Ogosta river and the bank of the Danube river at the gas pipeline crossing point fall within the protected site „Ogosta river" (BG0000614) according to the Directive on habitats (appendix 6. and detail below).



The banks of Ogosta river are diked. There are a lot of sediment deposits on the bottom of the river and the water is eutrophicated, which is due to the influence of the dam of Montana located in close vicinity.
The data on the species for which the site "Ogosta river" (BG0000614) has been designated and the survey results are shown in appendix 6.

The report on the Appropriate Assessment is an appendix to the BBEIA report and assesses the potential impact of the project on the protected sites of Natura 2000.

4.2.2 ROMANIAN BANK

The bank of the Danube river and Jiu River at the gas pipeline crossing point fall within the protected sites **ROSCI0045 Jiu Corridor and ROSPA0023 Jiu-Danube Confluence** according to the Habitats Directive.

Data on **ROSCI0045 Jiu Corridor** and **ROSPA0023 Jiu-Danube Confluence** are shown in appendix 9.

The report on the Appropriate assessment is an appendix to the ROEIA report and assesses the potential impact of the project on the protected sites of Natura 2000 mentioned above.

The Romanian Institute for Biology undertook a survey in the bank –floodbank area on the Romanian bank and on the Danube throughout April 2010- May 2011. The results of this survey are hereinafter shown, as well as in appendix 8.

INVERTEBRATES in the Danube ecosystems:

Ringed worms the species Tubifex tubifex is typical of the daltic benthos . Species of the genera Nais, Stylaria, Chaetogaster limnaei are found among the Oligochaeta. Species of the genus Enchytraeus serving as food for many terrestrial and aquatic animals are found in the terrestrial environment with a high humidity (under rests of algae, leaves, rocks onshore) The species Hirudo medicinalis is a common species in the Danube. Other species of ringed worms are Haemopis sanguisuga, and Piscicola geometra.
Mollusks: Snails such as Planorbarius corneus, and Lymnaea stagnalis are found in the standing waters rich in aquatic plants. Radix ovate is frequent in the Danube Delta. Among shell species, Anodonta cygnea and Dreissena polymorpha are frequently found in the Danube.
Crustaceans: Cladocera, Ostracoda and Copepoda include aquatic species forming a significant part of the dulcicole zooplankton.
Many filter feeders such as Daphnia cucullata, Daphnia magna or species in Copepoda group (Diaptomus serbicus) are found in the Danube.
Among superior crabs, a relatively common species in the terrestrial habitats of the Danube River is Armadillidium vulgare. The Danube crayfish (Astacus leptodactylus) has lower and lower populations due to the high pollution of dulcicole aquatic ecosystems in the delta.
Arachnids: large size species such as Lycosa singoriensis. The spider Argiope bruennichi as well as the water spider Argyroneta aquatica are frequently found.

The data concerning the bottom macro-invertebrate fauna (Macrozoobenthos) in the riverside area of the Danube river are presented in **Appendix 18**

ICHTYOFAUNA (FISH)

Description of the Danube River fish fauna at kp 0+000 on the gas pipeline route

Ichtyofauna of the Danube navigable channel was classified in point of the fish fauna into five categories, as follows:

1. Anadromous migratory fish (9 species) ;
2. Migratory catadromous fish (1 species) ;
3. semi-migratory reophilic fresh water fish (19 species)
4. semi-migratory stagnophilic fresh water fish (23 de species) ;
5. non-migratory fish (14 species).

The navigable channel of the Danube is characterized by the absence of the secondary arms and the occurrence of small islets in the area of interest for the project (the Danube sector from Calafat). The slope of the riverbed is 0.19% with a relatively high flow speed. The substrate of the riverbed is formed of coarse sand and gravel, and the floodplain is small due to damming.

The ichtyofauna of the investigated section of the Danube is made up of fish species typical of the tributaries in that area (Cerna, Bahna, Topolnița, Vodița) : barbel, nase, chub, Mediterranean barbel, streber together with other species of predatory fish specific to the Danube navigable channel in the Romanian sector. Among the species of fishing interest caught in the area, we mention: *Rutilus rutilus carpathorossicus*, Silver Bream (*Blicca bjoerkna*), Crucian Carp (*Carassius carassius*), *Carassius auratus gibelio*, sterlet (*Acipenser ruthenus*), blue bream (*Abramis ballerus*), Common carp (*Cyprinus carpio*), *Vimba vimba carinata*, Barbel (*Barbus barbus*), Mediterranean barbel (*Barbus meridionalis*), *Alburnus*

alburnus, common bream (*Abramis brama*), Rudd (*Scardinius erythrophthalmus*), Ziege (*Pelecus cultratus*), Black Sea Shad (*Alosa pontica*), ide (*Leuciscus idus*), asp (*Aspius aspius*), Perch (*Perca fluviatilis*), *Zingel zingel*, Streber (*Zingel streber*), *Lota lota*, Wels catfish (*Silurus glanis*), pikeperch (*Styzostedion lucioperca*), Northern pike (*Esox lucius*). It is also worth mentioning: *Leuciscus cephalus, Gobio kesslery, Gobio albipinatus, Rhodeus sericeus marus, Misgurnus fossilis, Gymnocephalus cernuus, Gymnocephalus schraestser, Lepomis gibbosus, Pseudorasbora parva.*

Fish fauna of the Danube river at the Jiu-Danube Confluence and of the Jiu river

The diversity of the habitat conditions and the floodplain lakes allow the existence of a fish fauna formed of species belonging to various ecological groups.

The experimental fishing actions undertaken in the Jiu crossing point area by the gas pipeline (km 10+250) have been performed on both banks over 50 m, in areas where the water is less than 1.5 m deep. The banks are steep, 2.5- 4 m high in the fishing areas. The substrate is mostly sandy, with narrow parts of rocky substrate. The substrate is clayey and muddy (with fine silt deposits) in the areas with a low water current. The right bank is covered with poplars and willows, at the root of which fish shelters have formed. The left bank is uncovered.

The following species have been fished :
Silurus glanis (Linnaeus) 1758, (Wels Catfish) ;
Gymnocephalus baloni (Holcik si Hensel) 1974 (Danube ruffe) ;
Rhodeus sericeus amarus (Bloch) 1782
Abramis brama (Pavlov) 1956
Carassius auratus gibelio (Bloch) 1783, Crucian carp
Alburnus alburnus Linnaeus, 1758
Aspius aspius Linnaeus, 1758, asp
Gobio albipinnatus Lukasch, 1933, White-finned Gudgeon
Leuciscus (Idus) idus Linnaeus, 1758, Ide
Leuciscus (Petroleuciscus) cephalus Linnaeus, 1758
Cyprinus carpio (Linnaeus) 1758, Common Carp
Perca fluviatilis (Linnaeus) 1758, European perch
Styzostedion lucioperca (Linnaeus) 1758

The following species were fished in the winter season:
Rhodeus sericeus amarus (Bloch) 1782
Abramis brama (Pavlov) 1956,
Carassius auratus gibelio (Bloch) 1783, Crucian carp
Alburnus alburnus Linnaeus, 1758
Gobio albipinnatus Lukasch, 1933, White-finned Gudgeon
Leuciscus (Idus) idus Linnaeus, 1758, Ide
Leuciscus (Petroleuciscus) cephalus Linnaeus, 1758
Cobitis taenia L, Spined Loach

It is worth mentioning that most of the fish captured were sub-adults (aged 0+ and 1+).

Among the fish species identified in the Danube in the winter season we mention: Barbel (*Barbus barbus* L., 1758), asp (*Aspius aspius* L., 1758), Common carp (*Cyprinus carpio* L., 1758), Crucian carp (*Carassius auratus* Bloch), Freshwater bream (*Abramis brama* L., 1758), *Petroleuciscus cephalus* L., 1758. *Perca fluviatilis* L., 1758, *Idus* (*Leuciscus idus* L., 1758), *Scardinius erithrophthalmus* L., 1758, *Silurus glanis* L., 1758, *Alburnus alburnus* L., 1758, *Styzostedion lucioperca* L., 1758, *Esox lucius* L.1758 are frequently fished in this period. Among cyprinids *Ctenopharhyngodon idella* and *Hypophthalmichthys nobilis* are frequently fished. The Acipenseridae species are rare: *Huso huso* L., 1758, *Acipenser ruthenus* L., 1758, *Alosa pontica* but their presence is still signalled in the area. The presence of vimba bream (*Vimba vimba*) is uncertain.

Table 4.4. below shows the conservation status of the fish species described on the middle course of the Danube and on the lower course of the Jiu river in Zaval settlement area.

Table 4.4. : Conservation status of the fish species described on the middle course of the Danube and on the lower course of the Jiu river in Zaval settlement area, in the crossing area

Ref. no.	Natura 2000 code	Species name	Common name	English Name	Protection status
1.		*Esox lucius*	Northern Pike	Northern Pike	
2.		*Alosa pontica*	**Pontic** Shad	**Pontic** Shad	
3.		*Abramis brama*	Common Bream	Carp Bream	
4.		*Blicca bjoerkna*	Silver Bream	Silver Bream	
5.	1130	*Aspius aspius*	Asp	Asp	Ber III, DH, RL
6.		*Barbus barbus*	Barbel	Barbel	
7.		*Barbus meridionalis*	Mediterranean Barbel	Mediterranean Barbel	Ber III, DH
8.		*Carassius auratus gibelio*	Prussian Carp	Prussian Carp	
9.		*Carassius carassius*	Crucian Carp	Crucian Carp	
10.		*Acipenser ruthenus*	Sterlet	Sterlet	
11.		*Abramis ballerus*	Blue bream	Blue bream	
12.		*Lepomis gibbosus*	Pumpkinseed	Pumpkinseed	
13.		*Leuciscus cephalus*	European Chub	European Chub	
14.		*Leuciscus idus*	Ide	Ide	
15.	2522	*Pelecus cultratus*	Sichel	Sichel	
16.		*Pseudorasbora parva*	Stone Moroko	Stone Moroko	
17.	1134	*Rhodeus sericeus amarus*	Amur Bitterling	Amur Bitterling	Ber III, DH
18.		*Cyprinus carpio*	Common carp	Common carp	
19.		*Scardinius erythrophthalmus*	Rudd	Rudd	
20.		*Gobio kessleri*	Kessler's Gudgeon	Kessler's Gudgeon	Ber III, RL
21.	1124	*Gobio albipinnatus*	White-finned Gudgeon	White-finned Gudgeon	
22.		*Vimba vimba carinata*	Black Sea **vimba**	Black Sea **vimba**	
23.		*Gymnocephalus cernuus*	Ruffe	Ruffe	
24.	1157	*Gymnocephalus schraetzer*	Schraetzer	Schraetser	RL
25.		*Perca fluviatilis*	European Perch	European Perch	
26.		*Styzostedion lucioperca*	Zander	Zander	
27.		*Lota lota*	Burbot	Burbot	
28.		*Silurus glanis* *Misgumus fossilis*	Wels Catfish	Wels Catfish	

Table A16.1 from appendix 16 shows the result of the surveys undertaken on the Danube on 15.09.2007 downstream of Calafat (on main channel) and on 17.09.2007 upstream of Turnu Magurele (mixed), regarding the fish species populations (Data supplied by the National Administration “Apele Romane” upon SC IPTANA SA. Request).
It is worth mentioning that no Cyprinidae species were found.

Appendix 17 shows the data concerning the ichtyo-fauna and bottom macro-invertebrate fauna (Macrozoobenthos) in the riverside area of the Danube river as well as accompanying information about the parameters of the environment in the section between river km 686 and 685. Totally 16 fish species of 5 families were identified in the surveyed area.

4.2.3. METHODS USED FOR COLLECTING THE INFORMATION ALONG THE NABUCCO PIPELINE ROUTE

The same methods have been used for collecting the information in the site ROSCI0045 Jiu Corridor , ROSPA0023 Jiu-Danube river Confluence and Ogosta river BG0000614 on the species.

The bird populations have been surveyed by selecting the optimal field method, depending on the type of habitat and ground structure. A combination of methods (fixed points and transects, as well as the playback for the species that may be easily detected by this method) has been used in case of the areas with a mosaic of habitats.
Aerial photos from the flight performed over an about 2 km corridor along the pipeline route have been used for planning the field methodology depending on the type of habitat, on the location of wetlands and of watercourses.
The information regarding the amphibians and reptiles has been obtained by using the refuge method and visual methods.
In the case of large mammals, the effective method was the transect method. In the case of small mammals, the population of the rodents and insectivores was determined by using traps.
The habitats were investigated by using the Braun-Blanquet method, and the highly inclined areas were investigated by the chorological- physiognomic profile method.

The survey of the invertebrate fauna at the ground level has been undertaken at different vegetation levels: at the grass layer, the crown level, by using various methods (e.g. direct-dynamic methods).

The fish in the mountain and plain streams have been collected by means of electrofishing, with various powers depending on the water flow rate and the water conductivity features. Photos have been taken by using the questionnaire (see Appropriate Assessment).

These methodologies are applicable to all the species, irrespective of whether they are protected or not.

5. POTENTIAL IMPACT OF NABUCCO PIPELINE

5.1. GENERALS

5.1.1. Defining the project's area of influence

Projects affect a specific area but this area can vary by resource types and by phase of development. The area of influence for a project is the combination of all of these.

Determining the area of influence (often called the region of influence [ROI] or affected environment) is the next step in performing an impact assessment. Determining the area of influence for a project can be complex and is rarely limited to the project footprint or some set distance from the project area.
The area of influence is often, if not always, variable and dependent on the impacting factor (both direct and indirect) and the affected resource. Some examples for different resources include:

- **Soils and Geology:** The area of influence is usually localized and restricted to the project footprint, its immediate surroundings, and borrow areas (i.e., areas from which raw materials, such as gravel, are excavated).

- **Water Resources:** The area of influence related to releases of pollutants to a water body will depend on the type of water body (e.g., stream, river, or lake), the volume and flow of that water body, the nature of the pollutant, and the chemical characteristics of the water body. For water releases, the area of influence can be limited to a single river or stream, but could extend many miles downstream. The area of influence related to use of water will depend upon the water source (e.g., surface water body, groundwater, captured wastewater), the volume of water required, and competing uses for the water.

- **Air Quality:** The area of influence for air emissions will be influenced by prevailing winds, weather patterns, terrain, and the nature of the pollutant being considered. Sophisticated air dispersion models can predict spatial patterns of air dispersion and deposition for various chemicals and allow for close delineation of the area of influence.

- **Land Use and Socioeconomics:** The area of influence will, in general, be localized and restricted to the project footprint and immediate surroundings, but land use in any area supplying workers to a project area can be affected. Area of influence will depend on regional socioeconomic conditions and can be quite different in rural as opposed to urban environments.

- **Ecological Resources:** The area of influence will be the combination of areas of influence for geology and soils, water, and air. The area of influence can be complicated by the presence of migratory species that are not present year-round. Thus, areas that are a great distance away from the project can be influenced by the project.

The area of influence is also dependent on project phase and differs between direct, indirect, and cumulative impacts:

- **Site Characterization:** The area of influence is usually limited to the immediate area of activities
- **Construction:** The area of influence includes the project footprint and immediate surroundings, and the socioeconomic regions supplying workers.

- **Operations:** The area of influence includes the project footprint and surroundings, areas affected by emissions and effluents, and the socioeconomic regions supplying workers.
- **Decommissioning:** The area of influence includes the project footprint and immediate surroundings, and the socioeconomic regions supplying workers

According to EIA Directive, 'project' means:
— the execution of construction works or of other installations or schemes,
— other interventions in the natural surroundings and landscape including those involving the extraction of mineral resources.

5.1.2. **Determining the area of investigation**

Surveys have been undertaken in the working corridor, in the location site of the construction camps, of the dredged material stockpiles and of the access roads.

5.1.3. Methodologies for identification of transboundary impacts

The methodology used for assessing the impact considered the EIA EU Directive 85/337/EEC and 97/11/EC, the Romanian legislation and the Bulgarian legislation transposing these directives, the guidelines developed by international bodies and financing banks, the guidance of the National Environmental Protection Agency of Romania.

The impact has been assessed both for the construction and for the operation and decommissioning of Nabucco gas pipeline. The 500 m pipeline corridor, as well as the zones of influence (construction camps, pipe dumps, pipe transport routes) have been considered.

The impact significance has been assessed based on the following key-indicators:

- For the European sites and for Natura 2000 networks: maintenance of the integrity;
- For the protected European species: maintenance of the conservation status as interpreted in relation to the favourable status and to any conservation objectives that have been set.

The main stages of the (positive or negative) impact assessment have been the following:

a) Identification of the activities performed within the project, likely to generate impact
b) Identification of resources and receptors likely to be affected by these impacts
c) Establishing the sequence of events or the cause-effect connections
d) Envisaging the probable nature, the extent and the size of any anticipated modifications or effects
e) Assessment of the consequences of any impact identified
f) Establishing the potential (positive or negative) consequences that may be considered significant

The significance of an impact has been established based on some criteria such as:

- Extent and size
- Short-term or long-term effect

- Reversibility or irreversibility
- Performance as compared to the environmental quality standards
- Receptor's sensitivity
- Compatibility with the environmental policies

The transboundary impact has been assessed by considering the two methods for Danube and Jiu crossing , namely:
- crossing by open cut method;
- crossing by trenchless method.

In order to assess the impact on the environmental factors and local communities the matrix in table 5.1 below was used both during the work execution and during the gas pipeline operation.

Table 5.1.: Matrix for assessing the impact on the environmental factors and local communities

	Receptors						Occurrence probability				
							A	B	C	D	E
Impact severity	AIR	WATER	SOIL	FLORA AND FAUNA	RESOURCES	POPULATION	Unexpected, but predictable	Rare	Possible	Expected	Expected and repeatable
0	No effect										
1	Very low effect										
2	Low										
3	Average										
4	High										
5	Very high										

The criteria used for the interpretation of the potential impact on the environmental features are shown in appendix 10.

The correct interpretation of impact significance is the most important part of the entire process. The impact significance was assessed at the level of each natural protected area of community interest, by considering the conservation status of the species and habitats at the level of the biogeographical region, starting from the reference data in the standard forms of N2000 sites (according to the national legislation in both countries).

5.2. SCREENING OF POTENTIAL TRANSBOUNDARY IMPACTS

5.2.1. General consideration

The following has been considered when assessing the transboundary impacts:
- Position of the boundary between Romania and Republic of Bulgaria : middle of the Danube river
- Methods for undercrossing of Ogosta River, Danube River and Jiu River:
  - Ogosta river by trenchless method
  - For Danube River and Jiu River , two methods have been taken into consideration: open cut method and trenchless method
- Loss of excavated material in the case of the Danube crossing by open cut

- Existing sites Natura 2000 and proposals on the designation of new sites Natura 2000:

  - Bulgarian bank: „Ogosta river" (BG0000614)

    An appropriate assessment study, appendix to BBEIA Report has been elaborated for „Ogosta river" (BG0000614). An extract from this study is presented in appendix

  - Romanian bank: ROSCI0045 Jiu Corridor and ROSPA0023 Jiu-Danube Confluence- Results of Appropriate Assessment for sites Natura 2000: Ogosta River, Jiu Corridor and Danube- Jiu Confluence.

    Appropriate assessment studies, appendix to ROEIA Report have been elaborated for both Natura 2000 sites.

- Sources of pollution
- Waste type generated and associated impact, including their management mode
- Provisions of the urban planning of the settlements crossed by the gas pipeline
- Other ongoing projects of the county or local councils
- Alternative routes.

The results of the screening show the following:

a. the open-cut method is shown in table 5.2.1 below
b. HDD method is shown in table 5.2.2 below.

Table 5.2.1 : Screening of potential transboundary impacts if the open-cut method is used

Position of the boundary between Romania and Republic of Bulgaria	The environment likely to be affected in the border area is represented by the aquatic ecosystem of the Danube river and its banks. In the crossing zones, the Danube River is about 1200 m wide at the average water level (map in figure 2.8.and figure 2.9 above). The state border between Romania and Bulgaria follows the course of the Danube river. **During construction:** The Ogosta River shall be crossed at kp 421+330, namely about 1.7 km far from the border line, by trenchless method. The air pollution and noise generated by the equipment operation and by the construction site-related traffic will not be felt on the territory of Romania. No impact on the fish species common to the Danube River and to Ogosta river, and no silt transport in the Danube river in the work period. Crossing shall be performed outside the cold season, therefore no glycol should be used as additive for the bentonite used in the preparation of the drilling fluid. The Jiu River shall be crossed at kp10+500, therefore 11 km far from the border, without a transboundary impact on air on the territory of the Republic of Bulgaria or without a noise pollution. The open cut crossing may have a significant impact on the common fish species in the Danube River and in the Jiu River. As regards the Danube river, the open cut method involves excavation works onshore and in the minor riverbed. As for air and noise, the effects hereinafter shown may occur from Bulgaria to Romania, as well as from Romania to Bulgaria, considering the location of the border line in the case of certain weather conditions. The boundary of the air pollution impact zone due to transports during construction works is 50 m (see BGEIA and ROEIA). . The bank protection works may result in the increase in water turbidity in the offshore/onshore interface zone. The impact is considered insignificant. The works impact is hereinafter analyzed in chap.5.3. Decomissioning after construction When completing the works, the onshore land taken by the construction camp shall be reinstated to its original use. Given the nature of the works and the distance from the border, no transboundary impact is expected as a result of these works.
Methods for undercrossing of Ogosta River, Danube River and Jiu River	Scenario 1: - All the three streams are crossed by the trenchless method. No transboundary impact will be recorded. Scenario 2: - If the Danube River and Jiu river are crossed by open cut, the potential transboundary impact is analyzed in chap. 5.3.below.
Existing sites Natura 2000 and proposals on the designation of new sites Natura 2000.	**Right bank** The entire lower course of Ogosta river and the bank of the Danube river at the gas pipeline crossing point fall within the protected site „Ogosta river" (BG0000614) according to the Habitats Directive (appendix 6) There are no proposals for new sites Natura 2000.

	Left bank The bank of Danube river and Jiu River at the gas pipeline crossing point fall within the protected sites **ROSCI0045 Jiu Corridor and ROSPA0023 Jiu-Danube Confluence** according to the Habitats Directive (appendix 9) There are no proposals for new sites Natura 2000
Results of Approppriate Assessment for sites Natura 2000: Ogosta River, Jiu Corridor and Danube- Jiu Confluence.	Results of the Appropriate Assessment are presented in ROEIA and BGEIA
Sources of pollution	**1. In the case of the Danube river crossing by open-cut** For the **Bulgarian bank**, we mention the following: - the construction camps where the personnel working on the construction site and not residing in the work area is accommodated, are not located in Natura 2000 sites„Ogosta river" (BG0000614) - the pipe needed to cross the Danube shall be mounted on the Romanian bank. - a mobile construction camp for offices equipped with ecological toilets will be located in the works area. When the works are completed, it shall be decommissioned. - the equipment will be fuelled at the work point by the tank car. The sources of pollution are the following: - Air pollution and noise as a result of the traffic and operation of the equipment, including dredging equipment. - Water and soil pollution (discharge of untreated wastewater (domestic water) and waste in the case of non-routine event) - Light and electro-magnetic radiation**:** felt only in the work zone - Noise as result of handling the pipe sections for installation **For the Romanian bank**, we mention the following: - the construction camps where the personnel working on the construction site and not residing in the work area is accommodated, are not located in Natura 2000 sites. The construction site on the route in the area of ROSPA0023 Jiu-Danube Confluence and ROSCI0045 Jiu Corridor is served by the construction camp located at kp 51, 735 m far from the boundary of ROSCI0045 Jiu Corridor and 2475 m far from ROSPA0023 Jiu-Danube Confluence. - the pipe dump located at kp 19 in Gângiova village Dj lies 3625 m far from ROSPA0023 Jiu-Danube Confluence and ROSCI0045 Jiu Corridor. - a mobile construction camp for offices equipped with ecological toilets will be located in the works area. This camp will be moved once with the construction site relocation. - the fuel will be stored in the construction camp at kp 51. The equipment will be fuelled at the work point by the tank car. The following are not located in ROSPA0023 Jiu –Danube Confluence: - Block valve stations and off-take stations

	- Concrete mixing plants The details regarding sources of pollution are presented in table 5.3.1 below The sources of pollution are the following: - Air pollution and noise as result of the traffic and operation of the equipment, including dredging equipment. - Water and soil pollution (discharge of untreated wastewater (domestic water) and waste in the case of non-routine event) - Light and electro-magnetic radiation**:** felt only in the work zone - Noise as result of handling the pipe sections for installation The material resulting from dredging in the open cut option is temporarily stored on the Romanian bank to drain water, and then transported on the existing roads outside the Natura 2000 sites. Dredged material has a volume of 360.000 m^3. Earth will be reused to fill the trench in which the concreted pipe has been installed. When completing the works the area affected will be reinstated to its original condition. Details on sources of pollution for both banks are presented in chap 5.3.1 below **Conclusion** : No transboundary impact is generated by the construction camp, pipe dumps and concrete mixing plants.
Waste type generated and associated impact	The installation works for Nabucco pipeline generate both hazardous and non-hazardous waste. These waste materials may have a transboundary impact if they reach the Danube river. Details concerning waste type generated, the impact and their management are presented in subchap. 5.2.2 below. No transboundary impact will occur as a result of the implementation of the measures included in the Waste Management Plan.
Provisions of the urban planning of the settlements crossed by the gas pipeline	As seen in figure 4.3 above, as well as in the urban planning made available to the designers by the authorities in the two countries, no build-up area of any settlement is crossed in the border zone.
Other ongoing projects of the county or local councils (cumulative impact)	- The wind farm is located in the area of influence (see figure 5.2.1 below) - Setting up a dump for radioactive waste with low or medium activity in the area known as "Radiana" in Bulgaria. The location is four kilometres far from the Danube bank. - Project :"Improving the navigation conditions on the Romanian-Bulgarian joint sector of the Danube river and related studies", reference EUROPEAID/122137/D/SV/RO, These projects will be considered in the cumulative impact assessment.
Alternative routes	These aspects have been approached in chap. 3. Only the alternatives on the crossing technique will be considered in the transboundary impact assessment, as the selection of the Danube crossing point has been established as a result of the analysis of various route alternatives on the Bulgarian and Romanian territory.
Nabucco gas pipeline operation	1. **The case of routine operation** Under normal operation conditions, no transboundary impact is recorded, as the pipeline is buried to a depth below the thalweg considering the erosion coefficient and the risk of pipeline deterioration in the navigable channel if a very heavy load is discharged. As a result of the calculations performed to determine the pipeline installation depth, the area of the navigable channel is less likely to be affected by erosion phenomena or shipwreck.

	2. The case of non-routine event In the case of a terrorist attack (the occurrence likelihood is almost zero), the pipeline may be affected in its integrity in the Danube crossing zone. In this case, the gas access will be closed on the damaged section by the block valves located on the Bulgarian and Romanian territories. The gas existing on the pipeline sector will be released. 3.The corrosion
Decommissioning at the end of the project	Decomissioning at the end of the project **When completing the operation,** a decision will be made on whether the pipeline will be abandoned in ground or removed from the ground. In the case of abandonment, no impact on the Danube riverbed or aquatic ecosystem is recorded after taking some protection measures, namely after completely emptying the pipeline. If it is decided to remove NGPL from the ground, the impact is similar to the one during the pipeline installation.

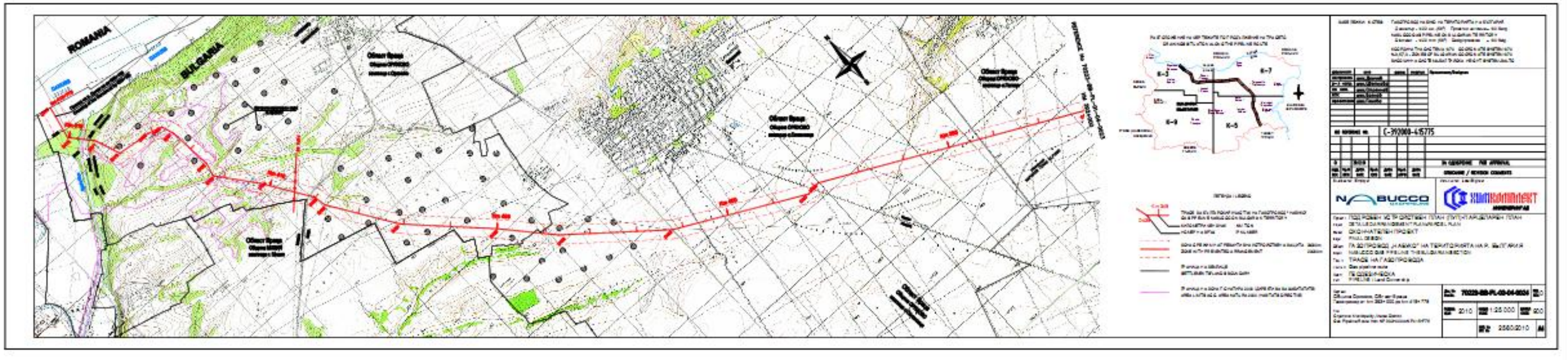


Figure 5.2.1:The position of the wind farm in the area of influence

The screening of potential transboundary impacts in the case of the Danube river crossing using HDD method is shown in table 5.2.2 below

Table 5.2.2 : Screening of potential transboundary impacts in the case of trenchless method

Position of the boundary between Romania and Republic of Bulgaria	During construction The use of the trenchless method for the Danube River and Jiu River generates no transboundary impact, including no impact on the fish species common to the two watercourses. The air pollution and noise generated by the equipment operation and by the construction site-related traffic will not be felt on the territory of Romania, respectively on the territory of Bulgaria, considering the distance to the border. The Ogosta River shall be crossed at kp 411+200, namely about 1.7 km far from the border line, by trenchless method. The air pollution and noise generated by the equipment operation and by the construction site-related traffic will not be felt on the territory of Romania. No impact on the fish species common to the Danube River and to Ogosta river, and no additional silt transport in Danube river in the work period will occur. The Jiu River shall be crossed at kp10+500, therefore 11 km far from the border, without a transboundary impact on air on the territory of the Republic of Bulgaria or without a noise pollution.
Methods for undercrossing of Ogosta River, Danube River and Jiu River	Scenario 1.: - All the three streams are crossed by the trenchless method. No transboundary impact will be recorded.
Existing sites Natura 2000 and proposals on the designation of new sites Natura 2000.	**See table 5.2.1 above**
Results of Appropriate Assessment for sites Natura 2000: Ogosta River, Jiu Corridor and Danube- Jiu Confluence.	See table 5.2.1 above
Sources of pollution	The work execution triggers the following pollution sources: - air pollution as a result of the noxious emissions (see table 5.2.1 above) - air pollution as a result of the dust emissions associated with the execution of the excavation pits for the location of the drilling rig, - accidental pollution in the case of non-routine event (see table from chap. 5.2.2 below) Light and electro-magnetic radiation**:** felt only in the work zone In the case of the Danube river crossing: - No dredged soil is stored on the Bulgarian bank, only soil from the bank excavation and vegetal soil, for the open cut method. Two soil stockpiles (vegetal soil and earth resulting from drilling) are stored on the Bulgarian bank in HDD method. This soil resulting from drilling will be carried to areas determined by the Bulgarian local authorities, and is not

	contaminated. - a working strip for pulling the pipe which will be placed on roller supports must be created for the HDD method on the Romanian bank. The working strip allocated outside the areas will be 20 m wide and 1200 m long. The details regarding the sources of pollution are shown in chap.5.2.2 . below. The construction camp, pipe dumps and concrete mixing plants generate no transboundary impact.
Waste type generated and associated impact	The installation works for Nabucco pipeline generate both hazardous and non-hazardous waste. These waste materials may have a transboundary impact if they reach the Danube river. Details concerning the waste types generated, the impact and their management are presented in subchap. 5.2.2 below.
Provisions of the urban planning of the settlements crossed by the gas pipeline	See table 5.2.1 above
Other ongoing projects of the county or local councils	See table 5.2.1 above
Alternative routes	See table 5.2.1 above
Nabucco gas pipeline operation	See table 5.2.1 above In the area of the navigable channel, the pipeline is located at quite a big depth not to be affected by erosion processes or by a shipwreck.
Decommissioning at the end of project	See table 5.2.1 above

Table 5.2.2 above shows that if the trenchless method is used, no transboundary impact will occur.

5.2.2. SOURCES OF POLLUTION

5.2.2.1. Sources of pollution in the case of the open-cut method

Considering those shown in table 5.2.1 and table 5.2.2 above and the fact that appropriate assessment studies have been prepared for the Natura 2000 sites crossed by Nabucco pipeline, the tables below shows the following:

- table 5.2.3 - the pollution sources of the environmental features in the Danube River, including banks area in the case of open-cut method and routine conditions
- table 5.2.4 - the pollution sources of the environmental features in the Danube River, including banks area in the case of open-cut method and non-routine conditions .
- table 5.2.5 - the pollution sources of the environmental features in the Danube River, including banks area in the case of trenchless method and routine condition
- table 5.2.6 - the pollution sources of the environmental features in the Danube River, including banks area in the case of trenchless method and non-routine event .

Table 5.2.3. : Pollution sources of the environmental features in the Danube River including banks area,in the case of open-cut method and routine condition

Activity	**Source of pollution**
During construction phase	
Surface and groundwater	
Ship transport of linepipes, valves and other materials	Irrespective of the crossing method adopted, the ship transport of linepipes, valves and other materials is a pollution source for the Danube river water. Transport can be done by motor ships, barge trains pushed by push boats or lighters towed by tow boats. The pollution sources related to motor ships, push boats and tow boats are: - **Bilge water from the engine room** Bilge water is actually a mix of water and fuel and oil residues generated by ship's operation and collected on board. The quantity of bilge water produced by a ship depends on ship's capacity, the engines' type, ship's operational life and the interval between two disposals in port. - **Waste water from the ship** Such water is stored on board and is then collected by specialised technical vessels belonging to the destination port. - **Solid waste produced on board** The structure of these wastes meets their origin. They are produced by the activity of the crew on board and by the ship maintenance and operation activities. Waste produced on board consists of: cooking and household waste, plastic, paper, cardboard, rags, glass and metal objects, food scraps, packaging of any kind, pieces of ropes, plastic bags, cardboard or metal boxes, scrap materials used in ship operation. To prevent water pollution, domestic and international law prohibits and punishes throwing overboard of waste produced by crew's activity and ship's operation. Both during navigation and while the ship is in port or harbour, it is mandatory to collect waste and deliver it to the port services charged with collecting, storing, transporting and treating it. These port services should facilitate the delivery of waste, upon request, without excessive delays. For sanitary reasons, the waste collected from ships is considered infested, so that the collection, transport and treatment of such waste are governed by special rules. As the Danube river is a navigable watercourse with a regime regulated by the Convention on navigation on the Danube, the impact generated by the transport of materials needed for Nabucco project does not belong to the transboundary impact category.
Performance of geotechnical and topographical surveys	Execution of boreholes near water courses at depths greater than 5 m can cause water pollution

Activity	**Source of pollution**
Work sites, including undercrossing of watercourses	The category of **point sources** includes *the discharges of faeces* **Undercrossing watercourses by open trench:** - Increased water turbidity, followed by dislodging of possible pollutants from the riverbed - Storage of dredged material, as well as of the excavated material
Air	
Ship transport of linepipes, valves and other materials	Irrespective of the crossing method adopted, the ship transport of linepipes, valves and other materials is a pollution source for the air. Transport can be done by motor ships, barge trains pushed by push boats or lighters towed by tow boats. Among the power compartments of a ship, the engine room is the main source generating toxic gases, which are present in a wide range, from primary substances (gases and solids), to secondary substances that can form photochemical and humid smog. Noxious emissions of an engine are generated by two causes: - fuel supply and burning; - Imperfections in the seal of the cylinder and the fuel tank . The literature identifies three basic systems for naval heat engines: - Engine exhaust - Crankcase lubrication and ventilation - Fuel supply as potential sources of pollution by toxic gases and hydrocarbons (simple and complex, as well as polycyclic aromatic, PAC) From literature data, emissions from operation of a push boat or tow boat could be quantitatively estimated, namely:

Compound	***Calculation formula***	***Result (kg/hour)***
NO_x	$17.5 \times 10^{-3} \times P \times N$	1.64
CO	$0.68 \times 10^{-3} \times P^{1,08} \times N$	0.063
HC	$0.28 \times 10^{-3} \times P \times N$	0.026
SO_2	Not applicable for engines with P<2000 kWh	-

<table>
<tr><th>Activity</th><th>Source of pollution</th></tr>
<tr><td>Performance of geotechnical and topographical surveys</td><td>Operation of equipment and transport vehicles</td></tr>
<tr><td>Work site</td><td>
Works’ execution involves a series of operations that can be stationary or mobile sources of emissions of air pollutants, namely:
- ground movement (land clearing, soil excavation, filling) and handling of aggregates. Sources related to handling and storage of aggregates are low sources, located on the ground or near ground level, open and specific. Sources associated to aggregates storage are open surface sources, close to the ground.
- traffic related to material and staff transportation
- emissions due to equipment operation, such as bulldozers, excavators and tip lorries. Emissions consist of combustion gases and air-floated and particulate matter, as follows:
<table>
<tr><th>Equipment</th><th>Source characteris-tics</th><th>Pollutant</th><th>Weight rate [g/h]</th><th>Emission time [hours/ day]</th><th>Emission concentra-tion [mg/mc]</th></tr>
<tr><td rowspan="3">Excavator</td><td rowspan="3">Diesel oil</td><td>NOx</td><td>18.4</td><td rowspan="3">4-7</td><td>108</td></tr>
<tr><td>SO_2</td><td>4</td><td>24</td></tr>
<tr><td>Soot</td><td>4.76</td><td>28</td></tr>
<tr><td rowspan="3">Tip lorry</td><td rowspan="3">Diesel oil</td><td>NOx</td><td>16.5</td><td rowspan="3">4-7</td><td>90</td></tr>
<tr><td>SO_2</td><td>4</td><td>22</td></tr>
<tr><td>Soot</td><td>5.9</td><td>3</td></tr>
<tr><td>Bulldozer</td><td></td><td>Powder</td><td>-</td><td>7</td><td>8.6</td></tr>
<tr><td colspan="6">The following will be used for the Danube crossing works:
- a sea dredger for trenching up to about 2 m far from the bank
- 2 draglines for the bank- water zone
- 2 excavators for the onshore area
The theoretical mass flow rate of polluting substances generated into the atmosphere at the simultaneous operation of 2 draglines, one sea dredger and 2 excavators (all equipment has Diesel motor) is the following:</td></tr>
</table>
</td></tr>
</table>

Polluting substance	Mass flow rate	
	(g/h)	(g/s)
NO_x	63900	17.75
N_2O	81	0.0225
CO	8834	2.454
NMVOC	3610	1.003
CH_4	42.76	0.01188
NH_3	1.72	0.00048
SO_x	1296	0.36
TSP	1350	0.375
PM_{10}	1350	0.375
$PM_{2,5}$	1350	0.375
Pb	0.08	0.22×10^{-4}
Cd	0.006	0.17×10^{-5}
Hg	0.01	0.28×10^{-5}
As	0.02	0.56×10^{-5}
Cr	0.03	0.39×10^{-5}
Cu	0.58	0.162×10^{-3}
Ni	0.66	0.19×10^{-3}
Se	0.06	0.167×10^{-4}
Zn	0.79	0.23×10^{-3}

The estimation of the atmospheric pollutant emissions was established on the basis of the emission factors included in documentation *EMEP – EEA pollutant emission inventory guidebook 2009 and the calculation methodology of the air pollutant emissions making use of the Guidebook of the European Environmental Agency – EMEP/CORINAIR Atmospheric Emission Inventory Guidebook, as well as the Guidebook EPA Air Chief).*

Emission levels are the greatest for mechanical and hydraulic dredges, so dredging will have the greatest negative impact on air quality. In general, a considerable reduction of the emissions during the construction phase can be achieved by utilization of off-road engines, which are in compliance with the requirements of DIRECTIVE 2002/88/EC3[8]

[8] DIRECTIVE 2002/88/EC amending DIRECTIVE 97/68 - relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery.

Activity	Source of pollution
Work related traffic	Pollutants specific to road traffic are: -tropospheric ozone precursors: carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (COVnm) - greenhouse-gas emissions: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O); - gases that contribute to the acidification of the atmosphere: sulphur dioxide (SO_2) and ammonia (NH_3); - particulate matter (PM) resulted in exhaust gas (mainly particles with equivalent aerodynamic diameter less than 2.5 µm – $PM_{2,5}$, the fraction PM_{10} – $PM_{2,5}$ being negligible) as a result of burning fuel, and particles from brake, tire and road wear driven into the air by the traffic-generated turbulence; - carcinogens (polycyclic aromatic hydrocarbons - PAH and persistent organic pollutants - POPs - toxic substances (dioxins and furans) - heavy metals (Pb, Cd, Cu, Cr, Ni, Se, Zn) contained in the particles released in exhaust gases The details on concentration are shown in EIA.
Soil, subsoil, phreatic water	
Performance of geotechnical and topographical surveys	Temporary storage of the soil removed from the borehole.
Work site	- Temporary storage of the soil removed from the open cut - Potential of erosion of the bank
Fauna – noise and vibration sources	
	The main noise sources during construction are as follows: Operation of road vehicles for the transport of pipes, other materials, including the excavated soil, as well as of the personnel; Operation of the construction equipment for: • Repairing the existing roads used as technological roads and the execution of new access roads; • Preparing the work corridor, trench excavation, handling the pipeline section in the trench area, filling the pipeline trench, trench filling, land ploughing and discing when completing the works.

Work site	• Handling of pipes in the pipe storage yard at unloading- piling- loading. • Assembling and pulling the pipeline - Operation of the electric generators, - Activation of safety alarms of the heavy equipment Noise generated by the equipment used for earthworks and foundations - excavator digging; - levelling and transport by motor grader and bulldozer; - loading by front end loader; - earth compacting by roller compactors. • Processing materials for placement on site: Concrete - mixing; - transport and pumping; - vibration; Asphalt mixtures: - drying, transport, screening; - mixing and storage; Ballast pit and quarry mineral aggregates: - transport; - crushing; - vibration screening; - separation of fines. • Road works: - hammer drills; - road milling machines; - mixture spreaders; - vibrating roller compactors. During the works, noise will be produced by construction equipment used for this purpose. The sound powers associated to some construction equipment are presented below: - bulldozers – L_w = 115 dB(A) - Wolla loaders - L_w = 112 dB(A) - excavators - L_w = 117 dB(A) - scrapers - L_w = 110 dB(A) - compactors - L_w = 105 dB(A) - top lorries - L_w = 107 dB(A) excavator – 80 - 91 dBA, - crane – 92 - 98 dBA,

	- front loader - 80 dBA, - hydraulic dredger - 76 dBA, - heavy truck – 80 - 92 dBA, - barge - 57 dBA The literature shows that in the open field, where sound is not reflected by obstacles, the sound level drops by 6 dB at double the distance from the source. The resulting sound levels are: - tyred hydraulic excavator – L_{Aeq} = 53 dB(A) - caterpillar hydraulic excavator < 100 kW - L_{Aeq} = 58 dB(A) - truck - L_{Aeq} = 43 dB(A) - loader - L_{Aeq} = 55 dB(A) - bulldozer - L_{Aeq} = 66 dB(A) - hydraulic dredger - 76 dBA - According to Order no. 558/2008[9], the allowable value of the equivalent noise level to the limit of functional areas in urban environment and the limit of industrial premises is: • L_{ech} = 65 dB(A) In the vicinity of the working machinery, for a certain period of time, noise with an equivalent level of approx. 90 dBA could be expected. The hygienic norm of 55 dBA for residential areas is reached at a distance of about 200m from the construction activities in case of unimpeded incidence. Temporary sites for reloading of construction materials (appr. 200 m^2) are to be set up in the vicinity of the construction sites. The anticipated equivalent noise level is about 75 dBA.
Work related traffic	Depending on load, speed and technical condition, heavy vehicles generate sound pressure levels of 85-90 dB (A) at the roadside and, depending on the land structure in the area and the type of buildings, important vibration thereof. Considering the legal provisions, the movement speed of the heavy vehicles via settlements cannot exceed 30 km/h, which reduces the sound pressure levels
All environmental characteristics	

[9] Order No 152/2008 of the Minister of Environment and Sustainable Development, Order No.558/2008 of the Minister of Transport, Order No.1.119 / 2008 of the Minister of Public Health and Order no. 532/2008 of the Minister of Interior and Administration Reform for approving the Guidelines for the adoption of limit values and how to apply them when developing action plans, for indicators Ldan and Lnight for noise generated by road traffic on major roads and in urban areas, rail traffic on major railways and in urban areas, air traffic at large and / or urban airports and for noise generated in certain urban areas where industrial activity is developed as provided in Appendix. 1 to the Government Emergency Ordinance no. 152-2005 concerning integrated pollution prevention and control, approved with amendments and completions by Law no. 84/2006- Official Journal 531/15.07.2008.

Operation period of the natural gas pipeline and related stations	Under normal operation, the gas pipeline does not generate air , water and soil pollution or noise and vibration

Table 5.2.4..: Accidental pollution sources of the environmental features in the Danube River including banks area, in the case of open-cut method and in the case of a non-routine event

Activity	**Source of pollution**
During construction stage	
Surface and groundwater	
Ship transport of linepipes, valves and other materials	Irrespective of the crossing method adopted, the ship transport of linepipes, valves and other materials is a pollution source for the Danube river water (See table 5.2.3. above). The non-compliance with the regulations on the navigation on the Danube may result in the river water pollution. This aspect refers to: - Deliberate discharge of bilge water and on-board waste into the Danube - Shipwreck of a ship carrying materials needed for the works, resulting in water pollution by hydrocarbons
Performance of geotechnical and topographical surveys	Execution of boreholes near water courses at depths greater than 5 m can cause water pollution
Work sites, including undercrossing of watercourses	**On work sites, diffuse sources** of pollution consist of**:** - *Accidental pollution by hydrocarbons* due to the lack of equipment maintenance. The presence of the excavator and other equipment are a potential source of pollutants, especially residues of petroleum products (diesel, oil, etc..). This source is activated only if the equipment is in imperfect technical condition or is improperly operated - *Accidental pollution* due to *improper handling of chemicals and hazardous substances;* - *Accidental pollution* due to *improper handling of fuel when refuelling the equipment;* - *Accidental pollution* due to *uncontrolled waste storage* **In addition to these pollution sources, when undercrossing watercourses, there should also be mentioned:** - dislodging of possible pollutants from the riverbed - pipeline concreting takes place in the major riverbed. The concrete forms must be lubricated.

Activity	**Source of pollution**
	Spills of grease may occur onto soil.
Pipe cleaning and testing	- *Accidental pollution by* waters from pipeline cleaning and hydraulic-pressure tests, by water insufficiently treated before disposal or accidentally disposed onto the ground.
Air	
Performance of geotechnical and topographical surveys	Bad maintenance of equipment and transport vehicles
Work site	**Works' execution** involves a series of operations that can be stationary or mobile sources of emissions of air pollutants (see table 5.2.3 above), An increase in the emissions to atmosphere takes place if the equipment is inappropriately maintained from the technical point of view.
Work related traffic	The lack of regular technical revisions may result in an increase in the air pollution
Operation period of the natural gas pipeline and related stations	Operating losses arise from: - Possible leakage of gas through macro-fissures and perforations (both on transport route and on the pipelines of the compressing, metering and delivery stations) - that can be easily detected visually; - Possible leakage of gas through macro-fissures and perforations at the transport pipelines - which can only be noticed through detection; - Unsealing of flanged or threaded joints of equipment at the gas transmission networks and installations (valves, separators, filters, etc..) joint - Unsealing of purge valve locks; - Unsealing of packing gland and other seals; - Unsealing of the pulse tubes of the measurement and control apparatus and automation systems; - Unsealing of packing gland at the reversing rods of networks' underground valves. Interventions on transport pipelines are performed after controlled release of gas from the pipe section that is damaged or under revision. Methane, having a lower density than air, rises into the upper layers of the atmosphere, where it interacts especially with ozone, which is a chemically active oxidant.

Activity	**Source of pollution**
Soil, subsoil, groundwater	
Work site	- *Accidental pollution by hydrocarbons* due to the lack of equipment maintenance. The presence of the excavator and other equipment are a potential source of pollutants, especially residues of petroleum products (diesel, oil, etc.). This source is activated only if the equipment is in imperfect technical condition or is improperly operated - *Accidental pollution* due to *improper handling of chemicals and hazardous substances;* - *Accidental pollution* due to *improper handling of fuel when refuelling the equipment;* - *Accidental pollution* due to *uncontrolled waste storage* - Disposal of untreated domestic wastewater from the personnel working on the construction site - *Storage of dredged material (on the Romanian bank), as well as of the excavated material* -
Pipe cleaning and testing	- *Accidental pollution by* waters from pipe cleaning and hydraulic-pressure tests, by water insufficiently treated before disposal or accidentally disposed onto the ground. The hydrostatic test shall be performed on the Romanian bank.
Operation period of the natural gas pipeline and related stations	In case of intervention to the gas pipelines, part of the diffuse sources specified in the Chapter on site management can be activated, namely: - *Accidental pollution by hydrocarbons* due to the lack of equipment maintenance or *improper handling of fuel when refuelling the equipment;* - *Accidental pollution* due to *uncontrolled waste storage*
Fauna – noise and vibration sources	
Work site	Noise and vibration are stronger if the equipment is inappropriately maintained from the technical point of view.
Work related traffic	The non-compliance with the legal provisions on the vehicle speed when crossing settlements may generate sound pressure levels of 85-90 dB (A) at the roadside and, depending on the land structure in the area and the type of buildings, important vibration thereof
Operation period of the natural gas pipeline and related stations	In the case of a terrorist attack (the occurrence likelihood is almost zero), the pipeline may be affected in its integrity in the Danube crossing zone. In this case, the gas access will be closed on the damaged section by the block valves located on the Bulgarian and Romanian territories. The gas existing on the pipeline sector will be released.

Table 5.2.5. : Pollution sources of the environmental features in the Danube River including banks area, in the case of trenchless method and routine condition

Activity	**Source of pollution**
During construction phase	
Surface and groundwater	
Ship transport of linepipes, valves and other materials	Irrespective of the crossing method adopted, the ship transport of linepipes, valves and other materials is a pollution source for the Danube river water – see table 5.2.3 above.
Performance of geotechnical and topographical surveys	Execution of boreholes near water courses at depths greater than 5 m can cause water pollution
Work sites, including undercrossing of watercourses	The category of **point sources** includes *the discharges of faeces* **Undercrossing watercourses by trenchless method:** - Storage of dredged material, as well as of the excavated material
Air	
Ship transport of linepipes, valves and other materials	Irrespective of the crossing method adopted, the ship transport of linepipes, valves and other materials is a pollution source for the air. Transport can be done by motor ships, barge trains pushed by push boats or lighters towed by tow boats – see table 5.2.3. above
Performance of geotechnical and topographical surveys	Operation of equipment and transport vehicles
Work site	**Works' execution** involves a series of operations that can be stationary or mobile sources of emissions of air pollutants, namely: - *ground movement* (land clearing, soil excavation, filling) and handling of aggregates. Sources related to handling and storage of aggregates are low sources, located on the ground or near ground level, open and specific. Sources associated to aggregates storage are open surface sources, close to the

Activity	**Source of pollution**
	ground. - *traffic related to material and staff transportation* - *emissions* due to equipment operation, such as bulldozers, excavators and tip lorries. All activities on the Romanian bank will be performed behind the protection dike. No transboundary impact will be recorded, given the presence of the dike and the distance to the border (more than 2km) The activities on the Bulgarian bank will be performed about 1 km far from the border. Air pollution as a result of the drilling rig operation will generate no transboundary impact.
Work related traffic	Pollutants specific to road traffic are: -tropospheric ozone precursors: carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (COVnm) - greenhouse-gas emissions: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O); - gases that contribute to the acidification of the atmosphere: sulphur dioxide (SO_2) and ammonia (NH_3); - particulate matter (PM) resulted in exhaust gas (mainly particles with equivalent aerodynamic diameter less than 2.5 µm – $PM_{2,5}$, the fraction PM_{10} – $PM_{2,5}$ being negligible) as a result of burning fuel, and particles from brake, tire and road wear driven into the air by the traffic-generated turbulence; - carcinogens (polycyclic aromatic hydrocarbons - PAH and persistent organic pollutants - POPs - toxic substances (dioxins and furans) - heavy metals (Pb, Cd, Cu, Cr, Ni, Se, Zn) contained in the particles released in exhaust gases The details on concentration are shown in the national EIA. No transboundary impact is anticipated.
Soil, subsoil, groundwater	
Performance of geotechnical and topographical surveys	Temporary storage of the soil removed from the borehole.
Work site	- Temporary storage of the bentonite, cement and mud
Fauna – noise and vibration sources	
	The main noise sources during construction are as follows: Operation of road vehicles for the transport of pipes, other materials, including the excavated soil, as

Activity	**Source of pollution**
Work site	well as of the personnel – see table 5.2.6 above. Operation of the construction equipment for: • Repairing the existing roads used as technological roads and the execution of new access roads; • Handling of pipes in the pipe storage yard at unloading- piling- loading. • Operation of drilling installation, assembling and pulling the pipeline - Operation of the electric generators, - Activation of safety alarms of the heavy equipment Noise generated by the equipment used for earthworks and foundations – see table 5.2.3 above
Work related traffic	Depending on load, speed and technical condition, heavy vehicles generate sound pressure levels of 85-90 dB (A) at the roadside and, depending on the land structure in the area and the type of buildings, important vibration thereof. Considering the legal provisions, the movement speed of heavy vehicles via settlements cannot exceed 30 km/h, which reduces the sound pressure levels.
All environmental characteristics	
Operation period of the natural gas pipeline and related stations	Under normal operation, the gas pipeline does not generate air , water and soil pollution or noise and vibration

Table 5.2.6. : Pollution sources of the environmental features in the Danube River including banks area, in the case of trenchless method and non-routine event

Activity	**Source of pollution**
During construction stage	
Surface and groundwater	
Ship transport of linepipes, valves and other materials	Irrespective of the crossing method adopted, the ship transport of linepipes, valves and other materials is a pollution source for the Danube river water (See table 5.2.3. above). The non-compliance with the regulations on the navigation on the Danube may result in the river water pollution. This aspect refers to: - Deliberate discharge of bilge water and on-board waste into the Danube - Shipwreck of a ship carrying materials needed for the works, resulting in water pollution by hydrocarbons
Performance of geotechnical and topographical surveys	Execution of boreholes near water courses at depths greater than 5 m can cause water pollution
Work sites, including undercrossing of watercourses	**On work sites, diffuse sources** of pollution consist of**:** - *Accidental pollution by hydrocarbons* due to the lack of equipment maintenance. The presence of the excavator and other equipment are a potential source of pollutants, especially residues of petroleum products (diesel, oil, etc.). This source is activated only if the equipment is in imperfect technical condition or is improperly operated - *Accidental pollution* due to *improper handling of chemicals and hazardous substances;* - *Accidental pollution* due to *improper handling of fuel when refuelling the equipment;* - *Accidental pollution* due to *uncontrolled waste storage*
Pipe cleaning and testing	- *Accidental pollution by* waters from pipeline cleaning and hydraulic-pressure tests, by water insufficiently treated before disposal or accidentally disposed onto the ground.
Air	

Activity	**Source of pollution**
Performance of geotechnical and topographical surveys	Bad maintenance of equipment and transport vehicles
Work site	**Works' execution** involves a series of operations that can be stationary or mobile sources of emissions of air pollutants (see table 5.2.3 above), An increase in the emissions to atmosphere takes place if the equipment is inappropriately maintained from the technical point of view.
Work related traffic	The lack of regular technical revisions may result in an increase in the air pollution
Operation period of the natural gas pipeline and related stations	Operating losses arise from: - Possible leakage of gas through macro-fissures and perforations (both on transport route and on the pipelines of the compressing, metering and delivery stations) - that can be easily detected visually; - Possible leakage of gas through macro-fissures and perforations at the transport pipelines - which can only be noticed through detection; - Unsealing of flanged or threaded joints of equipment at the gas transmission networks and installations (valves, separators, filters, etc..) joint - Unsealing of purge valve locks; - Unsealing of packing gland and other seals; - Unsealing of the pulse tubes of the measurement and control apparatus and automation systems; - Unsealing of packing gland at the reversing rods of networks' underground valves. Interventions on transport pipelines are performed after controlled release of gas from the pipe section that is damaged or under revision. Methane, having a lower density than air, rises into the upper layers of the atmosphere, where it interacts especially with ozone, which is a chemically active oxidant.
Soil, subsoil, phreatic water	
Work site	- *Accidental pollution by hydrocarbons* due to the lack of equipment maintenance. The presence of the excavator and other equipment are a potential source of pollutants, especially residues of petroleum products (diesel, oil, etc..). This source is activated only if the equipment is in imperfect technical condition or is improperly operated

Activity	**Source of pollution**
	- *Accidental pollution* due to *improper handling of chemicals and hazardous substances;* - *Accidental pollution* due to *improper handling of fuel when refuelling the equipment;* - *Accidental pollution* due to *uncontrolled waste storage* - Disposal of untreated domestic wastewater from the personnel working on the construction site - *Storage of drilling mud (on the Bulgarian bank), as well as of the bentonite, cement.* -
Pipe cleaning and testing	- *Accidental pollution by* waters from pipe cleaning and hydraulic-pressure tests, by water insufficiently treated before disposal or accidentally disposed onto the ground. The hydrostatic test shall be performed on the Romanian bank.
Operation period of the natural gas pipeline and related stations	In case of intervention to the gas pipelines, part of the diffuse sources specified in the Chapter on site management can be activated, namely: - *Accidental pollution by hydrocarbons* due to the lack of equipment maintenance or *improper handling of fuel when refuelling the equipment;* - *Accidental pollution* due to *uncontrolled waste storage*
Fauna – noise and vibration sources	
Work site	Noise and vibration are stronger if the equipment is inappropriately maintained from the technical point of view.
Work related traffic	The non-compliance with the legal provisions on vehicle speed when crossing settlements may generate sound pressure levels of 85-90 dB (A) at the roadside and, depending on the land structure in the area and the type of buildings, important vibration thereof
Operation period	
Operation period of the natural gas pipeline and related stations	In the case of a terrorist attack (the occurrence likelihood is almost zero), the pipeline may be affected in its integrity in the Danube crossing zone. In this case, the gas access will be closed on the damaged section by the block valves located on the Bulgarian and Romanian territories. The gas existing on the pipeline sector will be released.

<u>5.2.3</u>. <u>Evaluation of the downstream aggradation evolutions due to the volume of dragged material.</u>

5.2.3.1. General consideration

The large disproportion between the river meadow surface from the Romanian territory and the surface from the Bulgarian territory, in the crossing section, is explained by the fact that the Bulgarian bank is higher than the Romanian bank.

For the project, the „Hydrologic, Hydraulic and Hydromorphologic Study" has been prepared, establishing the following:

- The Danube erosion degree in the crossing zone
- The pipeline burial depth if the open-cut method is used;
- <u>The downstream aggradation evolutions due to the volume of dragged material</u>

<u>This chapter tackles only the issue of the downstream aggradation evolutions due to the volume of dragged material</u>

The following shows selectively the main objectives of the study on this approach:

- Modelling of the Danube's riverbed geometry on the crossing sector (686 km 300 - km 686 300) by cross sections performed with small equidistance (about100m) for the flow section between the dikes (Romanian bank.) and the slope (Bulgarian bank) and also on an extended section upstream and downstream with greater equidistance.
- Creation of complex databases necessary for the mathematical models of hydraulic type on the extended sector of the Danube and simulation of the aggradation (clogging) or degradation (erosion) phenomena specific to the morphological changes of the riverbed in the studied section, km 685 +300.
- Hydraulic calculations prepared for the Danube's extended sector located between the upstream Bechet Hydrometric Station and the downstream Bistret hydrometric station for a diverse range of probabilities of maximum flows (1%) and medium (multi-annual medium) flows; calibration of the hydraulic model in the area of hydrometric station. The analytical and graphic results of the hydraulic calculations applied in the crossing sector (km 686 300 - 300 686 km): medium velocities in the section, velocities in the design sectors of sections, level of free surface curve, wetted area, etc
- Estimation of the morphological changes developed on the Danube's riverbed for the analyzed crossing section of pipe centreline (685 300 km) by simulating the daily flows recorded during 2006 - 2010. The analytical and graphic results applied to the crossing section: general longitudinal section of the extended sector concerning the morphological evolution of the riverbed thalweg, cross section in the pipe centreline area concerning the morphological changes for different significant periods of sediments transport simulation. Calibration of the sediments transport simulation model, the riverbed morphological evolution on cross sections measured and calculated over the period of 2005 - 2010 at Bechet Hydrometric Station.
- Analysis of the chemical composition of sediments from the Danube's riverbed applying to the aggression at metal and concrete for the undercrossing area under study.
- Conclusion on the simulation calculations of morphological evolution, the limits of mathematical modelling and the implementing risk of calculations performed.

For a more comprehensive characterization of the area of interest, this study makes several references to the upstream sector of Calafat (km.795) - Bechet and the downstream sector of Bechet – Corabia (km 630)

The Danube course is linear and shows a relatively good stability between kp 690 (upstream Bechet) and kp 672. The major riverbed aspect is obviously asymmetric with the left bank consisting of low plains (1-2m above water level) and the right bank much higher (about 5m above sea level) and steep in places. Here, the minor riverbed shows a relatively symmetric cross section. Unlike the upstream sector, the minor riverbed widens and reaches a medium width of 700 m, at a wetted area of section about 5000m^2, at medium depths of 6-7m and maximum depths around 13 m

The analysis of the following parameters: drainage area, maximum depth and width of the riverbed at low-water line for the period of 1981-2010 at the hydrometric stations of Calafat, Corabia, Turnu Magurele, Zimnicea, Giurgiu, Oltenita and Silistra*, in conjunction with the liquid and solid flow values, indicates that on the Danube there is currently a trend of erosion in both depth and width (gradient of 20m^2/year for the area under the low-water line, and 0.5 m. / year for the low-water line width)*

The sections of Turnu Magurele, *Corabia Calafat and Bechet show a relative stability on the left side and* riverbed *bottom and the erosion trend is particularly evident on the right side under low-water line and the connection areas with the bed bottom.*

The following conclusions can be drawn from the analysis of existing studies on the morphological phenomena in the Danube riverbed during this period in the studied sector:

- *The Confluence Zone with the Jiu River (km. 712-690)* indicates that this area has been under a predominant process of erosion that has emerged through more prominent erosions of the Bulgarian bank.

- *The Downstream Confluence with the Jiu River between km 689 - 686* has an erosion tendency of the Bulgarian bank and deposits on the Romanian bank.

- *The Bechet Zone* between Km. 685 - 662, in the same period, is characterized by a predominant sedimentation phenomenon over erosion due to the occurrence and development of the surfaces of islets present in the riverbed.

Due to the fact that the Bechet Hydrometric Station is only 6 km downstream of the crossing area and that there are no significant changes on this section of the Danube, the continuity of water flows and sediments between the two sections can be taken into consideration.

To be able to analyze the time variation of the Danube riverbed morphology change in the cross section, it was necessary to choose the last period of simulation (2005-2010) concerning the emphasized manifestation of these phenomena, with medium daily monthly flows, respectively medium monthly flows that include two floods in 2006 and 2010 with the exceeding probabilities of 2% and respectively 10%.

The image of medium flow distribution during the year is given by the medium hydrograph of the monthly flow values which is also called the flow hydrograph of fictitious year (figure 5.2.2. below). Cross sections on the Danube river at Bechet h.s. throughout 1981-2010 for Qmax=8000 m^3/s is shows in figure 5.2.3 below.

The main data measured to determine graphically the discharge rating curves are shown in the following tables.

Table 5.2.7: Main data measured to determine graphically the discharge rating curves at the Bechet hydrometric station

THE BECHET DANUBE HYDROMETRIC STATION KM 678+660				
Probability flow	Q(m^3/s)	Hstaff (cm)	m MNS	m MN75
1%	16150	851	30.593	30.02
Qmax 2006	15900	841	30.493	29.92
2%	15370	821	30.293	29.72
5%	14290	777	29.853	29.28
10%;Qmax.2010	13370	739	29.473	28.9
20%	12320	697	29.053	28.48
30%	11500	653	28.613	28.04
50%	10530	605	28.133	27.56
80%	9020	512	27.203	26.63
	8000	447	26.553	25.98
	7000	380	25.883	25.31
Qmed.m.a.	6000	308	25.163	24.59
	5000	228	24.363	23.79
	4000	146	23.543	22.97
	3000	61	22.693	22.12
Q low-water	2500	17	22.253	21.68
		BECHET S.H. km 678.660		
		"0"m MNS=22.083		
		"0"m MN75=21.51		
		"0"m MB=21.31		

Figure 5.2.2: Cross sections on the Danube river at Bechet h.s. throughout 1981-2010

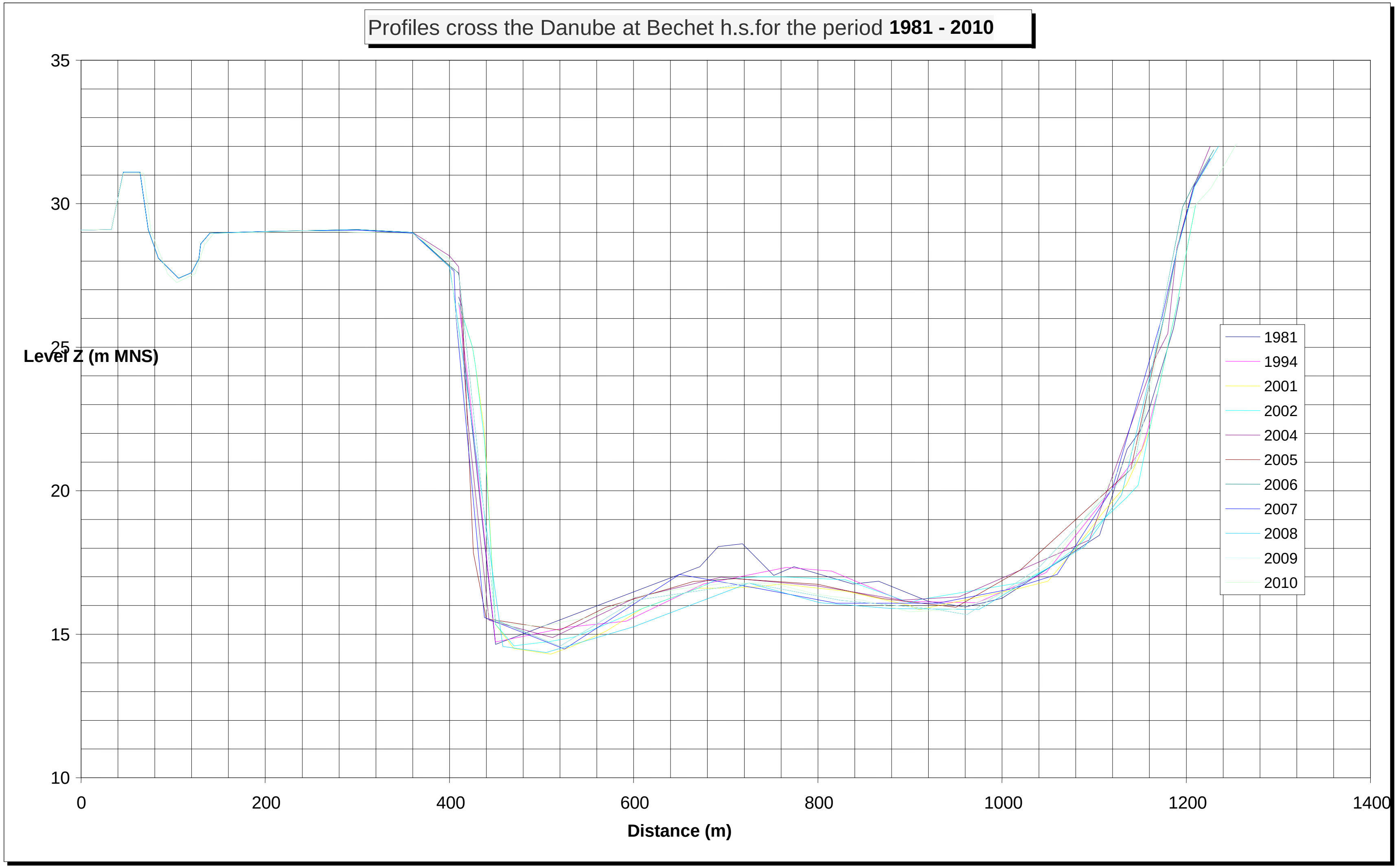
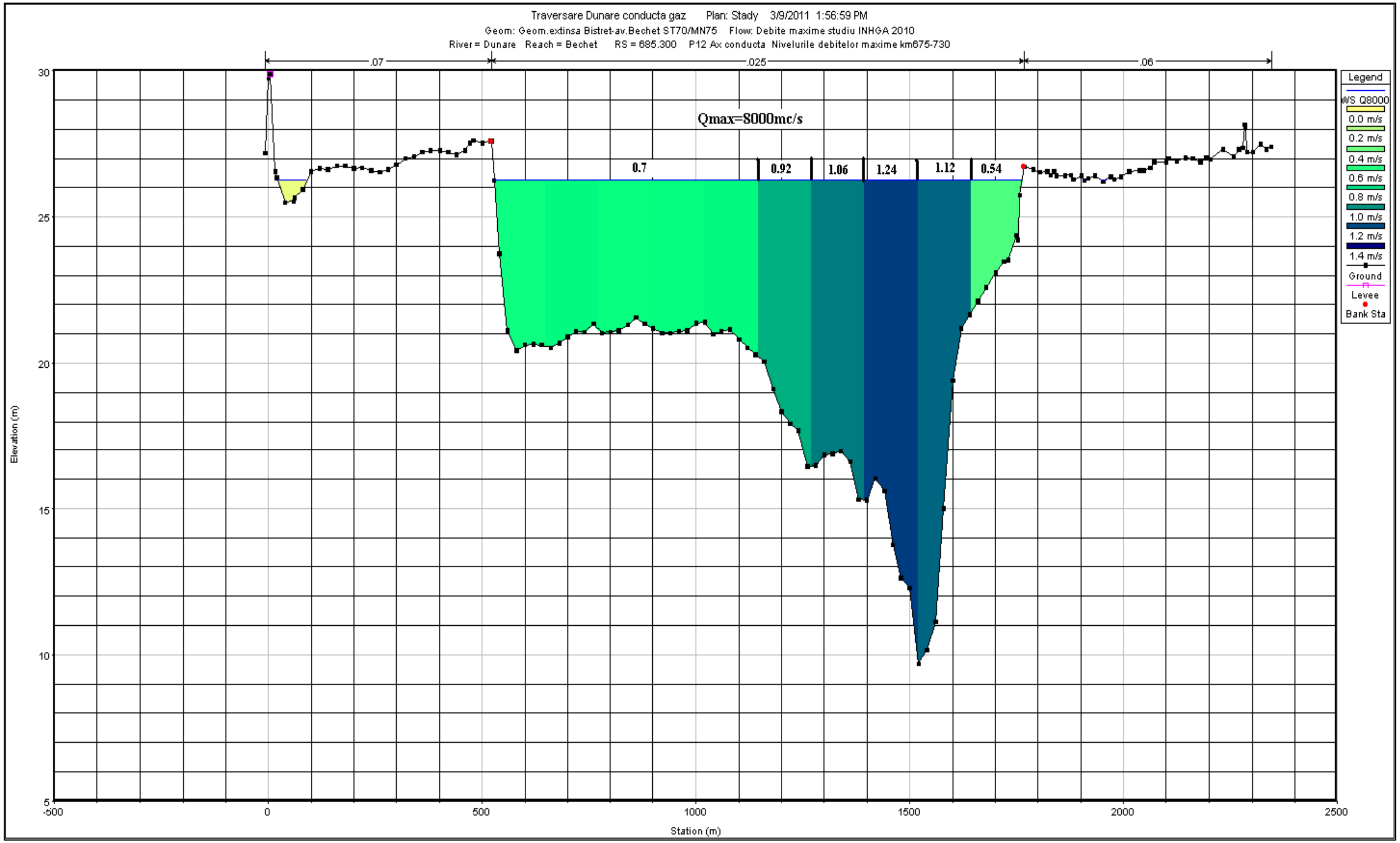


Figure 5.2.3. Idem,Kmr 685+300 Pipeline centreline section – the Danube river crossing, Qmax=8000 m^3/s



The data of the discharge rating curve at Bistret Hydrometric Station (km 725) are shown in Table 5.2.8. below.

Table 5.2.8: Main data measured to determine graphically the discharge rating curves at the Bistret hydrometric station

BISTRET HYDROMETRIC STATION, KM 725				
Probability flow	Qmax (mc/s)	Hstaff (cm)	m MNS	m MN75
1%	16150	890	32.725	32.48
Qmax2006	15900	878	32.605	32.36
2%	15370	860	32.425	32.18
5%	14290	818	32.005	31.76
10%;Qmax.2010	13370	780	31.625	31.38
20%	12320	737	31.195	30.95
30%	11500	701	30.835	30.59
50%	10530	656	30.385	30.14
	10390	650	30.325	30.08
	9370	590	29.725	29.48
80%	9020	577	29.595	29.35
	8510	550	29.325	29.08
	8000	519	29.015	28.77
	7000	462	28.445	28.2
Qmed.m.a.	6000	398	27.805	27.56
	5000	330	27.125	26.88
	4000	220	26.025	25.78
	3000	95	24.775	24.53
Qlow-water	2500	15	23.975	23.73
BISTRET S.H. km 725 "0"m MNS=23.825 "0"m MN75=23.58 "0"m MB=23.10				

5.2.3.2. General characteristics of the sediment transport on the Danube

The alluvial material is classified by the way it is transported into suspended sediments and bed loads, which are in fact, the main categories that present interest in practical calculations.

One of the most important characteristics of the sediments flow on the Danube is their large variability along the riverbank. This variability is due to the important contribution of suspended sediments carried by the rivers which are confluent on the whole lower sector of the Danube.

On the other hand, from an estimative calculation made by comparing the cross sections through the Danube riverbed, particularly in the section of hydrometric stations, performed at an interval of about 50 years, it has been found that although there were some powerful changes in the riverbed in several sectors during this period, however, the overall balance of sediments originating from the riverbed erosion is practically null

To get an accurate picture of the time and space evolution of the elements of liquid flow - solid flow, the following diagrams will show the variations of the parameters R (kg/s), medium annual / R (kg/s) and Q(m^3 /s) medium annual / Q(m^3 /s) multi-annual medium during 1931-1994 (figure 5.2.4 and figure 5.2.5. below), for the Orsova and Zimnicea sections.

The following conclusions have resulted from the analysis of the diagrams presented:

- Two distinct periods occur in the regime of solid flows on the Danube, namely the period before 1971 and the period after 1971 when the Iron Gates I reservoir was put into operation.
- The medium multiannual solid flow during 1971-1995 represented only 0.47% of the medium multiannual solid flow value during 1932-1960.

Also in case of the Bechet station (figure 5.2.6. below), if between 1956 – 1970 the medium multiannual sediment flow transported on this section was 1500kg/s, between 1970 – 1985, it decreases to 770kg/s and between 1985 – 2003, it was only 470kg/s, that is one third of the sediment flow drained on the Danube before damming. During the last period of 2003 -2009, the medium multiannual sediment flow transported and corresponding to the medium multiannual water flow was about 350 kg/s.

In terms of climate changes it is estimated that over 25 years, the sediment flow will stabilize at values of about 250 - 300 kg /s.

As seen in figure 5.2.7 below, for the period 1983-2003 when no measurements are given, the sediments flow have a slight increase of about 0.25 kg/s /year. Considering the small amount, it can be considered that the bed load transport is constant.

Changes in the evolution of the Danube's hydrological parameters, and also the anthropogenic causes due to the operating regimes of the Iron Gates HPS and pumping stations, plus the impact of river navigation have led to important events on the alluvial regime change, especially during the periods of poor hydrology.

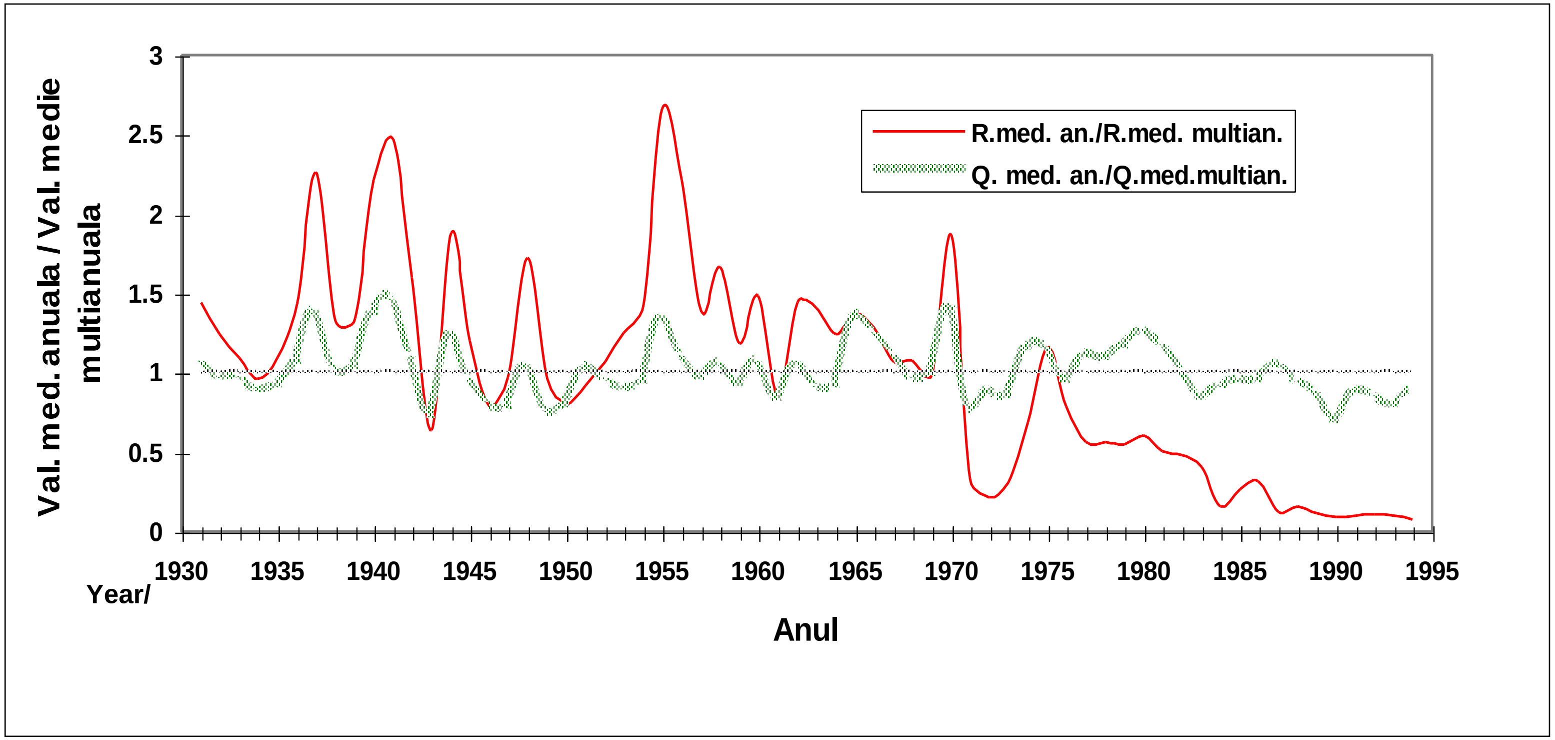


Figure 5.2.4: Variation of medium liquid and solid flow between 1931 – 1994 at H.S.Orsova

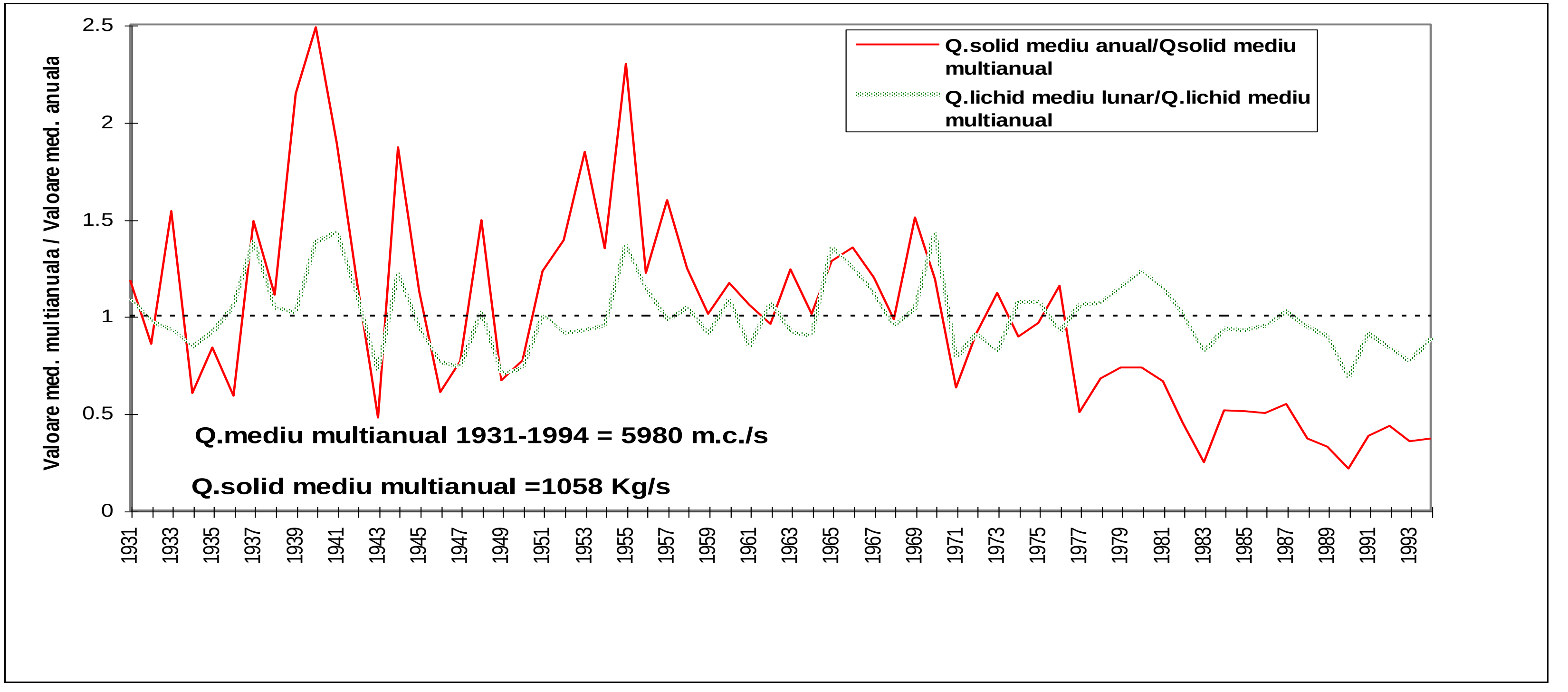


Figure 5.2.5. :Variation of medium annual liquid and solid flow during 1931-1994 at .Zimnicea H.S.

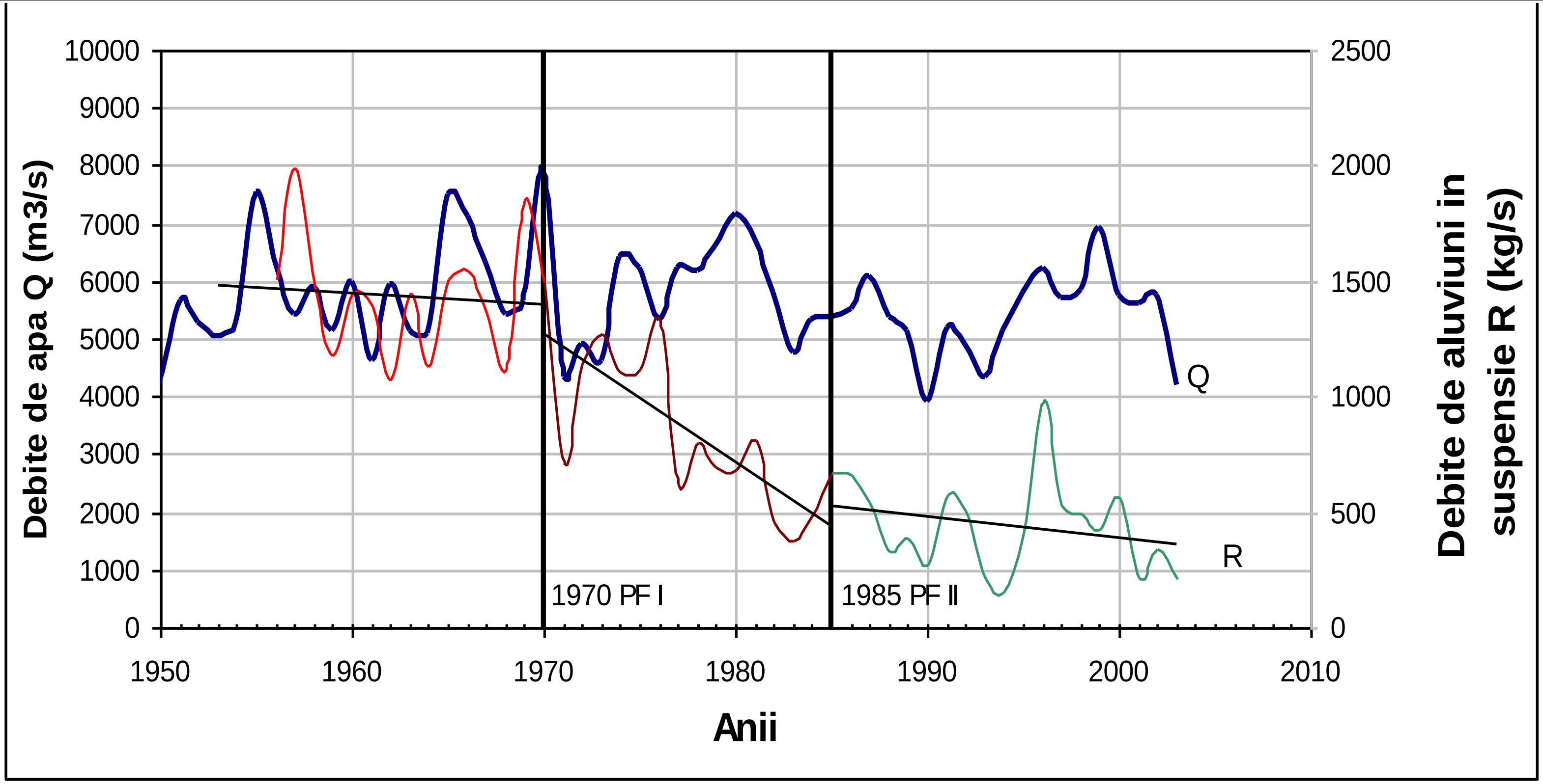


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Figure 5.2.6.: Time variation of medium annual water and suspended sediment flows at Bechet H.S.

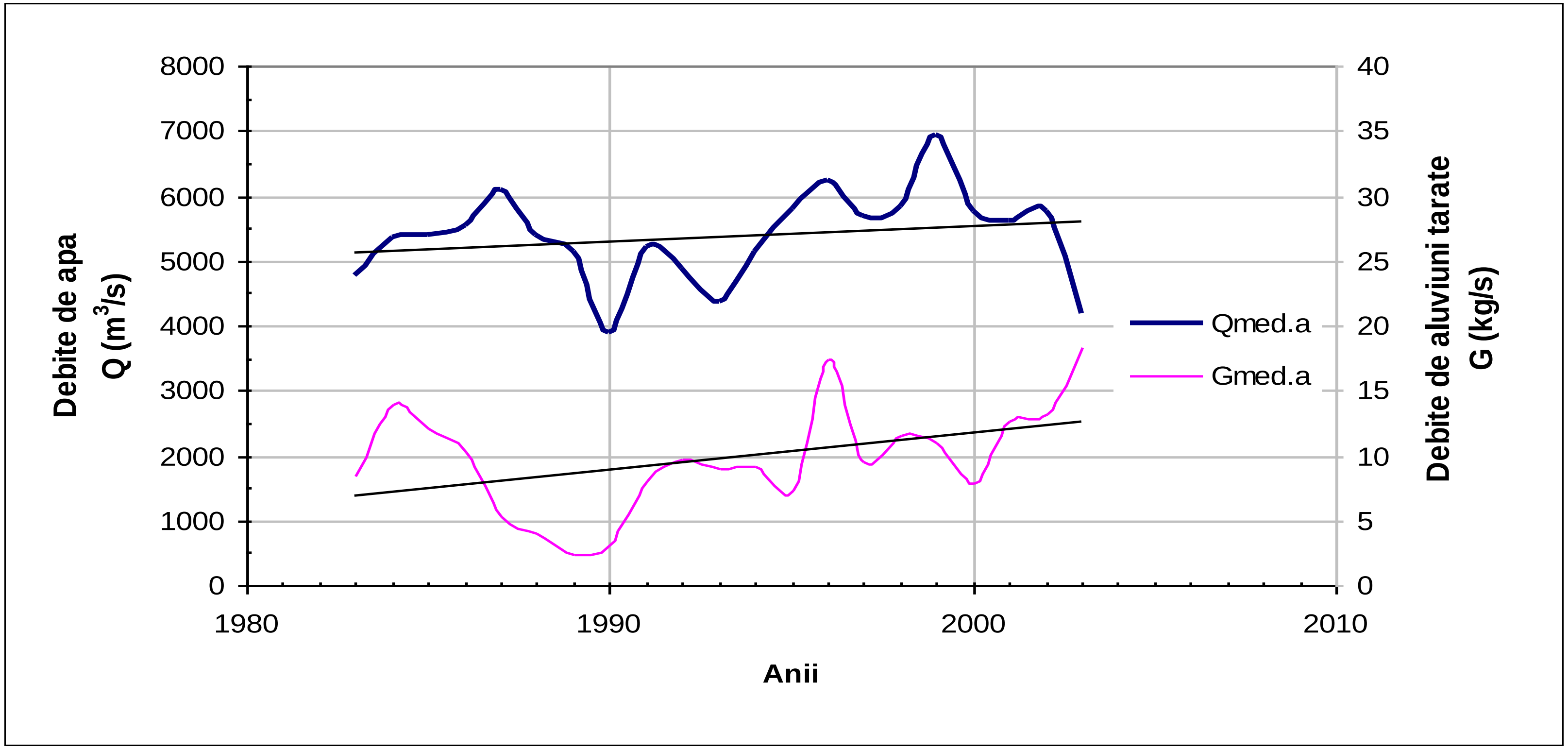


Figure 5.2.7: Time variation of water flows and medium annual bedload flows *at Bechet H.S.*

5.2.3.3. Mathematic model used to calculate the rates of the free surface curve by mediums of the Danube riverbeds geometry described through cross sections and considering the present hydrotechnical works

The modelling of a natural phenomenon and the impact on the environment in which it occurs, involves here the numerical simulation of maximum flows propagation for the design floods in the riverbeds in a virtual space (described by cross sections) in permanent conditions.

For the performed hydraulic calculations there was used the model of permanent movement concerning the calculation of free surface curve levels corresponding to the values of annual exceeding probabilities of maximum and medium flows provided by INHGA in the existing conditions of riverbed arrangement.

If the Danube river will be crossed by open cut, for the evaluation of the downstream aggradation due to the volume of dragged material, the ***Mathematic model of hydraulic type HEC-RAS*** will be used.

The mathematic model of hydraulic type HEC-RAS is produced by the U.S. Army Corps of Engineers, Hydrologic Engineering Center, being one of the most popular and used packages of digital models on the analysis of hydrographic systems in the world.
The model can calculate the maximum rates of the free water surface curve in non-permanent and permanent movement for rivers in uniform natural or arranged hydraulic regime (according to the works included in the arrangement or design schemes) as well as for one-way riverbeds or networks of dendritic and circular riverbeds (figure 5.2.8).

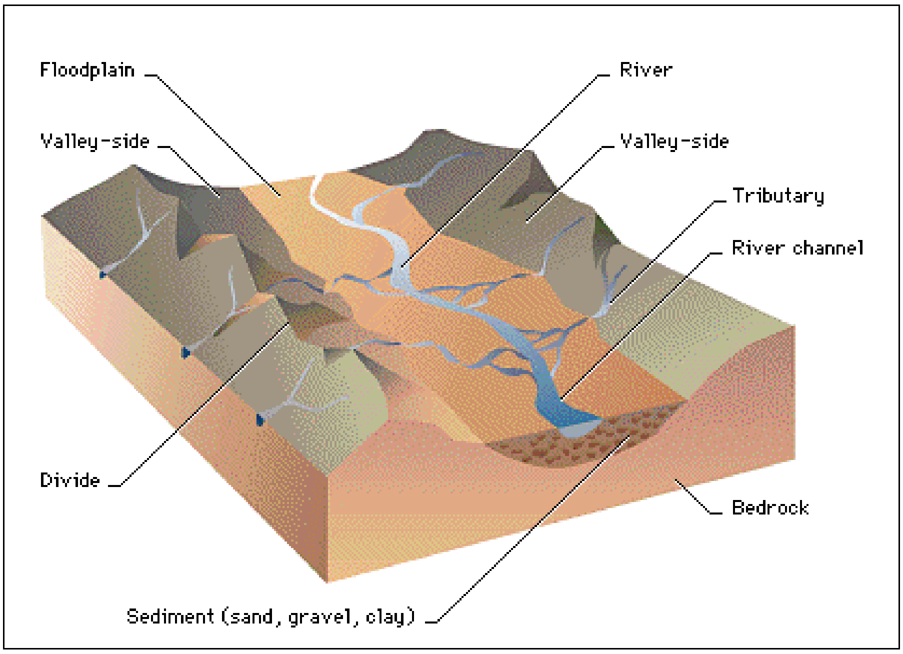


Figure 5.2.8: General scheme of the hydrographic grid introduced in model

The adjustment of the mathematical model can be analyzed consultatively on the range of flows and levels recorded and calculated in the form of discharge rating curves during 2005-2010, at the hydrometric stations on the Danube: Bistret H.S. and Bechet H.S..

The Nabucco document “The Hydrotechnical Works Necessary for “The Danube Undercrossing by the Nabucco Gas Pipeline” Specialized Study - Hydrologic, Hydraulic and Hydromorphologic Study -, shows the following data:

- Cross sections on the Danube river at Bechet h.s. throughout 1981-2010 are shown in figure 5.2.2 above and for Qmax=8000 m^3/s are shown in figure 5.2.3 above
- The grain size fractional composition of the suspended and dragged silt rates, depending on the grain size class is shown in table 5.2.8 below.
- The morphological evolution of the riverbed thalweg during the surveyed period is shown in figure 5.2.9 below.
- Verification of the calculation model on the measured and calculated morphological evolution of the Danube riverbed, in the area of Bechet hydrometric station (km678+660) in 2005 and 2010 is shown in figure 5.2.10 below.
- Layout of the location and bathymetry of the cross sections performed in 2010 in the crossing section is shown in figure 5.2.11 below.

The technological process for trenching consists in excavations below the water level. The volume of material carried along by the water current is estimated at about 280,000 m^3 .
The volume of material carried along by the water current is estimated at about 30%, according to the geotechnical surveys undertaken in the riverbed and to the grain size distribution used within the mathematical model, characterizing the riverbed (boreholes 4 and 5 in the Danube bad for the likely erodible horizons 1.60, and 1.70, respectively).
The silt material is categorized as suspended silt and dragged silt depending on how it is carried. They are in fact the main categories in the practical calculations.
The data presented in the grain size distribution curves show size fractions of d<0.15mm, i.e. the quantity of dragged material is about 60% of the total volume of silt material carried along by the water current (table 5.2.8 below).

Table 5.2.9 Grain size fractional composition of the suspended and dragged silt rates, depending on the grain size class. The particle content is given depending on the diameter range (mm).

Grain size classes	Size range (mm)	Qwater (mc/s)	**2674**	**3493**	**4718**	**5469**	**6720**	**7649**	**8511**	**9575**	**10297**	**11500**	**<13000**	Remarks
		Qsolid (t/zi)	**9331**	**10315**	**19016**	**24157**	**28261**	**32080**	**46543**	**57189**	**72170**	**87177**	**100000**	Silt nature
Clay	0.002-0.005	C	0.01	0.02	0.02	0.04	0.01	0.06	0.05	0.07	0.03	0.05	0.03	Suspended silts
Very Fine Silt	0.005-0.008	VFM	0.1	0.17	0.22	0.17	0.11	0.19	0.16	0.18	0.28	0.26	0.25	
Fine Silt	0.008-0.016	FM	0.1	0.17	0.19	0.16	0.11	0.14	0.12	0.14	0.2	0.18	0.18	
Medium Silt	0.0016-0.032	MM	0.26	0.24	0.32	0.31	0.35	0.31	0.35	0.26	0.3	0.32	0.34	
Coarse Silt	0.032-0.0625	CM	0.3	0.2	0.19	0.2	0.3	0.2	0.24	0.22	0.14	0.12	0.13	
Very Fine Sand	0.0625-0.125	VFS	0.21	0.17	0.04	0.1	0.1	0.08	0.06	0.12	0.03	0.05	0.05	
Fine Sand	0.125-0.25	FS	0.01	0.015	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	Dragged silts
Medium Sand	0.25-0.5	MS	0.006	0.01	0.006	0.005	0.006	0.006	0.005	0.005	0.006	0.006	0.006	
Coarse Sand	0.5-1.00	CS	0.003	0.003	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.003	
Very Coarse Sand	1.00 2.00	VCS	0.0005	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.001	
Very Fine Gravel	2.00 5.00	VFG	0.0005	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	

Note. The data processed this way have been input data for the simulation of the bed load transport phenomena for the Danube river in the crossing section.

Figure 5.2.9.: Morphological evolution of the riverbed thalweg during the surveyed period. Differences ΔH as compared to the original situation. Detail on the sector in the Danube riverbed crossing area (km686+300 - km684+300)

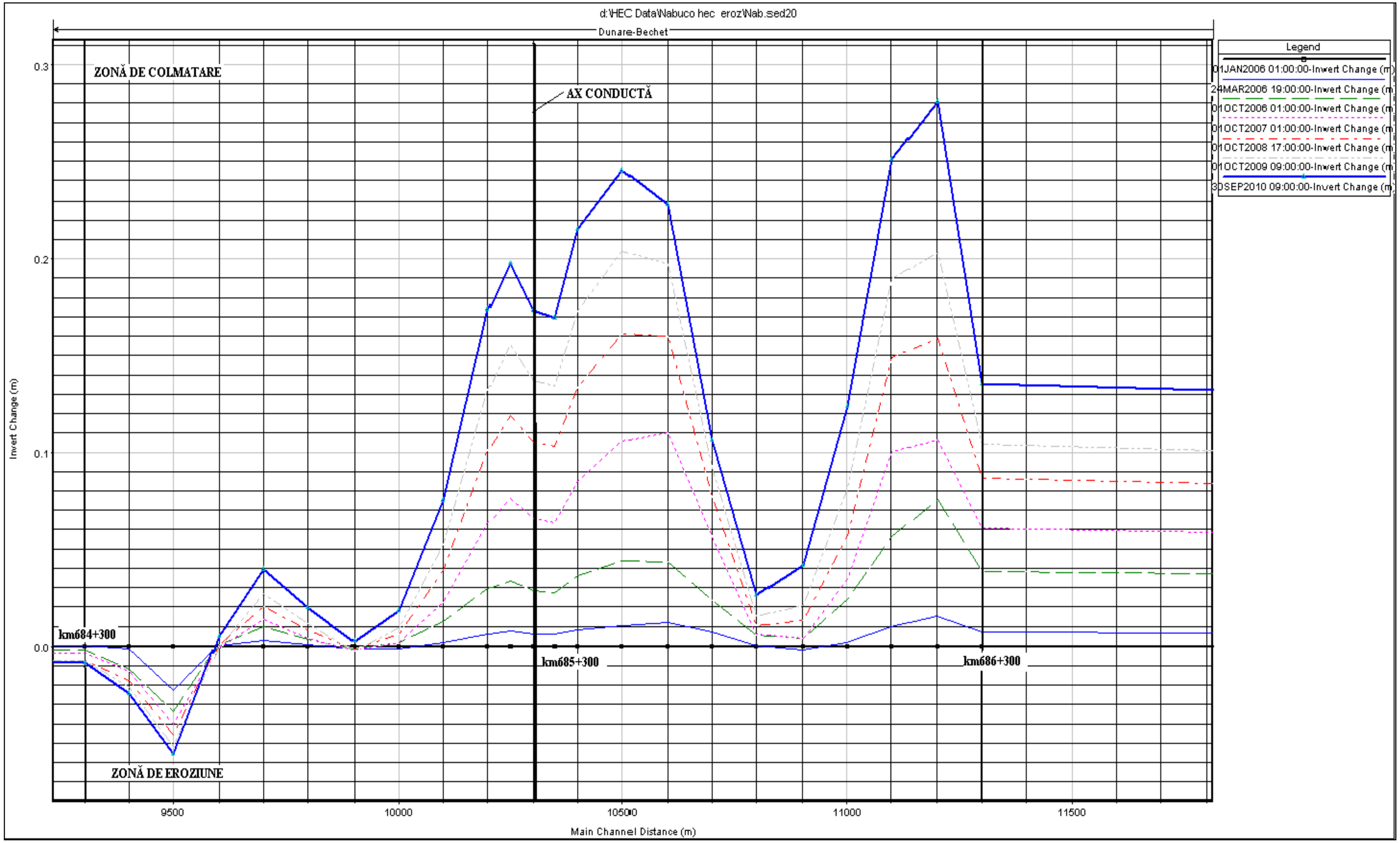


Figure 5.2.10.: Verification of the calculation model on the measured and calculated morphological evolution of the Danube riverbed, in the area of Bechet hydrometric station (km678+660) in 2005 and 2010.

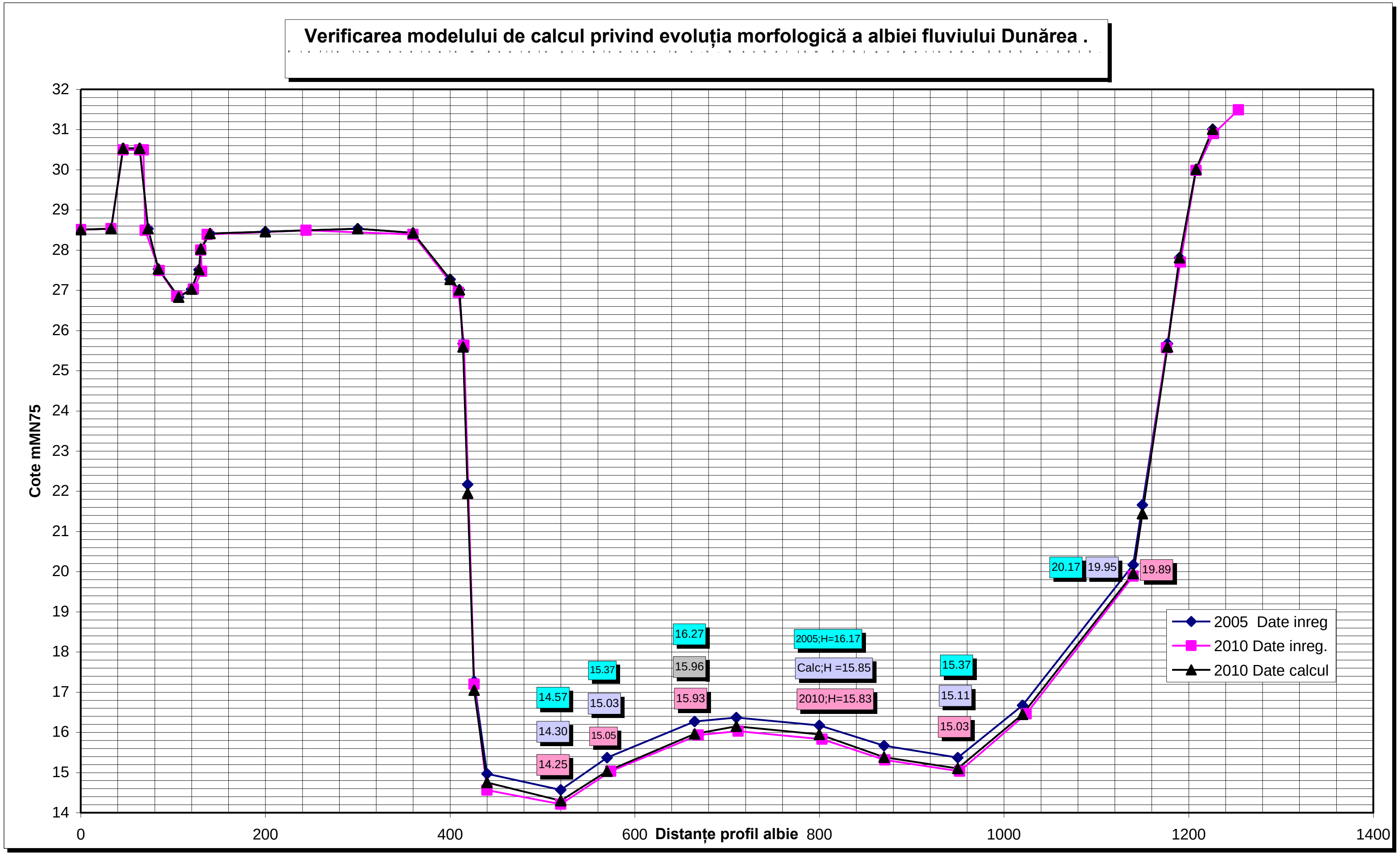
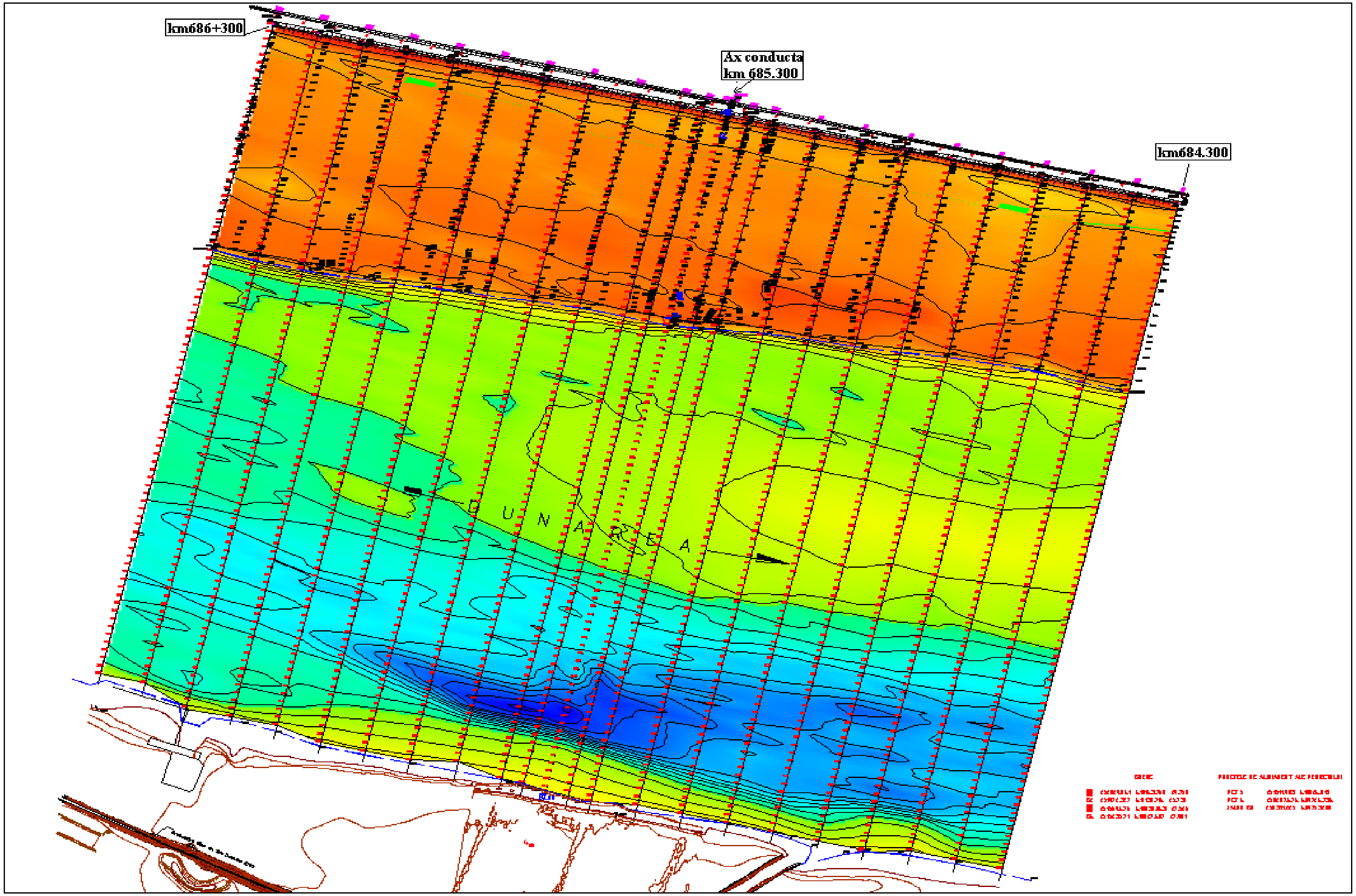


Figure 5.2.11.:. Layout of the location and bathymetry of the cross sections performed in 2010 in the crossing section



The analytical results and the graphs (figures 5.2.12 below) determined on numerical model regarding the evolution of the morphological modifications for the design sector (km 686+300 – km 684+300) and the pipeline installation section (km685+300) show that:

- The data confirm that the crossing section (km685+300) is morphologically subject to aggradation phenomena (sedimentation) dominating all the sectors of the minor riverbed due to the location of the Danube riverbed into a depression zone and to the relatively low velocities (as compared to the areas with erosions). It is anticipated that the annual silting rate is about 3-4cm
- It is anticipated that additional evolutions of the sedimentation phenomenon are likely in the downstream sector (km 685+300 – km 684+100) dominated by the aggradation phenomenon, due to the size fractions of d<0.15mm, representing the quantity of material dragged out of the volume of material carried by the water current estimated at about V_1= 170,000 m^3.
- The average sedimentation zone is determined by the riverbed estimated on cross section at about $L_{average}$ =1200m and the sector length (km 685+300 – km 684+100) is about 800. The average sedimentation surface area is approx. $S=10^6$ m^2.
- The quantity of silt material in an evenly distributed layer is about 0.2 m for that area. Due to the location in a hydrodynamic zone, the silt material will settle in the form of prism (depending on the diameters of the grains of the dragged silts) with the base of about 0.5 m lying downstream of the trenching section.
- A part of the silt material is the volume carried by the water current and is formed of the additional suspended silts in the Danube river. It is estimated at about 30% of the total volume V_2= 100.000 m^3. It it is considered that if the works last for about 20 days, and the specific weight of those silts is approx.. W_S=2t/m^3 , then it will be obtained an additional daily rate of $Q^`_s$=10,000 t/day
- As compared to the average flow rate of the Danube of about $Q_{m.m.a}$ =7000m^3/s , the suspended rate is approx.. Q_s=30,000t/day , the increase rate represented by the volume of dragged material is about 30%, i.e. a total suspended silt rate of about Q_s=40,000t/day. This solid rate is recorded by the Danube river for a liquid increase rate of about 1000 m^3/s, i.e. the water flow rate of Q=8000m^3/s. It is worth mentioning that no sedimentation phenomena are recorded in Bechet – Leovo area under these circumstances.
- An important factor is also the low value of the suspension flow rate of the Danube river over the last period, which favours the erosion phenomena on the sectors with a positive incline. Due to this phenomenon, the additional flow rate represented by the volume of dragged material results in a balance of the original regime.

It is worth mentioning that the multiannual mean solid rate throughout 1971-1995 is only 0.47% of the value of the multiannual mean solid rate throughout 1932-1960.

As for the Bechet section, the multiannual mean silt rate transited throughout 1956 – 1970 was 1500kg/s, then decreased to 770kg/s throughout 1970 – 1985 and reached only 470kg/s throughout 1985 – 2003, namely a third of the silt rate flowing on the Danube river before damming. Over the last period 2003 -2009 the multiannual mean silt rate corresponding to the multiannual mean water flow rate was about 350 kg/s.

According to the data shown downstream the pipeline centreline– Bechet (km 684+100 – km 678+660) the riverbed morphological modifications are characterized by the degradation of the mobile riverbed.

Figure 5.2.12.: Cross section in the pipe centreline area related to the morphologic modifications in various significant simulation periods of sediment transport, details on sectors

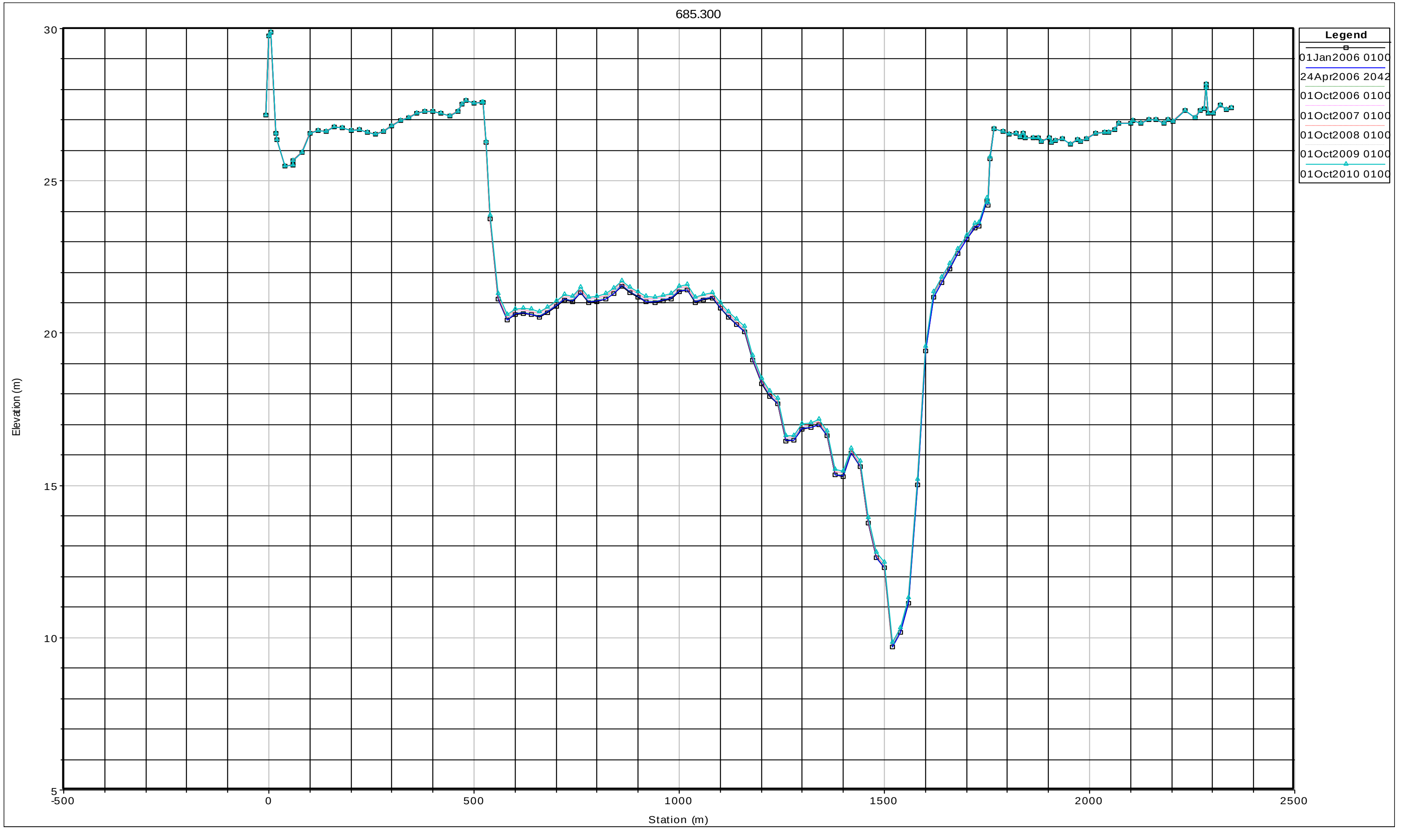


Figure 5.2.12.1.: Detail on the cross section sector: 560m +1060m

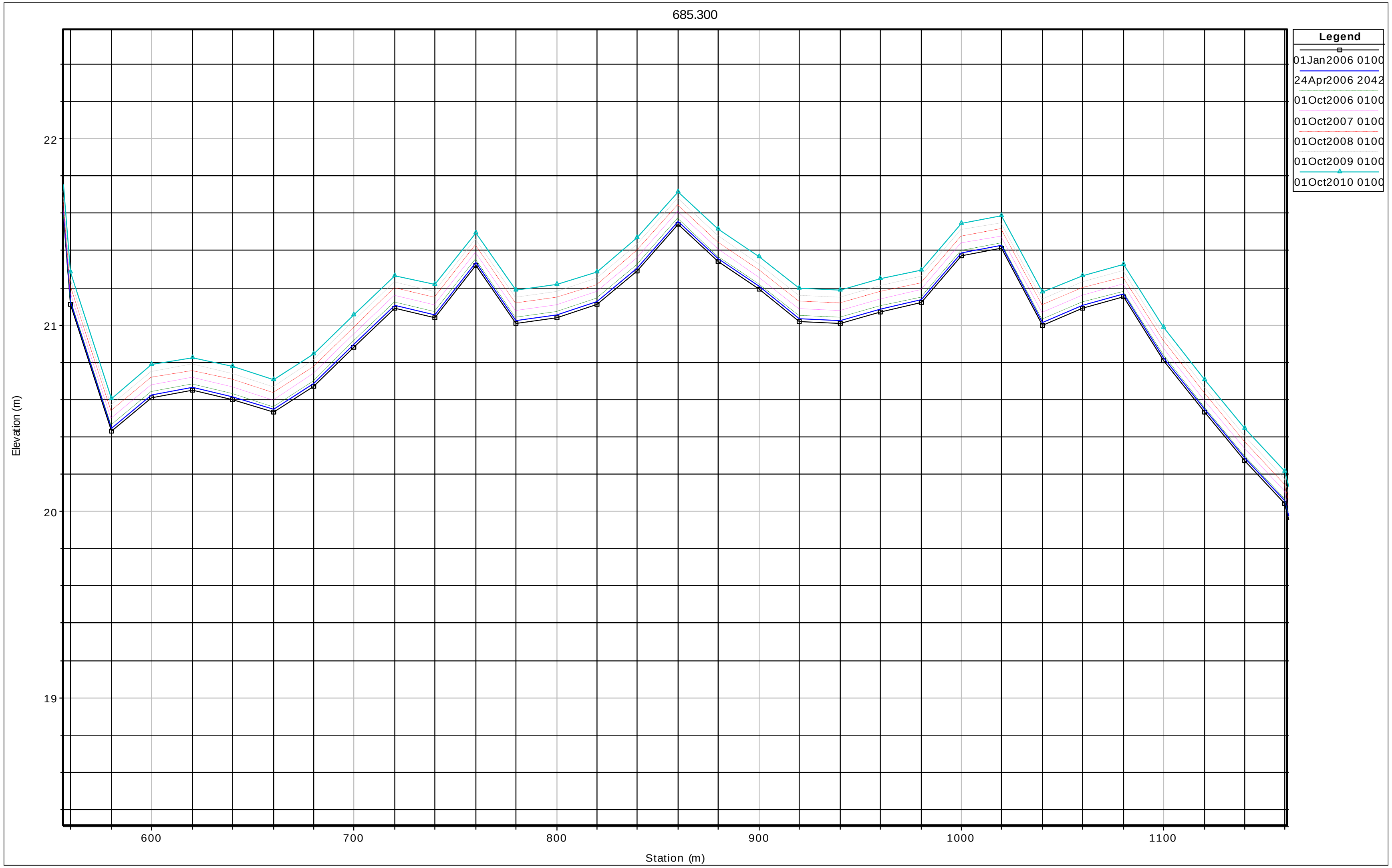


Figure 5.2.12.2.: Detail on the cross section sector: 1060m -1600m

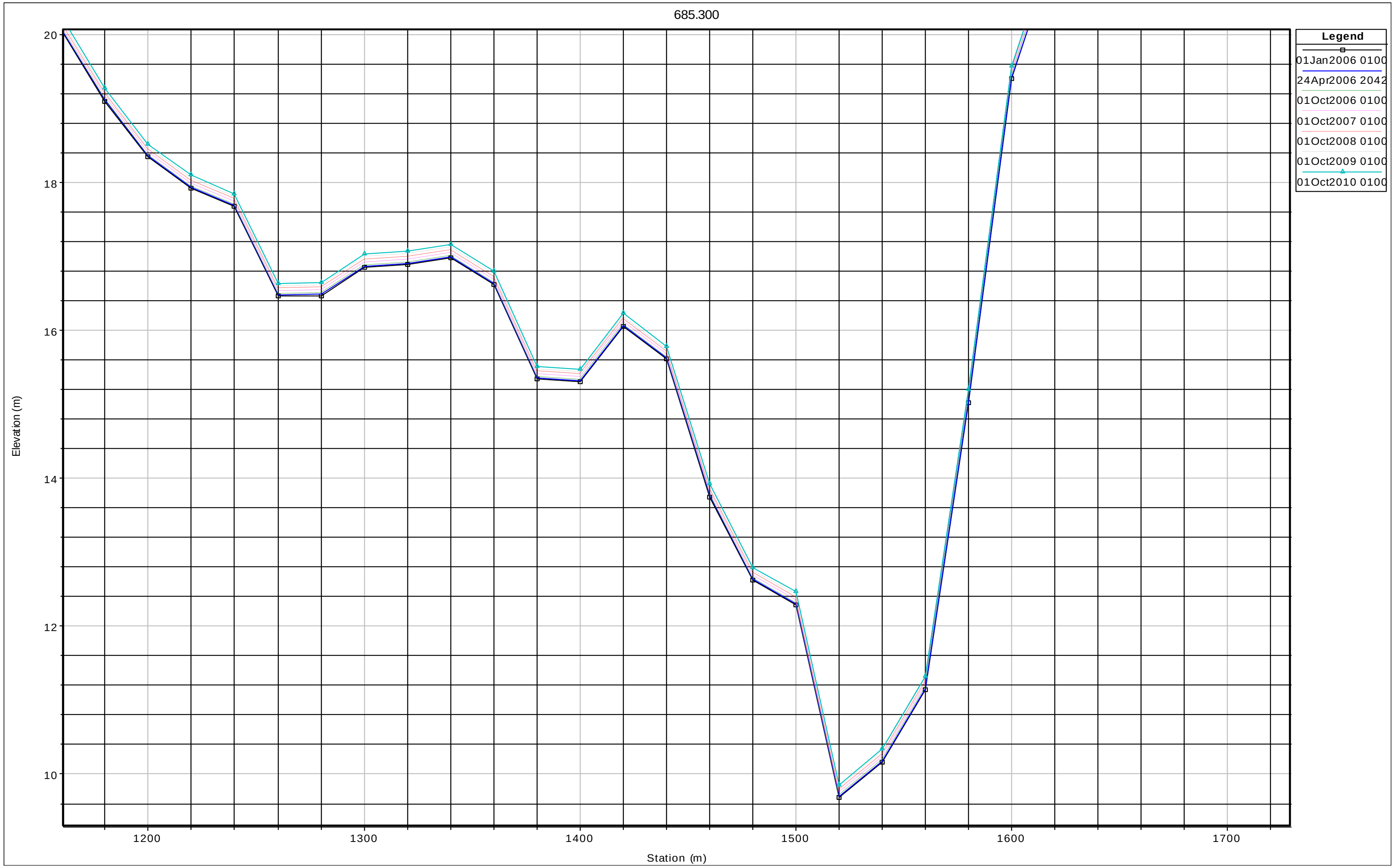
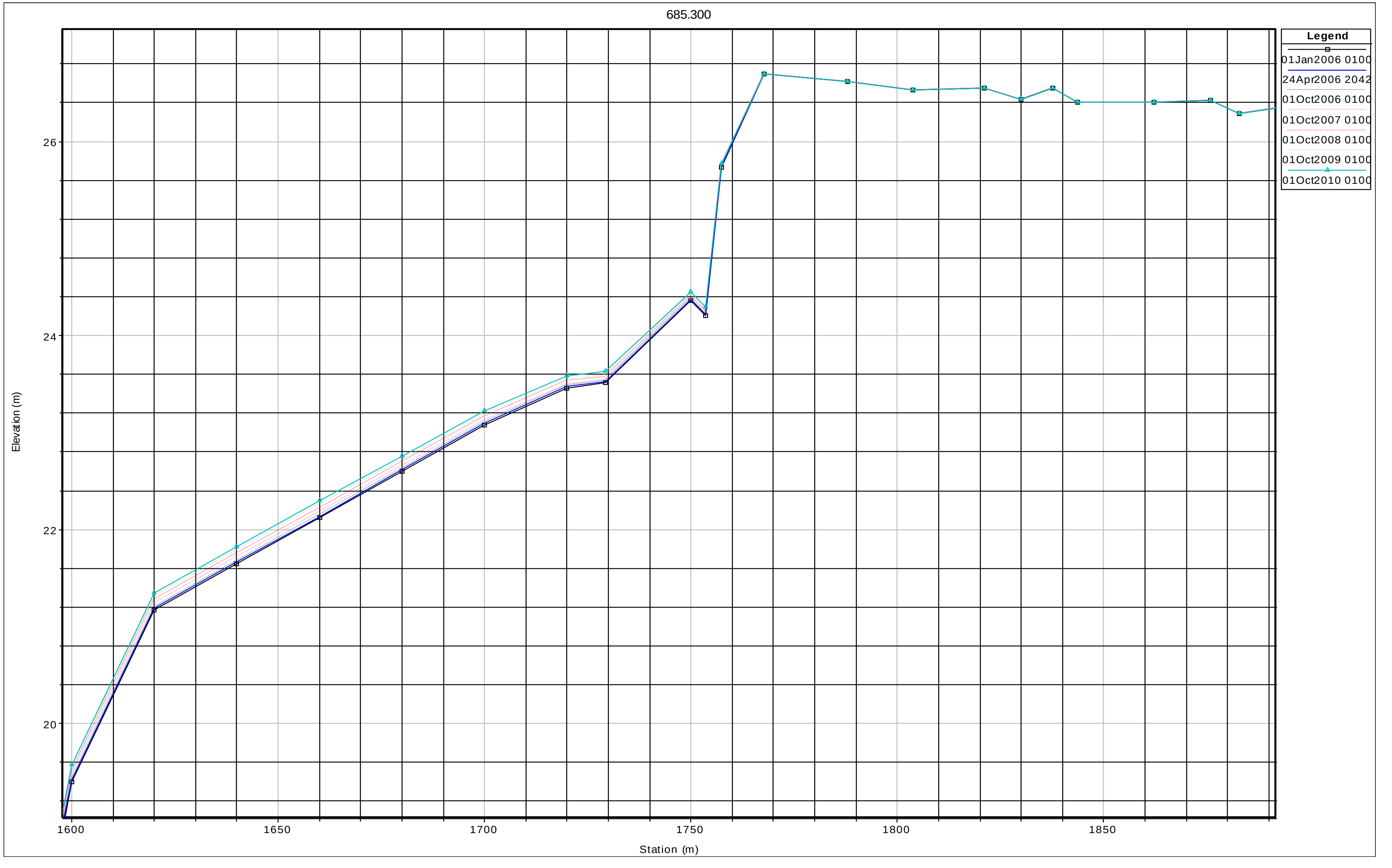


Figure 5.2.12.3.: Detail on the cross section sector:1600m – 1900m



Conclusion

Due to this specific character, no additional aggradation evolutions are expected due to the volume of material dragged.the discharge of the material dredged near of Romanian bank will reduced the tendency to settle onto the area downstream the crossing. Implicitly, the excavation works in the crossing zone will have no influence on Ostrov islet and Natura 2000 site. This islet lies in the vicinity of Oreahovo settlement, about 6 km far from the crossing site.

5.2.4. WASTE – TYPE AND QUANTITY OF THE EXPECTED WASTE, IN CASE OF OPEN CUT AND HDD CROSSING METHODS

The main sources of waste during construction are:

- Water transport of pipes and fittings
- Technological processes during construction (NGPL installation and commissioning, arrangement of construction camp and pipe dumps, rehabilitation of existing access roads and execution of new roads);
- Activities carried out in the production bases (pipe dumps) and in the construction camps
- Installations for producing mineral aggregates, concrete, asphalt mixtures and bituminous emulsions
- Constructor's employees and personnel in transit

No construction camps, pipe dumps, concrete mixing plants, asphalt mixture stations are located on the territory of Natura 2000 sites.
The waste generated by the activities performed is analyzed in the Report on environmental impact assessment.
The following types of waste will be obtained as a result of the construction activities:

Non-hazardous waste:

- ✓ 20 01 08 Biodegradable waste from kitchens
- ✓ Package waste (including segregated municipal package waste):
    - 15 01 01. Paper and cardboard packages
    - 15 01 02 plastic packages
    - 15 01 03 wooden packages
    - 15 01 07 glass packages
- ✓ 20 01 01 Paper and cardboard
- ✓ 19 08 05 Sludge from the wastewater treatment plant of the construction camp
- ✓ 17 05 04 Soil, rocks (other than those specified under 17 05 03)
- ✓ 17 04 07 Metal waste
- ✓ 16 01 03 Used tyres
- ✓ 17 09 04 Building material waste, including rejected concrete batches
- ✓ 12 01 13 Welding waste
- ✓ 17 02 01 Wood waste
- ✓ 02 01 07 Waste from the forest exploitation

- ✓ 17 05 06 Dredging waste, others than those specified under 17.05.05.
- ✓ 01 05 04 Drilling mud
- ✓ (Inert) waste from construction and demolitions, namely:
    - 17 01 01 concrete
    - 17 01 02 bricks
    - 17 01 03 tiles and ceramic materials
    - 17 01 07 mixtures of concrete, bricks, tiles and ceramic materials
    - 17 02 01 wood,
    - 17 02 02 glass
    - 17 02 03 plastics
    - 17 04 05 iron and steel

Hazardous waste:

- ✓ 17 05 03* Soil and rocks with a hazardous substance content
- ✓ 13 05 02* Sludge collected in the settling tanks in the construction camp
- ✓ 13 02 04* Mineral chlorinated motor, transmission and lubricating oils
- ✓ 13 04 01* Bilge oils from the inland waterway navigation
- ✓ 17 06 01* Building material waste with an asbestos content
- ✓ 16 06 01* Lead batteries
- ✓ 16 01 07* Oil filters
- ✓ 15 02 02* Contaminated textile waste (cloths)
- ✓ 08 01 11* Paint and primer packages
- ✓ 08 01 11* Paint and varnish waste with a content of organic solvents or other hazardous substances
- ✓ 15 01 10* packages containing residues of or contaminated with hazardous substances
- ✓ 16 02 15* Hazardous components dismounted from equipment out of use

- ✓ Medical waste
    - 18 01 03* Waste whose collection and disposal are the object to some special measures on the prevention of infections
    - 18 01 06* Chemicals consisting of or containing hazardous substances
- ✓ 17 05 05* Dredging waste with a toxic potential
- ✓ 16 04 01* Ammunition waste
- ✓ 15 02 02* Used protective equipment

The quantities of waste may be globally estimated according to number of employees and the work quantity lists

The quantities of domestic waste have been estimated based on the formula:
$Q_{med} = N \times i_{med} \times 0.001$ (t/day)
where: N – number of people present on the construction site, $i_{med} = 0.5 \div 0.8$
N= 700, $i_{med} = 0.5$ has been considered

The linepipes, valves and other materials may be carried by motorships, barge convoys pushed by push boats or towed barges.
The solid waste generated on board of the motorships, push boats and tugboats and from the ship maintenance and operation activities is formed of: domestic-culinary rests, plastics, paper, cardboard, cloths, glass, metal items, leftovers, packages, parts of hawsers, plastic bags, cardboard boxes or metallic boxes, rests of materials used to operate the ship.

According to the Recommendations of the Danube Commission for navigation issues of 21 April 1986, the garbage resulted on board of the ships is calculated based on the sanitary standards stipulating 5 dm^3/man, day (1 kg/man,day). Considering that the average time coefficient (time when the crews generate garbage) is 0.5 and the navigation period is 30 days, it is obtained:

$5 \times 1 \times 30 \times 0.5 =$ 75 kg/month

For sanitary reasons, the waste materials collected from ships are considered infested, therefore their collection, transport and treatment follow special rules, according to the regulation of the port taking these waste materials.

Appendix 11, Table 11.1 shows the management of non-hazardous waste resulted from the NGPL construction and operation activities, and Table 12.2, the management of hazardous waste resulted from NGPL construction and operation activities.

At the completion of the operation period of the Nabucco natural gas pipeline, if it is decided to remove the gas pipeline from the ground, quantities of generated waste will be similar to those during the pipeline installation.

5.2.5. WASTE MANAGEMENT PLAN

The waste recovery/recycling/reuse is a priority in the management hierarchy included both in the European Union regulations and in the national regulations.

The options imposed envisage especially:
- *The prevention of the use of non-recyclable and non-usable* (including multifunctional packages), as well as of the toxic products.
- *Minimization/reduction in the waste volume and especially the decrease in the quantity of hazardous materials,* when their use cannot be prevented.
- *Recycling:* consists in the recovery of certain products/materials, such as paper, plastic, glass (e.g. the rechargeable glass tanks can be averagely reused for 30-35 times before breaking).
- *Controlled storage:* by using the landfills which are geologically stable and waterproof areas, typically with a synthetic coating at its base. The hazardous materials should not be stored in such sites, but in separate sites enabling their "*safe*" storage.

The waste management will reduce the risks for environment and population, as well as limit the quantities of waste materials disposed. Waste recycling will reduce the resources used for manufacturing paper, packages etc.

Waste management in the design stage

The works shall be designed by considering the need of reducing the quantities of waste produced during construction.

Platforms specially designed for the waste temporary storage and selective collection in appropriately labelled containers shall be designed for the construction camp and NGPL-related stations.

Waste management during construction/operation/decommissioning of Nabucco pipeline and related stations

The waste produced during Nabucco pipeline construction/operation/ decommissioning will be selectively collected, transported and disposed to the dump site for being neutralized or reused, in accordance with Directive 2008/98/CE and the national regulations in force.

The following measures shall be taken with a view to undertaking an adequate waste management and to complying with the

- According to the provisions of the *Government Emergency Ordinance no. 195/2005 on environmental protection,* „**the legal persons undertaking activities with a significant environmental impact must organize their own structure for environmental protection".** To this effect, a person responsible for environmental protection and waste management shall be appointed both during the construction and during the operation of the pipeline and of its related stations, as well as during decommissioning.

Each legal person involved in the construction and operation of NGPL and of its related station should implement the standard *ISO 14001:2004 – Environmental management systems – Guidelines on principles, systems and support-techniques.* The environmental aspects shall be assessed with a view to implementing the standard and measures shall be taken for waste management, including for their monitoring.

The following shall be developed:

- Waste management procedure
- Waste monitoring programme
- Yearly training and awareness programme. This programme will consider the legal requirements, as well as the environmental impact per types of waste. The presentation of the duty of case principle and of the advantages obtained from the waste selective collection/ recycling/reuse, safe storage shall be emphasized.
- waste management plan (Appendix 10, tables 10.3., 10.4, 10.5, 10.6, 10.7, 10.8)
- emergency response plan.

- waste shall be segregated in appropriately labelled containers.
- areas for the safe storage per waste types shall be established within the construction camps.
- waste management sheets per identified waste types shall be opened according to the template provided in annex 1 of the Government Decision no. 856/2002.
- the waste materials from reusable packages shall be returned to the suppliers or reused. In accordance with art. 20, alin. 2 of GD no. 621/2005[10], the economic operators owning package waste must:

[10] GD no. 621/2005 with further amendment on package management, package waste recycling and reuse

- ensure the reuse and recycling of package waste by own means or by delivering them to the authorized economic operators;
- report upon local environmental protection authorities' request the quantities of package waste managed in accordance with the legal provisions in force.

- the waste shall be transported for being reused/permanently disposed based on a documentation prepared for the waste transfer, as per GD 1061/2008.
- The constructor and administrator of NGPL and of its related stations shall set up sites for the temporary storage of domestic and associated waste and shall conclude a contract with the sanitation unit in the nearest settlement in order to remove the waste types.
- the largest part of the inert waste coming from excavations shall be recycled in the pipeline covering works or shall be used for provisional road works, platforms etc.
- the containers for the segregation of the reusable waste shall be appropriately labelled.
- the metal containers for the used oil storage shall be marked with the oil types and shall be located on fenced, concrete areas.
- any metal waste shall be stored in specially arranged sites, namely portable container within the construction camp, of the pipe dumps, as well as in the work location site. The constructor considers their regular reuse in units specialized in the metal waste recovery and recycling.
- no metal waste coming from the equipment repair works shall be stored on the pipeline route. The works are to be performed in specially arranged sites intended for the equipment maintenance activities.
- the waste shall not be stored near the watercourses or protection zones.
- the used oils from the electric transformers shall be managed by the electric company owning the transformer.
- the waste resulted on board of the pipe transport ships shall be taken by the specialized units in the port.

The waste management plan is in close connection with the following plans developed by the contractor:

- Plan on community health management
- Community liaison plan
- Employment and training plan
- Pollution prevention plan
- Traffic management plan Emergency response plan

5.3. TRANSBOUNDARY IMPACT ASSESSMENT DURING CONSTRUCTION AND COMMISSIONING PHASES

The transport of materials and personnel via roads, railways and waterways may determine the increase in the concentrations of atmospheric pollutants that may contribute both to the increase in the atmosphere's acidity and to the formation of the tropospheric ozone with direct and/or indirect effects on all the environmental components (vegetation, fauna, soil and water).

The impact assessment of the emissions from traffic associated on all the environmental components is presented in BBEIA and ROEIA.
The estimation of the atmospheric pollutant emissions was established on the basis of the emission factors included in documentation *EMEP – EEA pollutant emission inventory guidebook 2009 and the calculation methodology of the air pollutant emissions making use of the Guidebook of the European Environmental Agency – EMEP/CORINAIR Atmospheric Emission Inventory Guidebook, as well as the Guidebook EPA Air Chief) (*Table 5.2.3. above).

The impact area of air pollution due to the onshore traffic is maximum 50 m.

It is about 600 m between the Bulgarian bank and the border line, although the activity carried out onshore on the Romanian territory will have no impact on the Bulgarian territory and the activity undertaken on shore on the Bulgarian territory will have no impact on the Romanian territory. On the imaginary border line, the air pollution impact within the 50 m is both from the Romanian side to the Bulgarian side and from the Bulgarian side to the Romanian side. The work quantities are identical, and the effects depend on the weather conditions.

As already mentioned, neither construction camps for housing the workers nor pipe dumps will be located within the analyzed Natura 2000 sites.
The construction camp on the Romanian bank will be located at kp 51, Calopăr village, and the pipe dump at kp 19, Gângiova village.

- Technical solutions analyzed for Ogosta river crossing:
  - Trenchless method, during the summer low waters of the river

- Technical solutions analyzed for the Danube river crossing:
  - Open cut (1370.00 m proper crossing plus 630.00 m in the major riverbed)
  - Directional drilling (HDD) – 2000.00m crossing length

- Technical solutions analyzed for the Jiu river crossing:
  - Open cut (184.00 m for concrete coated pipe, 220.00 m undercrossing length in horizontal projection, 224.00 m developed length of undercrossing
  - Directional drilling (HDD) – *Distances between the axes of the dykes are about 680.00 meters: respectively from the left bank is about 270.00 meters and from the right bank is about 250.00 meters, the width of the river cross section being about 160.00 meters. Undercrossing length in this option is about 866.00 m in horizontal projection and the developed length of undercrossing is about 868.00 meters*

The designer considers that the duration of the Danube crossing works by open cut will be 6 months and for the trenchless method 4 months.

The matrix shown in table 5.3.1 below has been used for the assessment of the impacts on the environmental features.

Table 5.3.1.: Matrix for impact intensity assessment

Ref. no.	Impact intensity	Occurrence likelihood				
		A	B	C	D	E
		Unexpected, but foreseeable	Rare	Likely	Expected	Expected and recurring
0	No effect					
1	Very low effect					
2	Low					
3	Medium					
4	High					
5	Very high					

5.3.1. POTENTIAL TRANSBOUNDARY IMPACT IN THE CASE OF OGOSTA RIVER CROSSING

Ogosta river shall be crossed by trenchless method, during low waters in summer.

5.3.1. A. Potential transboundary impact in the case of routine condition

The possible impacts on the species and habitats , subject to protection within the site, shall be mitigated or avoided through implementation of the measures and plans, provided for in the Environmental Management and Monitoring Plan of the project. An Appropriate assessment (AA) for the protected site „Ogosta river" (BG0000614) has been developed in accordance with the national and European legislation, within the frameworks of the EIA procedure. This report on Appropriate assessment is an appendix to the EIA report and assesses the potential impact of the project on the Natura 2000 protected sites.
The subject of the study and EIA is the designaited species and habitats, including the fish types which are a priority for protection of the updated standard form for the protected site „Ogosta river" (BG0000614): *Zingel streber, Aspius aspius, Barbus meridionalis, Gobitis elongata, Gobitis taenia(=elangatoides), Eudonthomyzon mariae, Gobio albipinnatus, Gymnocephalus baloni, Gymnocephalus schraetzer, Misgurnus fossilis, Pelecus cultratus, Rhodeus sericeus amarus, Zingal zingel, Alosa pontica, Sabanejewia aurata.*

- If the drilling execution procedures are complied, no impact on the riverbed and Ogosta river water will occur. The envisaged activities will not affect the priority habitats within the protected site.

5.3.1. B. Potential transboundary impact in the case of non-routine event

If undesired events, such as the breaking of the drilling head during works, occur, pollution of underground and of Ogosta river water by bentonite may be generated. Bentonite is a natural, non-polluting element. Additives enabling the fluidization of bentonite are introduced into the bentonite for it to be used. They are in a very small quantity as compared to the bentonite quantity used. If the drilling is performed during winter, glycol, which is a toxic substance for aquatic organisms is additionally introduced. Under these circumstances, the significance of impact on fish species in Ogosta river water is the one shown in table 5.3.2. below.

Table 5.3.2.:Assessment of impact on fish species subject to protection on SCI Ogosta river

Impact	Magnitude	Sensitivity of the receptor	Significance of the impact
During construction			
Pollution	4 - high	D-high	D4
Disturbance	2-low	B-low	B2
During operation			
No impact			

The conclusions of the study are the following:

- Ogosta river shall be crossed within 50 days,
- If the impact mitigation measures proposed are adopted, namely the Ogosta river crossing during summer, no transboundary impact on the Danube river water will be generated, even if an unforeseen event, such as the breaking of the drilling head occurs.

The operation of the drilling rig may generate a temporary impact on air during this period, a local impact, with no transboundary influences.

5.3.2. POTENTIAL TRANSBOUNDARY IMPACT IN THE CASE OF JIU RIVER CROSSING

The Jiu river crossing section is located in ROSCI0045 Jiu Corridor

ROSCI0045 JIU CORRIDOR has been designated for the following fish species:

1146	Sabanejewia aurata
1149	Cobitis taenia
2491	Alosa pontica
1124	Gobio albipinnatus
1130	Aspius aspius
1134	Rhodeus sericeus amarus
1145	Misgurnus fossilis
1157	Gymnocephalus schraetzer
1159	Zingel zingel
1160	Zingel streber
2522	Pelecus cultratus
2555	Gymnocephalus baloni
4125	Alosa immaculata

From the **fish species of Community interest** listed in the standard form of site ROSCI0045 Jiu Corridor several species were identified on the route of the project on site (*Cobitis taenia, Aspius aspius, Rhodeus sericeus, Misgurnus fossilis, Gymnocephalus schroetyer, Zingel zingel, Zingel streber, Pelecus cultratus, Gymnocephalus baloni*) – see table 5.3.3 below.

Table 5.3.3. : Fish species described on the middle course of the Danube and on the lower course of the Jiu river in Zaval settlement area

Item	Code Natura 2000	Name of species	Common name	English Name	Protection STATUS[11]
1.		*Esox lucius*	northern pike	Northern Pike	
2.	*1149*	*Cobitis taenia taenia*	Spined loach	Spined Loach	Ber III, DH
3.	*1146*	*Sabanejewia aurata*	Sand Loach	Sand Loach	Ber III, DH, RL
4.	*1145*	*Misgurnus fossilis*	European weatherfish		
5.	*2491*	*Alosa pontica*	Black Sea Herring		
6		*Abramis brama*	carp bream	Carp Bream	
7.		*Alburnus alburnus*	bleak	Bleak	
8.	*1130*	*Aspius aspius*	Asp	Asp	Ber III, DH, RL
9.		*Barbus barbus*	Common Barbel	Barbel	
10.		*Barbus meridionalis*	Mediterranean Barbel	Mediterranean Barbel	Ber III, DH
11.		*Carassius auratus gibelio*	Prussian Carp	Prussian Carp	
12.		*Ctenopharyngodon idella*	Grass Carp	Grass Carp	
13.		*Cyprinus carpio carpio*	Common carp	Common Carp	RL
14.		*Hypophthalmicthys molitrix*	Silver carp	Silver Carp	
15.		*Lepomis gibbosus*	pumpkinseed sunfish	Pumpkinseed	
16.		*Leuciscus cephalus*	European chub	European Chub	
17.		*Leuciscus idus*	Ide	Ide	
18.	*2522*	*Pelecus cultratus*	sabre carp		
19.		*Pseudorasbora parva*	topmouth gudgeon	Stone Moroko	
20.	*1134*	*Rhodeus sericeus amarus*		Amur Bitterling	Ber III, DH
21.		*Rutilus rutilus*	Common Roach	Roach	
22.		*Scardinius erythrophthalmus*	Common rudd	Rudd	
23.		*Gobio kessleri*	Kessler's Gudgeon	Kessler's Gudgeon	Ber III, RL
24.	*1124*	*Gobio albipinnatus*	whitefin gudgeon		
25.	*2555*	*Gymnocephalus baloni*	Balon's ruffe	Danube Ruffe	RL
26.		*Gymnocephalus cernuus*	Eurasian Ruffe	Ruffe	
27.	*1157*	*Gymnocephalus schraetzer*	Schraetzer	Schraetser	RL
28.		*Perca fluviatilis*	European perch	European Perch	
29.		*Styzostedion lucioperca*	zander	Zander	
30.	*1159*	*Zingel zingel*	Zingel	Zingel	RL
31	*1160*	*Zingel streber*	Streber	Streber	RL
32.		*Silurus glanis*	Wels Catfish	Wels Catfish	

[11] BER – Bern Convention; DH- Habitats Directive; RL- Red List of Romania

The conclusions of the Nabucco document 70223-BB-RPT-EV-8001-0041 Appropriate Assessment- ROSPA0023 JIU-DANUBE CONFLUENCE and ROSCI0045 JIU CORRIDOR are the following:

The following options have been analyzed for the Jiu river crossing:

a) *The undercrossing of the Jiu river by open cut method will be achieved with concrete weighted pipeline on a length of 184.00 m, the flood protection dikes will be crossed by pipe ramming method using casings, with attached spacers, sealing devices, cathodic protection test facilities and vent device.*

b) *Undercrossing length in horizontal projection is about 220.00 meters and total length (developed) in this option is about 224.00 meters.*

5.3.2. A. Potential transboundary impact in the case of Jiu river crossing *by open cut method*

5.3.2. A.1. Potential transboundary impact in the case of Jiu river crossing *by open cut method* in routine condition

During construction phase

The excavation works in the riverbed have an impact on the aquatic ecosystem, including on the avifauna likely to be felt in the Jiu-Danube confluence zone, as well.

The increase in the water turbidity degree in the undercrossing area may occur in the dredging area. Moreover, there is the risk for local water pollution by suspended particles to occur. The mineral matters consist in sand particles, and the organic ones in dead organisms and organic substances. Their ecological importance is given by the fact that they serve as food for the smallest animal organisms. The aquatic soil disturbance results in the sudden increase in the concentration of suspended solids in water. Their dispersion is delayed by the existence of some disturbing factors or currents to slow down some processes. A larger amount of suspended matters for a longer period of time, the result of a repeated action on the water bottom may prevent the light from penetrating the depths. The lack of solar radiation affects the photosynthesis process in the aquatic organisms.

The impact on the aquatic organisms may be noticed by modification of the water physical-chemical quality, of the flow velocity in several river sections and by modification of the sub-layer configuration. By executing construction works in the rivers' minor streambed the species groups of aquatic organisms will be affected both in the construction area and on a variable distance downstream. The excavation works will cause the increase in the quantity of organic and mineral suspended materials, from the water, leading thus to a negative effect on all aquatic organisms, blocking the development of biological functions (breathing, feeding process) or of activities such as migration, reproduction. Likewise, a temporary modification of water chemistry with negative effects on organisms may occur during excavation, following the extraction of organic materials and mineral aggregates from the sub-layer.

During the works there will occur fragmentation of habitats, which may lead to unfavourable effects on the migration of species.

This type of impact cannot be avoided by using open-cut.

Impact on the Jiu riverbed and river banks

The deterioration of the Jiu river banks as a result of the excavation works results in an increase in the water turbidity.

The excavation works in the riverbed result in a loss of about 20% of the dredged material which is carried downstream.

The works are executed at kp 10 of Nabucco pipeline.

Figure 4.2. above shows a tendency of sedimentation of the silts carried along by the Jiu river towards the Romanian bank. No transboundary impact is anticipated on the Danube river, in the navigable channel, as a result of the Jiu river crossing works.
When completing the works, if no bank protection works are executed, the erosion process will continue, having negative influences on the pipeline stability.

During Nabucco gas pipeline operation
Due to the fact that Nabucco pipeline is buried, no impact on the aquatic ecosystem will occur.

During decommissioning
When completing the operation, a decision will be made on whether the pipeline will be abandoned in ground or removed from the ground. In the case of abandonment, no impact on avifauna is recorded after taking some protection measures, namely after completely emptying the pipeline. If it is decided to remove NGPL from the ground, the impact is similar to the one during pipeline installation.

5.3.2. A.2. Potential transboundary impact in the case of Jiu river crossing *by open cut method* in non-routine event

The presence of the dredging installations may result in a potential risk of pollution of river waters due to oil and fuel leakages from construction machines and vessels, discharge of bilge water and solid waste from construction vessels, etc.), with direct impact on aquatic life.
Uncontrolled waste storage may cause mortality for the fish fauna.
The lack of workers information about the prohibition period when the fish spawn, may lead to deliberate capturing/collecting of some species of community interest and fishing during the prohibition period
No cumulative impact is anticipated during high flood, considering that the works will be stopped if such phenomena occur.

The impact on fish species taking into consideration the situation mentioned at chap 5.3.2. A1. and 5.3.2. A2 is analyzed in table 5.3.4 below.

Table 5.3.4: Potential impact generated by NGPL construction on the fish species in ROSCI0045 Jiu Corridor by using open-cut method

		Open cut-method		
Type of impact		Magnitude	Sensitivity of the receptor	Significance of the impact
During construction				
Loss of individuals	During reproduction period	4-higher	D-higher	D4
	Outside sensitive periods	2-low	D-higher	D2
Fragmentation of species population	During reproduction period in sensitive sectors	4-higher	D-higher	D4
	Outside reproduction period	2-low	D-higher	D2
Deterioration of habitat quality	Pollution of water	3-medium	C -medium	C3

Type of impact		Open cut-method		
		Magnitude	Sensitivity of the receptor	Significance of the impact
Disturbance		4-higher	C-higher	C4
Loss of food base		2-low	D-higher	D2
During operation				
No impact				

5.3.2. B. Potential transboundary impact in the case of the Jiu river crossing *by trenchless method*

5.3.2. B.1. Potential transboundary impact in the case of Jiu river crossing *by trenchless method* in routine condition

If the drilling execution procedures are complied, then no impact on the Jiu riverbed or water will occur.
The envisaged activities will not affect the priority habitats within the protected site.

5.3.2. B.2. Potential transboundary impact in the case of the Jiu river crossing *by trenchless method* in non-routine event

If undesired events, such as the breaking of the drilling head during works, occur, pollution of underground and of Jiu river water by bentonite may be generated. Bentonite is a natural, non-polluting element. Additives enabling the fluidization of bentonite are introduced into the bentonite for it to be used. They are in a very small quantity as compared to the bentonite quantity used. If the drilling is performed during winter, glycol, which is a toxic substance for aquatic organisms is additionally introduced. Under these circumstances, the significance of impact on fish species in Jiu river water is the one shown in table 5.3.5. below.

Table 5.3.5.:Assessment of impacts on fish species subject to protection on ROSCI0045 JIU CORRIDOR by using the trenchless method for the Jiu river crossing

Impact	**Magnitude**	**Sensitivity of the receptor**	**Significance of the impact**
During construction			
Pollution	4 - high	D-high	D4
Disturbance	2-low	B-low	B2
During operation			
No impact			

5.3.2.C. **Conclusion and recommendation**:

- The Jiu river shall be crossed at kp 10, without recording a transboundary impact as a result of equipment operation in the crossing zone.
- The Jiu river will be crossed in 2 months if open-cut method is used and in 4 months if the trenchless method is used.
- Period when construction works using open cut may be performed so that the impact on fish species should be minimum, is between 15 June and the end of November
- If the Jiu river is crossed by the trenchless method, under normal operation of the drilling rig, no impact on the riverbed and aquatic ecosystem will occur.

- If the drilling head is damaged, when the crossing is performed when no glycol is necessary, no impact on the aquatic ecosystem of the river, which may influence the Danube ecosystem, will occur.
- The Jiu river crossing, irrespective of the crossing method, generates no transboundary impact on the social environment in the Republic of Bulgaria, given the distance to the borders. The operation of the drilling rig may generate a temporary impact on air during this period, a local impact, with no transboundary influences.

For the Jiu river crossing, the open-cut method should be used, as no priority species will be affected if the impact mitigation measures proposed in ROEIA are complied.

5.3.3. POTENTIAL TRANSBOUNDARY IMPACT IN THE CASE OF DANUBE RIVER CROSSING

Two crossing solutions have been analyzed for the Danube river crossing, namely:

a) Open cut crossing – time of execution: 6 months .
b) Trenchless crossing - time of execution: 4 months ..

The Danube river crossing section is located in ROSPA0023 JIU-DANUBE CONFLUENCE and ROSCI0045 JIU CORRIDOR. In the crossing section this two Natura 2000 sites overlap.

An appropriate assessment study has been done in Nabucco document 70223-BB-RPT-EV-8001-0041 Appropriate Assessment- ROSPA0023 JIU-DANUBE CONFLUENCE and ROSCI0045 JIU CORRIDOR

The conservation status of the fish species identified in the Danube river is shown in table 5.3.3. above.

The biological and ecological data on the fish species of Community interest affected by the project are presented in table 5.3.6 below.

Table 5.3.6 .: Biological and ecological data on the fish species of Community interest affected by the project,

Code	Species	Bio-ecological data
1130	Aspius aspius – asp fish	Reproduction occurs in spring, during March-April, when the water temperatures are of 6-10 degrees Celsius. Spawns are deposited on hard substrates in both rivers and lakes. Juvenile individuals (one year old) feed on plankton, while adults are predominantly ichthyophagous. In Romania, the presence of the species is reported in the Danube, and in the lower reaches of Danube's tributaries. It inhabits the Danube and the inland rivers from lowlands to the hills. Some individuals swim up the Danube's tributaries to breed in lakes or ponds and come back with decreasing water. It is generally a rheophilic species, but some individuals are adapted to specific stagnant water habitats.
1134	Rhodeus sericeus amarus	Its presence in aquatic habitats is dependent on the presence of lamellibranchiate of the Unio and Anodonta genera. Reproduction occurs during April-July, the eggs being laid in clutches every 10-12 days. Food is represented by unicellular and multicellular algae, plant tissues, debris and, less commonly, animal food. In Romania, the species is reported throughout the Danube, in the floodplain lakes and ponds and in some coastal lakes. It inhabits all major tributaries of the Danube located on Romanian territory and some of the smaller tributaries of these rivers. Exclusively freshwater species which prefers waters with low currents or sections of river with slower waters. It inhabits both the large rivers and smaller tributaries, being common in river secondary arms.
1145	Misgurnus fossilis	Reproduction occurs from March to June, when the females lay the spawns on vegetable substrate (eggs adhere to the substrate). The food consists of detritus, plant tissues, aquatic invertebrates, insect larvae and crustaceans. Although it previously had a wide distribution in Romania, inhabiting the lakes in the Danube floodplain, flood plains of major rivers, side segments of the lowland rivers and tributaries with relatively low flow rates and oozy substrate of the lower reach of large rivers, its present spreading area has narrowed greatly, with little reliable data on its current distribution. Habitat: Freshwater species inhabiting lentic or slightly running habitats with oozy substrate and abundant vegetation
1157	Gymnocephalus schraetzer	Reproduction occurs in spring, from April to May, spawns being deposited on hard substrates. Food consists of aquatic invertebrates. The species has been reported in the Danube. In Mureş is more common downstream of Arad in the Bega downstream of Timişoara, in Timiş downstream of Lugoj and in the Cerna at Orşova. Habitat: It is a rheophilic species whose presence was reported in the lower Danube and the rivers with low flow velocity and sand substrate.
1159	Zingel zingel	Reproduction occurs from March to April. The eggs are sticky and adhere to the substrate (gravel). Food consists of aquatic insects and larvae, aquatic invertebrates. It is a rheophilic species whose presence was reported in the Danube and the lower reaches of large rivers, on sandy or rocky substrate, in areas with strong currents of water.

1160	Zingel streber	Reproduction occurs in spring, from March to May. The eggs are deposited on rocks or branches and adhere to the surface of the substrate. The food is mainly animal: adult insects, insect larvae, aquatic invertebrates. Habitat: It is a rheophilic species whose presence was reported in the Danube and the rivers in lowland and hill regions, in areas with strong currents of water, on sandy or rocky substrate.
2522	Pelecus cultratus	Reproduction occurs in spring, in April-June, at water temperatures above 12 degrees Celsius, especially in ponds and lakes of the Danube floodplain. Adults retire in the Danube after reproduction. The eggs are hemipelagic and hatch 3-4 days after fecundation. In their first year of life juveniles are planctophagous. Adults feed on aquatic invertebrates, insect larvae, adult insects and fish. Habitat: It inhabits the waters of the Danube and the lower reach of large rivers, but also some large inland lakes, especially coastal lakes.
2555	Gymnocephalus baloni	Habitat: It is a rheophilic species whose presence was reported in the Danube and the rivers in lowland regions. It is a highly territorial species. It usually occupies deeper waters with hard substrate.

5.3.3. A. Potential transboundary impact in the case of Danube river crossing *by open cut method*

5.3.3. A.1. Potential transboundary impact in the case of Danube river crossing *by open cut method* in routine condition

During construction phase

The impact on air, soil and water quality is analyzed in table 5.3.7 below, taking into account table 5.2.4. above .

Impact on the Danube navigable channel

The deterioration of the Danube river banks as a result of the excavation works results in an increase in the water turbidity.
The excavation works in the riverbed result in a loss of about 30% of the dredged material carried downstream.
Chapter 5.2.3 above analyzes, on the basis of the Mathematic model of hydraulic type HEC-RAS, how the material lost in the work execution process (excavation, loading in mud lighters and transport of excavated material for temporary storage, and the reverse process of the stored material excavation, loading in mud lighters, transport and unloading for covering the pipeline) is carried along downstream.

According to the data shown downstream the pipeline centreline– Bechet (km 684+100 – km 678+660) the riverbed morphological changes are characterized by the degradation of the mobile riverbed. Due to this specific character, no additional aggradation evolutions are expected due to the volume of material dragged.
As a result of the hydraulic calculations performed, the quantity of silts carried along downstream is not bigger than the one carried along in case of high water on the Danube River. A part of the silt material is the volume carried by the water current and is formed of the additional suspended silts in the Danube river. It is estimated at about 30% of the total volume V_2= 100.000 m^3. It is considered that if the works last for about 20 days, and the specific weight of those silts is approx.. W_S=2t/m^3 , then it will be obtained an additional daily rate of $Q`_s$=10,000 t/day
As compared to the average flow rate of the Danube of about $Q_{m.m.a}$ =7000m^3/s , the suspended rate is approx.. Q_s=30,000t/day , the increase rate represented by the volume of dragged material is about 30%, i.e. a total suspended silt rate of about Q_s=40,000t/day. This solid rate is recorded by the Danube river for a liquid increase rate of about 1000 m^3/s, i.e. the water flow rate of Q=8000m^3/s. It is worth mentioning that no sedimentation phenomena are recorded in Bechet – Leovo area under these circumstances.

During Nabucco gas pipeline operation

Due to the fact that Nabucco pipeline is buried, no impact on the aquatic ecosystem will occur.

During decommissioning

When completing the operation, a decision will be made on whether the pipeline will be abandoned in ground or removed from the ground. In the case of abandonment, no impact on avifauna is recorded after taking some protection measures, namely after completely emptying the pipeline. If it is decided to remove NGPL from the ground, the impact is similar to the one during pipeline installation.

Table 5.3.7.: Potential transboundary impact generated by the Danube river crossing by NGPL using open cut-method, in routine conditions

Environmental characteristics	*Activity/Potential Impact*	*Probability/ Magnitude*[12]
Air	**Traffic** The transport of materials and personnel via roads, railways and waterways (see figures 2.5 and 2.6 above) may determine the increase in the concentrations of atmospheric pollutants that may contribute both to the increase in the atmosphere's acidity and to the formation of the tropospheric ozone with direct and/or indirect effects on all the environmental components (vegetation, fauna, soil and water). This increase in the concentrations of atmospheric pollutants is local, and ROEIA Report and BBEIA Report do not prove the occurrence of a transboundary impact.	A0
	The transport of pipes and other materials on the Danube river belongs to the category of international transport on the Danube river. Both Romania and Republic of Bulgaria are Part of the Convention on the navigation on the Danube river and have taken the risks coming from it.	A0
Air	**Equipment operation** The emissions coming from the operation of the equipment located onshore are local, with no transboundary impact, given the distance of about 500 m to the border line- see ROEIA Report and BBEIA Report.	A0
	As regards the dredging works, the works shall be executed by the same dredger in the border zone. Practically, the emissions that will reach Romania as a result of the works performed on the Republic of Bulgaria shall be similar to those reaching the Bulgarian territory as a result of the works performed on the Romanian territory. The impact on air can be considered negligible in the border zone, namely in the middle of the Danube river.	A0
River banks	**Bank deterioration.** The deterioration of the Danube river banks as a result of the excavation works results in an increase in the water turbidity. Given the size of the receptor, this increase in water turbidity is felt especially in the work zone. When completing the works, if no bank protection works are performed, the erosion process will continue, having negative influences on the pipeline stability.	D3
Riverbed	**Excavation works in the Danube riverbed** The excavation works in the riverbed result in an increase in the water turbidity with negative influences on the aquatic environment.	D3

[12] "Probability/magnitude" refers to transboundary effects. The local impact is analyzed in ROEIA and BBEIA reports.

Environmental characteristics	*Activity/Potential Impact*	*Probability/ Magnitude*[13]
Aquatic ecosystem	The increase in the water turbidity degree in the undercrossing area may occur in the dredging area. Moreover, there is the risk for local water pollution by suspended particles to occur. The aquatic soil disturbance results in the sudden increase in the concentration of suspended solids in water. Their dispersion is delayed by the existence of some disturbing factors or currents to slow down some processes. A larger amount of suspended matters for a longer period of time, the result of a repeated action on the water bottom may prevent the light from penetrating the depths. The lack of solar radiation affects the photosynthesis process in the aquatic organisms. The invertebrate and the species with slow movement are mainly affected.	D2
	If the works are performed during fish breeding, a high negative impact may be recorded on larvae and spawn, by destructing them.	D4
	The impact on the aquatic organisms may be noticed by modification of the water physical-chemical quality, of the flow velocity in several river sections and by modification of the sub-layer configuration. By executing construction works in the rivers' streambed the species groups of aquatic organisms will be affected both in the construction area and on a variable distance downstream. The excavation works will cause the increase in the quantity of organic and mineral suspended materials, from the water, leading thus to a negative effect on all aquatic organisms, blocking the development of biological functions (breathing, feeding process) or of activities such as migration, reproduction. Likewise, a temporary modification of water chemistry with negative effects on organisms may occur during excavation, following the extraction of organic materials and mineral aggregates from the sub-layer. The ecological importance of the mineral matters (consist in sand particles, and the organic ones in dead organisms and organic substances) is given by the fact that they serve as food for the smallest animal organisms.	D3
	The excavation works result in a temporary fragmentation of the habitat.	D3

5.3.3. A.2. Potential transboundary impact in the case of Danube river crossing *by open cut method* in non-routine event

The transboudary impact is analyzed in table 5.3.8 and 5.3.9 below, taking into account table 5.2.5. above.
No cumulative impact is anticipated during high flood, considering that the works will be stopped if such phenomena occur.

[13] "Probability/magnitude" refers to transboundary effects. The local impact is analysed in ROEIA and BBEIA reports.

Table 5.3.8.: Potential transboundary impact generated by the Danube river crossing by NGPL using open-cut method, in non-routine event

Environmental characteristics	Activity/Potential Impact	Probability/ Magnitude[13]
Surface water	**Presence of dredging installations** The presence of the dredging installations may result in a potential risk of pollution of river waters due to oil and fuel leakages from construction machines and vessels, discharge of bilge water and solid waste from construction vessels, etc.).	D3
	If water is polluted by oil and fuel, and no immediate measures for retaining the pollution spot are taken , it may propagate downstream. Depending on the severity of pollution, the pollution wave may propagate to the Oreahovo and Bechet port area, thus preventing the ferry crossing activities.	D4
	Hydrostatic test Accidental pollution of the Danube river water if the water used for hydrotest is not appropriately treated before being discharged into the river.	D3
Birds	**Presence of dredging installations** The Danube crossing by open-cut results in the disturbance of the water and noise. In this case, the waterfowl will no longer use the work zone as feeding site	D2
Fish stock	Not complying with the fishing prohibition periods during construction may result in a significant impact on the fish stock.	D4
	The deliberate capture/collection of some species of community interest by workers and fishing during the prohibition period as a result of the lack of information	D2
	The accidental pollution of the Danube water by oil and fuel and uncontrolled waste storage may cause mortality for the fish fauna.	D2
Social impact	**Presence of dredging installations** Temporary impact on fishermen during construction	D3
	Impact on the traffic on the Danube river. The works shall be performed without disrupting the traffic on the Danube river. The ships will inform the competent authorities in the two countries, and the constructor will withdraw its work equipment. The traffic will be disrupted in the 3-4 days needed for pulling the pipeline. During the works, a Navigation Plan will be applied by the constructor together with the authority for navigation.	D1
	It is worth mentioning that no sedimentation phenomena are recorded in Bechet – Leovo area (see above explanation).	D0

The impact on fish species taking into consideration the situation mentioned at chap 5.3.2. A1. and 5.3.2. A2 is analyzed in table 5.3.9 below.

Table 5.3.9: Potential impact generated by NGPL construction using open-cut method on the fish species in the Danube river

		Open cut-method		
Type of impact		Magnitude	Sensitivity of the receptor	Significance of the impact
During construction				
Loss of individuals	During reproduction period	4-higher	D-higher	D4
	Outside the sensitive periods	2-low	D-higher	D2
Fragmentation of species population	During reproduction period in sensitive sectors	4-higher	D-higher	D4
	Outside the reproduction period	2-low	D-higher	D2
Deterioration of habitat quality	Pollution of water	3-medium	C -medium	C3
Disturbance		4-higher	C-higher	C4
Loss of food base		2-low	D-higher	D2
During operation				
No impact				

5.3.3. B. Potential transboundary impact in the case of the Danube River crossing *by trenchless method*

5.3.3. B.1. Potential transboundary impact in the case of the Danube River crossing *by trenchless method* in routine condition

If the drilling execution procedures are complied, no impact on the Danube riverbed and water will occur.
The envisaged activities will not affect the priority fish species within the protected site.

5.3.3. B.2. Potential transboundary impact in the case of the Danube River crossing *by trenchless method* in non-routine event

If undesired events, such as the breaking of the drilling head during works, occur, pollution of underground and of the Danube river water by bentonite may be generated. Bentonite is a natural, non-polluting element. Additives enabling the fluidization of bentonite are introduced into the bentonite for it to be used. They are in a very small quantity as compared to the bentonite quantity used. If the drilling is performed during winter, glycol, which is a toxic substance for aquatic organisms is additionally introduced. Under these circumstances, the significance of impact on fish species in Danube river water is the one shown in table 5.3.10. below.

Table 5.3.10.:Assessment of impacts on fish species subject to protection on ROSCI0045 JIU CORRIDOR using trenchless method for Danube river crossing

Impact	Magnitude	Sensitivity of the receptor	Significance of the impact
During construction			
Pollution	3-high	D-high	D3
Disturbance	2-low	B-low	B2
During operation			
No impact			

5.3.3.C. Conclusion and recommendation for the Danube River crossing:

HDD

- The Danube river shall be crossed at kmr 685+300, without recording a transboundary impact as a result of equipment operation in the crossing zone.
- The works on the Romanian bank shall be executed from behind the protection dike, and the works on the Bulgarian bank in front of the protection dike without affecting it.
- If the Danube river is crossed by the trenchless method, under normal operation of the drilling rig, no impact on the riverbed and aquatic ecosystem will occur.
- If the drilling head is damaged, when the crossing is performed when no glycol is necessary, no impact on the aquatic ecosystem of the river, which may influence the Danube ecosystem, will occur.
- The Danube River will be crossed in 4 months if the open-cut method is used and in 6 months if the trenchless method is used.

Open cut

In case of choosing the open cut method the following potential transboundary impacts are expected during the construction phase:

- Potential significant impacts on the quality of river waters (increase in water turbidity, accidental non-routine events), Impacts on ambient air due to gas and dust emissions generated by construction machines and vessels. This impact will be local only in the border area (middle of the river) The impact has been assessed in RREIA Report and BBEIA Report
- Impacts on river ecosystem – the local habitats and all food-dynamic modules in aquatic ecosystems which are likely to be affected due to the disturbance of the substrate, increase in water turbidity, water pollution, destruction of habitats of invertebrates, amphibians and fish, disturbance of fish migration, disturbance of the terrestrial fauna and flora connected with aquatic fauna and flora, etc.;
- Impacts on socio-economic environment due to difficulties and limitation for the river transport.
- Impact on traffic safety during construction
- Period when construction works using open cut may be performed so that the impact on fish species be minimum, is between 15 June and end of November and will respect the period of fish prohibition (spawning).
- As compared to the average flow rate of the Danube of about $Q_{m.m.a}$ =7000m^3/s , the suspended rate is approx.. Q_s=30,000t/day , the increase rate represented by the volume of dragged material is about 30%, i.e. a total suspended silt rate of about Q_s=40,000t/day. This solid

rate is recorded by the Danube river for a liquid increase rate of about 1000 m^3/s, i.e. the water flow rate of Q=8000m^3/s. It is worth mentioning that no sedimentation phenomena are recorded in Bechet – Leovo area under these circumstances.

The following potential transboundary impacts are expected during operation stage:

- No transboundary impacts are expected during the operation stage of the project, except the emergency cases and accidents in close vicinity to the Bulgarian-Romanian border and the Danube crossing. If an attempt occurs, the pipeline may break and gas emissions generated by big fires and explosions may be released into the ambient air.
- The pipeline burial depth has been calculated by considering the erosion in the area, the possibility for a ship in danger to cast its anchor or the discharge of a heavy quantity of material over the pipeline (see appendix 12).

When completing the operation, a decision will be made on whether the pipeline will be abandoned in ground or removed from the ground. In the case of abandonment, no impact on avifauna is recorded after taking some protection measures, namely after completely emptying the pipeline. If it is decided to remove NGPL from the ground, the impact is similar to the one during pipeline installation.

Considering the appropriate assessment result (Nabucco document 70223-BB-RPT-EV-8001-0041 Appropriate Assessment- ROSPA0023 JIU-DANUBE CONFLUENCE and ROSCI0045 JIU CORRIDOR), for Danube river crossing, HDD method should be used**.**

5.4. CUMULATIVE TRANSBOUNDARY IMPACT

According to Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991), *Transboundary impact*" means any impact, not exclusively of a global nature, within an area under the jurisdiction of a Party caused by a proposed activity the physical origin of which is situated wholly or in part within the area under the jurisdiction of another Party.
Directive 85/337/EEC, and the subsequent amendment (11/97/EC) requires that an EIA should include:
„A description of the aspects of the environment likely to be significantly affected by the proposed project, including, in particular, population, fauna, flora, soil, water, air, climate factors, material assets, including the architectural and archaeological heritage, landscape and the interrelationship between the above factors. This description should cover the direct effects and any indirect, secondary, cumulative, short, medium and long term, permanent and temporary, positive and negative effects of the project."
The EIA Directive also requires that the "inter-relationships" and "interactions" between specified environmental effects should be given explicit consideration.
The EU Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions provide the following definition of cumulative impacts as "impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project".
The Habitats Directive, Article 6(3) specifies that "Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives."

In case of a line construction such as NGPL, the cumulative effects must be considered over long distances in a relatively narrow corridor and reflect a wide range of developments and interests likely to contribute to the cumulative effects.
The following methods for identifying the ecosystem components likely to be affected by a cumulative impact have been used:

- Taking aerial photos within the 500 m corridor of NGPL;
- Field surveys on flora and fauna;
- Hydrological, hydro-geological and geotechnical surveys;
- Social surveys based on questionnaires, consultation of the local public administration representatives based on specially developed questionnaires,
- Consultation of the authorities, as well as of the utility owners or of the project developers in the project's area of influence.

Last but not least, the experts' opinion has been considered.

The CEA spatial boundaries will reflect the pipeline corridor and the project's area of influence that includes the related and associated facilities (e.g. access roads, borrow pits, off-take infrastructure), and include airshed or areas of land or water directly disturbed as a result of the Nabucco Project.
Temporal Boundaries will cover developments within or affecting the Area of Influence that are:

- Past: actions that are abandoned but still may cause effects of concern. There are no abandoned actions within the project.

- Existing: currently active actions.

- Future: actions that may yet occur. It is highly likely for the gas supply network in the area to be connected to Nabucco pipeline. Moreover, the following project have been considered:

Bulgarian bank

No anticipated cumulative impacts in transboundary context is expected as a result of the development of all the investment proposals situated on the territory of SCI Reka Ogosta or in its vicinity, respectively:

– "High pressure transmission gas pipeline" which crosses Nabucco pipeline at kp 416.9 and
- The two installations of the "Wind power plants project"

All other projects listed in BBEIA Report are far enough from the pipeline route not to have significant impact on the Danube river.

No cumulative impacts are expected during operation of the project, as Nabucco pipeline is completely buried in the Danube crossing zone.

Romanian bank

There are no proposals of new projects.

The Danube River

An ISPA project was approved in 2005. It ensures technical assistance for improving some Danube sections for navigation, especially on the relatively long sector along the Romanian-Bulgarian border from Portile de Fier II up to Silistra/Călăraşi, as well as Brăila-Sulina canal, the Danube –Black Sea canal and Poarta Alba-Midia Năvodari canal on the Romanian territory.

The Report to the Environmental Impact Assessment prepared within the contract „Technical Assistance for Improving the navigation conditions on the Romanian – Bulgarian joint section of the Danube river and related studies", reference

EUROPEAID/122137/D/SV/RO shows that one of the critical points for navigation lies between rkm728 and rkm 721 Archar Outlet-Alimanu and between rkm679 and rkm 673, namely the area Carabulea: Bechet/Oriahovo. The areas where works for improving the navigation conditions are proposed on the Romanian-Bulgarian joint section of the Danube River, in close proximity of Nabucco pipeline location are shown in fig. 5.4.1 and 5.4.2 below.

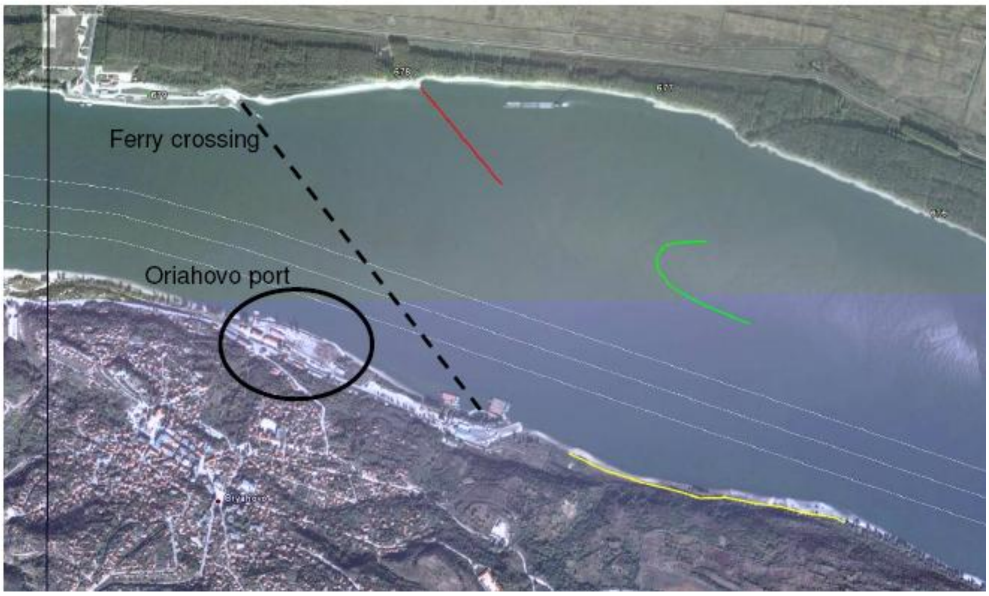


Figure 5.4.1.: Location of construction works in the optimized alternative in relation to the ferryboat crossing points Bechet-Oreahovo

The works proposed for improving the navigation conditions on the Romanian-Bulgarian joint sector of the Danube may have an impact on the sectors upstream and downstream of the critical sectors.

Cumulative effects on fish are likely to occur in the construction stage, if the works are performed at the same time, as a result of the water turbidity and air pollution during the Danube River crossing by using the open-cut-method.

Kozloduy power plant related activities have been taken into consideration.
According to the map (appendix 3), Kozloduy power plant is located about 7,200 m far from the Danube crossing site. If the water transports serving the power plant take place at the same time with the transports intended for the Nabucco pipeline works or during the Danube crossing, then a cumulative impact may occur as a result of air pollution.

Table 5.4.1 below identifies the Valued Ecosystem Components that could be affected by the cumulative impact of Nabucco Project. The changes in the major components of the ecosystems are noted as follows:

Negative cumulative impact with major significance	
Negative cumulative impact with moderate significance	
Negative cumulative impact with minor significance	
No cumulative impact	x
Positive cumulative impact	

Figure 5.4.2.: Planned Works within Natura 2000 sites in the area between Kozlodui -Ostrov

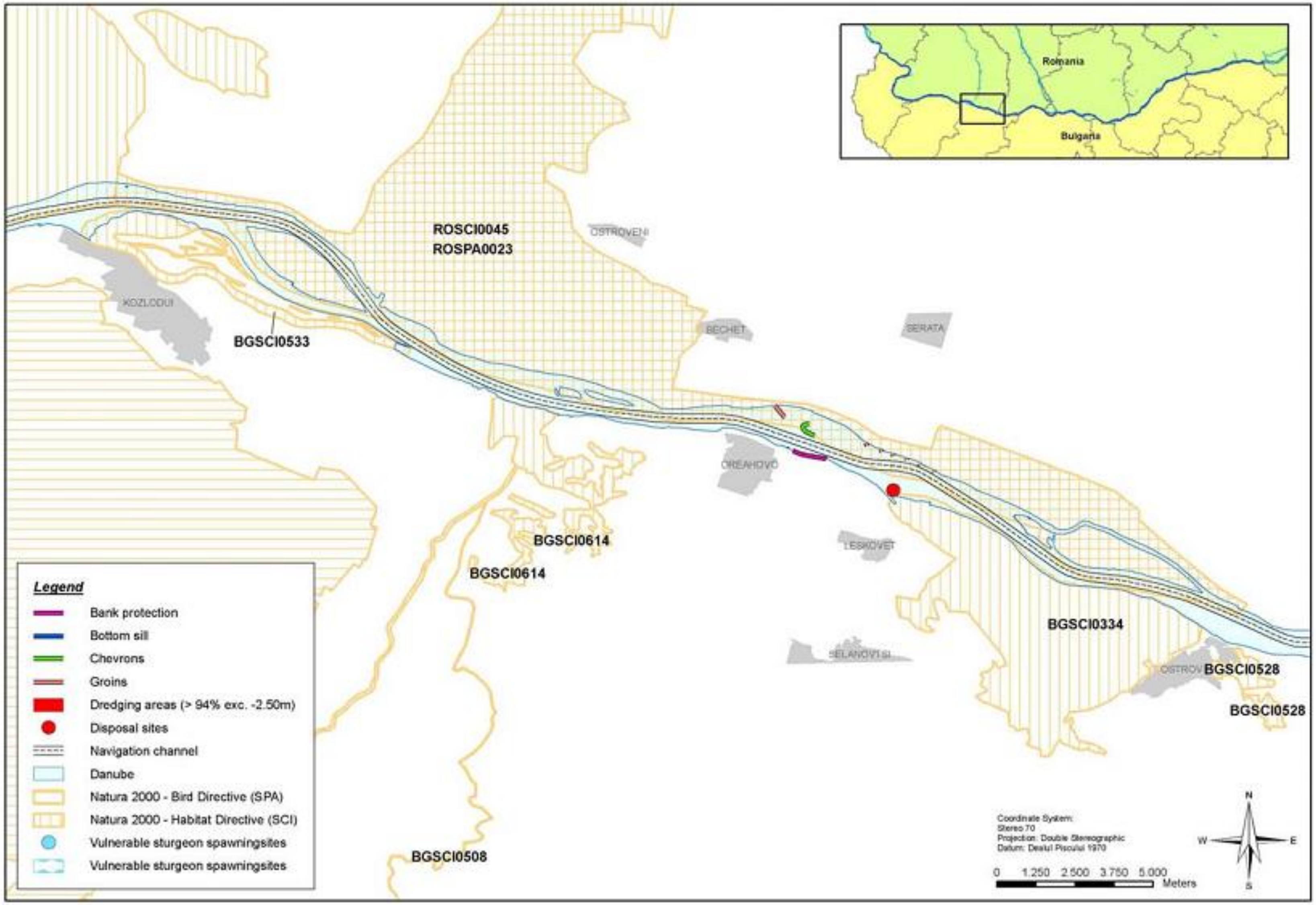


Table 5.4.1: Matrix for the identification of the major cumulative effects in the transboubdary. context

Activity under the Nabucco Gas Pipeline Project/Other investment projects	Environmental components							
Activity under the Nabucco Project which generate cumulative effects	Ambient air	Surface water	Groundwater	Soil	Noise	Waste	Cultural heritage	Biodiversity
From additional road traffic during the construction		x	x	x		x	x	x
Crossing of river by open cut	x		x	x	x	x	x	
From auxiliary facilities temporary bases and construction camps	x	x	x	x			x	x
Combined cumulative effects with other projects during the construction of the Nabucco gas pipeline								
Navigation on Danube			x	x			x	x
<u>Project: Improving the navigation conditions on the Romanian – Bulgarian joint section of the Danube river</u>			x	x			x	
Combined cumulative effects with other projects during the operation of the Nabucco gas pipeline								
During the transportation of natural gas and maintenance of the gas pipeline	x	x	x	x	x	x	x	x

6. DESCRIPTION OF MITIGATION MEASURES TO KEEP ADVERSE ENVIRONMENTAL IMPACT TO A MINIMUM

The implementation of the envisaged mitigation measures in the project will decrease the significance of the expected impacts.

The matrix 5.3.1 has been used for the residual impact assessment
The transboundary impact mitigation measures refer to both methods analyzed regarding the Danube crossing by considering the two Danube crossing methods, as well as the construction, commissioning and operation stages and measures taken at the expiry of the pipeline lifetime.
The measures for mitigating the impact during construction, operation and decommissioning are structured as follows:

- Measures proposed by technical project
- Measures on equipment
- Management measures
- Measures on behaviour
- Compensatory measures

The constructor must implement these measures, and NIC shall monitor their implementation.

6.1. Impact mitigation measures during geological surveys as well as during water transport

Irrespective of the crossing method adopted, geological surveys shall be undertaken and the linepipes and other materials shall be transported. Assuming that the pipes are brought by water transport, table 6.1 below proposes impact mitigation measures in the two above-mentioned situations.

Table 6.1: Impact mitigation measures during geological surveys, as well as during water transport

Impact	Impact mitigation measures	Residual Impact	
			Probability/ Magnitude
Danube river pollution as result of the geological and topographical surveys	**Design and precondition** The technical solutions set by the designer must be based on geotechnical and hydrogeological surveys with a view to ensuring a minimum impact of the objective on soil and on groundwater. Moreover, soil aggressiveness analyses shall be conducted. *Effects: Substantiation of the works designed from the geotechnical point of view and establishing the crossing solution*	None	
	Equipment The chemical analysis of phreatic water must be conducted in specialized laboratories by representative samples collected by personnel qualified for such operations. *Effects: Ensuring the quality and accuracy of results*	None	
Danube river pollution as result of the geological and topographical surveys	**Management** The drilling rig shall be well anchored onto the platform, in order to avoid pollution of the Danube water. In case of high flood or strong wind, the rig shall be removed. *Effects: Pollution prevention of the Danube River waters*	None	
	Behaviour Personnel training The construction works must not be commenced before ensuring the correct storage sites for materials and products.	None	
	Offsets None	None	

Activity	Impact mitigation measures	Residual Impact	
			Probability/ Magnitude
Danube river pollution as a result of the water transport	**Design and precondition** According to *MARPOL73/78*, "all ships must be equipped with bilge water filtration and separation systems in order to prevent the seawater pollution by hydrocarbons". Moreover, according to the *Convention on the navigation* on the *Danube* [14] and to the Convention for the Danube river protection[15], the ships navigating on the Danube must be equipped with such systems. To prevent the water pollution, the national and international legislation forbids and sanctions the throwing overboard of the garbage coming from the crew's activity and from the ship operation. The port services must facilitate the waste delivery upon request without generating excessive delays to the ships. For sanitary reasons, the waste materials collected from ships are considered infested, therefore their collection, transport and treatment follow special rules.	None	
	Equipment The collection of waste and its delivery to the port services in charge of the waste collection, storage, transport and treatment is mandatory both during the navigation and when the ship is in port or in the port road.	None	
	Management Waste segregation **Behaviour** Personnel training on the legislation in the field **Offsets** None	None	
	Effects: Pollution prevention of the Danube River waters	None	

[14] *Convention on the regime of the navigation on the Danube, signed* at Belgrade *on* 18 august 1948.
[15] Convention on the cooperation for the protection and sustainable use of the Danube river (Convention for the Danube river protection), signed at Sofia, on 29 June 1994

6.2. IMPACT MITIGATION MEASURES DURING CONSTRUCTION

6.2.1. IMPACT MITIGATION MEASURES IN THE CASE OF THE DANUBE RIVER CROSSING BY OPEN CUT

River Basin Management Plans containing objectives and proposals of measures for the protection of environment and water bodies have been prepared both in the Republic of Bulgaria and in Romania based on the Framework Directive on the policy in the water field.

The main purpose of the WBMP is reaching, keeping and improving the good condition of waters in the Danube region for basin management until 2015
Depending on the current status of the water bodies, the specific ecological purpose for surface water is generally to avoid the deterioration of the ecological status and to reach a moderate or a good status. The specific ecological purpose for the groundwater body is keeping the good condition of the groundwater or reaching the good condition of the ground waters.
For the drinking water protection areas the purpose is: "reducing the necessity for water treatment/purification before its use and assuring the design quantity in water.
For the areas, in which the waters appear sensitive to biogenic elements, the purposes are: "reducing and/or avoiding the further contamination by nitrates of the surface waters from agricultural sources into the threatened and vulnerable areas until 2015" and "reducing and/or avoiding the further pollution by biogenic elements of the surface waters in the sensitive areas until 2015"
For these ecological purposes to be reached in the WBMP there have been envisaged programs with measures for preventing and reducing the anthropogenic pressure (point and diffuse sources of pollution), the pollution resulting from failures and impact on water resources, including measures concerning the areas for water protection.

As already mentioned, an appropriate assessment study has been prepared for the two Natura 2000 sites, respectively ROSPA0023 JIU-DANUBE CONFLUENCE and ROSCI0045 JIU CORRIDOR.
The mitigation measures for the impact on birds must consider the species phenology and their habitat needs and living conditions. The disturbance of the nesting (migratory and sedentary) species must be avoided in the breeding, nesting and brood-rearing period (especially March- beginning of August).

For the migratory passage species, especially aquatic species of cormorants, ducks and gulls, the passage occurs in September, October and early spring, especially depending on the climate conditions in that year. During that time period, thousands of specimens transit the area and stop for food and rest. To avoid the disturbance of birds during that time period the abovementioned passage months must be avoided when planning the works. The Jiu Corridor is also an important natural area for the wintering of a species with conservation value (annex I, Birds Directive): *Phalacrocorax pygmaeus.*

The species presence in the site has been confirmed, but in a low number of individuals at the beginning of the passage period (March). It is highly likely that the Pygmy cormorant may have preferred other wintering areas in the site due to the high river water this year (e.g. Jiu's discharge mouth into the Danube) and that is why it has not been observed in winter.

Table 6.2. below show the mitigation measures in the case of the Danube river crossing by open cut.

Table 6.2: Impact mitigation measures during the Danube river crossing by open cut in routine condition.

Impact	Impact mitigation measures	Residual Impact	
			Probability/ Magnitude
Impact on baseline condition as results of pipeline excavation and installation	**Design and precondition** Acquiring the appropriate permits from the administrators of streams, channels and flood protection works.	None	
	Equipment Suitable equipment maintained according to the legal requirements Appropriate signalling of works	None	
	Management Execution of stream crossing works during low water periods *Effects: Reducing the crossing duration*	None	
	Support measures for the trench bank *Effects: Avoiding the bank erosion and the occurrence of pipeline instability*	None	
	Behaviour Compliance with the requirements in the permits of the owners of utilities crossed Compliance with conditions in the water management permits and in the environmental consent	None	
	Offsets None	None	
Water pollution as result of Hydrostatic Test	**Design and Pre-Condition** Assess quantity required, source and discharge point. Acquire appropriate licenses. Avoid use of additives. **Hardware** Pumps and hoses Settling tanks **Management** Hydrotest in summer months so no use of glycol Reuse as much water as possible, shunting it into next pipe section Where possible discharge to same catchment area. Control discharge to avoid erosion to river bed and banks. Filter discharge. *Effects: Avoiding pollution of soil, groundwater and watercourse , the bank erosion* **Behaviour** Follow abstraction and discharge requirements **Offsets** None	Use of large water volumes	D1

Impact	Management measures	Residual impact	Probability/ Magnitude
Impact on navigation	The technical design for the Danube crossing for the open cut option shows that the trench cover and excavation works will be executed by keeping the traffic of the ships and convoys on the Danube open. The type and number of the floating equipment shall be established by the constructor, complying with design sizes and with the quality conditions imposed and by assuming the deadline for the work completion. Moreover, the constructor shall take all the measures for withdrawing the floating equipment to the bank, outside the navigable channel, when the work zone is transited by ships/convoys. The traffic will be disrupted only when the pipeline is pulled from one bank to another by previously informing A.F.D.J. Galați and its Bulgarian counterparts on the time when the navigation is closed in the crossing area. The duration of disruption (estimated at 3-4 days) and the exact period when this will happen shall be jointly established between the constructor, beneficiary and authorities with responsibilities in the assurance of the navigation conditions on the Danube in Romania (AFDJ Galați) and in Bulgaria	Possible little delays during pipeline pulling period	**D2**
Impact on fishermen	Planning the works so that crossing could be performed in the shortest time possible from the technical point of view and considering the weather conditions	The impact cannot be completely avoided	**D1**
Impact on fish	Execution of stream undercrossing works through open cut outside the fishing prohibition periods	The losses of individuals cannot be avoided as a result of the increase in water turbidity and reducing of biota in the undercrossing area	**D2**
	Water for conducting the hydrostatic test will be extracted from the Danube by pumps fitted with strainer with filter.		
	The waste generated shall be segregated and managed according to the Waste management plan.	None	
Impact on bird's species	Location of construction camps and pipe dumps in the anthropogenic areas, outside Natura 2000 site	**None**	
	A low level of human intervention must be maintained during that period.	**None**	
	Crossings in ROSPA0023 Jiu-Danube Confluence	Possible disturbance of	**D3**

	outside the bird nesting period. This is difficult to achieve, as the crossing period without a significant impact on the bird species is August.	the water flow	
	The noise generated by equipment activity shall be abated to minimum.	**None**	
	The waste generated shall be segregated and managed according to the Waste management plan.	**None**	

Table 6.3. below shows impact mitigation measures during undercrossing of the Danube river by open cut in non-routine event .

Table 6.3.: Management measures for impact mitigation during undercrossing of the Danube river by open cut in non-routine event.

Impact	Management measures	Residual impact	
			Probability/ Magnitude
Accidental pollution of soil and water by oil and fuel	Appropriate maintenance of equipment Daily information on the weather forecasts and the hydrological warnings regarding the RoW for removing the equipment from the floodable area in case of high water Storage and careful handling of hazardous substances under safe conditions The equipment shall be supplied by modern tank cars enabling the connection to the supply systems without leaks. If a fuel tank must be mounted, it shall be above-ground, and a tank for retaining the leaks in case of damage shall be envisaged underground. Immediate measures for cleaning the polluted area shall be taken in case of local leaks of hydrocarbons. Collection and segregation of waste according to the Waste management plan Ensuring the stability of the dredging installation in case of the trench excavation Periodical checking of the equipment and operative intervention in case of failures Equipment removal from the riverbed in case of flooding event Selective collection, appropriate storage and disposal of waste Performing simulations regarding the emergency situations in case of accidental pollution with impact on water resources, soil and underground. Ecological toilets shall be used at the working points; they shall be scooped by authorized operators. The constructor shall elaborate and put into practice the **Accidental Pollution Prevention Plan.**	**None**	

	Effects: Accidental pollution prevention		

Following is recommended: the works should start at the end of July, so that the works may be extended to autumn until the winter season, if there are recorded Danube water levels likely to trigger work disruption –

6.2.2. IMPACT MITIGATION MEASURES IN THE CASE OF THE DANUBE RIVER CROSSING BY HDD

The Danube River crossing by HDD will mitigate the direct impact on water quality and on the aquatic environment. The use of bentonite for performing the drilling may have an impact on water quality unless the measures proposed in table 6.4 below are taken.

Table 6.4 : Impact mitigation measures during the Danube river crossing by trenchless method in routine conditions

Impact	Impact mitigation measures	Residual Impact	
			Probability/ Magnitude
Pollution of air, soil and water; noise	**Design and precondition** The technical solutions set by the designer must be based on geotechnical and hydrogeological surveys with a view to ensuring a minimum risk during the execution of works **Equipment** Selection of appropriate drilling equipment, depending on the drilling parameters, use of equipment for the localization of the drill head. **Management** The drilling suspension (mixture of water and bentonite – natural clay soluble in water) shall be stored in a pit. The drilling waste is managed and not directly discharged into the river. When completing the works, this suspension shall be dried and stored in a waste dump. The use of additives shall be avoided. The drilling works shall be performed outside the cold periods. *Effects: Prevention of soil and water pollution* The noise generated by the drilling activity shall be abated to minimum. *Effects: abating the noise to minimum* The waste generated shall be segregated and managed according to the Waste management plan. *Effects: avoiding soil pollution and indirectly the pollution of water by waste* The areas temporarily affected by works shall be reinstated at least to their original condition. *Effects: reinstating the lands affected by construction camp location* **Behaviour** Personnel training The construction works must not be commenced before ensuring the correct storage sites for materials and products. **Offsets** None	None	

Impact	Impact mitigation measures	Residual Impact	
			Probability/ Magnitude
Impact on birds	**Design and precondition** Location of HDD installation dumps in the anthropogenic areas **Equipment** Storage of toxic substances in closed spaces, in their original packages All equipment and machinery involved in the construction site activity will be maintained and technically checked in order to avoid accidental leaks of toxic substances, the high noise level, immissions. **Management** Avoiding the bulk storage of bentonite and cement that may pollute the air if they are carried along by wind. *Effects: Prevention of air pollution* The noise generated by the drilling activity shall be abated to minimum. *Effects: abating the noise to minimum* The waste generated shall be segregated and managed according to the Waste management plan. *Effects: avoiding soil pollution and indirectly the loss of individuals* The areas temporarily affected by works shall be reinstated at least to their original condition. *Effects: reinstating the lands affected by construction camp location* **Behaviour** Personnel training The construction works must not be commenced before ensuring the correct storage sites for materials and products. **Offsets** None	None	

The above-mentioned measures in table 6.6. are also applied if the Danube river is crossed by trenchless method in non-routine event

6.3. IMPACT MITIGATION MEASURES DURING GAS PIPELINE OPERATION

Under normal operation, no environmental impact will occur as a result of the measures taken, as Nabucco pipeline is buried in the Danube river crossing zone:

- When designing the pipeline:
  - setting the location parameters (see appendix 12)
    The pipeline depth and foundation level are determined by parameters obtained from the hydraulic, hydrologic, hydro-morphological and erosion study data acquired from the National Institute of Hydrology and Water Management (NIHWM), Bucharest, Romania.

  These parameters are:

  - Prediction of erosion in the riverbed and banks area
  - Thickness of the pipeline sleeve:
  - Protection from anchors
  - Effect of accidental fall of weights into the water over the pipeline
  - Establishing the quality of the materials used, of the pipeline test and maintenance methods during operation (details are shown in ROEIA Report and BBEIA Report)
  - drying gas before delivery

- During construction (e.g. compliance with the requirements regarding the material quality shall be provided, etc. Details are shown in ROEIA Report and BBEIA Report)

For reducing the risk of damage occurrence as a result of bank erosion, in the banks area, after backfilling the trench with the material resulted from excavations, the bank protection will be executed in accordance with the drawings (see appendix drawing 70223-RR-PL-8160). The backfills will be compacted in 15-20 cm layers above the water level.

The bank protections will be executed in the variation area of the water level, on about 3 m above and below the average water level.

Above the water level, the protection will consist of a 30 cm thick support layer of 40÷65 mm crushed stone and placed on a geotextile filter of Madril type. Over the crushed stone layer, quarry stone of 10 ÷ 200 kg/pcs will be carefully laid at the slope profile as follows: the grade between 10 ÷ 50 kg / pc. must be placed over the crushed stone, on a 30 cm thickness and large blocks of 50 ÷ 200 kg / pcs will be laid on the protection face.

The characteristics of the geotextile filter and of the crushed and rubble stone are specified in the Technical Specifications.

On completing the trench backfill operation and bank protection, A.F.D.J. Galați will make a cross section to check the backfill levels.

. Conclusions on mitigation measures for the environment . impacts during the operation of Nabucco gas pipeline

As a result of the mitigation measures proposed, a residual impact may occur only in case of a terrorist attack.

6.4. IMPACT MITIGATION MEASURES AT THE END OF THE LIFE CYCLE

In the case of the Danube crossing, the decision will be made on whether the pipeline will be abandoned in ground or removed from the ground. In the case of abandonment, no impact on avifauna is recorded after taking some protection measures, namely after completely emptying the pipeline. If it is decided to remove NGPL from the ground, the impact is similar to the one during pipeline installation.

6.5 . CONCLUSION CONCERNING TRANSBOUNDARY IMPACT

HDD method is the solution recommended for the Danube river crossing, as:

- Environmental analysis for both crossing methods indicated that HDD does not produce a significant environment impact
  Cumulative impact is expected to be minimal and generated only during construction using HDD. In the case of open-cut, the cumulative impact is likely to occur if the Danube crossing works are performed at the same time with the works on the implementation of the Project: Improving the navigation conditions on the Romanian – Bulgarian joint section of the Danube river

- In point of the protection of the species in ROSPA0045, the suitable period for performing works starts at the end of July. The comparative timeframe for HDD is 4 month and in the case of open-cut is 6 months.

- In case of open cut, during construction, part of the excavated material will be lost in the riverbed, in the area downstream of the crossing. A larger amount of suspended matters for a longer period of time, the result of a repeated action on the water bottom may prevent the light from penetrating the depths. The lack of solar radiation affects the photosynthesis process in the aquatic organisms. The invertebrate and the species with slow movement are mainly affected.

- In case of HDD method, the functions of the Danube river ecosystem are maintained.

7. INVENTORY OF GAPS AND UNCERTAINTIES FOUND WHEN COMPILING THE INFORMATION

1. *Pipe transport routes, pipe supplier*

Several scenarios regarding the pipe transport modes have been considered in the impact assessment study. They may be carried by sea and by river, by railway- by the existing and new access roads.
The transport routes to the pipeline are selected from the technically feasible alternatives, by considering both the economic reasons and the environmental protection aspects. Details on the pipe transport shall be established in the future stages of design.
The pipe supplier is not known in this stage.
The accurate number of voyages by each transport route can be established after identifying the pipe supplier, the transport modes to the pipeline corridor and the exact pipeline length.

2. Number of machinery, equipment needed for construction, time needed for construction

The constructor shall establish the number of machinery and equipment.
The work schedule shall be established depending on the number of teams simultaneously commencing works in various route points.
The duration of construction may also be modified by a number of unpredictable circumstances (e.g. delay in the archaeological works, bad weather conditions).

8. NON-TECHNICAL SUMMARY

The project takes into account the possibility for the Danube River (the border between Bulgaria and Romania) to be crossed by the trenchless method with horizontal directional drilling (HDD method).
The works on the Romanian bank will be performed from behind the flood protection dike, without affecting it. The dike will be undercrossed by Nabucco pipeline by using the ramming method.

On the Bulgarian bank, the protection dike will not be affected, as the construction camp is located in front of it.

In such case no transboundary impacts are expected on Danube river.

The potential impact generated by the construction using HDD method on the bird species is negative, low, on the short term due to the habitat loss on the temporary construction camp, to the increased human presence, noise and vibration generated by the equipment, the channels covered with water and reed.

HDD method is the solution recommended for the Danube river crossing.

In case of choosing the open cut method the following transboundary impacts are expected during the construction, operation and decommissioning phase:

- Impacts on the quality of river waters (increase in water turbidity, potential risk of pollution of river waters due to oil and fuel leakages from construction machines and vessels, discharge of bilge water and solid waste from construction vessels, etc.);
- Impacts on ambient air due to gas and dust emissions generated by construction machines and vessels;
- Impacts on aquatic biocenosis – the local habitats and all food-dynamic modules in aquatic ecosystems which are likely to be affected due to the disturbance of the substrate, increase in water turbidity, water pollution, destruction of habitats of invertebrates, amphibians and fish, disturbance of fish migration, disturbance of the terrestrial fauna and flora connected with aquatic fauna and flora, etc.;
- Impacts on socio-economic environment due to difficulties and limitation for the river transport.
- Impact on traffic safety during construction
- The technical design for the Danube crossing for the open cut option shows that the trench cover and excavation works will be executed by keeping the traffic of the ships and convoys on the Danube open. The type and number of the floating equipment shall be established by the constructor, complying with design sizes and with the quality conditions imposed and by assuming the deadline for the work completion. Moreover, the constructor shall take all the measures for withdrawing the floating equipment to the bank, outside the navigable channel, when the work zone is transited by ships/convoys.
- The traffic will be disrupted only when the pipeline is pulled from one bank to another by previously informing A.F.D.J. Galați and its Bulgarian

counterparts on the time when the navigation is closed in the crossing area. The duration of disruption (estimated at 3-4 days) and the exact period when this will happen shall be jointly established between the constructor, beneficiary and authorities with responsibilities in the assurance of the navigation conditions on the Danube in Romania (AFDJ Galați) and in Bulgaria.

- The fishing prohibition period is continuous for about 6 weeks and may be different for each bank. In Romania, this period is established every year, depending on the hydrological and weather conditions, by joint order of the ministers of Agriculture and Environment.
- In the open cut option, the technological process of the offshore works includes the trenching operations, the loading from the mud lighter into the stockpile of excavated material, the excavation from the stockpile of the material needed for covering the trench and the unloading of material from the mud lighter over the trench. Based on the grading resulted from the geotechnical survey, on the surveys undertaken in the past for such situations and on the experience from the prior crossing, the estimation on the volume of suspended or dragged material carried along by the water current and transported downstream, due to the dredging process and to unloading the mud lighters for covering the trench is about 288,000 m^3. Considering that the multiannual mean rate of silts carried along on the Danube recorded throughout 2003 – 2009 in the crossing area was about. 350 kg/s, (about 30,240 t/day), it is anticipated that the material carried along for the trench execution and filling is insignificant as compared to the volume of silts carried by the Danube river Natura 2000 site BG0000334"Ostrov" will not be affected by the works performed.

The potential impact generated by the construction using open cut on the bird species is negative, low, on the short term due to the habitat loss on the working strip, to the increased human presence, noise and vibration generated by the equipment, the channels covered with water and reed.

- Birds will avoid the affected area during the construction period. The scrub and tree vegetation will be reinstated instead of being used as bird nesting and shelter sites.
- Consequently, the optimum time for field works is thus restricted to the critical areas for the aquatic birds in order to avoid the disturbance during nesting, migration and wintering.
- Outside the critical time, birds will use for feeding the lands with similar habitat features adjacent to the area affected.
- After completing the works and during the pipeline operation, the impact will be negative until the reinstatement of the habitat and of the vegetation on the affected sector.

No transboundary impacts are expected during the operation stage of the project, except the emergency cases and accidents in close vicinity to the Bulgarian-Romanian border and the Danube crossing. In case of emergency situations and accidents the following impacts may occur:

- Gas emissions into the ambient air generated by big fires and explosions. Block valve stations are envisaged on either bank in order to avoid the occurrence of gas explosions;
- Damage on lands and soils due to the emergency and repair activities conducted;
- Potential adverse impacts on fauna in the area of the accident;
- Potential damage on buildings, facilities and infrastructural items in the area of the accident caused by fire, explosions, or emergency and repair activities;
- Potential Health & safety risks for the local population.

REFERENCES

2. http://www.natura2000bg.org/natura/bg/data_maps.php

3. http://natura2000.eea.europa.eu

4. http://www.bd-dunav.org/content/upravlenie-na-vodite/plan-za-upravlenie-na-rechniia-baseyn/
5. http://www.biodiversitate.ro/
6. International Finance Corporation (IFC),2011,

Performance Standard 1 – Assessment and Management of environmental and Social Risks and Impacts,

Performance Standard 2 –Labour and Working Conditions-,

Performance Standard 3 – Resource Efficiency and Pollution Prevention

Performance Standard 4 – Community Health, Safety and Security

Performance Standard 5 – Land Acquisition and Involuntary Resettlement

Performance Standard 6 – Biodiversity Conservation and sustainable Management of Living natural Resources

Performance Standard 7 – Indigenous Peoples

Performance Standard 8 – Cultural Heritage

www.ifc.org/performancestandards

7. *teeic.anl.gov/am/assess/.../**area**/index.cfm*

APPENDIX 1: NOTIFICATION

Ministry of Environment and Forestry

No: 8849 /LB/ 22-11 2010

Ref: Notification for the Romanian section of NABUCCO pipeline

To: Nona Karadjova

Minister of Environment and Water

Bulgaria

Dear Minister,

In accordance with the provisions of the Espoo Convention and the EIA Directive, we hereby notify the Bulgarian party that the environmental impact assessment procedure for Romanian section of the pipeline NABUCCO has started.

Therefore, please, dear minister, find attached to the present letter the following documentation in English language:

- Notification for the contact point, in the format required by the Espoo Convention.
- Technical memoire of the project.

Our initiative is based on the necessity to coordinate the national procedure with the others that have been started in the countries involved in the NABUCCO project. Currently, the project owner is undertaking the activity of translating these documents in Bulgarian language and, as soon as the translation is finalized we will submit it to you.

We are waiting for the Bulgarian party to inform us whether it intends to participate in the EIA procedure for the Romanian section of the NABUCCO Pipeline and if so, your comments for the scoping stage.

Please accept, dear minister, the assurances of my highest consideration.

Yours sincerely,

MINISTER

László BORBÉLY

MINISTERUL MEDIULUI ŞI PĂDURILOR
REGISTRATURĂ
Intrare Data
Nr.
Ieşire

B-dul Libertăţii nr. 12, sector 5, RO – 040129, Bucureşti
http://www.mmediu.ro
Telefon: 021 316.02.18; 316.02.46; 316.02.66 / Fax: 021 312.42.27
E-mail: cabinet.ministru@mmediu.ro

HR. 160695/SM/25.01.2011

REPUBLIC OF BULGARIA

Nr. 307/LB
Data 24-01-2011

MINISTERUL MEDIULUI ŞI PĂDURILOR
REGISTRATURĂ
Intrare Nr. 70548 Data 24.01.2011

MINISTRY OF ENVIRONMENT AND WATER

99-00-431
11 **January 2011**

Ref.: *Notification for the Romanian section of the NABUCCO gas pipeline*

Dear Minister,

By this letter I would like to confirm that the notification to an affected party and the attached documentation under the requirements of the Convention on EIA in a transboundary context for the Romanian section of the NABUCCO gas pipeline project have been received in the Ministry of Environment and Water. Pursuant to Art 3.3 of the Convention, I would like to inform you that the Republic of Bulgaria will participate in the EIA procedure for this project.

Following previous arrangements, we expect the EIA report to include a separate chapter "Transboundary impacts" developed jointly with Bulgarian and Romanian EIA experts, in which the impact of the construction and operation of the pipeline section crossing the Danube river to be considered and assessed in detail.

I avail myself of the opportunity to express our willingness for a fruitful cooperation in the EIA procedure in a transboundary context.

Please accept the assurance of my highest consideration.

Sincerely Yours,

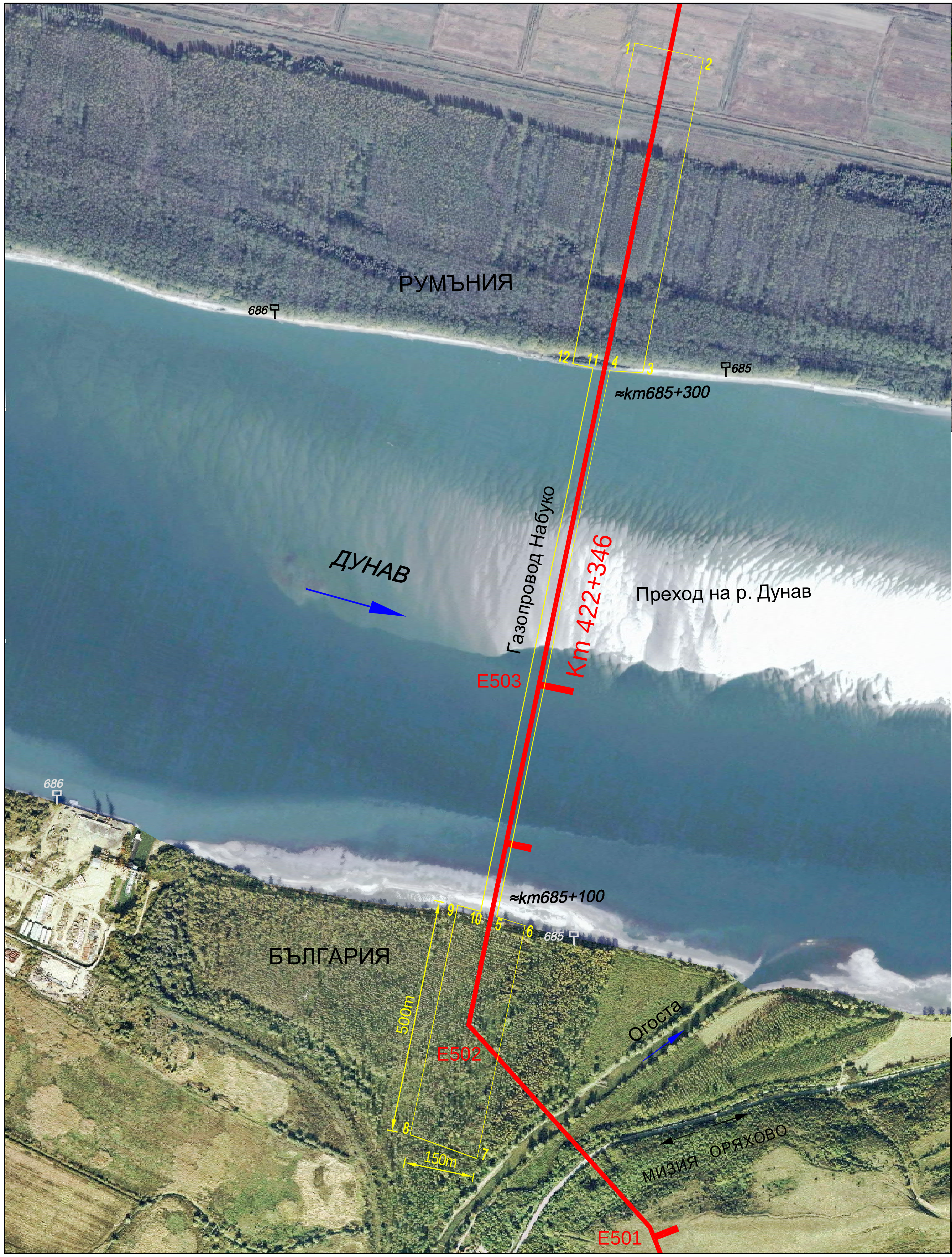
Nona Karadjova

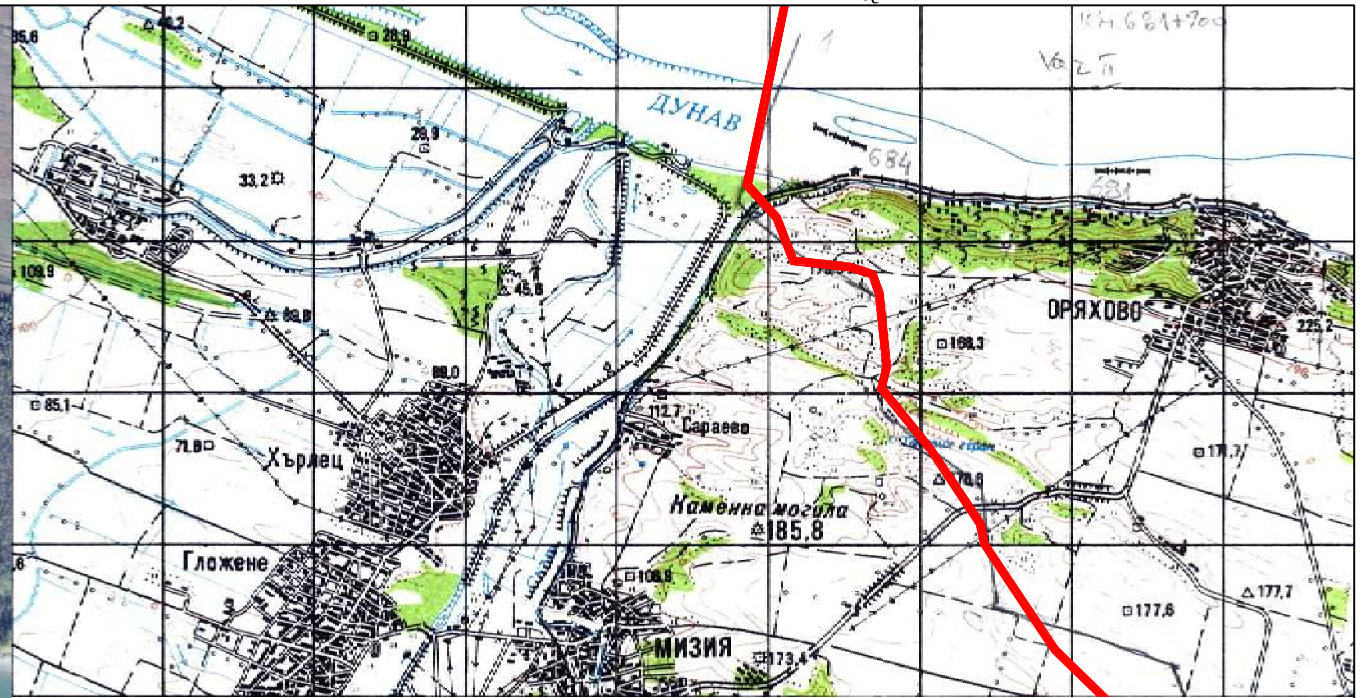
Dl. Bran!
+ Dir. interesate!
25.01.2011

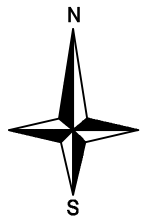
Mr Laszló Borbély
Minister of Environment and Forestry
b-dul Libertatii nr, 12, sector5
RO-040129
Bucharest, ROMANIA

Sofia 1000, 22 Maria-Luisa Blvd
Phone: + 359 2 940 6000; Fax: +359 2 986 25 33

Appendix 2: Maps concerning coordinates of points on the designed route







	КООРДИНАТНА СИСТЕМА 1970			КООРДИНАТНА СИСТЕМА WGS84	
	X /Nord/	Y /East/		B /Nord/	L /East/
	/m/	/m/		/ ° /	/ ° /
E501	4756311.68	8552047.79	E501	43°44'28.37	23°52'56.48
E502	4756742.77	8551660.36	E502	43°44'42.45	23°52'39.33
E503	4757469.84	8551810.79	E503	43°45'05.96	23°52'46.32
5	4756973.93	8551720.35	5	43°44'49.92	23°52'42.09
6	4756955.38	8551780.95	6	43°44'49.30	23°52'44.80
7	4756457.75	8551677.95	7	43°44'33.21	23°52'40.01
8	4756509.19	8551535.45	8	43°44'34.91	23°52'33.66
9	4756998.64	8551636.75	9	43°44'50.74	23°52'38.37
10	4756985.49	8551685.99	10	43°44'50.30	23°52'40.56

ТРАСЕ НА ГАЗОПРОВОД "НАБУКО"

ЗОНА ЗА СТРОИТЕЛСТВО НА ГАЗОПРОВОДА

NABUCCO GAS PIPELINE

CHIMCOMPLECT ENGINEERING COMPANY

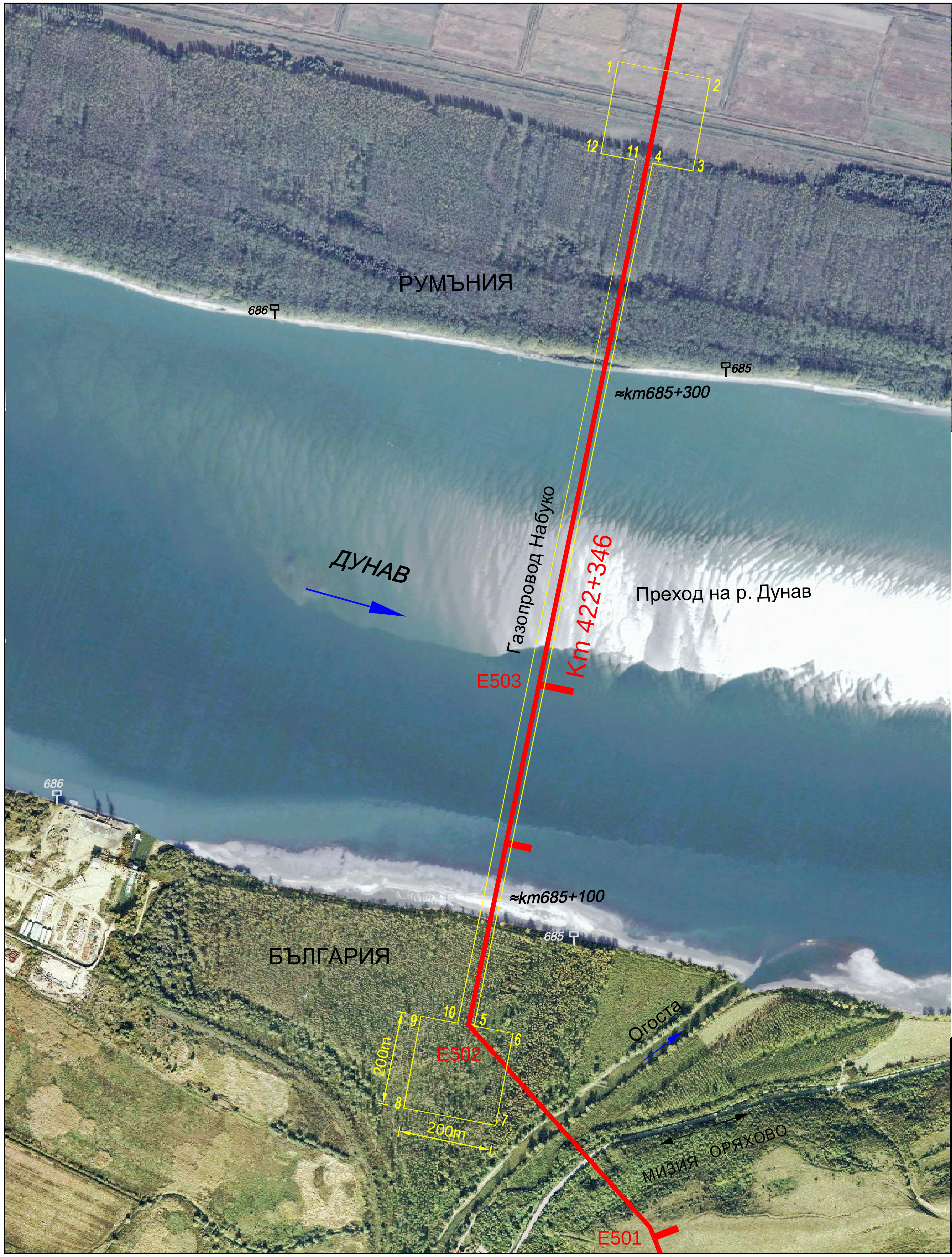
ГАЗОПРОВОД „НАБУКО"
НА ТЕРИТОРИЯТА НА Р. БЪЛГАРИЯ

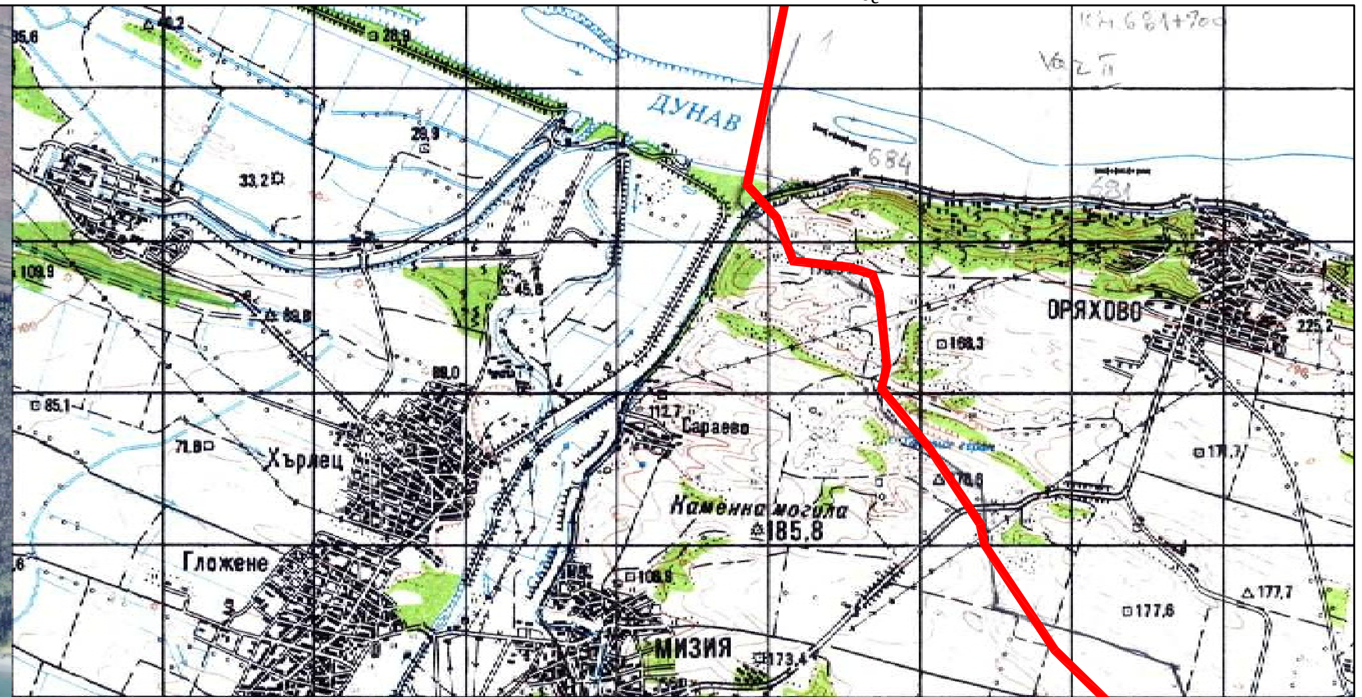
NABUCCO GAS PIPELINE
THE BULGARIAN SECTION

ПРЕСИЧАНЕ НА РЕКА ДУНАВ
ПО ОТКРИТ СПОСОБ

A3

M 1:10 000 / 1:100 000





	КООРДИНАТНА СИСТЕМА 1970			КООРДИНАТНА СИСТЕМА WGS84	
	X /Nord/	Y /East/		B /Nord/	L /East/
	/m/	/m/		/ ° /	/ ° /
E501	4756311.68	8552047.79	E501	43°44'28.37	23°52'56.48
E502	4756742.77	8551660.36	E502	43°44'42.45	23°52'39.33
E503	4757469.84	8551810.79	E503	43°45'05.96	23°52'46.32
5	4756740.66	8551672.08	5	43°44'42.37	23°52'39.85
6	4756725.18	8551754.79	6	43°44'41.85	23°52'43.54
7	4756528.63	8551718.03	7	43°44'35.49	23°52'41.83
8	4756565.39	8551521.47	8	43°44'36.73	23°52'33.06
9	4756761.95	8551558.24	9	43°44'43.09	23°52'34.77
10	4756747.28	8551636.69	10	43°44'42.60	23°52'38.27

ТРАСЕ НА ГАЗОПРОВОД "НАБУКО"

ЗОНА ЗА СТРОИТЕЛСТВО НА ГАЗОПРОВОДА

NABUCCO GAS PIPELINE

ГАЗОПРОВОД „НАБУКО"
НА ТЕРИТОРИЯТА НА Р. БЪЛГАРИЯ

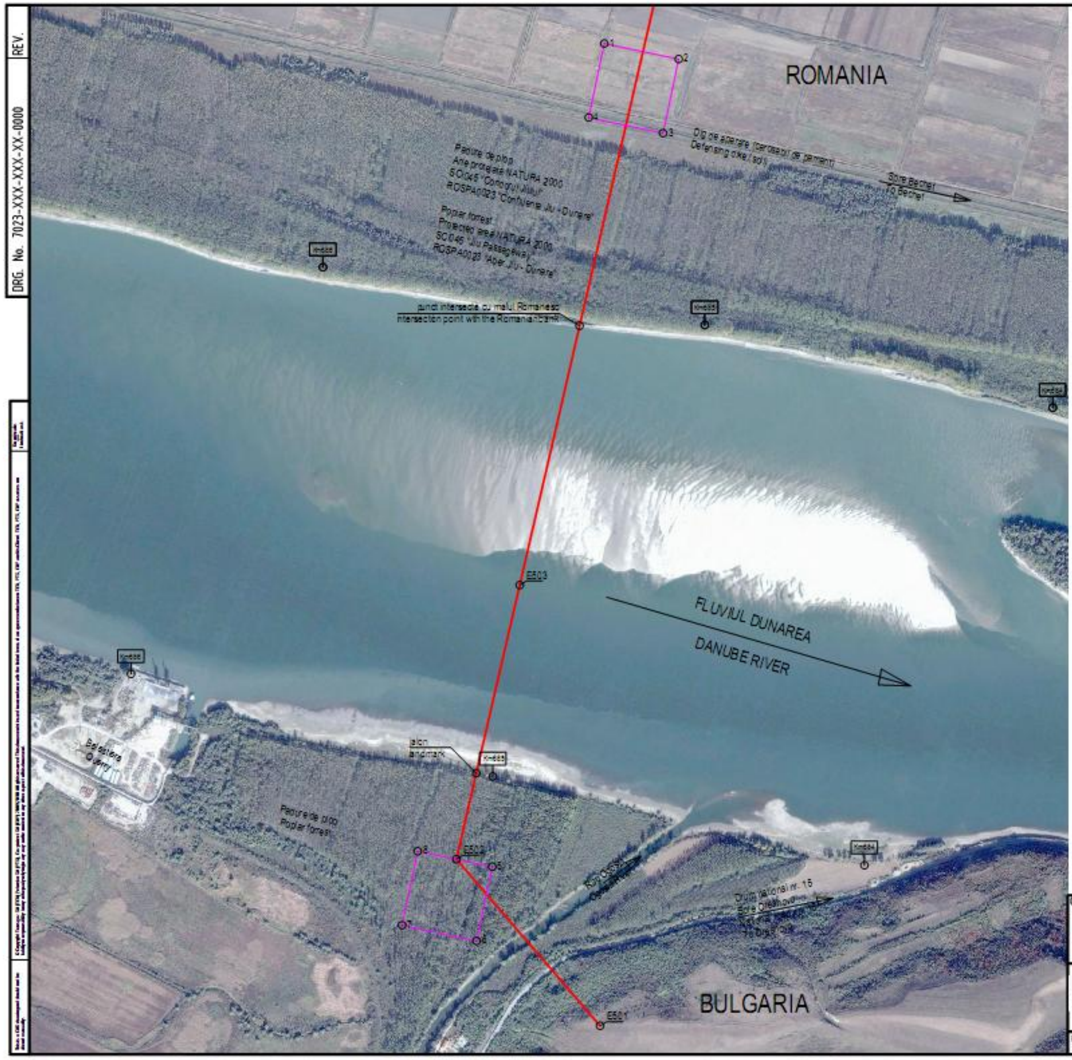
NABUCCO GAS PIPELINE
THE BULGARIAN SECTION

CHIMCOMPLECT ENGINEERING COMPANY

ПРЕСИЧАНЕ НА РЕКА ДУНАВ
ПО МЕТОДА - HDD

A3

M 1:10 000 / 1:100 000



N
V
E
S

COORDONATE PUNCTE DE PE TRASEUL PROIECTAT
COORDINATES OF POINT ON THE PROJECTED ROUTE

point number	STEREO 70			GEOGRAFICE WGS 84	
	X	Y		Φ	λ
	m	m		N	E
1	252256.974	410089.662	1	43°45'52.35878"	23°52'55.36809"
2	252215.880	410285.395	2	43°45'51.11490"	23°53'04.14165"
3	252020.148	410244.301	3	43°45'44.75632"	23°53'02.42521"
4	252061.241	410048.569	4	43°45'46.00014"	23°52'53.65195"
5	250084.196	409795.322	5	43°44'41.84548"	23°52'43.55371"
6	249888.463	409753.961	6	43°44'35.48670"	23°52'41.82652"
7	249929.557	409558.228	7	43°44'36.73010"	23°52'33.05558"
8	250125.289	409599.322	8	43°44'43.08877"	23°52'34.77098"
E501	249664.278	410078.848	E501	43°44'28.37"	23°52'56.48"
E502	250104.161	409701.066	E502	43°44'42.45"	23°52'39.33"
E503	250827.648	409883.719	E503	43°45'05.96"	23°52'46.32"
landmark BG	250331.225	409753.200	landmark BG	43°44'49.82850"	23°52'41.51918"
RO bank	251511.749	410024.621	RO bank	43°45'28.19"	23°52'52.92"

NABUCCO GAS PIPELINE
HDD method workingstrip

CLIENT: NABUCCO GAS PIPELINE

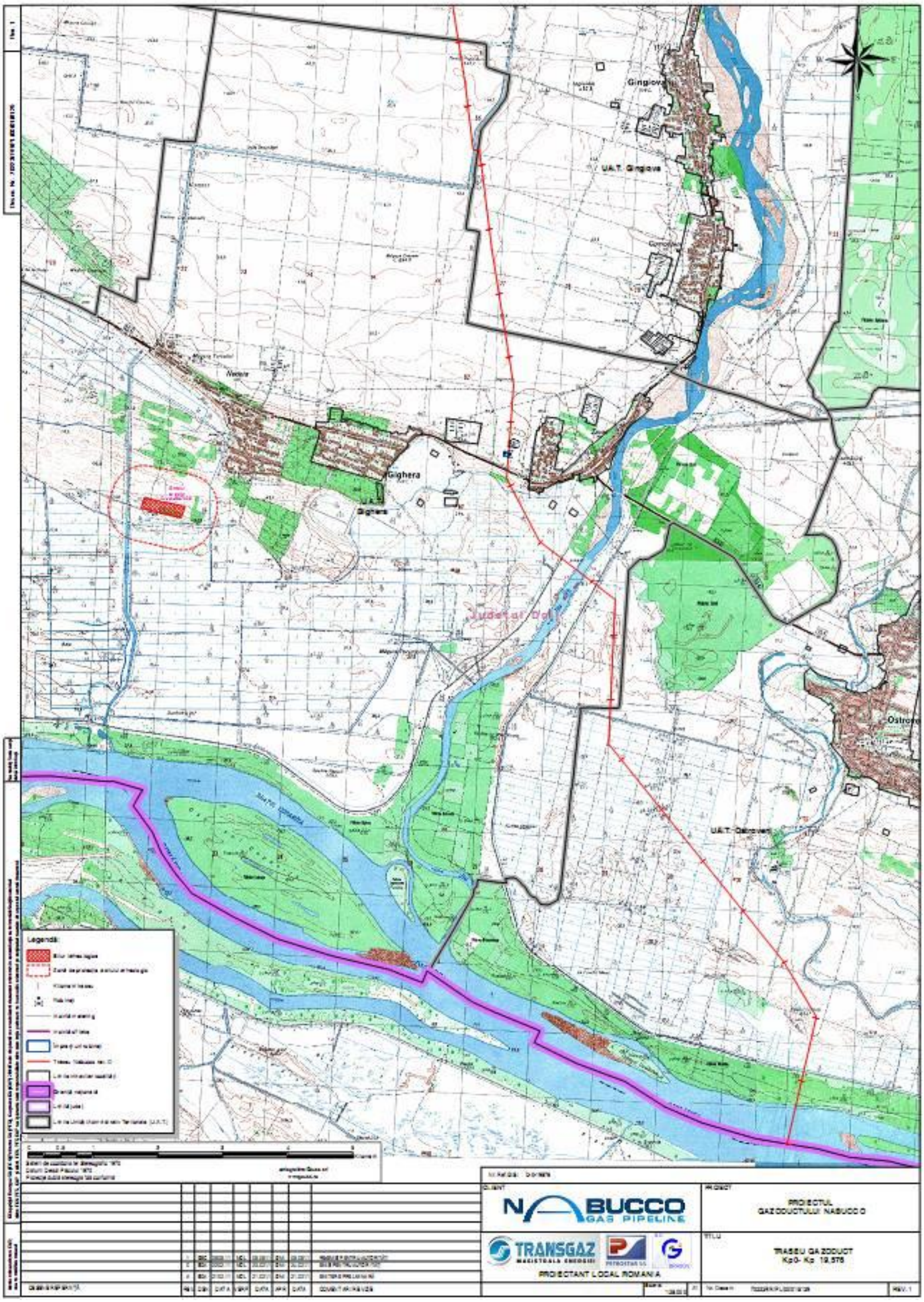
PROJECT: NABUCCO GAS PIPELINE PROJECT

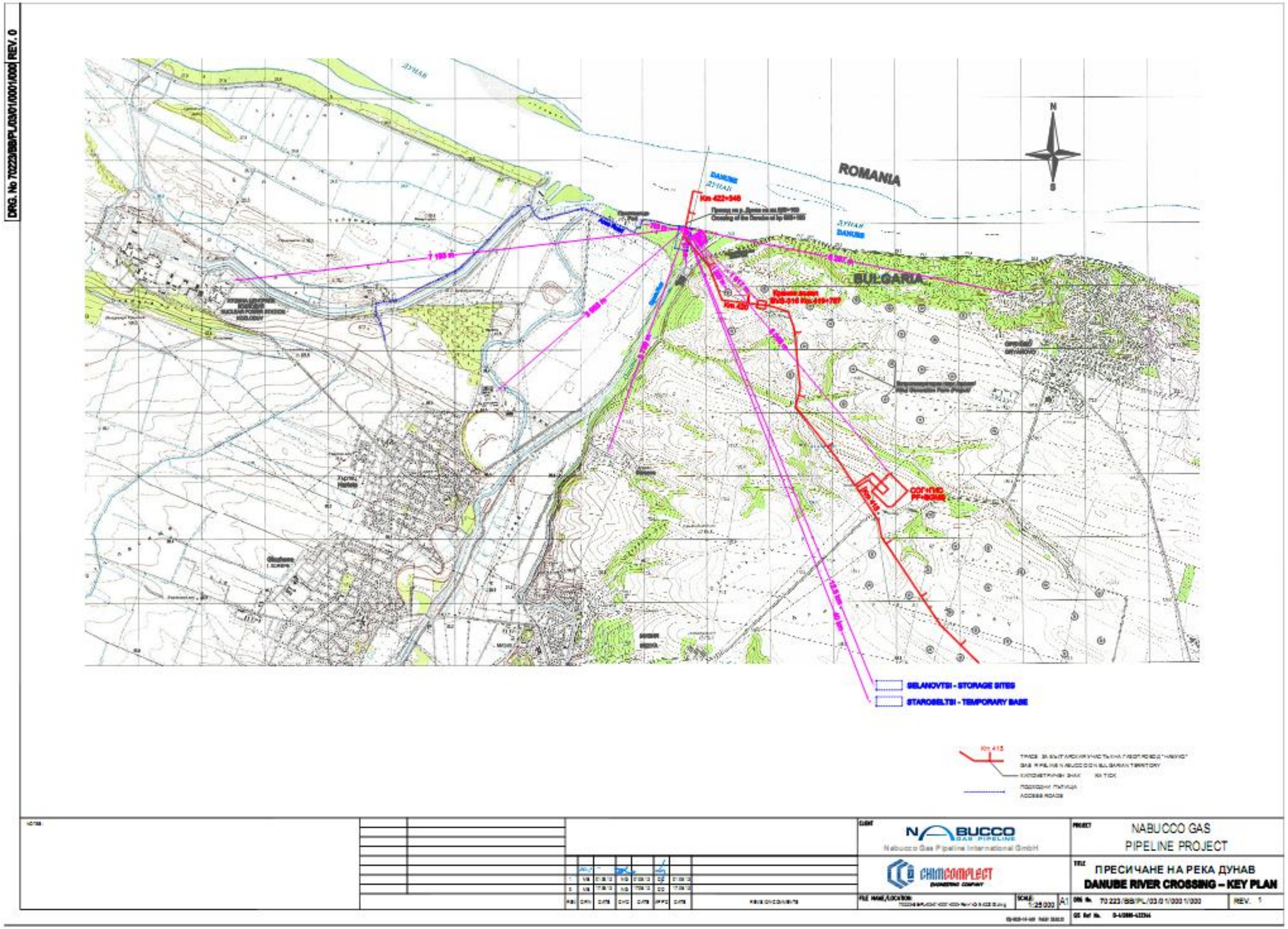
TRANSGAZ
ROMANIA LOCAL FEED ENGINEER

TITLE: DANUBE CROSSING
HDD method workingstrip

SCALE: 1:10000 | A3 | DRG.No. 7023-XXX-XXX-XX-0000 | REV.

Appendix 3: Location of BVS on the Romanian territory and on the territory of the Republic of Bulgaria in the area of interest


Gingiova
U.A.T. Gingiova
Gighera
Ostroveni
U.A.T. Ostroveni
Legenda:
PROIECTANT LOCAL ROMANIA
PROIECTUL
GAZODUCTULUI NABUCCO
TRASEU GAZODUCT
Kp0- Kp 19,578
REV. 1


DRG. No 70223/BB/PL/03/01/0001/000 REV. 0
ДУНАВ
ROMANIA
BULGARIA
N
S
SELANOVTSI - STORAGE SITES
STAROSELTSI - TEMPORARY BASE
Km 415
GAS PIPELINE NABUCCO ON BULGARIAN TERRITORY
KM TICK
ACCESS ROADS
NABUCCO GAS
PIPELINE PROJECT
Nabucco Gas Pipeline International GmbH
CHIMCOMPLECT
ПРЕСИЧАНЕ НА РЕКА ДУНАВ
DANUBE RIVER CROSSING – KEY PLAN
1:25 000
A1
70 223/BB/PL/03/01/0001/000
REV. 1

Appendix 4 : Location of temporary construction camp and storage of excavated/dredged material/ drilling mud, depending on the Danube crossing method used

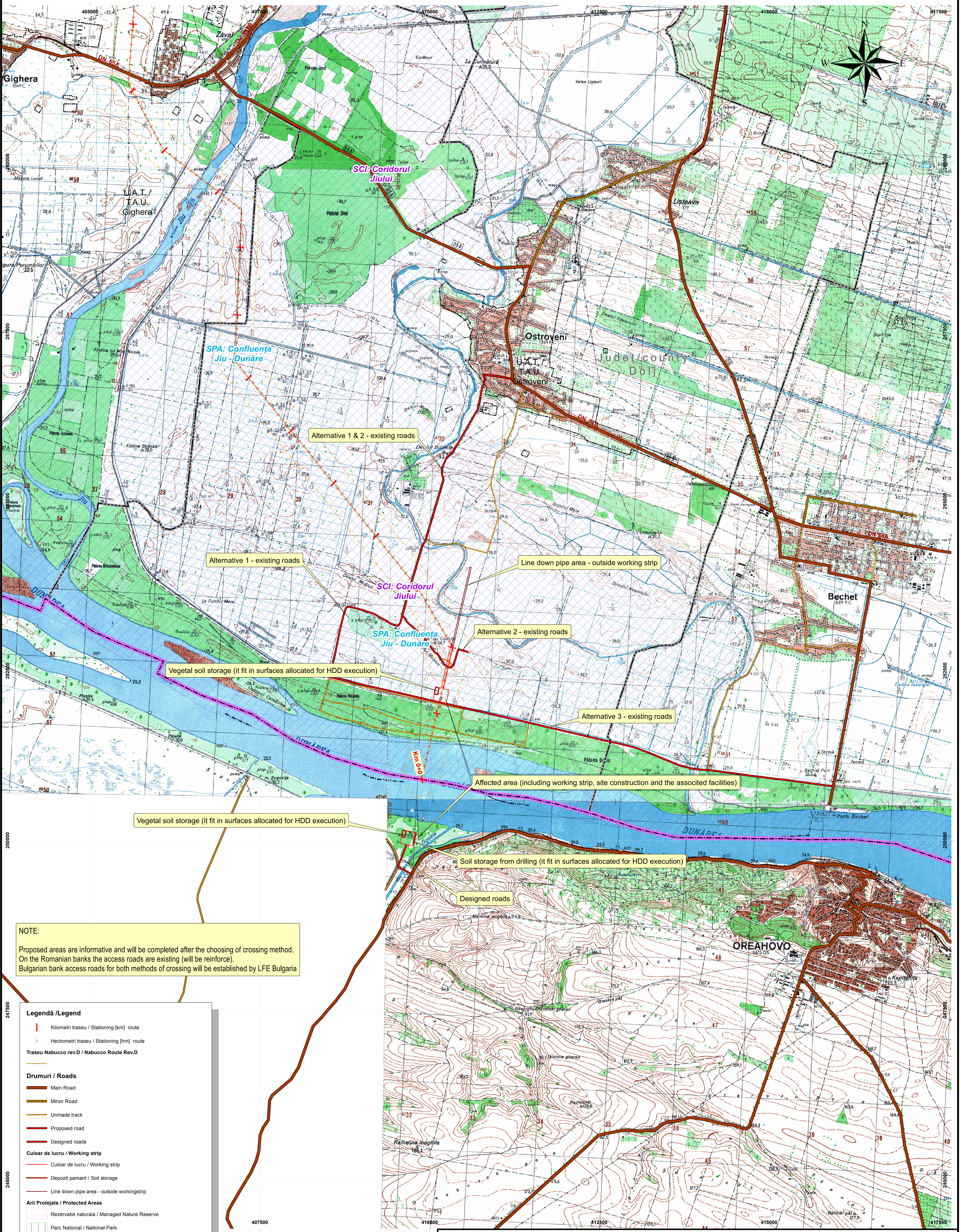
Appendix 4:1 : Location of temporary construction camp and storage of excavated material/ drilling mud if HDD method is used

Appendix 4:2 : Location of temporary construction camp and excavated/dredged material if the open cut method is used

Rev. x

DRG. No. 70223/RR/PL/xx/xx/xxxx

Do not scale. If in doubt ask

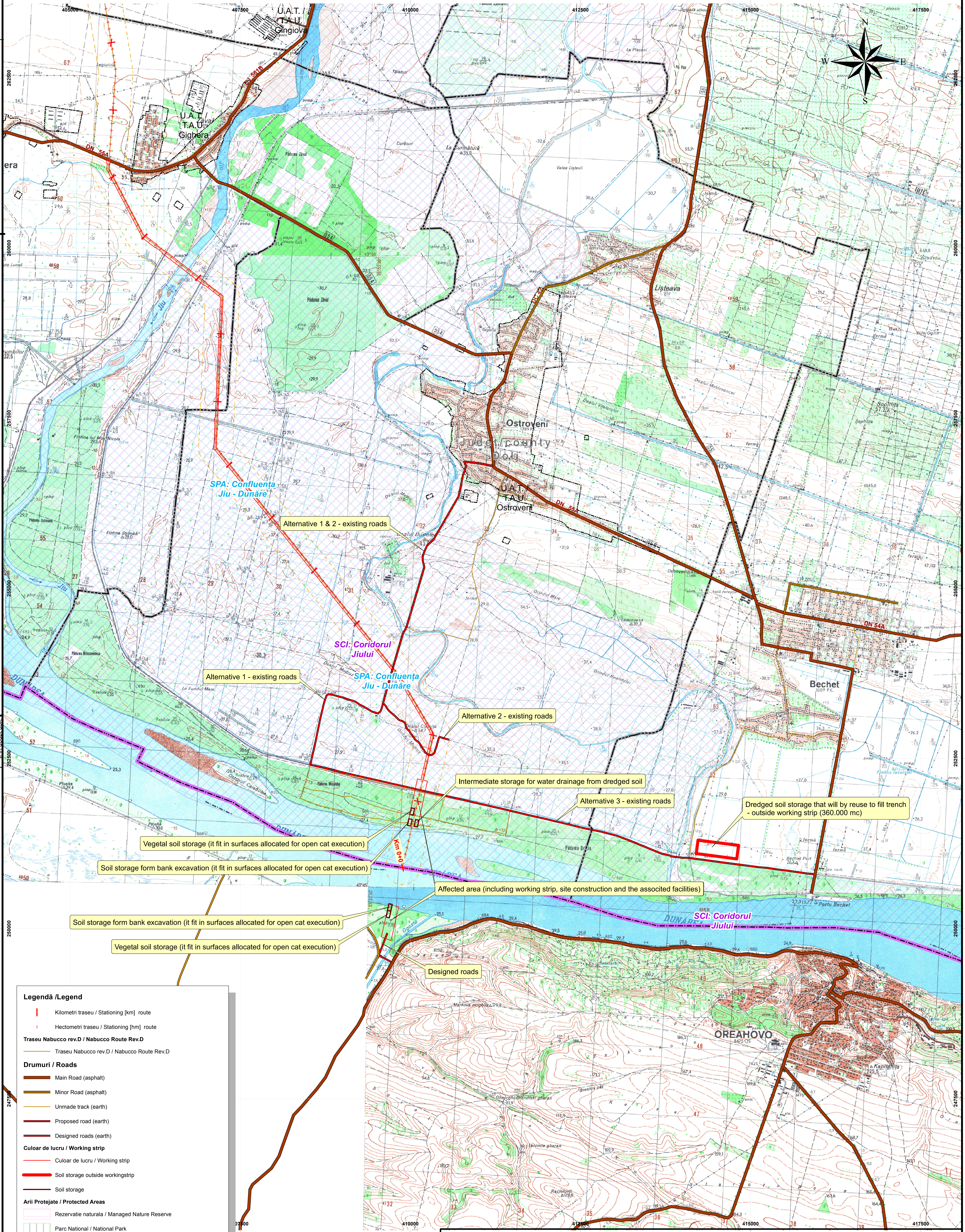


GIS Ref. No.	
CLIENT: NABUCCO GAS PIPELINE	PROJECT: NABUCCO GAS PIPELINE PROJECT
ROMANIA LOCAL FEED ENGINEER	TITLE: DANUBE CROSSING Site construction, Surface affected, Road, Soil storage, HDD method
FILE LOCATION — SCALE: 1:25,000 — A1	DRG. No. 70223/RR/PL/xx/xx/xxxx — REV. x

Rev. x

DRG. No. 70223/RR/xx/xx/xxxx

Do not scale. If in doubt ask.



Legendă /Legend

- Kilometri traseu / Stationing [km] route
- Hectometri traseu / Stationing [hm] route

Traseu Nabucco rev.D / Nabucco Route Rev.D

- Traseu Nabucco rev.D / Nabucco Route Rev.D

Drumuri / Roads

- Main Road (asphalt)
- Minor Road (asphalt)
- Unmade track (earth)
- Proposed road (earth)
- Designed roads (earth)

Culoar de lucru / Working strip

- Culoar de lucru / Working strip
- Soil storage outside workingstrip
- Soil storage

Arii Protejate / Protected Areas

- Rezervatie naturala / Managed Nature Reserve
- Parc National / National Park
- Sit Natura 2000 (SCI) / Natura 2000 (SAC)
- Sit Natura 2000 (SPA) / Natura 2000 (SPA)
- Coridor traseu 250m stânga-dreapta / Route corridor left-right 250m
- Limite intravilan localități / Settlements built area limits
- Granița națională / National border

NOTE:

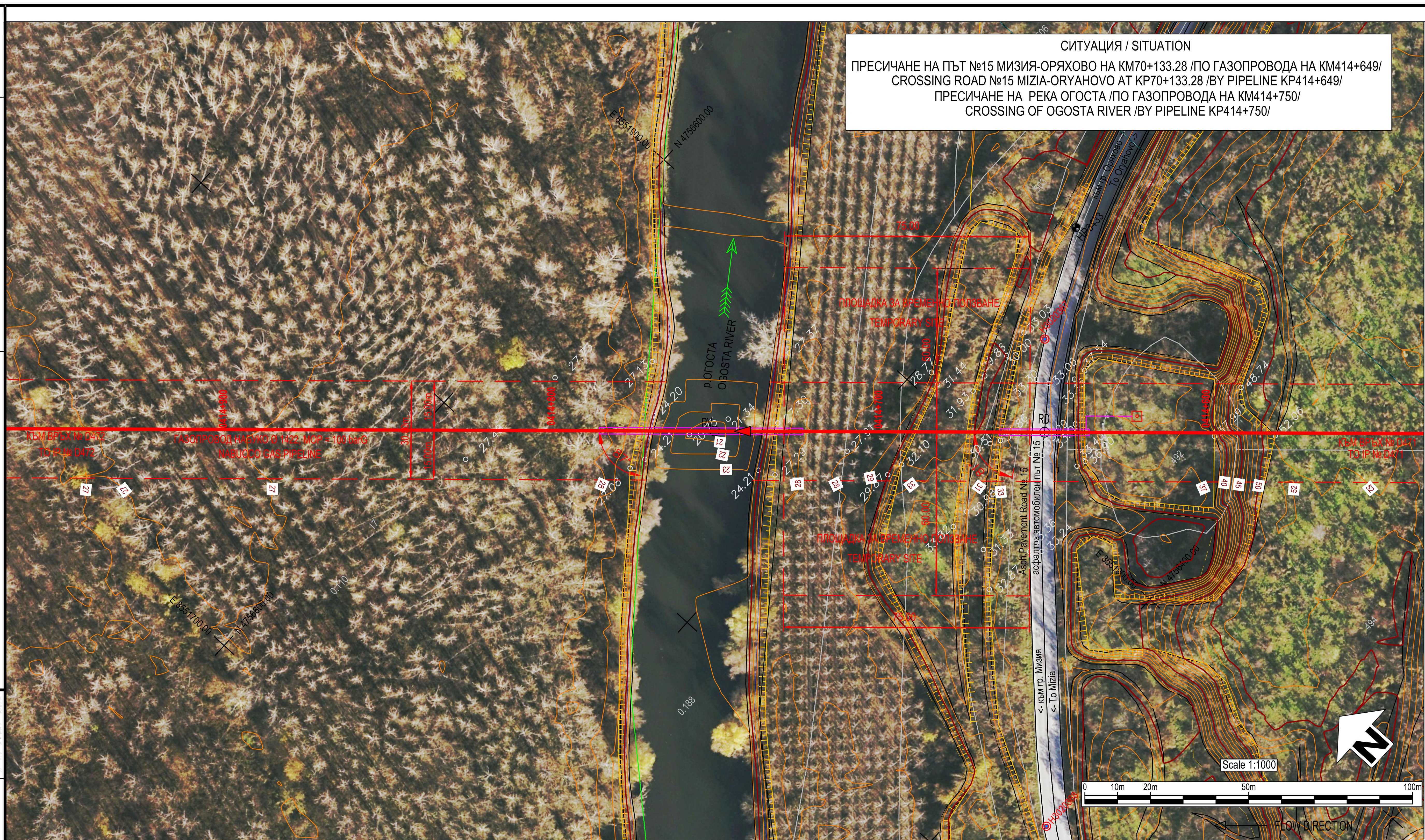
Proposed areas are informative and will be completed after the choosing of crossing method.
On the Romanian banks the access roads are existing (will be reinforce).
Bulgarian bank access roads for both methods of crossing will be established by LFE Bulgaria

GIS Ref. No.	
CLIENT: NABUCCO GAS PIPELINE	PROJECT: NABUCCO GAS PIPELINE PROJECT
ROMANIA LOCAL FEED ENGINEER	TITLE: DANUBE CROSSING Site construction, Surface affected, Road, Soil storage, Open cut method
FILE LOCATION — SCALE: 1:25,000 — A1	DRG. No. 70223/RR/xx/xx/xxxx — REV. x

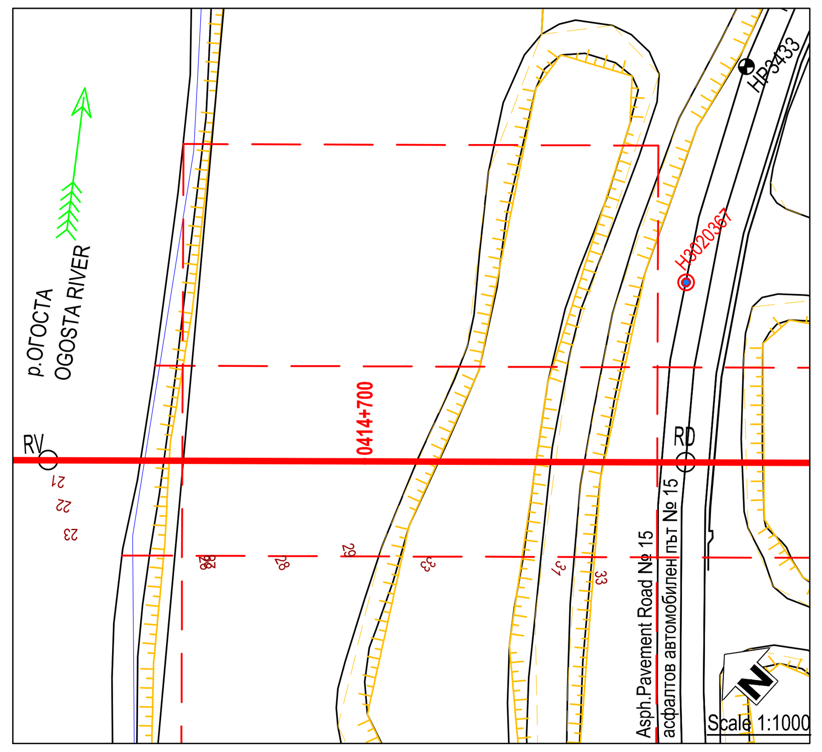
APPENDIX 5: Crossing of the Ogosta river

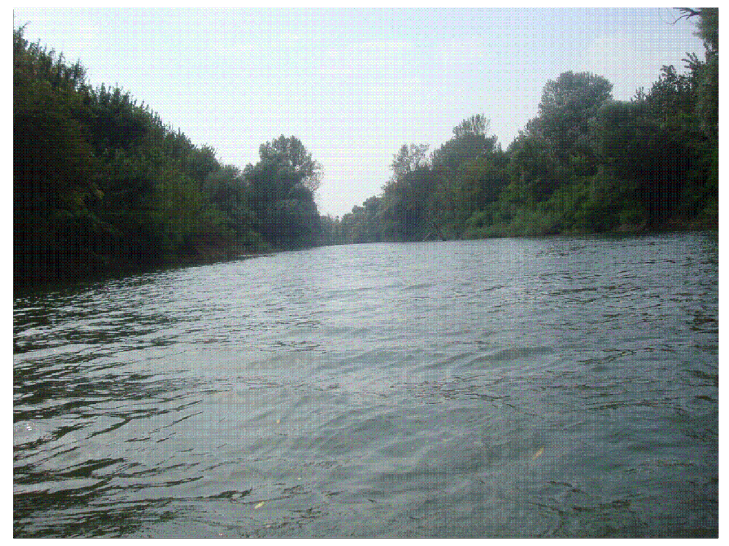
СИТУАЦИЯ / SITUATION

ПРЕСИЧАНЕ НА ПЪТ №15 МИЗИЯ-ОРЯХОВО НА КМ70+133.28 /ПО ГАЗОПРОВОДА НА КМ414+649/
CROSSING ROAD №15 MIZIA-ORYAHOVO AT KP70+133.28 /BY PIPELINE KP414+649/
ПРЕСИЧАНЕ НА РЕКА ОГОСТА /ПО ГАЗОПРОВОДА НА КМ414+750/
CROSSING OF OGOSTA RIVER /BY PIPELINE KP414+750/



C X E M A / S H E M E
НА МЕСТОПОЛОЖЕНИЕТО НА РЕПЕР ЗА НИВО ПРИ СТРОИТЕЛСТВОТО
BENCHMARK LOCATION FOR CONSTRUCTION LEVEL





ГРАНИЦА НА ОБЛАСТ/DISTRICT BOUNDARY
ГРАНИЦА НА ОБЩИНА/MUNICIPAL BOUNDARY
ГРАНИЦА НА ЗЕМЛИЩЕ/SETTLEMENT LAND BOUNDARY
ГРАНИЦИ НА СОБСТВЕНОСТ ПО КВС
BORDERS OF PROPERTY PER MRP

112.29 — НОМЕР ПОЗЕМЛЕН ИМОТ / LAND PROPERTY NO.; НОМЕР КАДАСТРАЛЕН РАЙОН (МАСИВ) / CADASTRAL AREA NO.

ЗЕМЛИЩЕ ОРЯХОВО, ЕКАТТЕ 54020
ОБЩИНА ОРЯХОВО, ОБЛАСТ ВРАЦА
ORYAHOVO, EKATTE 54020
ORYAHOVO MUNICIPALITY, VRATCA DISTRICT

ОПОРНА МРЕЖА / SURVEY CONTROL STATION

КООРДИНАТНА СИСТЕМА 1970Г.- К7 / LOCAL GRID

№	X / North	Y / East	H Height system-Baltic
3433	4756492.900	8551968.935	33.267
H3020367	4756477.108	8551937.328	33.288
H3020368	4756376.941	8551827.394	33.658

ТАБЛИЦА НА ВЪРХОВЕТЕ ПО ОСТА НА ГАЗОПРОВОДА

IPS ALONG PIPELINE CL

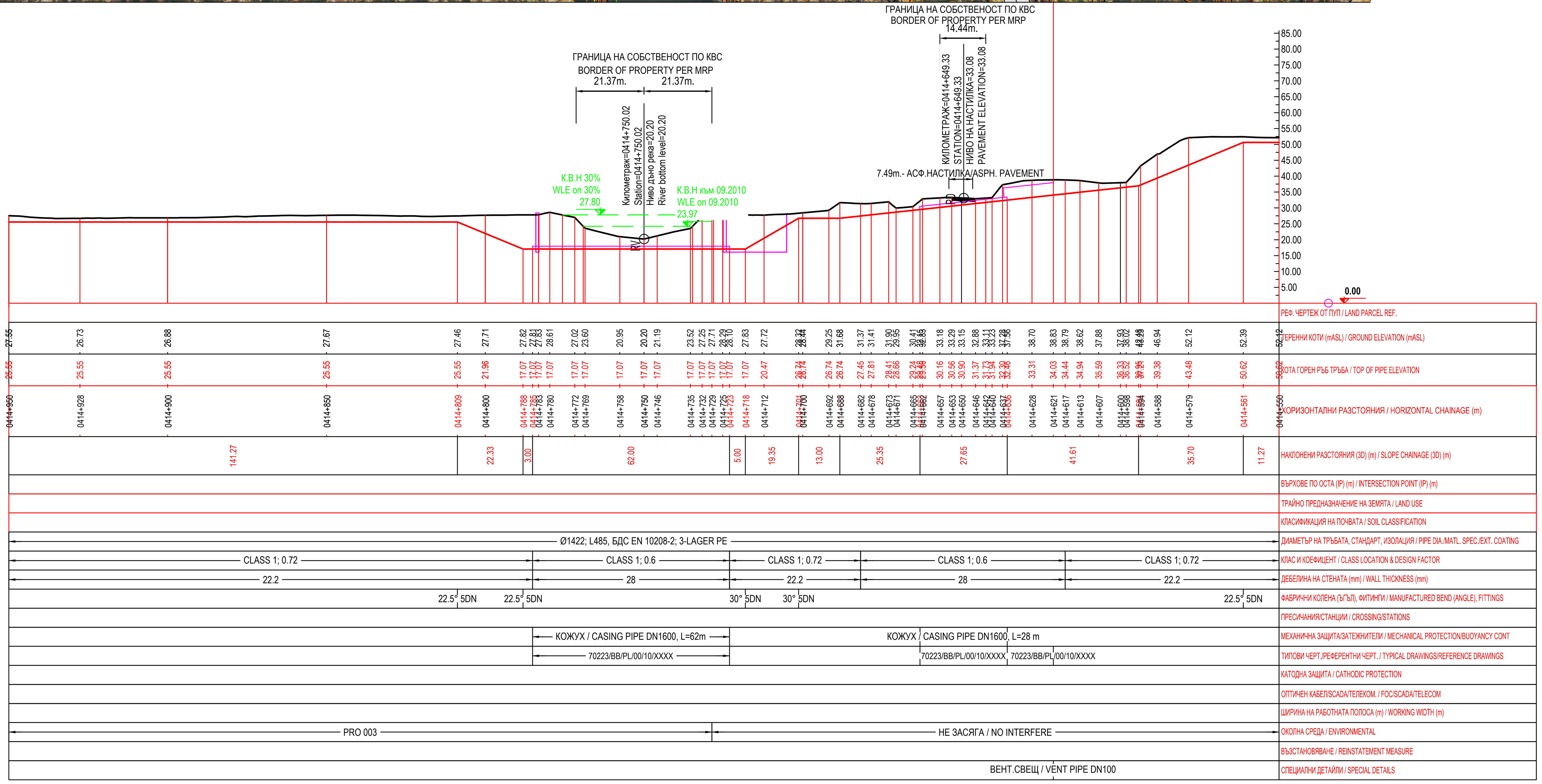
№	X / North	Y / East
D471	4756311.676	8552047.786
D472	4756742.773	8551660.359

ЗАБЕЛЕЖКА / NOTES :

КВС - КАРТА НА ВЪЗСТАНОВЕНАТА СОБСТВЕНОСТ
MRP - MAP OF RESTORED PROPERTY
К.В.Н - КОТА НА ВОДНОТО НИВО
CL - CENTER LINE
WLE - WATER LEVEL ELEVATION
ГЛ.Р - ГЛАВА РЕЛСА
RH - RAIL HEAD
С КОЖУХ / CASING PIPE

ЛЕГЕНДА / LEGEND

- ГАЗОПРОВОД / PIPELINE
- КРАНОВ ВЪЗЕЛ (ЛКВ) / BLOCK VALVE STATION(BVS)
- СТАНЦИЯ ЗА ОЧИСТВАНЕ НА ГАЗОПРОВОДА (СОГ) / PIG TRAP STATION (PS)
- ИЗМЕРВАТЕЛНА СТАНЦИЯ/ METERING STATION
- КОМПРЕСОРНА СТАНЦИЯ (КС)/ COMPRESSOR STATION(CS)
- ТРАЕН ЗНАК/ PIPELINE MARKER
- ТРАЕН ЗНАК ЗА ВЪЗДУШНА РЕФЕРЕНЦИЯ/ PIPELINE AIR MARKER
- ГРАНИЦИ НА РАБОТНАТА ПОЛОСА/ LIMITS OF WORKING AREA
- ВРЪХ С ЪГЪЛ И КИЛОМЕТРАЖ/ IP WITH ANGLE & CHAINAGE
- W — СЪЩЕСТВУВАЩ ВОДОПРОВОД/ EXISTING WATER PIPELINE
- G — СЪЩЕСТВУВАЩ ГАЗОПРОВОД/ EXISTING GAS PIPELINE
- OP — СЪЩЕСТВУВАЩ ПРОДУКТОПРОВОД/ EXISTING OIL PIPELINE
- OH ETL — ВЪЗДУШЕН ЕЛЕКТРОПРОВОД/ OVERHEAD ELECTRIC TRANSMISSION LINE (OETL)
- UG ETL — ПОДЗЕМЕН ЕЛЕКТРОПРОВОД/ UNDERGROUND ELECTRIC TRANSMISSION LINE (UETL)
- T — СЪЩЕСТВУВАЩ ТЕЛЕКОМУН. КАБЕЛ/ EXISTING TELECOMMUNICATIONS CABLE
- ПОСОКА НА ГАЗТА / DIRECTION OF GAS FLOW
- ПРЕСИЧАНЕ / CROSSING
  - RD - ПЪТ / ROAD
  - RV - ВОДЕН ПОТОК / WATERCOURSE
  - RL - ЖП ЛИНИЯ / RAILWAY
  - SVX - КОМУНИКАЦИИ / (SERVICE / UTILITY)
  - IRX – НАПОИТЕЛЕН КАНАЛ/IRRIGATION CHANNEL
- ПРОВИСВАНЕ НА ЕЛ. КАБЕЛ/ SAGGING POWER LINES
- (M) (S) ИЗВОР/КАПТАЖ / WELL/SPRING – WELL
- ЗАВОДСКО КОЛЯНО / MANUFACTURED BEND
- 30° SAG КОЛЯНО ВЕРТ. НАДОЛУ / SAG – SAG BEND
- КОЛЯНО ВЕРТ. НАГОРЕ / OB – OVER BEND
- ХОРИЗОНТАЛНО КОЛЯНО ЛЯВО/ SBL–SIDE BEND LEFT
- ХОРИЗОНТАЛНО КОЛЯНО ДЯСНО/ SBR–SIDE BEND RIGHT
- ИЗОЛИРАЩА ВРЪЗКА / ISOLATING JOINT – CP
- GB АНОДЕН ЗАЗЕМИТЕЛ / GROUND BED DRW 70223/BB/PL/YY/ZZ/XXXX
- TP КОНТРОЛНО ИЗМЕРВАТЕЛНА КОЛОНА (КИК)/ TEST POST – TP DRW 70223/BB/PL/YY/ZZ/XXXX
- TRS КАТОДНА СТАНЦИЯ / TRANSFORMER RECTIFIER STATION – CP DRW 70223/BB/PL/YY/ZZ/XXXX
- CP — КАБЕЛ КАТОДНА ЗАЩИТА/ CABLE CATHODIC PROTECTION
- НЕПОДВИЖНА ОПОРА/ФЛАНЕЦ/ ANCHOR BLOCK/FLANGE
- ВЕНТ. СВЕЩ / VENT PIPE DRW 70223/BB/PL/YY/ZZ/XXXX
- CONCRETE — БЕТОНОВА ОБЛИЦОВКА / АРМОБЕТОНОВ ТОВАР/ CONCRETE COATING / SET ON
- CASING (TYPE) — КОЖУХ / PIPE CASING DRW 70223/BB/PL/YY/ZZ/XXXX
- TELECOM КАБЕЛНА ШАХТА / FOC JOINT BOX DRW 70223/BB/PL/YY/ZZ/XXXX
- TB СМЯНА НА ТРАНШЕЯТА / TRENCH BREAKER
- BP УКРЕПВАНЕ НА БРЕГА/ BANK PROTECTION
- SP УКРЕПВАНЕ НА СКЛОНА/ SLOPE PROTECTION
- ОГРАДА / FENCE
- 100 — ХОРИЗОНТАЛИ (m) НАДМОРСКА ВИСОЧИНА/ CONTOUR LINE (m) ABOVE SEA LEVEL



PROFILE
1 : 1,000
1 : 1,000
ELEVATION IN METRES
HORIZONTAL & VERTICAL SCALE :

ЗАБЕЛЕЖКА / NOTES.

КООРДИНАТНА СИСТЕМА 1970 - COORDINATE SYSTEM 1970
ВИСОЧИННА СИСТЕМА-БАЛТИЙСКА - HEIGHT SYSTEM-BALTIC

H1023097	ТРИАНГУЛАЧНА ТОЧКА ОТ НАЦИОНАЛНАТА GPS МРЕЖА /КЛАС H1/ TRIANGULAR OF THE NATIONAL GPS REFERENCE SYSTEM /CLASS H1/
H2021234	РЕПЕР ОТ НАЦИОНАЛНАТА НИВЕЛАЧНА МРЕЖА /КЛАС H2/ BENCHMARK OF THE NATIONAL GEODETIC REFERENCE LEVEL SYSTEM /CLASS H2/
H2025001	ТРИАНГУЛАЧНА ТОЧКА ОТ НАЦИОНАЛНАТА МРЕЖА /КЛАС H2/ TRIANGULAR OF THE NATIONAL REFERENCE SYSTEM /CLASS H2/
H3020353	ТОЧКА ОТ ОПОРНАТА МРЕЖА НА ГАЗОПРОВОД "NABUCCO" /КЛАС H3/ TRIANGULAR OF THE REFERENCE SYSTEM OF PIPELINE "NABUCCO" /CLASS H3/
H3020353	РЕПЕР ЗА НИВО ПРИ СТРОИТЕЛСТВОТО BENCHMARK LEVEL FOR CONSTRUCTION

REFERENCE DRAWINGS: CASING PIPE DN1600; VENT PIPE DN100

REV	DR'N	DATE	CH'D	DATE	APP'D	DATE	REVISION COMMENTS
0	PB	09.12.2012	PB	15.12.2012	DD	16.12.2012	ISSUED FOR CLIENT REVIEW

CLIENT

CHIMCOMPLECT ENGINEERING COMPANY

ПРОЕКТ / PROJECT: ГАЗОПРОВОД НАБУКО НА ТЕРИТОРИЯТА НА РЕПУБЛИКА БЪЛГАРИЯ / NABUCCO GAS PIPELINE PROJECT

ОБЕКТ: ПРЕСИЧАНЕ НА ПЪТ №15 МИЗИЯ-ОРЯХОВО НА КМ70+133.28 /ПО ГАЗОПРОВОДА НА КМ414+649/ CROSSING ROAD №15 MIZIA-ORYAHOVO AT KP70+133.28 /BY PIPELINE KP414+649/ ПРЕСИЧАНЕ НА РЕКА ОГОСТА /ПО ГАЗОПРОВОДА НА КМ414+750/ CROSSING OF OGOSTA RIVER /BY PIPELINE KP414+750/

FILE NAME/LOCATION: ACAD-70223-BB-PL-03-03-0006-00-Rev-0-C-414550-414950.dwg

SCALE: 1:1000 A1

DRG. No. 70223/BB/PL/03/03/0006-00 REV. 0

GIS Ref. No. C-414550-414950

* DRAWING ORIGINALLY PRODUCED USING: AUTODESK CIVIL 3D (2011)

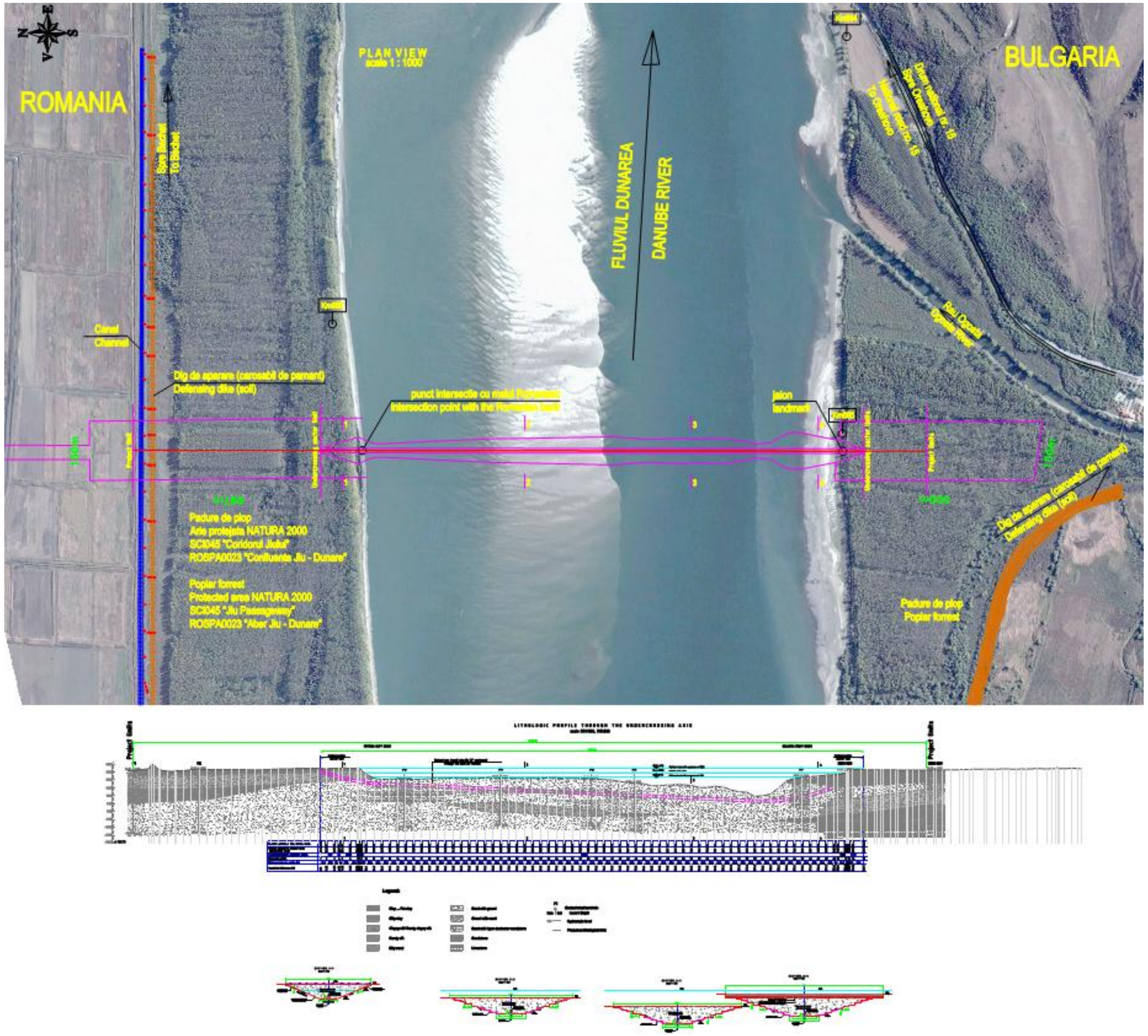
DRG. No. 70223/BB/PL/03/03/0006-00 GIS Ref. No.C-414550-414950 REV. 0

Do not scale. If in doubt ask.

This is a CAD drawing and should not be altered manually.

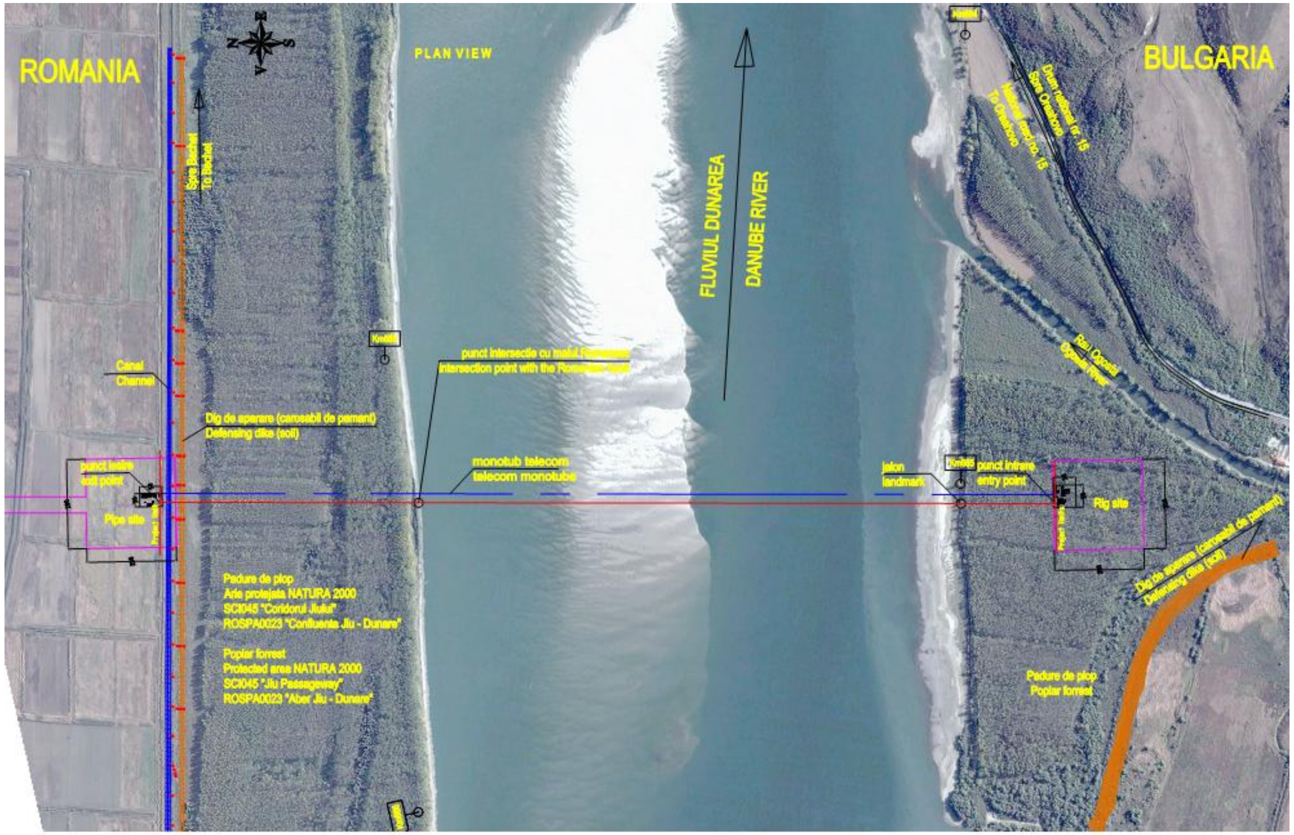
APPENDIX 6 – Danube river crossing by using open-cut method

Figure A6.1.: The Danube River crossing. Longitudinal profile open cut crossing option

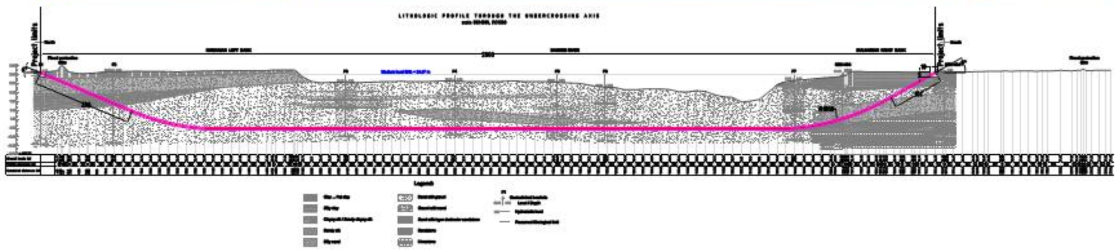

PLAN VIEW
scale 1 : 1000
ROMANIA
BULGARIA
Spre Bechet
To Bechet
Canal
Channel
Dig de aparare (carosabil de pamant)
Defensing dike (soil)
punct intersectie cu malul
intersection point with the
FLUVIUL DUNAREA
DANUBE RIVER
jalon
landmark
Padure de plop
Arie protejata NATURA 2000
SCI045 "Coridorul Jiului"
ROSPA0023 "Confluenta Jiu - Dunare"
Poplar forrest
Protected area NATURA 2000
SCI045 "Jiu Passageway"
ROSPA0023 "Aber Jiu - Dunare"
Drum national nr. 15
Spre Oreahovo
National road no. 15
To Oreahovo
Rau Ogosta
Ogosta River
Dig de aparare (carosabil de pamant)
Defensing dike (soil)
Padure de plop
Poplar forrest
Project limits
Legend

APPENDIX 7: Danube river crossing by using HDD method

Figure A7.1: Undercrossing the Danube river. Longitudinal profile horizontal directional drilling option



ROMANIA
PLAN VIEW
BULGARIA
FLUVIUL DUNAREA
DANUBE RIVER
Canal
Channel
Dig de aparare (carosabil de pamant)
Defensing dike (soil)
punct iesire
exit point
Pipe site
monotub telecom
telecom monotube
jalon
landmark
punct intrare
entry point
Rig site
Padure de plop
Arie protejata NATURA 2000
SCI045 "Coridorul Jiului"
ROSPA0023 "Confluenta Jiu - Dunare"
Poplar forrest
Protected area NATURA 2000
SCI045 "Jiu Passageway"
ROSPA0023 "Aber Jiu - Dunare"
Padure de plop
Poplar forrest



APPENDIX 8 : DATA ON ROSCI0045 JIU CORRIDOR AND ROSPA0023 JIU-DANUBE CONFLUENCE

8.1. ROSCI0045 JIU CORRIDOR

General description

According to the Standard Form, published in O.J. no. 739/2007[16], the site is located between N 43º41 28.3 and E 24º09'08.9" at its southern boundary and N 44º 56'38.6" and E 23º18'48.4" at its northern boundary, on NNW-SSE direction of approx. 140 km, this area crosses 4, respectively 27% of the 15 ecoregions (Getic Plateau, Gavanu-Burdea Plains, Romanian Plain forest steppe, the Danube Meadow) of the continental bio-geographical region of Romania, on a level difference of 326 m, arranged between 6 and 332 m in altitude.

The spread of old floodplain with alluvial soils and sand banks is characterized as lowland with a high phreatic table, crossed by several large drainage ditches. The forests supports an ensemble of mainly natural ecosystems, with a considerable diversity and a local abundance much higher than the average values specific to the Romanian forests, which gives it a remarkable bio-geographical personality.

Supporting relevant numbers of the live inventory of the country, out of which many sub-Mediterranean rare, endemic, partly protected elements offer a remarkable specific character to the territory, pointed out by:

- the existence of some vegetal associations of great bio-historical value reflecting the interface of the southern thermophile elements with the central-European elements;
- the conservation of some unaltered relict fragments of the archetypal forest structures situated at the boundary of bio-geographical areas (beech isles of Dâlga, Ţuglui, Bucovăţ, Quercus pedunculiflora of Braniştea Bistreţului Forest etc.);
- supporting some sustainable populations of animal and plant species whose conservation require the designation of special areas of conservation, special protection areas and a strict protection etc.

[16] Environment Minister's Decree 1.964/2007 on the setting up of the status of natural protected area for the sites of community importance, as an integral part of the European ecological network Natura 2000 on Romania, modified by Minister's Decree 2.387/2011

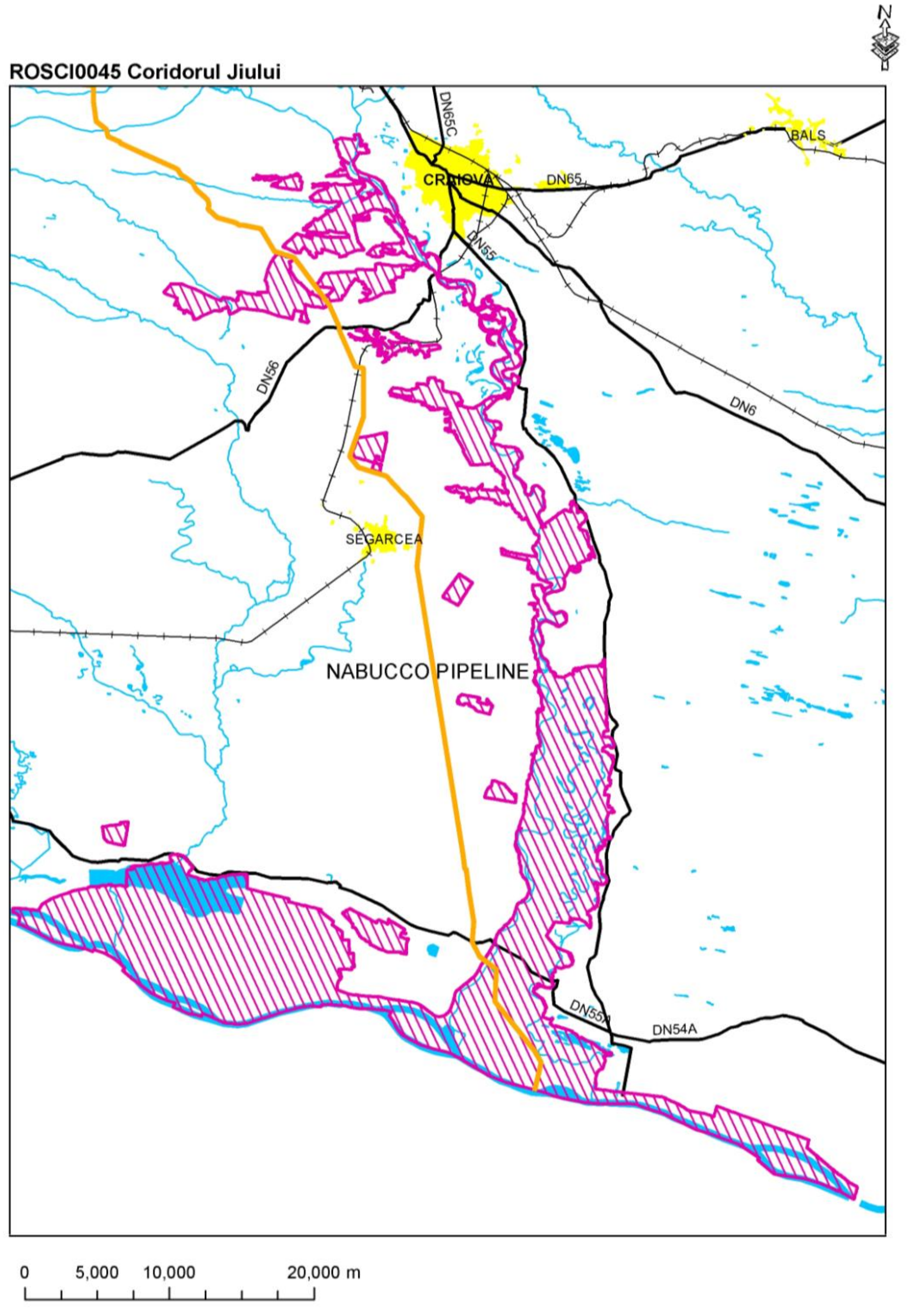


Figure 8.1: NGPL position in relation to Natura 2000 site ROSCI0045 Jiu Corridor

Site Protection Designation

- Conservation targets:

Dolj County Council, the administrator of ROSCI0045 Jiu Corridor, is currently working on the approval of a management plan for ROSCI0045 Jiu Corridor. In general, the appropriate conservation objectives of Natura 2000 aim at the

maintenance or restoration of favorable conservation status of species and habitats of community interest. These are contained in the management plans approved at the national level.
General conservation objectives for species belonging to the Natura 2000 areas crossed by the route of the Nabucco project may refer to:
- Maintaining species and habitats of EU directives, and if necessary restoring the favorable conservation status
- Adjusting the activities to the conservation needs of the species,
- Ecological reconstruction of damaged habitats,
- Providing natural breeding, feeding nesting / hibernation territories
- Reducing sources of water pollution, air, soil and noise pollution.

- Habitats and species subjects of protection in ROSCI0045 Jiu Corridor are listed in tables 8.1.1. and 8.1.2. below.

Table 8.1.1.: Natural habitats objects of protection in ROSCI0045 Jiu Corridor

Habitats types subject of protection in the SCI listed in Standard Data Form						
Code	*Habitat name*	*%*	*Repres.*	*Rel. area*	*Conserv.*	*Global*
3130	Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea	0,5	B	C	B	B
3270	Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation	0,1	B	C	B	B
6260*	Pannonian and west-Pontian sand steppe	0,1	B	B	B	B
6440	Alluvial meadows of the Cnidion dubii	1	B	B	B	B
6510	Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)	1	B	C	B	B
1530*	Pannonic salt steppes and salt marshes	3	B	B	B	B
9130	Asperulo-Fagetum beech forests	1,7	B	C	B	B
9170	Galio-Carpinetum oak-hornbeam forests	0,4	B	B	B	B
91E0*	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)	0,1	A	B	B	A
91I0*	Euro-Siberian steppic woods with Quercus spp.	1	A	B	B	B
91M0	Pannonian-Balkanic turkey oak- sessile oak forests	6,8	A	B	B	B
91Y0	Dacian oak & hornbeam forests	3	A	C	A	A
92A0	Salix alba and Populus alba galleries	3,7	A	B	B	B
91F0	Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)	0,5	A	B	B	B
3140	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.	0,01	C	C	C	C
3150	Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation	0,01	C	C	C	C
3260	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* Vegetation	0,01	C	C	B	B

Habitats types subject of protection in the SCI listed in Standard Data Form						
Code	*Habitat name*	*%*	*Repres.*	*Rel. area*	*Conserv.*	*Global*
6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	1	B	C	B	B

Tables 8.1.2..: Species listed in annex II of Council Directive 92/43/CEE objects of protection in ROSCI0045 Jiu Corridor

Species subject of protection in the SCI listed in Standard Data Form	Code	Species	Population: resident	Reproduction	Wintering	Passage	Site Pop.	Conserv.	Isolation	Global
Mammals	1335	Spermophilus citellus	P				C	B	C	B
	1355	Lutra lutra	P				C	B	C	B
amphibians and reptiles	1188	Bombina bombina	P				B	B	C	B
	1220	Emys orbicularis	P				C	B	C	B
	1166	Triturus cristatus	P				B	B	C	B
fish	1146	Sabanejewia aurata	P				C	B	C	B
	1149	Cobitis taenia	P				C	B	C	B
	2491	Alosa pontica		R			C	B	B	B
	1124	Gobio albipinnatus	P				C	B	C	B
	1130	Aspius aspius	P				B	B	C	B
	1134	Rhodeus sericeus amarus	P				C	B	C	B
	1145	Misgurnus fossilis	P				C	B	C	B
	1157	Gymnocephalus schraetzer	P				C	B	B	B
	1159	Zingel zingel	P				B	B	C	B
	1160	Zingel streber	P				B	B	C	B
	2522	Pelecus cultratus	P				C	B	C	B
	2555	Gymnocephalus	P?							

Species subject of protection in the SCI listed in Standard Data Form	Code	Species	Population: resident	Reproduction	Wintering	Passage	Site Pop.	Conserv.	Isolation	Global
		baloni								
	4125	Alosa immaculata	P	R			C	B	B	B
Invertebrates	4013	Carabus hungaricus	R				C	B	B	B
	1042	Leucorrhinia pectoralis	P				A	B	C	B
	1044	Coenagrion mercurial	R				B	B	C	B
	4045	Coenagrion ornatum	R				B	B	C	B
	4048	Isophya costata	P				B	B	C	B
	4054	Pholidoptera transsylvanica	P				B	B	A	B
	1083	Lucanus cervus	P				C	B	C	B
Plants	1428	Marsilea quadrifolia	V				C	C	C	C

. **Results of survey on the Romanian bank**

The team of specialists within the Institute of Biology Bucharest undertook field surveys, on the pipeline route throughout a calendar year - April 2010- April 2011..
Between Kp 0 +500m – Kp 10, a large expanse of old floodplain with alluvial soils and sand banks lies in the Jiu-Danube confluence area. The area is crossed by several large drainage ditches.

Vegetation

Several areas where the pipeline is to be located were investigated as a result of the field visits undertaken in September 2010. The access to the area was restricted due to floods in the Jiu-Danube confluence zone in May –August. The stations where the records were performed are near Ostroveni settlement.

The field visit undertaken in April 2011 enabled the inventory of the vernal species vegetating there as the access to the area was restricted due to floods in May-August 2010. The stations where records were carried out is near Ostroveni settlement (N 43º 45' 29,1'' E 023º 52' 55,5'').
The inventory where all the species of superior plants observed were recorded was undertaken along a transect starting from point kp 0 (the Danube bank) up to kp 3+100.

kp 0 + 500 - Kp 1+200 - Bechet Dike
The area at kp 0+500 considered lies on the Danube bank (VEG014) (N43 45 38.9 E23 51 38.7) close to the pipeline entry point in the country. It is flooded in the periods with rich rainfall. The substrate is represented by wet sands.
The meadow vegetation (VEG014), between the dyke and river is a thick plantation of poplar tree (*Populus × canadensis* Moench s.l.) and white willow – *Salix alba* L., with grassy aquatic and swamp plants: reed- *Phragmites australis* (Cav.) Steudel, Narrow Leaf Cattail - *Typha angustifolia* L., yellow water lily - *Nuphar lutea* (L.) Sm., white water lily- *Nymphaea alba* L., *Rorippa amphibia* (L.) Besser, Field Horsetail - *Equisetum arvense* L., rush - *Scirpoides holoschoenus* (L.) Soják, *Ranunculus lingua* L., *Alisma plantago-aquatica* L., yellow iris- *Iris pseudoacorus* L.
The section in the close proximity to the water is dominated by the invasive species *Amorpha fruticosa* (As. *Salicetum triandrae* subas. *amorphosum fruticosae*). Besides it, we find: *Portulaca oleracea* var. *oleracea* (Common Purslane), *Xanthium italicum, Salix triandra, Salix purpurea, Setaria viridis* (Green Bristle Grass), *Iva xantiifolia, Cyperus fuscus* (brown galingale), *Crypsis alopecuroides, Lycopus europaeus, Lithrum salicaria, Polygonum lapathifolium.*
<u>The conservation value of the habitat is low, even negative being an invasive stage.</u>
Walking the road near the Danube bank (parallel to it) N43 45 30.1 E23 52 41.4 to N43 45 28.4 E23 52 57.5 poplar plots (VEG002) and (VEG004), *Populus x canadensis* can be observed as follows: plots with trees planted for about 5 years, wooded for about 15 years, being 5-6 m high, in the next plot the trees have been cut, now there is a barren ground but prepared for afforestation (in the pipeline crossing point).
Species of vascular plants found there: *Solanum nigra, Aristolochia lutea, Xanthium italicum, Asparagus pseudoscaber*, *Lysimachia nummularia*, *Rubus caesius, Rubus idaeus, Amorpha fruticosa, Alnus glutinosa, Potentilla reptans, Plantago media, Inula britannica, Oxalis fontana*, *Vitis sylvestris*, *Morus alba*, *Erigeron canadensis* , *Humulus lupulus, Bidens tripartite*, *Setaria viridis*.

At the dyke base towards the floodplain there is a portion covering several km of short locust tree - *Amorpha fruticosa* L.

There are also species of *Medicago orbicularis* (L.) Bartal growing on the dyke, trefoil - *M. minima* (L.) L., *Trifolium retusum* L. subsp. *clusii,* yellow clover- *T. campestre* Schreber, *T. medium* L. subsp. *banaticum* (Heuffel) Hendrych, *T. striatum* L. subsp. *tenuiflorum* (Ten.) Archangeli, *Dipsacus laciniatus* L., Obsigă - *Bromus sterilis* L., field poppy- *Papaver dubium* L.

VEG007 – there are also species of *Medicago orbicularis* (L.) Bartal growing on the dyke, trefoil - *M. minima* (L.) L., *Trifolium retusum* L. subsp. *clusii,* yellow clover- *T. campestre* Schreber, *T. medium* L. subsp. *banaticum* (Heuffel) Hendrych, *T. striatum* L. subsp. *tenuiflorum* (Ten.) Archangeli, *Dipsacus laciniatus* L., Obsigă - *Bromus sterilis* L., field poppy- *Papaver dubium* L., *Haynaldia villosa, Vicia cracca, Vicia grandiflora, Capsella bursa-pastoris, Plantago lanceolata, Tragopogon dubius, Convolvulus arvensis, Aegilops cylindrica, Gnaphalium luteoalbum, Verbascum blattraia, Matricaria recutita, Medicago sativa, Tanacetum vulgare, Poa bulbosa, Artemisia scoparia, Polygonum aviculare, Xanthium italicum.*

On the other side of the dyke, following a channel covered with reed - *Phragmites australis* (Cav.) Steudel, mace reed - *Typha angustifolia* L, farm land stretches up to the Zăval deciduous forest.

The pipeline route crosses a barren ground populated by herbaceous species such as *Senecio vernalis*, *Glechoma hederacea*, *Capsella bursa-pastoris*, *Lysimachia nummularia*, *Ranunculus acris, Lamium maculatum, Rumex acetosella, Carex sp.* Dominating species: *Rubus caesius* , *Galium aparine*, *Lamium maculatum*. Other species: *Carpinus betulus, Urtica dioica, Symphytum tuberosum*, *Iris sp., Leucojum aestivum*.

Kp 1 + 500; Point GPS 122

The area considered lies near the dyke (N43 45 56.4 E23 53 11.4) and is represented by riparian vegetation (VEG014).

The substrate is represented by alluvial deposits, sands and gravel, with silty-sandy soils.

The superior level is represented by species such as: *Schoenoplectus lacustris* that may reach 2 m in height, *Typha angustifolia*, *Calamagrostis epigejos*, *Cyperus glomeratus*. Other species: *Alisma plantago-aquatica* , *Butomus umbellatus, Lycopus europaeus*, *Heleocharis lacustris*, *Inula britannica, Solanum dulcamara, Mentha aquatica*, *Lythrum salicaria, Gratiola officinalis*. The invasive species *Sambucus ebulus* has installed in this area, as well.

The pipeline route follows croplands (VEG011) and ruderal communities (VEG019) that include the following species: *Cicorium inthybus, Vicia cracca, Xanthyum italicum, Erigeron annuus, Setaria viridis, Cynodon dactylon, Lotus corniculatus, Daucus carota, Inula britannica.*

Kp 3 + 100

Cropland (VEG011) and ruderal communities (VEG019) (N43 47 05.6 E23 52 14.0). Dominant species: *Ambrosia artemisiifolia, Cannabis sativa, Sclerochloa dura, Polygonum aviculare, s.a.*

Status conservation of plants or bryophita : No species of plants or bryophita of conservation importance have been noticed on the area of the natural gas pipeline (the 36 m section where the work is executed and the 500 m location corridor) until now. No elements of flora protected at European level have been mentioned within the sites.

The conservation value is low.

FAUNA
INVERTEBRATES
Terrestrial

Carabus hungaricus prefers the steppes, sandy meadows along the Danube and Jiu, and it is a **rare, protected species** being characteristic to the Pannonian region.
Jiu water meadow offers a habitat advantageous for Odonata at the crossing point of the pipeline yet no protected species have been identified.
No terrestrial invertebrate species of conservation interest were identified in the sites surveyed during the field visit in the ROSCI0045 Jiu Corridor in June 2010.
The only species of conservation interest identified on this section is *Lucanus cervus* (coleopteran in Lucanidae family) in **Corabia Forest - Calopăr at km 46.9 of the pipeline.** This species is listed in annex II of the Habitats Directive.
Habitat – oak and hornbeam forests
Larva's food- wood material, Imago- sap of Qeurcus species.
Relation with the project-affected area.- dead specimens and rests (mandibles of male adult) have been collected from soil- their presence is confirmed.

FISH

Many species of fish are found on the Jiu river course. Twelve of them are listed in annex II of the Council Directive Pe 92/43/CEE-*Sabanejewia aurata, Cobitis taenia, Alosa pontica, Gobio albipinnatus, Aspius aspius, Rhodeus sericeus amarus, Misgurnus fossilis, Gymnocephalus schraetzer, Zingel zingel, Zingel streber, Pelecus cultratus, Gymnocephalus baloni.*

AMPHIBIANS AND REPTILES

On the standard form of the site there are specified amphibian and reptiles species mentioned in Annex II of Council Directive 92/43/CEE such as *Bombina bombina, Emys orbicularis.*.

MAMMALS

Several entrances in galleries have been identified for ground squirrel (*Spermophilus citellus*) at kp 10 of the pipeline in the Jiu river crossing area. No animals have been confirmed in the summer season. The galleries may be abandoned due to grazing.
One *Felis silvestris* with conservation value has been observed at the boundary of the plantation of Canadian poplar *Populus × Canadensis.*
Frequent prints of hunting species: *Meles meles, Capreolus capreolus, Sus scrofa have been observed in the flood bank area at the Danube crossing*.

A8.2. ROSPA0023 JIU-DANUBE CONFLUENCE

According to the Standard Form, published in O.J. no. 1964/2007[17], the site ROSPA0023 Jiu-Danube Confluence overlaps ROSCI0045 Jiu Corridor in Bechet area and shows the same characteristics.

This site hosts large numbers of protected bird species. According to the data, we have the following categories:

- number of species in appendix 1 of Bird Directive: 34
- number of other migratory species listed in the appendices of the Convention on migratory species (Bonn): 77
- number of globally endangered species: 5

The site is important for the nesting populations of the following species:
Crex crex

[17] GD no. 1.284/2007 concerning the declaration of SPA , as an integral part of the European ecological network Natura 2000 on Romania, modified by GD 971/2011

Haliaetus albicilla
Ciconia ciconia
Burhinus oedicnemus
The site is important during migration for the species:
Tringa glareola
Pelecanus crispus
Platalea leucorodia
Plecadis falcinellus

The site is important for wintering for the following species:
Phalacrocorax pygmaeus
During migration, the site hosts more than 20,000 wading birds, thus being a potential candidate as RAMSAR site.

- Conservation targets:

Dolj County Council, the administrator of ROSPA0023 Jiu-Danube Confluence, is currently working on the approval of a management plan for this Natura 2000 site.

In general, the appropriate conservation objectives of Natura 2000 aim at the maintenance or restoration of favorable conservation status of species and habitats of community interest. These are contained in the management plans approved at the national level.
General conservation objectives for species belonging to the Natura 2000 areas crossed by the route of the Nabucco project may refer to:
- Maintaining the species and habitats of EU directives, and if necessary restoring the favorable conservation status
- Adjusting the activities to the conservation needs of the species,
- Ecological reconstruction of damaged habitats,
- Providing natural breeding, feeding nesting / hibernation territories
- Reducing sources of water pollution, air, soil and noise pollution.

- Birds species subjects of protection in ROSPA0023 Jiu-Danube Confluence are listed in tables 8.2.1. and 8.2.2. below.

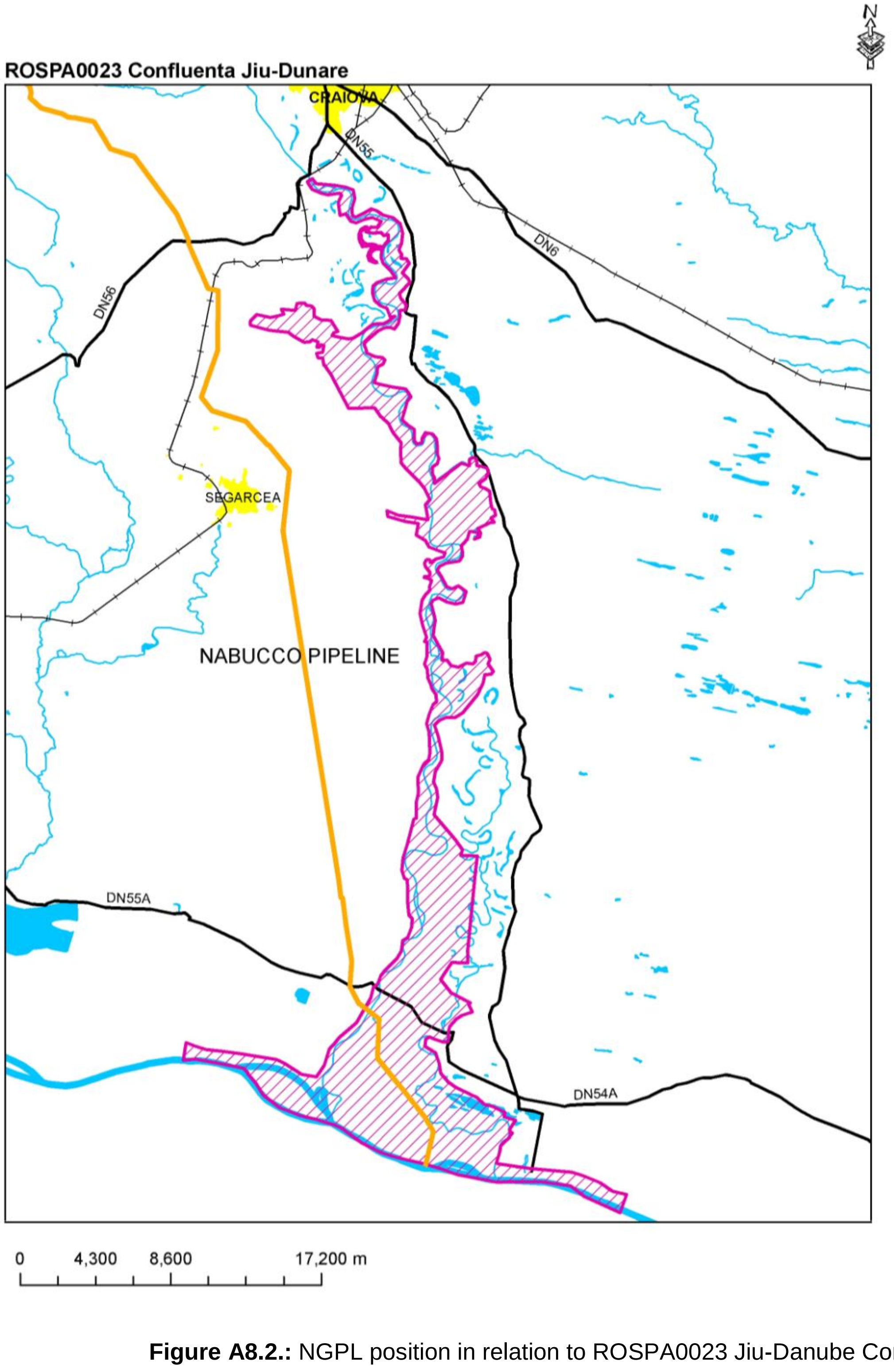


Figure A8.2.: NGPL position in relation to ROSPA0023 Jiu-Danube Confluence

Conservation status for the species observed in ROSPA0023 Jiu-Danube Confluence is presented in table A8.2.1 below.

Avifauna

Field visits were undertaken throughout a year (2010-2011), in all the seasons in order to identify the brooding and passage bird species or the winter guests likely to be affected by the project. The surveys on avifauna have been undertaken on the impact corridor of the project, from km 0 (the Danube crossing) to km 11 (the Jiu river crossing)- field questionnaires shown in appendix 9.

Forty-nine bird species were identified for ROSPA0023 Jiu-Danube Confluence, out of which 10 bird species are included in appendix 1 of the Bird Directive: *Ciconia nigra, Circus aeruginosus, Egretta garzetta, Aythya nyroca, Lanius collurio, Ciconia ciconia, Dendrocopos syriacus, Chlidonias niger, Pelecanus crispus and Phalacrocorax pygmeus.* Six species are of national interest (annex 4B, GEO 57/2007[18]).

The surveys were undertaken on the project impact corridor (500 m), following a line transect overlapping the pipeline route. Surveys on the water table and banks were undertaken when crossing the Jiu and the Danube river.

During nesting season, in summer, several species that may use the impact corridor as a nesting, feeding or stop-over site were identified due to the suitable habitats found there. Among them, we mention the following protected species: Circus aeruginosus, Aythya nyroca, Lanius collurio, Ciconia ciconia.

During passage, throughout September and March, the entire site becomes an extremely important area, offering stop-over and food sites for thousands of birds in migration.

The following protected species in passage have been identified: Ciconia nigra, Pelecanus crispus, Phalacrocorax pygmeus, Egretta garzetta, Chlidonias hybridus. During the winter season, field visits were undertaken in order to identify the bird species wintering in the project impact zone and to confirm the presence/absence of the species Phalacrocorax pygmeus (Pygmy cormorant). The Pygmy cormorant is mentioned in the standard form of the site ROSPA0023 Jiu-Danube Confluence as a species wintering there, with a population of 40-70 individuals. Its presence has been confirmed in the site, in the pipeline impact corridor, on the Danube bank, but there are only 2 individuals and at the end of winter they may be in passage.

Moreover, a large number of wild ducks, Eurasian Coots and cormorants use the area during migration, and a part of them during winter and summer, too.

The surveys on avifauna have been undertaken on the impact corridor of the project, from km 0 (the Danube crossing) to km 11 (the Jiu river crossing).

Thus, the species of special protection interest have been observed in the following points of the route:

- Ciconia nigra (Black stork): the species was observed outside the corridor and on the impact corridor, from km 0 and km 11 of the route (N43 45 16.5 E23 55 46.5 and N43 49 50.9 E23 51 01.8), in May 2010 and then at the beginning of March 2011, 5 specimens in migration.
- Circus aeruginosus: the species has been observed for several times, especially in the areas close to the rivers (N43 45 44.9 E23 52 57.7 and N43 49 50.9 E23 51 01.8), with reed.
- Egretta garzetta: several specimens observed near the Danube crossing, in the waterlogged area (N43 45 16.5 E23 55 46.5)
- Aythya nyroca: flying in the area of the reed channels near the Danube (N43 45 16.5 E23 55 46.5)
- Lanius collurio: frequent specimens on the entire route
- Ciconia ciconia: on the impact corridor, at km 0 and km 11 of the route (N43 45 16.5 E23 55 46.5 and N43 49 50.9 E23 51 01.8), and feeding on the field.
- Dendrocopos syriacus: observed in Zăval forest
- Chlidonias niger: 7 specimens observed flying (N 43 50 15.2 E 23 50 45.4)

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- Pelecanus crispus: 3 individuals observed in the surveys undertaken from the boat, on the Danube, in the project impact corridor (N43 44.925 E23 57.282 şi N43 45.345 E23 53.151)
- Phalacrocorax pygmeus: 2 individuals observed in the surveys undertaken from the boat, on the Danube, in the project impact corridor (N43 45.221 E23 53.975)

Table A8.2.3.. below shows the synthesis of the surveys undertaken in ROSPA0023 Jiu-Danube Confluence

The complete list of the birds species observed in ROSPA0023 Jiu-Danube Confluence is shown in table A8.2.4 below, in conjunction with their conservation status.
The tables A8.2.5. below show the endangered and critically endangered bird species on Nabucco route.

ROSPA0023 Jiu-Danube Confluence overlaps ROSCI0045 Jiu Corridor on this sector of NGPL.

The conservation status of the bird species and habitats used by them in ROSPA0023 Jiu-Danube Confluence is good both for brooding and for passage and wintering. The number of migratory birds and winter guests ranges depending on the climate conditions and the status of the habitats (flood periods, land use).

Table A8.2.1.: Bird species listed in annex I of Council Directive 79/409/CEE objects of protection in ROSPA0023 Jiu-Danube Confluence

Code	Species	Population: Resident	Nesting	Wintering	Passage	Site Pop.	Conserv.	Isolation	Global
A255	Anthus campestris		10-20 p			D			
A029	Ardea purpurea				10-30 i	D			
A133	Burhinus oedicnemus		10-20 p			B	B	C	B
A224	Caprimulgus europaeus		120-150 p			C	B	C	B
A196	Chlidonias hybridus				200-300i	D			
A197	Chlidonias niger				50-100 i	C	B	C	C
A081	Circus aeruginosus		6-10 p			C	B	C	B
A122	Crex crex		100-150 p			C	B	C	B
A429	Dendrocopos syriacus		90-120 p			C	B	C	C
A238	Dendrocopos medius		100-130 p			C	B	C	B
A027	Egretta alba				20-30 i	D			
A026	Egretta garzetta				150-200i	D			
A075	Haliaeetus albicilla		1-2 p			C	B	C	B
A131	Himantopus himantopus				20-30 i	D			
A338	Lanius collurio		C			D			
A177	Larus minutus				100-150i	C	B	C	B
A246	Lullula arborea		RC			D			
A073	Milvus migrans		2-4 p			C	B	C	C
A072	Pernis apivorus		12-20p			D			
A132	Recurvirostra avosetta				30-40 i	D			
A193	Sterna hirundo				150-250i	C	B	C	C
A166	Tringa glareola				1000-2000i	D	C	C	C
A021	Botaurus stellaris		2-4 p			D	B	C	B
A231	Coracias garrulus		46-50 p			D	C	C	C
A022	Ixobrychus minutus		12-20 p			D	B	C	B
A020	Pelecanus crispus				30-70 i	B	B	C	A
A393	Phalacrocorax pygmeus			40-70 i		C	B	C	B
A034	Platalea leucorodia				150-200i	D	C	C	C
A032	Plegadis falcinellus				750-1000i	D			
A229	Alcedo atthis		50-60p			C	B	C	B

Code	Species	Population: Resident	Nesting	Wintering	Passage	Site Pop.	Conserv.	Isolation	Global
A403	Buteo rufinus		2-4 p			C	B	C	B
A030	Ciconia nigra		2-3p			C	B	C	B
A031	Ciconia ciconia		P		500-800i	C	B	C	C
A321	Ficedula albicollis				300-400 i	D			
A089	Aquila pomarina		2-2 p			D			
A195	Sterna albifrons				70-140 i	C	B	C	C

Table A8.2.2.: Bird species with regular migration not mentioned in the annex I of Council Directive 2009/147/EC objects of protection in ROSPA0023 Jiu-Danube Confluence -

Code	Species	Population: Resident	Nesting	Wintering	Passage	Site Pop.	Conserv.	Isolation	Global
A247	Alauda arvensis		RC			C	C	C	C
A383	Miliaria calandra		C			D			
A262	Motacilla alba		C		C	D			
A260	Motacilla flava				C	D			
A319	Muscicapa striata		RC		C	D			
A277	Oenanthe oenanthe		RC			D			
A337	Oriolus oriolus		RC			D			
A017	Phalacrocorax carbo				RO	D			
A273	Phoenicurusochruros		RC			D			
A274	Phoenicurus phoenicurus				RO	D			
A315	Phylloscopus collybit		C		C	D			
A005	Podiceps cristatus				C	D			
A249	Riparia riparia				RO	D			
A275	Saxicola rubetra		RC			D			
A351	Sturnus vulgaris		C		P	D			
A311	Sylvia atricapilla		RC			D			
A310	Sylvia borin		R			D			
A309	Sylvia communis		RC			D			
A308	Sylvia curruca		RC			D			
A004	Tachybaptus ruficollis				C	D			
A165	Tringa ochropus				RO	D			
A283	Turdus merula		RC			D			
A285	Turdus philomelos		RC			D			
A232	Upupa epops		RC			D			
A142	Vanellus vanellus				RC	D			
A298	Acrocephalus		RC			D			

Code	Species	Population: Resident	Nesting	Wintering	Passage	Site Pop.	Conserv.	Isolation	Global
	arundinaceus								
A296	Acrocephalus palustris		R			D			
A297	Acrocephalus scirpaceus		RC			D			
A295	Acrocephalus schoenobaenus		RC			D			
A336	Remiz pendulinus		RC			D			
A056	Anas clypeata				R	D			
A051	Anas strepera		RC		R	D			
A041	Anser albifrons				R	D			
A043	Anser anser				R	D			
A258	Anthus cervinus				R	D			
A257	Anthus pratensis				RC	D			
A259	Anthus spinoletta				R	D			
A256	Anthus trivialis		RC			D			
A221	Asio otus				R	D			
A059	Aythya farina				RC	D			
A061	Aythya fuligula				R	D			
A147	Calidris ferruginea				RC	D			
A145	Calidris minuta				R	D			
A146	Calidris temminckii				R	D			
A366	Carduelis cannabina		RC			D			
A364	Carduelis carduelis		C			D			
A136	Charadrius dubius					D			
A137	Charadrius hiaticula				R	D			
A207	Columba oenas		RC		R	D			
A113	Coturnix coturnix		R			D			
A208	Columba palumbus		RC			D			
A212	Cuculus canorus		RC			D			
A253	Delichon urbica		RC		RC	D			
A269	Erithacus rubecula				RC	D			
A099	Falco subbuteo		RC			D			
A096	Falco tinnunculus		RC			D			
A359	Fringilla coelebs		RC		C	D			
A251	Hirundo rustica		C		C	D			
A340	Lanius excubitor				RO	D			
A291	Locustella fluviatilis		RC			D			
A292	Locustella luscinioides		C			D			
A270	Luscinia luscinia		V			D			
A271	Luscinia megarhynchos		C			D			
A230	Merops apiaster		R			D			
A052	Anas crecca				4000-	D			

Code	Species	Population: Resident	Nesting	Wintering	Passage	Site Pop.	Conserv.	Isolation	Global
					6000i				
A050	Anas penelope				1000-1200i	C	C	C	C
A053	Anas platyrhynchos				2000-3000i	D			
A055	Anas querquedula				1500-2000i	D			
A028	Ardea cinerea				500-600i	D			
A156	Limosa limosa				2000-3000i	C	B	C	B
A125	Fulica atra		RC		2000-2500i	D			
A179	Larus ridibundus		R		2000-3000i	C	C	C	C
A153	Gallinago gallinago				1000-1200i	D			
A161	Tringa erythropus				600-800i	C	B	C	B
A164	Tringa nebularia				500-600i	C	B	C	B
A459	Larus cachinnans				800-1000i	D			

Table A8.2.3.: Results of surveys on the birds on the pipeline route kp0+000 – kp 10 - ROSPA0023 Danube –Jiu Confluence

No	Nabucco pipeline route	Habitat	Survey results	
			Existing data	Coordinates / Photo
1	**ROSPA0023 Jiu-Danube Confluence kp 0+000 – kp 1+200 N 43º 45' 48,4" E 23º 53' 10,4")**	Meadow habitats. Floodplain forest with aquatic plants and plantation of Euramerican poplar	Of all the species of **community interest** we specify: white stork (A031*Ciconia ciconia*), black stork (A030*Ciconia nigra*), Marsh harrier (A081*Circus aeruginosus*), Red-backed Shrike (A338*Lanius collurio*), Little Egret (A026*Egretta garzetta*), Ferruginous Duck (A060*Aythya nyroca*), Pygmy Cormorant (A020 *Phalacrocorax pygmeus)*. Other species noticed: common heron (*Ardea cinerea*), whinchat (*Saxicola rubetra*), Common Moorhen (*Gallinula chloropus*), Wild duck (*Anas platyrhynchos*), Great Reed Warbler *(Acrocephalus aerudinaceus),* Great Cormorant (*Phalacrocorax carbo)*, Chaffinch *(Fringilla coelebs)*, Common Kestrel (*Falco tinnunculus)*, Corn Bunting *(Miliaria calandra)*, Eurasian Linnet (*Carduelis cannabina)*, White Wagtail (*Motacilla alba)*, Northern Lapwing (*Vanellus vanellus)*, the rook (*Corvus frugilegus*), Yellow-legged Gull (*Larus michaellis*).	**N43 45 28.4 E23 52 57.5**  **Photo 1. *Anas platyrhynchos***
2	**kp 3+000 – kp 4+000 pf the pipeline, N43 47 05.6 E23 52 14.0**	Agricultural crop habitats	Surveys have been undertaken along the transect. The species seen or heard on the left and right of the transect have been recorded. Thus, 6 species have been recorded, as follows: Corn Bunting (*Miliaria calandra-photo 2*), Skylark (*Alauda arvensis*), Northern Lapwing (*Vanellus vanellus*), white stork (A031*Ciconia ciconia*), Common Pheasant (*Phasianus colchicus*), the rook (*Corvus frugilegus*), Common Buzzard (*Buteo buteo*). Except the white stork (which was observed flying over the route) the **species do not have a high conservation value, being generally common species, frequently found and typical of the habitats of agricultural crops.**	**N43 47 05.6 E23 52 14.0**  **Photo 2. *Miliaria calandra***

3	**kp 10** **N 43º 50' 15,2'' E 23º 50' 45,4'',**	**Jiu Crossing**	A number of 28 species have been observed: white stork (A031*Ciconia ciconia*), European Bee-eater (*Merops apiaster-photo 7*), Whiskered Tern (*Chlidonias hybridus*), Sand Martin (*Riparia riparia*), wild duck (*Anas platyrhynchos- photo 5*), Great Cormorant (*Phalacrocorax carbo*), Little Egret (A026*Egretta garzetta*), *Domestic* Pigeon (*Columba livia domestica*), Eurasian Coot (*Fulica atra*), Northern Lapwing (*Vanellus vanellus*), Chaffinch (*Fringilla coelebs*), Common Kestrel (*Falco tinnunculus- photo 4*), Marsh-harrier (A081*Circus aeruginosus- photo 3*), Corn Bunting (*Miliaria calandra*), linnet (*Carduelis cannabina*), Grey Heron (*Ardea cinerea*), White Wagtail (*Motacilla alba*), Northern Lapwing (*Vanellus vanellus*), Green Sandpiper (*Tringa ochropus*), *Corvus corone cornix*, the rook (*Corvus frugilegus*), Yellow-legged Gull (*Larus michaellis*), Black-headed Gull (*Larus ridibundus*) Red-backed Shrike (*Lanius collurio- photo 6*), Common Teal (*Anas crecca*), Willow Warbler (*Phylloscopus trochilus*), Greylag Goose (*Anser anser*), Tree Pipit (*Anthus trivialis-photo 8),* Spotted Redshank (*Tringa erythropus*). A large number of specimens (hundreds) of ducks, gulls and cormorants were observed on the water, on the bank and on the islets on the Jiu river during the passage period (September).	**N 43 48 482; E 23 52 558**  **Photo 3. *Circus aeruginosus***

Photo 4. ***Falco tinnunculus***

Photo 5. ***Anas plathyrhynchos***

Photo 6. ***Lanius collurio***

Photo 7. ***Merops apiaster***

Photo 8. ***Anthus trivialis***

Photo 9. Phalacrocorax carbo **(cormorant)**

4	**kp 10** **(N43 49 50.9** **E23 51 01.8)**	**Forest**	Zăval forest has been visited in the area bordering the pasture. Species typical of the plain forests have been observed: *Falco tinnunculus*, *Fringilla coelebs*, *Phylloscopus trochilus – photo 10*.	**N43 50 14.7 E23 50 44.9**  **Photo 10. *Phylloscopus trochilus***

Table A8.2.4.: Conservation status for the species observed in ROSPA0023 Jiu-Danube Confluence

Code N2000	Species	Common name	Conservation status			
			Birds directive (2009/147/EC)	**GEO57/2007**	**National red list**	**SPEC category**
	Acrocephalus arundinaceus	Great Reed Warbler				
	Alauda arvensis	Skylark	Annex II/2	Annex 5 C	-	3
	Anas cercca	Common Teal	Annex II/1	Annex 5C, 5D	-	-
	Anas platyrhynchos	Wild duck	Annex II/1	Annex 5C, 5D		
	Anser anser	Greylag Goose	Annex II/1	Annex 5C, 5D		
	Anthus trivialis	Tree Pipit	-	-	-	-
	Ardea cinerea	Grey Heron				
A060	*Aythya nyroca*	Ferruginous Duck	Annex I	Annex 3	vulnerable	
	Buteo buteo	Common Buzzard				
	Carduelis canabina	Linet	-	Annex 4B	-	4
A196	*Chlidonias hybridus*	Whiskered Tern	Annex I			3
A031	*Ciconia ciconia*	White stork	Annex I	Annex 3	vulnerable	2
A030	*Ciconia nigra*	Black stork	Annex I	Annex 3	vulnerable	3
A081	*Circus aeruginosus*	Marsh Harrier	Annex I	Annex 3	-	-
	Columba livia domestica	Domestic pigeon	Annex II/1	-	-	-
	Corvus corone cornix	Hooded crow	Annex II/2	Annex 5 C	-	-
	Corvus frugilegus	Rook	Annex II/2	Annex 5 C	-	-
A429	*Dendrocopos syriacus*	Syrian Woodpecker	Annex I	Annex 3		4
A026	*Egretta garzetta*	Little Egret	Annex I	Annex 3		
	Falco tinnunculus	Common Kestrel	-	Annex 4B	-	3
	Fringilla coelebs	Chaffinch	-	-	-	4

Code N2000	Species	Common name	Conservation status			
			Birds directive (2009/147/EC)	**GEO57/2007**	**National red list**	**SPEC category**
	Fulica atra	Eurasian Coot	Annex II/1, III/2	Annex 5C, 5E	-	-
	Gallinula chloropus	Common Moorhen	Annex II/1, II/2	Annex 5C		
A338	*Lanius collurio*	Red-backed Shrike	Annex I	Annex 3		3
	Larus michaellis	Yellow-legged Gull	-	-	-	-
	Larus ridibundus	Black-headed Gull	-	-	-	-
	Merops apiaster	Bee eater		Annex 4B		3
	Miliaria calandra	Corn Bunting	-	Annex 4B	-	4
	Motacilla alba	White Wagtail	-	Annex 4B	-	-
	Phalacrocorax carbo	Great Cormorant	-	-	-	-
	Phasianus colchicus	Pheasant	Annex II/1	Annex 5C, 5D	-	
	Phylloscopus trochilus	Willow Warbler	-	Annex 4B	-	-
	Riparia riparia	Sand Martin				3
	Saxicola rubetra	Whinchat				4
	Tringa ochropus	Green Sandpiper				
	Tringa erythropus	Spotted Redshank				
	Vanellus vanellus	Northern Lapwing	Annex II/2	-	-	-

SPEC Categories (species of conservation interest at the European level) are defined as follows:
SPEC 1. Species of conservation interest at the global level (threatened at the global level), dependent on conservation
SPEC 2. Concentrated in Europe and with unfavourable conservation status
SPEC 3. Not concentrated in Europe and with unfavourable conservation status
SPEC 4. Concentrated in Europe and with favourable conservation status

The National Red List is extracted from the work *Rare, vulnerable and threatened birds of Romania*, Dan Munteanu, Ed. Amna Mater, Cluj-Napoca, 2009.[101].

Appendices of **Romanian Government Emergency Ordinance no. 57 of 20/06/2007** on the status of the natural protected areas, conservation of natural habitats, wild flora and fauna, mentioned in text:

- APPENDIX no. 2 – Types of natural habitats whose conservation requires the designation of special conservation areas.
- APPENDIX no. 3 – Species of plants and animals whose conservation requires the designation of special conservation areas and of special protection areas
- APPENDIX no. 4B – Species of national interest. Species of plants and animals requiring strict protection
- APPENDIX no. 5C – Species of community interest whose hunting is permitted.
- APPENDIX no.5D – Species of birds of community interest whose commercialization is permitted.
- APPENDIX no. 5E – Species of birds of community interest whose commercialization is permitted under special conditions.

Table A8.2.5.: Endangered and critically endangered bird species on Nabucco route in ROSPA0023

Species	Status	Type of habitat	Specimens observed	36m RoW/ 500 m corridor	kp
Pelecanus crispus	**CRITICALLY ENDANGERED**	The Danube river	**3**	**36 m**	0-1
Egretta garzetta	**ENDANGERED**	In the waterlogged area near the Danube crossing – east of the route	Several specimens		0-1

Pop. – the number of individuals observed in the survey.

APPENDIX 9 : Impact significance

Table A9.1.: Significance of impact on habitats and species

CATEGORY	**No effect**	**VERY LOW**	**LOW**	**MEDIUM**	**HIGH**	**VERY HIGH**
Ranking	0	1	2	3	4	5
Habitat integrity	No effect	Impact on the habitat integrity[1] largely not discernable	Loss of habitat integrity not measurable using standard techniques	Reduction in integrity of regionally (in the country context) important habitat using standard techniques	Reduction in integrity of nationally important habitat using standard techniques	Reduction in integrity of internationally important habitat using standard techniques
Species behaviour and interactions		No discernable effect due to disruption[2] on behaviour or species interactions	Disruption of behaviour or species interactions discernable using standard techniques	Disruption of behaviour or species interactions of regionally (in the country context) important species discernable using standard techniques	Disruption of behaviour or interactions of nationally important species discernable using standard techniques	Disruption of behaviour or interactions of internationally important species discernable using standard techniques
Habitat/ species recovery (temporary landtake)		Immediate return to baseline conditions on completion of reinstatement activities	Return to baseline conditions within 2 years on completion of reinstatement activities	Return to baseline conditions within 2-5 years on completion of reinstatement activities	Return to baseline conditions after 5-7 years on completion of reinstatement activities	Return to baseline conditions after >7 years on completion of reinstatement activities
Protected Habitats		Not impacting an area affected by national laws, international conventions, company policies or IFI Policies	Activities may temporarily disturb protected areas but not lead to any long-term effects on the ecological integrity of the protected area	Potential to contravene the very high (5) category; assuming re-instatement likely within three years	Potential to contravene the provisions or intent of national laws, international conventions, company policies or IFI Policies after mitigation, assuming full re-instatement to pre-disturbance condition within five years	Contravenes the provisions or intent of national laws, international conventions, company policies or IFI Policies.

Protected species		Loss of area or extent of biotope	Reduced habitat suitability or quality (fauna)	Loss of suitable habitat Reduced breeding success resulting in reduced population	Reduced population size or viability	Mortality of individuals

Note 1: The ecological integrity includes issues such as the habitat loss, the habitat fragmentation, destruction and loss of wild life corridors, of the ecological capacity.
Note 2: Disturbance caused by physical changes, visual intrusion, noise and emissions to air, e.g. for reproduction, nesting, mating/egg laying, seasonal and diurnal migration, hibernation, territorial activities, prey-predator relations and mortality.

Table A9.2.: Significance of impact on Landscape

CATEGORY	No effect	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
Ranking	0	1	2	3	4	5
Impact on Visual Receptors (resident and transitory)	No effect	Change in view not discernable from most viewpoints	Few viewpoints affected / minor change in view	Many viewpoints affected / moderate changes in view	Majority of viewpoints affected / major changes in view	All of viewpoints affected
Duration, and extent of change in landscape / Quality and value of Landscape		No noticeable change in landscape / or landscape is low quality	Virtually imperceptible change in the l landscape; or Reinstatement within 1-2 years	Changes in the natural landscape in a localized area; or Reinstateme nt in 2-5 years	Change in natural or high value landscape over an extensive area; or Reinstatem ent in 5-10 years	Change in natural or high value landscape over an extensive area; and Reinstateme nt

Table A9.3.: Significance of impact on Soils

CATEGORY	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
Ranking	1	2	3	4	5
Soil erosion	Soil erosion generally not discernable	Soil erosion predicted to occur at approximately the same rate as soil formation	Soil erosion predicted to be visibly active but no rill and gully formation evident	Rill and gully formation predicted to be evident	Rill and gully formation predicted to be extensive
Reduced soil productivity	Productivity losses generally not discernable	Productivity losses are discernible and predicted to last less than three months after construction	Limited productivity losses predicted to last less than one year after construction but more than three months	Moderate areal extent of productivity losses predicted to last more between one and five years after construction	Productivity losses are predicted to be extensive last more than five years after construction
Waterlogged soils	Water logging generally not discernable	Water predicted to remain in surface depressions less than three months after construction	Water predicted to remain in surface depressions less than one year after construction but more than three months	Water predicted to remain in surface depressions for between one and five years after construction	Water predicted to remain in surface depressions permanently
Sediment transport to water courses	Visible sediments generally not discernable	Visible sediment predicted in watercourses for less than three weeks after construction and no obscuration of the bed	Visible sediment predicted in watercourses for longer than three weeks after construction but no obscuration of bed	Visible sediment predicted in watercourses for longer than three weeks after construction and obscuration of the bed	Permanent features in watercourses

Table A9.4.: Contamination of Land due to Project activities

CATEGORY	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
Ranking	1	2	3	4	5
Description	Concentrations below DIV	DIV concentrations exceeded by <25% in project area and can affect receptors	DIV concentrations exceeded by 25-50% in project area and can affect receptors	DIV concentrations exceeded by 50-100% in project area and can affect receptors	DIV concentrations exceeded by >100% in project area and can affect receptors

[1]DIV refers to Dutch Intervention Standards used internationally as screening criteria. The DIV Intervention Standards are levels at which intervention to clean up is recommended. Their use here is to provide a measure of impact rather than as a trigger level for intervention during construction should any contamination be exposed

Table A9.5.: Significance of noise impact (for human receptors)

CATEGORY	**VERY LOW**	**LOW**	**MEDIUM**	**HIGH**	**VERY HIGH**
Ranking	1	2	3	4	5
Construction	Ambient noise level raised by <3dBA (not perceptible by most people) and less than LAeq 5 minutes 70/75 dB(A)1 outside dwellings between agreed daytime working hours and limit of Leq (1-hour) 45 dB(A)2 at night (to avoid sleep disturbance)	Ambient noise level raised by 3-5dBA and less than LAeq 5 minutes 70/75 dB(A) outside dwellings between agreed daytime working hours and limit of Leq (1-hour) 45 dB(A) at night	Ambient noise levels at sensitive receptors raised by 6-10dB (A) and less than LAeq 5 minutes 70/75 dB(A) outside dwellings between agreed daytime working hours and limit of Leq (1-hour) 45 dB(A) at night	Ambient noise levels at sensitive receptors raised by >10dB (A); or exceedance of LAeq 5 minutes 70/75 dB(A) outside dwellings between agreed daytime working hours and limit of Leq (1-hour) 45 dB(A) at night	As for Level 4 and either tonal or impulsive noise present.
Continuous operational noise in residential areas	Leq (1-hour) <45 dB(A)3 at night and Leq (1-hour) <55 dB(A)3 during the day	Leq (1-hour) <45 dB(A) at night and Leq (1-hour) <55 dB(A) during the day but ambient noise level raised by no more than 3dBA	Leq (1-hour) <45 dB(A) at night and Leq (1-hour) <55 dB(A) during the day but ambient noise levels at sensitive receptors raised by 3-6dB (A)	Exceedance of Leq (1-hour) <45 dB(A) or Leq (1-hour) <55 dB(A) during the day As guidance any operational noise of duration greater than 1 hour and exceeding the above standards and that is more frequent than once per week	Exceedance of Leq (1-hour) <45 dB(A) or Leq (1-hour) <55 dB(A) during the day and tonal or impulsive noise present As guidance any operational noise of duration greater than 1 hour and exceeding the above standards and that is more frequent that once per week

CATEGORY	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
Ranking	1	2	3	4	5
Continuous operational noise in industrial/commercial areas	Leq (1-hour) <70 dB(A)3	Leq (1-hour) <70 dB(A) and ambient noise level raised by no more than 3dBA	Leq (1-hour) <70 dB(A) ambient noise levels at sensitive receptors raised by 3-6dB (A)	Exceedance of Leq (1-hour) 70 dB(A)	Exceedance of Leq (1-hour) 70 dB(A) or Leq (1-hour) and tonal or impulsive noise present

1 World Bank Group "Pollution Prevention Abatement Handbook – General Environmental Guidelines". Recommended level for Industrial installations.
2 WHO "Guidelines for Community Noise" (1999).
3 World Bank Group "Pollution Prevention Abatement Handbook – General Environmental Guidelines". For a residential area, the World Bank recommend that daytime limits do not exceed LAeq 55dB daytime, and LAeq 45dB night-time, or a maximum 3dBA increase than the existing noise level should the existing ambient noise level already exceed 45dBA.
4 World Bank Group "Pollution Prevention Abatement Handbook – General Environmental Guidelines"
5. Duration – Should any of the construction impacts occur for more than 2 weeks, the next consequence/severity level up will be used.

Table A9.6.: Significance of impact on Air quality

CATEGORY	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
Ranking	1	2	3	4	5
Short term (<24 hours) concentrations	Process concentrations that are not discernable	Process concentrations that are <75% of the EU standards	Process concentrations that are 75-100% of the EU standards	Process concentrations that are 100-149% of the EU standards	Process concentrations that are >150% of the EU standards
Long term (>24 hours) concentrations	Maximum process and baseline concentrations are <10% of the EU standards	Maximum process and baseline concentrations are 10-20% of the EU standards	Maximum process and baseline concentrations are 20-50% of the EU standards	Maximum process and baseline concentrations are 50-100% of the EU standards	Maximum process and baseline concentrations are >100% of the EU standards
	Maximum process annual emissions are <0.5% of the Romanian National Emissions Inventory values	Maximum process annual emissions are 0.5-2% of the Romanian National Emissions Inventory values	Maximum process annual emissions are 2-5% of the Romanian National Emissions Inventory values	Maximum process annual emissions are 5-10% of the Romanian National Emissions Inventory values	Maximum process annual emissions are >10% of the Romanian National Emissions Inventory values

Note: EU standards refer to ambient air quality.

Table A9.7.: Significance of impact of Dust

CATEGORY	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
Ranking	1	2	3	4	5
Construction Nuisance	No measurable or notable increase	Measurable and notable increase in dust levels	Nuisance to people but no adverse health effects or on crops/property	Significant nuisance to people or with sensitive individuals affected, or minor property or crop damage	Very significant nuisance to people with measurable health effects, or significant damage to property or crops

Note 1: Nuisance takes account of duration by the inherent assumption that in order to cause a nuisance the impact must last for a reasonable duration (eg. greater than one week or repeated impacts).
Note 2: The above criteria are qualitative in nature, but require professional judgement in order to assign the appropriate ranking

Table A9.8.: Groundwater - Quality and Quantity

CATEGORY	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
Ranking	1	2	3	4	5
Groundwater used, or could be used, as a resource, being of sufficient quantity and quality	No discernible change in groundwater baseline conditions *and* no discernible change in groundwater resource quantity.	Change of <25% in any parameter from the DIV1 criteria *or* depletion of resource that does not recover within 6 months post construction (within 10% of original elevation).	Change of 25-50% in any parameter from the DIV1 criteria *or* depletion of resource that does not recover within 6-12 months post construction (within 10% of original elevation).	Change of 50-100% in any parameter from the DIV1 criteria *or* depletion of resource that does not recover within 1-2 years post construction (within 10% of original elevation).	Change of >100% in any parameter from the DIV1 criteria *or* depletion of resource that does not recover after 2 years post construction (within 10% of original elevation).
Effect on users	No effect	Temporary effect	Short term but reversible effect	Long term but reversible effect	Permanent and irreversible effect

1 DIV refers to Dutch Intervention Standards. The DIV Intervention Standards are levels at which intervention to clean up is recommended. Their use here is to provide a measure of impact rather than as a trigger level for intervention should contaminated groundwater be encountered during construction

Table A9.9.: Significance of impact on Surface Water - Quality and Quantity

CATEGORY	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
Ranking	1	2	3	4	5
For surface water used, or may be used, as a resource, being of sufficient quantity and quality	No discernible change in surface water baseline conditions and no discernible change in downstream river	Change of <25% in any parameter from the DIV1; or visible sediment observed for less than 3 weeks; or	Change of 25-50% in any parameter from the DIV1;or visible sediment observed for more than 3 weeks; or	Change of 50-100% in any parameter from the DIV1; or visible sediment observed for more than 3	Change of >100% in any parameter from the DIV1; or visible sediment observed for more than 3 weeks; or

CATEGORY	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
	discharge.	<15% decrease of downstream river discharge for no more than 1 day.	15-40% decrease of downstream river discharge for 1-2 days.	weeks; or >40% decrease of downstream river discharge for 2-3 days.	>40% decrease of downstream river discharge for >3 days.
Effect on Benefecial users	No effect	Temporary effect	Short term but reversible effect	Long term but reversible effect	Permanent and irreversible effect

1 DIV refers to Dutch Intervention Standards. The DIV Intervention Standards are levels at which intervention to clean up is recommended. Their use here is to provide a measure of impact rather than as a trigger level for intervention

Table A9.10.: Significance of impact on Social Impacts

CATEGORY	SOCIAL IMPACT
Beneficial	Improvement in the ability of household or settlement to maintain or improve its livelihood/store of assets Enhancement in quality or availability of resource leading to improvement in quality of life. For example: Enhancement in physical capital including availability of infrastructure Enhancement in social capital, including skills for future employment Enhancement of relationship between BP/Construction Contractor and communities Enhancement in health and safety of local population
Low	Possible short term decrease in availability of resource or access to infrastructure not affecting livelihood Possible short term decrease in quality of life of household or settlement not affecting long term outcomes No effect on human health No discernable long term effect of the local economy Impacts which are long lasting but to which the community is able to adapt, such as increased access to information/possible slow cultural change/changes in economic structure
Medium	Potential effect or perceived effect on ability of household to maintain livelihood/store of assets in short term Potential reduction in quality of life in short term Potential disruption to lifestyle in short term Perception of missed opportunity to improve Possible decrease or perceived decrease in access to infrastructure to which community is unable to adapt in the short term Quality of life Negative effect on human health which can be contained and is therefore short term with no increased mortality Impacts which may result in high levels of complaint in the short term
High	Negative effect on safety of humans or animals Negative effect on human health which can not be contained or results in increased mortality Effect or perceived effect on ability of household to maintain livelihood/store of assets to an extent not acceptable to affected people Permanent or perceived permanent reduction in quality of life Permanent cultural change to which the communities are unable to adapt Widespread perception of missed opportunity to improve quality of life, resulting in frustration and disappointment Result in tensions with communities which lead to sabotage to pipeline construction or operation by local communities, or outbreaks of violence between workers and communities

Appendix 10: WASTE MANAGEMENT

Table A10.1: Type, quantity and the management of the non – hazardous waste during the construction period in case of using the open-cut method-

№	Waste name	Quantity to be generated[19]	Physical state (Solid- S, Liquid – L, Semisolid-SS)	Waste code[20]	Code regarding the main hazardous feature[21]	Waste management • quantity to be generated (tone/year)		
						Recycled	Eliminated	In stock
1.	Domestic or assimilable	0.35 t/day	S	20 01 08	H9; H3-B; H13	Partially 0.2 t/day	Partially 0.15 t/day	-
2.	Package waste (paper and cardboard, plastic, metal, glass materials)	0.1 t/month	S	15 01 01 15 01 02 15 01 04 15 01 07		Integral 0,1 t/month	-	-
3.	Paper and specific waste from office work	10 kg/month	S	20 01 01		Integral 10 kg/month	-	-

[19] Data have been insufficient to estimate all the quantities of waste materials generated
[20] In accordance with the Bulgarian and Romanian legislation:

1. In accordance with Regulation № 3 dated 1 April 2004 for waste classification (issued by the MoEW and MH, promulgated in SG, issue 44 dated 25 May 2004)
2. In accordance with List comprising waste, including hazardous waste provided in appendix №2 to the Government Decision №856/2002 on the waste management record and for the approval of the list containing waste, including hazardous waste

[21] In accordance with the Bulgarian and Romanian legislation:

1. In accordance with Regulation № 3 dated 1 April 2004 for waste classification (issued by the MoEW and MH, promulgated in SG, issue 44 dated 25 May 2004)
2. Law 211/2011 on waste regime

№	Waste name	Quantity to be generated[19]	Physical state (Solid- S, Liquid – L, Semisolid-SS)	Waste code[20]	Code regarding the main hazardous feature[21]	Waste management • quantity to be generated (tone/year)		
						Recycled	Eliminated	In stock
4.	Sludge collected in the settlers in the production base	Approx.0.3 m^3/day	SS	19 08 05		-	0.3 m^3/day	-
5.	Soil, stones	7,481.42 m^3	S	17 05 04, other than those specified in 17 05 03			7,481.42[5] m^3	-
6.	Metal waste	0.5 t/month	S	17 04 07		0.5 t/month	-	-
7.	Tires	Approx 40 pieces per month	S	16 01 03		Approx 40 pieces per month	-	-
8.	Construction material waste, including rejected concrete charges	Up to 10 tons / month it varies depending on the work, done during the month	S	17 09 04		10 t/month	-	-
9.	Welding electrodes	0.1 t/month	S	12 01 13		0.1 t/month	-	-
10.	Wood waste		S	17 02 01			-	
11.	Waste from forestry exploitation		S	02 01 07		Integral	-	-

№	Waste name	Quantity to be generated[19]	Physical state (Solid- S, Liquid – L, Semisolid- SS)	Waste code[20]	Code regarding the main hazardous feature[21]	Waste management • quantity to be generated (tone/year)		
						Recycled	Eliminated	In stock
12.	Waste from electrical and electronic equipment		S	16 02 14		Integral	-	-
13.	Waste resulted from the dredger							
	Domestic or assimilable		S	20 01 08			Integral	
	Package waste (paper and cardboard, plastic, metal,glass materials)		S	15 01 (15 01 01, 15 01 02, 15 01 04, 15 01 07)			Integral	
14.	Waste products produced on the ships transporting pipes outside RO or BG							
	Domestic or assimilable		S	20 01 08			Integral	
	Package waste (paper and cardboard, plastic, metal,glass materials)		S	15 01 (15 01 01, 15 01 02, 15 01 04, 15 01 07)			Integral	

Table A10.2: Type, quantity and the management of the non – hazardous waste during the construction period in case of HDD method

№	Waste name	Quantity to be generated[22]	Physical state (Solid- S, Liquid – L, Semisolid-SS)	Waste code[23]	Code regarding the main hazardous feature[24]	Waste management • quantity to be generated (tone/year)		
						Recycled	Eliminated	In stock
1.	Domestic or assimilable	0.35 t/day	S	20 01 08		Partially 0.2 t/day	Partially 0.15 t/day	-
2.	Package waste (paper and cardboard, plastic, metal, glass materials)	0.1 t/month	S	15 01 01 15 01 02 15 01 04 15 01 07		Integral 0,1 t/month	-	-
3.	Paper and specific waste from office work	10 kg/month	S	20 01 01		Integral 10 kg/month	-	-
4.	Sludge collected in the settlers in the production	Approx.0.3 m^3/day	SS	19 08 05		-	0.3 m^3/day	-

[22] Data have been insufficient to estimate all the quantities of waste materials generated

[23] In accordance with the Bulgarian and Romanian legislation:

1. In accordance with Regulation № 3 dated 1 April 2004 for waste classification (issued by the MoEW and MH, promulgated in SG, issue 44 dated 25 May 2004)
2. In accordance with the List comprising waste, including hazardous waste provided in appendix no. 2 to the Government Decision no. 856/2002 on the waste management record and for the approval of the list containing waste, including hazardous waste

[24] In accordance with the Bulgarian and Romanian legislation:

1. In accordance with Regulation № 3 dated 1 April 2004 for waste classification (issued by the MoEW and MH, promulgated in SG, issue 44 dated 25 May 2004)
2. Law 211/2011 on waste regime

№	Waste name	Quantity to be generated[22]	Physical state (Solid- S, Liquid – L, Semisolid- SS)	Waste code[23]	Code regarding the main hazardous feature[24]	Waste management • quantity to be generated (tone/year)		
						Recycled	Eliminated	In stock
	base							
5.	Soil, stones	7,481.42 m^3	S	17 05 04, other than those specified in 17 05 03			7,481.42[5] m^3	-
6.	Metal waste	0.5 t/month	S	17 04 07		0.5 t/month	-	-
7.	Tires	Approx 40 pieces per month	S	16 01 03		Approx 40 pieces per month	-	-
8.	Construction material waste, including rejected concrete charges	Up to 10 tons / month it varies depending on the work, done during the month	S	17 09 04		10 t/month	-	-
9.	Welding electrodes	0.1 t/month	S	12 01 13		0.1 t/month	-	-
10.	Wood waste	Total 1,497.03 m^3	S	17 02 01		149 m^3	-	1,348 m
11.	Waste from forestry exploitation	Clearing 65.43 ha	S	02 01 07		Integral	-	-
12.	Waste from dredging, other than those specified in 17 05 05	2,466 m^3 for the Danube	SS	17 05 06			2,466 m^3 (for the Danube)	-

№	Waste name	Quantity to be generated[22]	Physical state (Solid- S, Liquid – L, Semisolid-SS)	Waste code[23]	Code regarding the main hazardous feature[24]	Waste management • quantity to be generated (tone/year)		
						Recycled	Eliminated	In stock
13.	Drilling mud	5,500÷ 12,000 t[25]	SS	01 05 04				5,500÷ 12,000 t
14.	Sanitary waste	Function of the interventions	S	18 01 01 18 01 04 18 01 07 18 01 09	H9	-	Integral	-
15	Waste products produced on the ships transporting pipes outside RO or BG							
	Domestic or assimilable		S	20 01 08			Integral	
	Package waste (paper and cardboard, plastic, metal,glass materials)		S	15 01 (15 01 01, 15 01 02, 15 01 04, 15 01 07)			Integral	

- **List with hazardous waste**

During the construction period the type and quantities of the hazardous waste are presented in the next tables (Table **A10**.3 and Table **A10**.4).

[25] The quantity will depend on the solutions adopted for undercrossing (open cut or HDD). This quantity may decrease due to reuse.

Table A10.3: Type, quantity and the management of the hazardous waste during the construction period in case of open-cut method

No.	Waste name	Quantity to be generated [1]	Physical state (Solid- S, Liquid – L, Semisolid -SS)	Waste code [2]	Code regarding the main hazardous feature [3]	Waste management • quantity to be generated (tone/year)-		
						Recycle	Eliminated	In stock
1.	Soil and stone containing dangerous substances		S	17 05 03*	H4		Integral	-
2.	Sludge collected in settling tanks of site organization		L	13 05 02*	H3-B	-	Integral	
3.	Waste engine, gear and lubricating	Monthly, cca. 1500l	L	13 02 06*	H-3A	Monthly, cca. 1500 litre	-	-
4.	Bilge oils		L	13 04 03*	H-3A	Integral	-	-
5.	Oil sludge	yearly, cca 2 m3	L	13 07 03*	H-3A	Annually, cca 2 m3	-	-
6.	Waste building materials containing asbestos		S	17 06 05*	H7	-	Integral	-
7.	Accumulators	Approx 20 pieces per month	S	16 06 01*	H8	Approx 20 pieces per month	-	-
8.	Oil filters	Approx 20 pieces per month	S	16 01 07*	H5	-	Approx 20 pieces per month	-
9.	Waste contaminated	Approx 30 pieces per	S	15 02 02*	H5	Approx 30 pieces per month	-	-

No.	Waste name	Quantity to be generated [1]	Physical state (Solid- S, Liquid – L, Semisolid -SS)	Waste code [2]	Code regarding the main hazardous feature [3]	Waste management • quantity to be generated (tone/year)-		
						Recycle	Eliminated	In stock
	textile (cloths)	month						
10.	Packaging primers and paints	Approx 100 pieces per month	S	15 01 10*	H4	-	Approx 100 pieces per month	-
11.	Waste paint and varnish containing organic solvents or other dangerous substances		SS	08 01 11*	H4	-	Integral	-
12.	Packaging containing residues of or contaminated with dangerous substances		S	15 01 10*	H4	-	Integral	-
13.	Waste from electrical and electronic equipment		S	16 02 15*	H5	Integral	-	-
14.	Waste from dredging, potentially toxic		L	17 05 05*	H5	-	Integral	-
15.	Waste resulted from the dredger							
	Bilge oils		L	13 04 01*			Integral	
	Textiles impregnated with hazardous		S	15 02 02*			Integral	

No.	Waste name	Quantity to be generated [1]	Physical state (Solid- S, Liquid – L, Semisolid- SS)	Waste code [2]	Code regarding the main hazardous feature [3]	Waste management • quantity to be generated (tone/year)-		
						Recycle	Eliminated	In stock
	substances							
16.	Waste products produced on the ships transporting pipes outside RO or BG							
	Bilge oils		L	13 04 01*			Integral	
	Textiles impregnated with hazardous substances		S	15 02 02*			Integral	

Table A10.4: Type, quantity and the management of the hazardous waste during the construction period in case of HDD method

No.	Waste name	Quantity to be generated [1]	Physical state (Solid- S, Liquid – L, Semisolid- SS)	Waste code [2]	Code regarding the main hazardous feature [3]	Waste management • quantity to be generated (tone/year)-		
						Recycle	Eliminated	In stock
1.	Soil and stone containing dangerous substances		S	17 05 03*	H4		Integral	-
2.	Sludge collected in settling tanks of site organization		L	13 05 02*	H3-B	-	Integral	

No.	Waste name	Quantity to be generated [1]	Physical state (Solid- S, Liquid – L, Semisolid- SS)	Waste code [2]	Code regarding the main hazardous feature [3]	Waste management • quantity to be generated (tone/year)-		
						Recycle	Eliminated	In stock
3.	Waste engine, gear and lubricating	Monthly, cca. 1500l	L	13 02 06*	H-3A	Monthly, cca. 1500 liter	-	-
4.	Bilge oils		L	13 04 03*	H-3A	Integral	-	-
5.	Oil sludge	yearly, about 2 m3	L	13 07 03*	H-3A	yearly, about 2 m3	-	-
6.	Waste building materials containing asbestos		S	17 06 01*	H7	-	Integral	-
7.	Accumulators	Approx 20 pieces per month	S	16 06 01*	H8	Approx 20 pieces per month	-	-
8.	Oil filters	Approx 20 pieces per month	S	16 01 07*	H5	-	Approx 20 pieces per month	-
9.	Waste contaminated textile (cloths)	Approx 30 pieces per month	S	15 02 02*	H5	Approx 30 pieces per month	-	-
10.	Packaging primers and paints	Approx 100 pieces per month	S	15 01 10*	H4	-	Approx 100 pieces per month	-
11.	Waste paint and varnish containing organic solvents or other dangerous substances		SS	08 01 11*	H4	-	Integral	-
12.	Packaging containing residues of contaminated wit h dangerous substances		S	15 01 10*	H4	-	Integral	-
13.	Waste from electrical and electronic		S	16 02 15*	H5	Integral	-	-

No.	Waste name	Quantity to be generated [1]	Physical state (Solid- S, Liquid – L, Semisolid- SS)	Waste code [2]	Code regarding the main hazardous feature [3]	Waste management • quantity to be generated (tone/year)-		
						Recycle	Eliminated	In stock
	equipment							
15.	Waste products produced on the ships transporting pipes outside RO or BG							
	Bilge oils		L	13 04 01*			Integral	
	Textiles impregnated with hazardous substances		S	15 02 02*			Integral	

Types of waste generated during operation of NGPL

During NGPL operation under normal conditions, no waste materials are produced on the Danube crossing section, as the pipeline is buried. If the pipeline is cleaned by pigging, the sludge extracted is stored in metal containers and carried for final storage under the conditions envisaged by the environmental authorization. If an accident occurs, the waste materials produced are similar to those generated during pipeline installation, when they have to respond in order to repair the affected pipeline section.

Waste management plan

Waste materials pollute the air, water and soil, and degrade the landscapes over wide areas. The waste recovery/recycling/reuse is a priority in the management hierarchy included both in the European Union regulations and in the national regulations.

The options imposed envisage especially:
- *The prevention of the use of non-recyclable and non-usable* (including multifunctional packages), as well as of the toxic products.
- *Minimization/reduction in the waste volume and especially the decrease in the quantity of hazardous materials,* when their use cannot be prevented.
- *Recycling:* consists in the recovery of certain products/materials, such as paper, plastic, glass (e.g. the rechargeable glass tanks can be averagely reused for 30-35 times before breaking).
- *Controlled storage:* by using the landfills which are geologically stable and waterproof areas, typically with a synthetic coating at its base. The hazardous materials should not be stored in such sites, but in separate sites enabling their "*safe*" storage.

The waste management will reduce the risks for environment and population, as well as limit the quantities of waste materials disposed. Waste recycling will reduce the resources used for manufacturing paper, packages etc.

Waste management in the design stage

The works shall be designed by considering the need of reducing the quantities of waste produced during construction.

Platforms specially designed for the waste temporary storage and selective collection in appropriately labelled containers shall be designed for the construction camp and NGPL-related stations.

Waste management during construction/operation/decommissioning of Nabucco pipeline and related stations

The waste produced during Nabucco pipeline construction/operation/ decommissioning will be selectively collected, transported and disposed to the dump site for being neutralized or reused, in accordance with Directive 2008/98/CE and the national regulations in force.

The following measures shall be taken with a view to undertaking an adequate waste management

- a person responsible for environmental protection and waste management shall be appointed both during the construction and during the operation of the pipeline and of its related stations, as well as during decommissioning.

- Each legal person involved in the construction and operation of NGPL and of its related station should implement the standard *ISO 14001:2004 – Environmental management systems – Guidelines on principles, systems and support-techniques.* The environmental aspects shall be assessed with a view to implementing the standard and measures shall be taken for waste management, including for their monitoring.

- The following shall be developed:
  - Waste management procedure
  - Waste monitoring programme
  - Yearly training and awareness programme. This programme will consider the legal requirements, as well as the environmental impact per types of waste. The presentation of the duty of case principle and of the advantages obtained from the waste selective collection/ recycling/reuse, safe storage shall be emphasized.
  - waste management plan (tables A10.5., A10,6, A10,7, A10,8, A10,9, A10,10 below)
  - emergency response plan.

- waste shall be segregated in appropriately labelled containers.
- areas for the safe storage per waste types shall be established within the construction camps.
- waste management sheets per identified waste types shall be opened according to the template provided in annex 1 of the Government Decision no. 856/2002.
- the waste materials from reusable packages shall be returned to the suppliers or reused. In accordance with national legislation, the economic operators owning package waste must:
  - ensure the reuse and recycling of package waste by own means or by delivering them to the authorized economic operators;
  - report upon local environmental protection authorities' request the quantities of package waste managed in accordance with the legal provisions in force.
- the waste shall be transported for being reused/permanently disposed based on a documentation prepared for the waste transfer, as per national legislation.
- The constructor and administrator of NGPL and of its related stations shall set up sites for the temporary storage of domestic and associated waste and shall conclude a contract with the sanitation unit in the nearest settlement in order to remove the waste types.
- the largest part of the inert waste coming from excavations shall be recycled in the pipeline covering worksor shall be used for provisional road works, platforms etc.
- the containers for the segregation of the reusable waste shall be appropriately labelled.
- the metal containers for the used oil storage shall be marked with the oil types and shall be located on fenced, concrete areas.
- any metal waste shall be stored in specially arranged sites, namely portable container within the construction camp, of the pipe dumps, as well as in the work location site. The constructor considers their regular reuse in units specialized in the metal waste recovery and recycling.
- no metal waste coming from the equipment repair works shall be stored on the pipeline route. The works are to be performed in specially arranged sites intended for the equipment maintenance activities.
- the waste shall not be stored near the watercourses or protection zones.
- the used oils from the electric transformers shall be managed by the electric company owning the transformer.
- the waste resulted on board of the pipe transport ships shall be taken by the specialized units in the port.

The waste management plan is in close connection with the following plans developed by the contractor:

- Plan on community health management
- Community liaison plan

- Employment and training plan
- Pollution prevention plan
- Traffic management plan
- Emergency response plan

Table A10**.5. :** Management plan for non-hazardous waste produced during construction, including decommissioning

Waste type	Who/what generated the waste material	Collection/treatment/disposal/ permanent storage[26]	Responsibilities	Resources
1	2	3	4	5
Paper and waste specific to office activity	Record-keeping activities, site supervision and inspection, correspondence and records during operation	They shall be collected and separately stored with a view to reusing them by authorized operators– R5. The construction site shall be equipped with a paper shredder.	Records on the quantities disposed shall be kept.	Financial resources needed for: -paper shredder purchase
Domestic or associated	Staff performing activities within the location site Staff performing the regular revisions	The recyclable parties are selectively collection and delivered to the authorized operators – R4. The mixed fractions shall be disposed by the sanitation services of the settlements in the area - D1 Collection points equipped with covered skips shall be set up. They shall be regularly removed by the authorized operators and carried to the dump sites and to the transfer stations of the settlements.	Strict records on the calendar data, quantities disposed and the identifiers of the transport means used shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator
Package waste (paper and cardboard, plastics, metal and glass)	Supply process	They shall be collected and separately stored with a view to reusing them by the authorized operators – R5. The construction site shall be equipped with metal boxes embossing machines.	Records on the quantities disposed shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator - purchase of metal boxes embossing machines
Metal waste	Results from activities on: - equipment maintenance, - building demolitions - pipeline installation	They shall be collected and temporarily stored in the enclosure, on concrete platforms They shall be mandatorily reused in specialized units– R4	Records with the reused quantities shall be kept in accordance with GEO 16/2001	Financial resources needed for: -concluding the contract with the authorized

[26] R- coding the reuse operations according to annex II to Directive 2008/98/CE
D – coding the disposal operations according to annex I to Directive 2008/98/CE

Waste type	Who/what generated the waste material	Collection/treatment/disposal/ permanent storage[26]	Responsibilities	Resources
1	2	3	4	5
				operator
Wood waste, package waste	Bank abutment activities, packages	They shall be selected, and the material used for the bank abutment shall be used on another sector. The waste left shall be disposed as support elements and accessories in construction works depending on their sizes. Moreover, they can be reused as fire wood for the population in the area depending on their quality – R1. The pallets shall be returned to the supplier.	Records with the reused quantities shall be kept.	
Waste from excavation (topsoil and stripping material)	Trenching, foundations, damaged road restoration	They are not hazardous waste. The topsoil shall be stored so that to be reused. The inert residues left shall be carried to the existing lands where fertilization works shall be ensured– R10. As an alternative, the residues can be used as cover material in the urban (municipal) waste dump sites in order to reduce the emissions to atmosphere and to prevent the access of people and animals to waste -		Financial resources needed for transport

Waste type	Who/what generated the waste material	Collection/treatment/disposal/ permanent storage[26]	Responsibilities	Resources
1	2	3	4	5
Sawdust and fine wood material (biodegradable material)	Land clearing	Depending on the quality of the fine wood material, it can be reused: - as fire wood for the population in the area R1 - or will be stored –D1. The sawdust and the fine wood material are biodegradable waste and can be stored in a garbage dump or left in forest in areas specified by the forest personnel. The waste coming from clearing the coniferous forests must be treated before being sotred in the woods–D1 The sawdust shall be collected and delivered to the companies specialized in the reuse of this type of waste or shall be used as solid fuel – R1.	The sawdust shall not be stored on the water bank.	
Concrete batch refuse and building material waste	Building demolitions Execution of pipeline related stations	Selective collection on specially arranged platforms– R13 and reuse depending on the type of waste (e.g. rejected concrete batches can be used in road infrastructure).	Strict records on the quantities disposed and the identifiers of the transport means used shall be kept.	Financial resources needed for transport

Table A10**.6. :** Management plan for hazardous waste produced during NGPL construction, including demobilization, during operation and decommissioning

Waste type	Who/what generated the waste material	Collection/treatment/disposal/ permanent storage[27]	Responsibilities	Resources
1	2	3	4	5

[27] R- coding the reuse operations according to annex II to Directive 2008/98/CE
D – coding the disposal operations according to annex I to Directive 2008/98/CE

Waste type	Who/what generated the waste material	Collection/treatment/disposal/ permanent storage[27]	Responsibilities	Resources
1	2	3	4	5
Waste from the electric and electronic appliances	Electric and electronic appliances	They shall be collected and separately stored with a view to reusing them.	Records with the disposed quantities shall be kept.	
Sludge collected by settlers of storm waters	Washing water for the construction site platform	Periodically, they shall be safely transported to a garbage landfill recommended by the Town Hall – D1	Records with the disposed quantities shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator
Waste oils	*The motor, transmission and lubricating used oils* coming from oil change for equipment and vehicles	They shall be collected per types, in metal containers. They shall be stored in the area designated for the intermediary waste storage[20]. The used oils shall be periodically taken over based on an order or contract, by companies certified for their collection and processing – R9 or shall be permanently eliminated by incineration in an authorized incinerator- R1, if reuse is not possible.	Oil shall be changed in specially arranged places. Strict records with the calendar dates, quantities disposed and the identifiers of the transport means used shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator
Oil filters	Coming from vehicles, equipment	They shall be collected in metal containers located in the designated area. These waste materials shall be finally eliminated by incineration by certified companies, if reuse is not possible – R1.	Strict records with the calendar dates, quantities disposed and the identifiers of the transport means used shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator
Used accumulators	Maintenance activities for equipment and vehicles within workshops	Materials with an extremely high toxic potential[20] shall be stored locked up in order to be reused in specialized units-R6.	Strict records with the calendar dates, quantities disposed and the identifiers of the transport means used shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator
Used tyres	Maintenance activities for equipment and vehicles	They shall be stored in specially arranged places[20], and delivered to the specialized units. -R5 The construction site shall be equipped with a tyre	Incineration is forbidden. Strict records with the calendar dates, quantities disposed and the identifiers	Financial resources needed for: -concluding the contract with the

Waste type	Who/what generated the waste material	Collection/treatment/disposal/ permanent storage[27]	Responsibilities	Resources
1	2	3	4	5
		shredder in order to reduce the waste volume needed to the temporarily stored/transported.	of the transport means used shall be kept.	authorized operator - purchasing tyre shredder
Medical waste	Medical point within the construction camp Medical kits on the machinery and work points Medical kits in the operative buildings in stations	Medical waste resulting from treatments shall be separately collected in special containers and shall be carried by a firm specialized in the transport of hazardous waste with a view to incineration. The expired medicines shall be separately collected and taken by firms specialized in such waste materials.	Records with the disposed quantities shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator
Oil slime	Fuel storage site within construction camp	Collection in tight metal vessels and delivered to the specialized units for reusing them by recycling - R9	Records with the reused quantities shall be kept in accordance with the provisions of GD 235/2007[28]	Financial resources needed for: -concluding the contract with the authorized operator
Textile waste contaminated with oil products (cloths)	Pipeline cleaning	They shall be collected in metal containers located in the designated area. These waste materials shall be finally eliminated by incineration by certified companies. - R1		Financial resources needed for: -concluding the contract with the authorized operator
Paint and primer packages	Priming and painting activities	They shall be collected and separately stored with a view to reusing them by the supplier or shall be eliminated by incineration by authorized companies . - R1	Records with the disposed quantities shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator

[28] GD no.235/2007 on waste oil management

Waste type	Who/what generated the waste material	Collection/treatment/disposal/ permanent storage[27]	Responsibilities	Resources
1	2	3	4	5
Dredging waste others than those specified at 17 05 05	Watercourse crossing by open cut	It shall be partly used for filling the trench after installing the pipeline. The rest is stored in areas specified by the authority managing the watercourse or the navigable channel, such as the Danube river.		

Table A10**.7.:** Management plan for non-hazardous waste during Nabucco pipeline operation

Location	Waste type	Who/what generated the waste material	Collection/treatment/disposal/ permanent storage[15]	Responsibilities	Resources
0	1	2	3	4	5
Pipeline location: - only in case of a flaw to the pipeline (corrosion or fracture)	Waste from excavation (topsoil and stripping material), in case of repair works	Pipeline stripping	It shall be stored with a view to covering the pipeline. Special attention shall be paid to the topsoil.		Financial resources needed for transport
	Metal waste	Resulted from: - regular revisions during operation - interventions during operation	They shall be collected and temporarily stored in the enclosure, in landfills and/or specialized containers. They shall be compulsorily reused in the specialized units - R4	Strict records with the calendar dates, quantities disposed and the identifiers of the transport means used shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator

Table A10**.8.:** Management plan for hazardous waste produced during the gas pipeline operation

Location	Waste type	Who/what generated the waste material	Collection/treatment/disposal/ permanent storage[15]	Responsibilities	Resources
0	1	2	3	4	5
	Paint and primer	Priming and painting	They shall be collected and separately	Records with the	Financial resources

Pipeline location site	packages	activities	stored with a view to reusing them by the supplier.	disposed quantities shall be kept.	needed for: -concluding the contract with the authorized operator
	Absorbents, filter materials (including oil filters), protective clothing contaminated with hazardous substances	Maintenance works	They shall be collected in metal containers located in the designated area. These waste materials shall be eliminated by incineration by authorized companies - R1	These waste materials shall be eliminated by incineration by authorized companies	Financial resources needed for: -concluding the contract with the authorized operator

Table A10**.9.:** Management plan for non-hazardous waste generated after the completion of the operation of the gas pipeline and of its related stations

Scenario 1: the gas pipeline remains buried. There are obtained waste materials only from the demolition of the above-ground installations related to the pipeline.

Scenario 2: the pipeline is dismounted and removed from the ground.

The table below shows the worst case scenario, namely scenario no. 2

Waste type	**Who/what generated the waste material**	**Collection/treatment/disposal/ permanent storage**[15]	**Responsibilities**	**Resources**
1	**2**	**3**	**4**	**5**
Paper and waste specific to office activity	Activities of recording, supervision and site inspection	They shall be collected and separately stored with a view to reusing them by authorized operators– R5.	Records with the disposed quantities shall be kept.	
Domestic or	Personnel performing	The recyclable parts are segregated	Strict records with the	Financial resources

Waste type	Who/what generated the waste material	Collection/treatment/disposal/ permanent storage[15]	Responsibilities	Resources
1	2	3	4	5
associated	activities within the construction camp, in the pipe dumps and production bases, in the work location site Maintaining the premises clean	and delivered to the authorized operators– R4. The mixed fractions are disposed by the sanitation services of the settlements in the area - D1 Collection points equipped with skip-type containers shall be set up. They shall be regularly removed by the authorized operators and carried to the waste dumps and to the transfer stations of the settlements.	calendar dates, quantities disposed and the identifiers of the transport means used shall be kept.	needed for: -concluding the contract with the authorized operator
Package waste (paper and cardboard, plastics, metal and glass)	Supply process	They shall be collected and separately stored with a view to reusing them by the authorized operators – R5. The construction site shall be equipped with metal boxes embossing machines.	Records with the disposed quantities shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator -purchasing metal boxes embossing machines
Sludge collected by storm water settlers	Water for washing the platform of the construction camp	Regularly, they shall be safely transported to a garbage dump recommended by the Town Hall - D1	Records with the disposed quantities shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator
Metal waste	Resulted from the equipment maintenance activities and from the pipeline dismounting activities	They shall be collected and temporarily stored in the enclosure, in landfills and/or specialized containers. They shall be compulsorily reused in the specialized units - R4	The repair works shall be carried out in specially arranged places. Records with the reused quantities shall be kept according to GEO 16/2001	Financial resources needed for: -concluding the contract with the authorized operator

Waste type	Who/what generated the waste material	Collection/treatment/disposal/ permanent storage[15]	Responsibilities	Resources
1	2	3	4	5
Wood material	Building demolition	Depending on the wood quality, it can be reused as fire wood for the population in the area– R1 or shall be stored with a view to reusing it to other constructions	The sawdust shall not be stored on the water bank.	

Table A10**.10.–** Management plan for the hazardous waste generated after the completion of the operation of the gas pipeline and of its related stations

Scenario 1: the gas pipeline remains buried. There are obtained waste materials only from the demolition of the above-ground installations related to the pipeline.

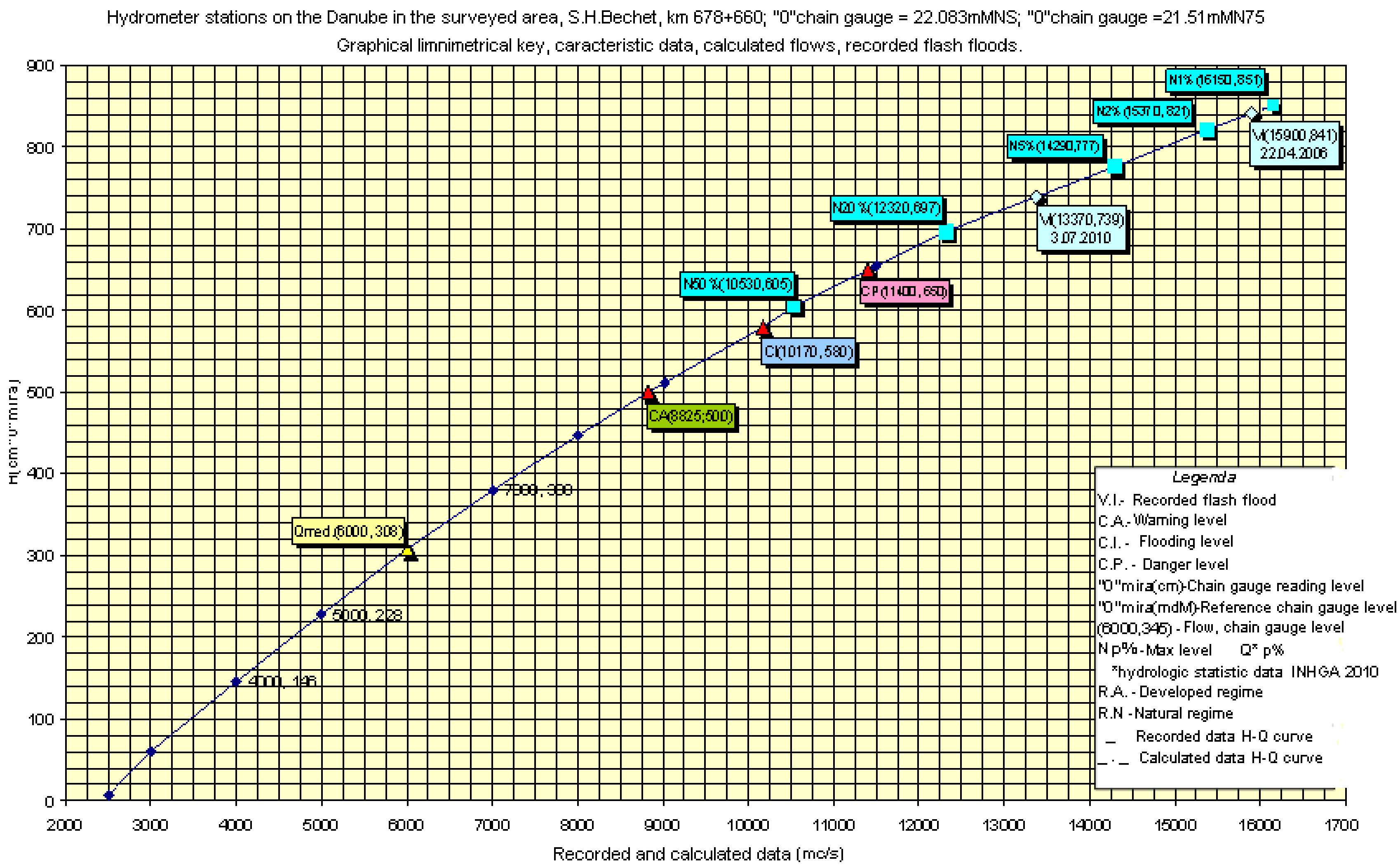
Scenario 2: the pipeline is dismounted and removed from the ground.

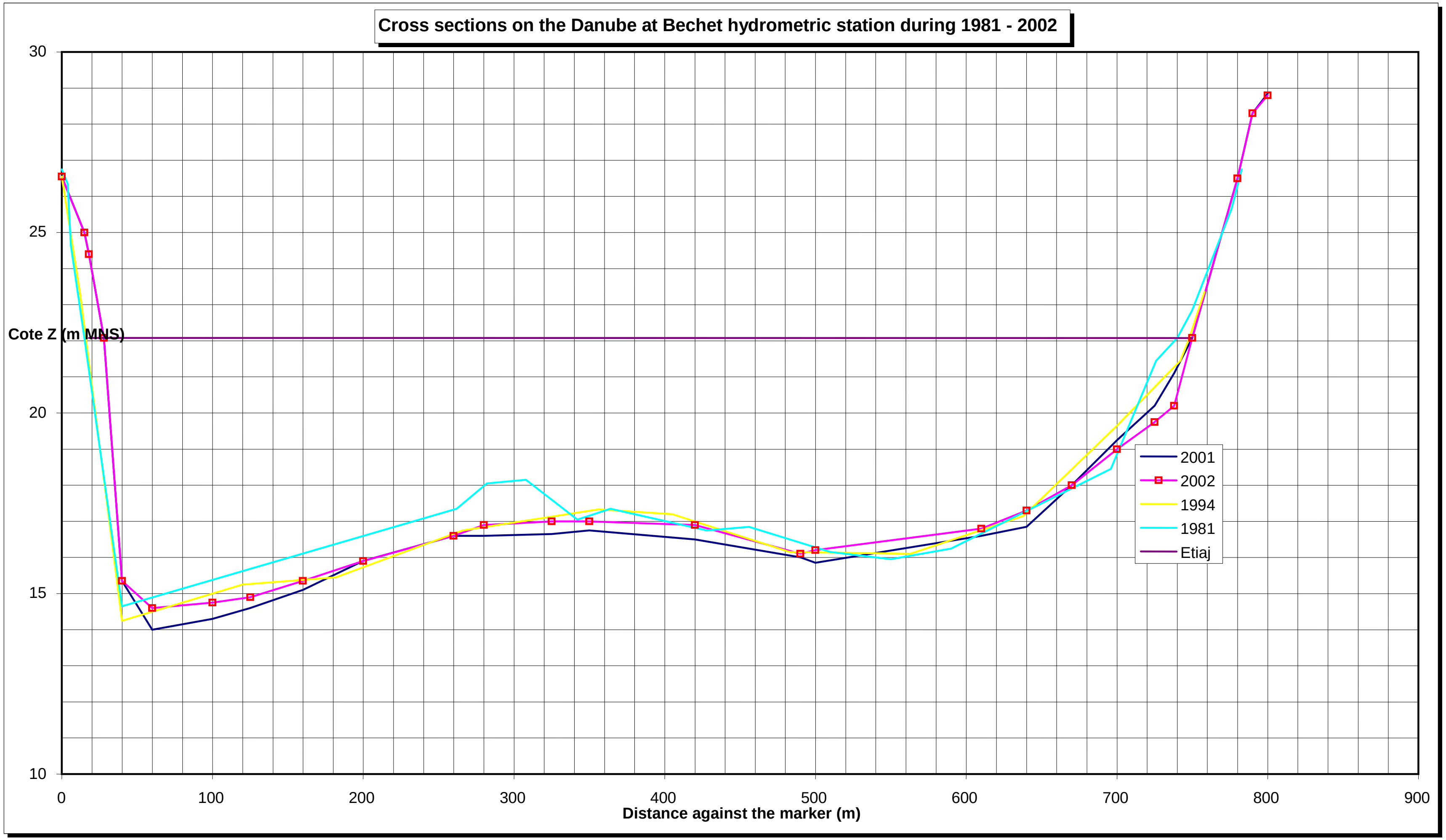
The table below shows the worst case scenario, namely scenario no. 2

Waste type	Who/what generated the waste material	Collection/treatment/disposal/ permanent storage[15]	Responsibilities	Resources
1	2	3	4	5
Waste from the electric and electronic appliances	electric and electronic appliances	They shall be collected and separately stored with a view to reusing them.	Records with the disposed quantities shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator
Package waste (paper and cardboard, plastics, metal and glass)	Supply process	They shall be collected and separately stored with a view to reusing them by the authorized operators – R5. The construction site shall be equipped with metal boxes embossing machines.	Records with the disposed quantities shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator - purchasing metal boxes embossing machines
Sludge collected by storm water settlers	Water for washing the platform of the construction camp	Regularly, they shall be safely transported to a garbage dump recommended by the Town Hall	Records with the disposed quantities shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator

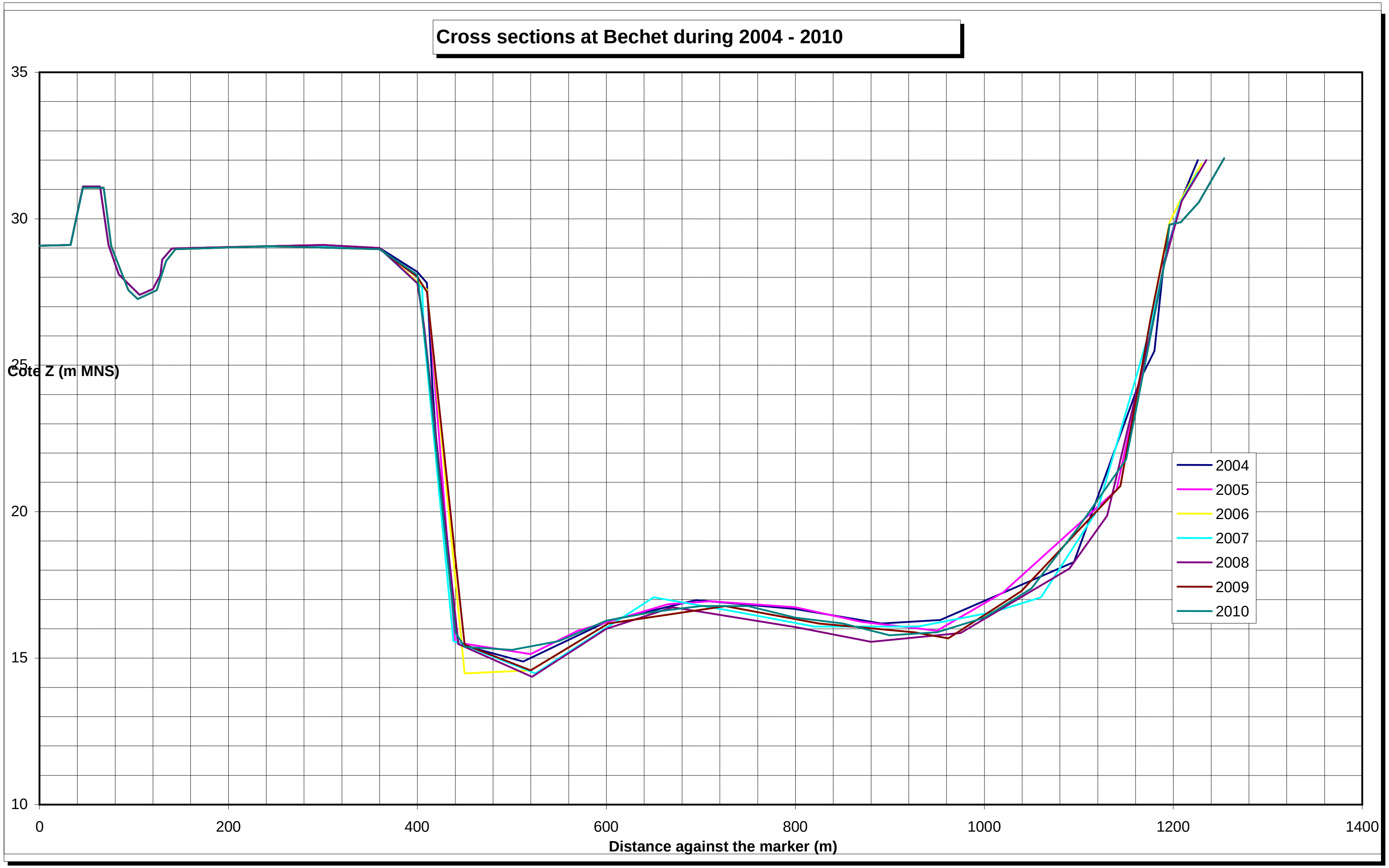
Waste type	Who/what generated the waste material	Collection/treatment/disposal/ permanent storage[15]	Responsibilities	Resources
1	2	3	4	5
Used oils	The motor, transmission and lubricating used oils coming from oil change for equipment and vehicles	They shall be collected per types, in metal containers. They shall be stored in the area designated for the intermediary waste storage[20]. The used oils shall be periodically taken over based on an order or contract, by companies certified for their collection and processing – R9 or shall be permanently eliminated by incineration in an authorized incinerator- R1, if reuse is not possible.	The oil shall be changed in specially arranged places. Strict records with the calendar dates, quantities disposed and the identifiers of the transport means used shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator
Oil filters	Coming from equipment and vehicles	They shall be collected in metal containers located in the designated area. These waste materials shall be finally eliminated by incineration by certified companies, if reuse is not possible – R1.	Strict records with the calendar dates, quantities disposed and the identifiers of the transport means used shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator
Used accumulators	Maintenance activities for equipment and vehicles within workshops	Materials with an extremely high toxic potential[20] shall be stored locked up in order to be reused in specialized units- R6.	Strict records with the calendar dates, quantities disposed and the identifiers of the transport means used shall be kept.	Financial resources needed for: -concluding the contract with the authorized operator

APPENDIX 11: **Cross-sections (graph) on the Danube in the Bechet area performed during the period of 1980 – 2010, according to the distance from the marker to the elevations related to "0" staff**


Hydrometer stations on the Danube in the surveyed area, S.H.Bechet, km 678+660; "0"chain gauge = 22.083mMNS; "0"chain gauge =21.51mMN75
Graphical limnimetrical key, caracteristic data, calculated flows, recorded flash floods.
H(cm "0" mira)
Recorded and calculated data (mc/s)
N1% (16150,851)
N2% (15370,821)
V(15900,841) 22.04.2006
N5%(14290,777)
N20 %(12320,697)
V(13370,739) 3.07.2010
N50 %(10530,605)
CP(11400,650)
CI(10170,580)
CA(8825;500)
7000, 380
Qmed (6000,308)
5000, 228
4000, 146
Legenda
V.I.- Recorded flash flood
C.A.- Warning level
C.I. - Flooding level
C.P. - Danger level
"0"mira(cm)-Chain gauge reading level
"0"mira(mdM)-Reference chain gauge level
(6000,345) - Flow, chain gauge level
N p% - Max level Q* p%
*hydrologic statistic data INHGA 2010
R.A. - Developed regime
R.N - Natural regime
_ Recorded data H-Q curve
_ . _ Calculated data H-Q curve

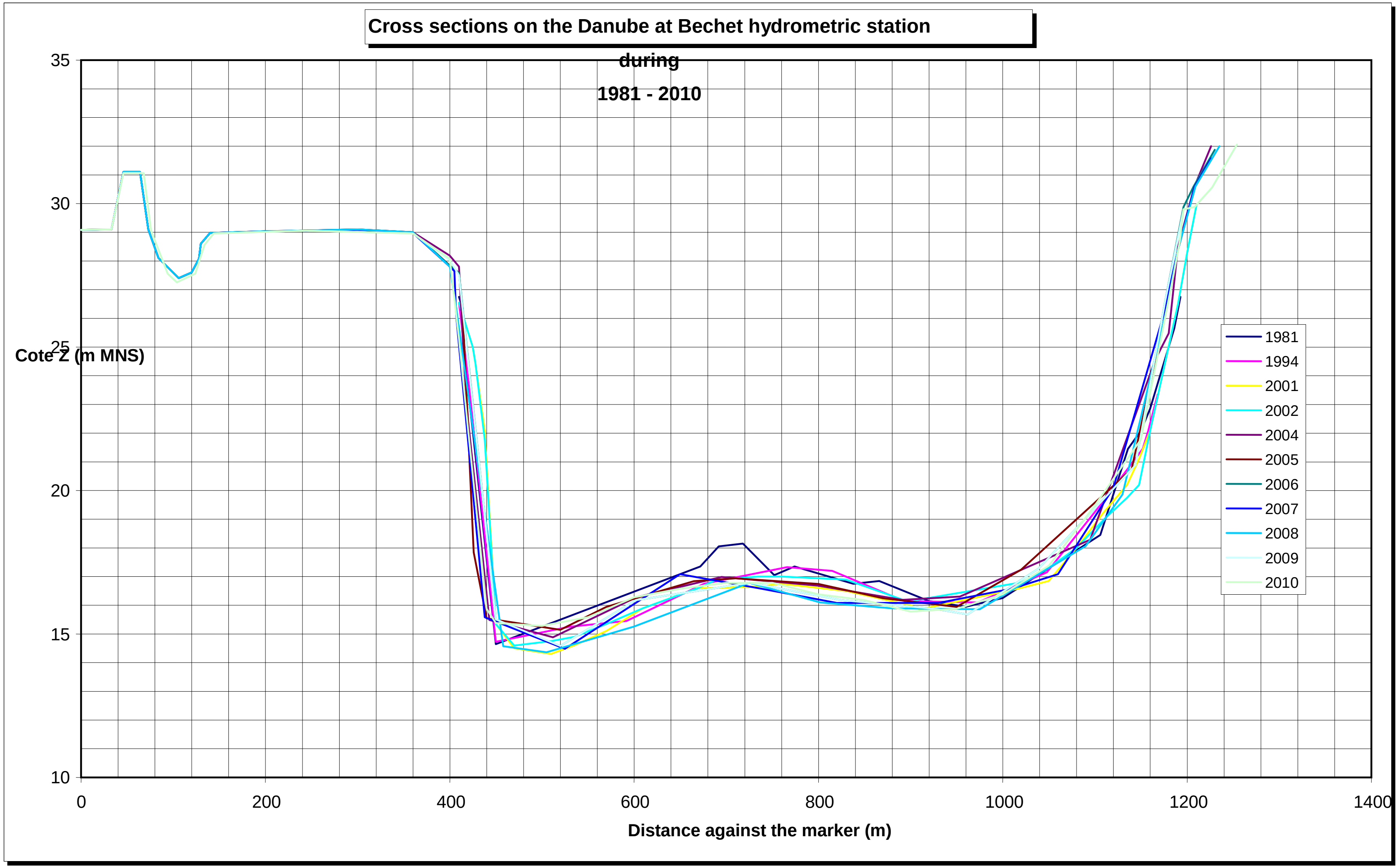


2. Period of 2004 - 2010

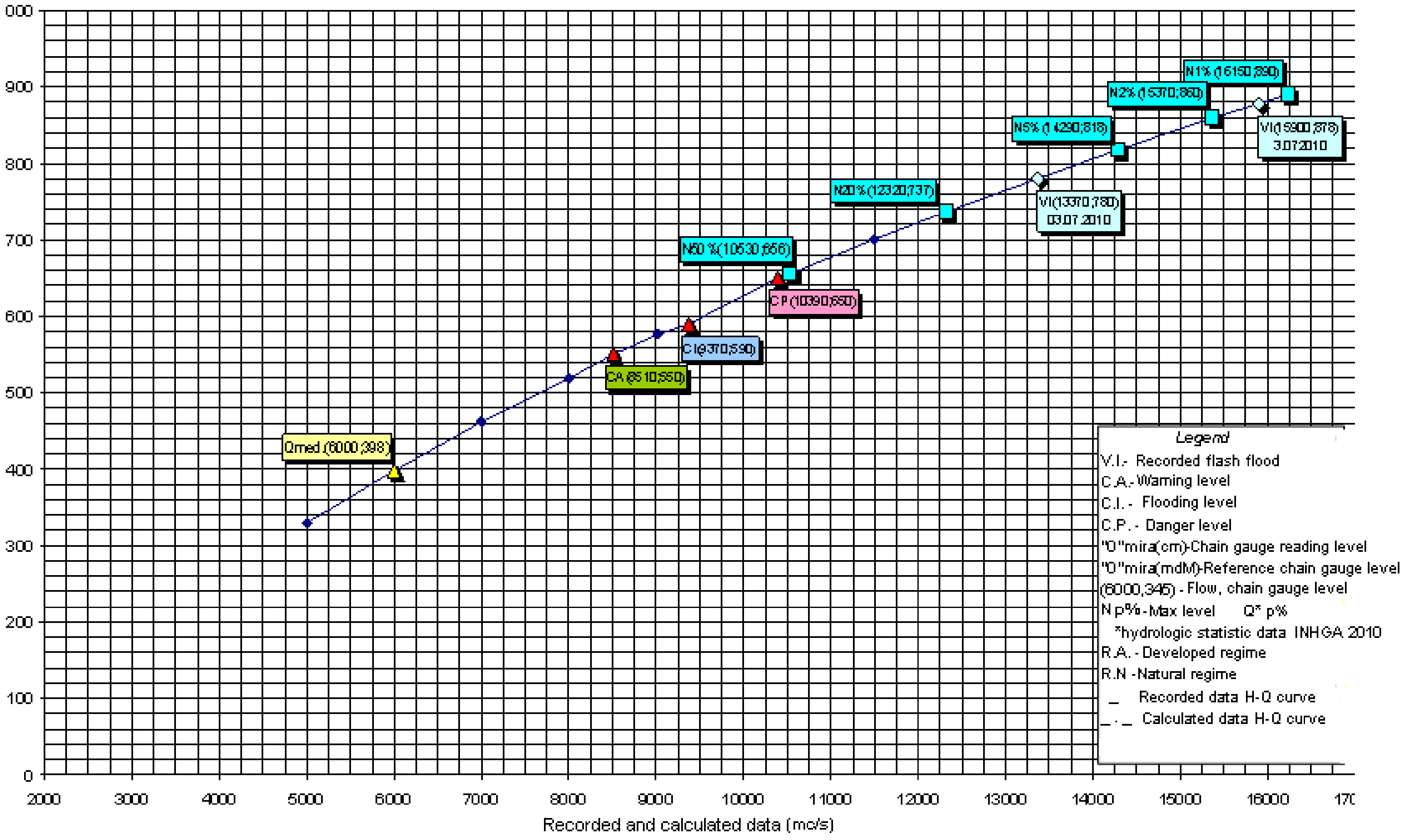


3.

Complete period of 1981 - 2010


Cross sections on the Danube at Bechet hydrometric station
during
1981 - 2010
Cote Z (m MNS)
Distance against the marker (m)
35
30
25
20
15
10
0
200
400
600
800
1000
1200
1400
1981
1994
2001
2002
2004
2005
2006
2007
2008
2009
2010

Hydrometer stations on the Danube in the surveyed area, S.H.Bistret, km 725; "0"chain gauge = 23.825mMNS; "0"chain gauge =23.58mMN75
Graphical limnimetrical key, caracteristic data, calculated flows, recorded flash floods.



APPENDIX 12 – DETERMINING THE BURIAL PARAMETERS OF NABUCCO PIPELINE IF THE OPEN-CUT METHOD IS USED

A12.1 Prediction of erosion in the riverbed and banks area

In order to determine the morphological and dynamic mobility characteristics of the riverbed in the crossing section, it was necessary to develop the following related studies:
Hydrological study on the determination of: value of maximum and medium water flows associated to the occurrence probability; value of medium daily flows during the selected simulation period between 2005-20010; value of total solid flows (suspended and bedload) depending on the respective water flows; and also their grain size distribution; specific data recorded to the hydrometric stations of Bechet and Bistret located on the extended design sector
Study of the chemical composition of bed sediments and water chemistry (as an integral part of the hydrological study).
Following the analysis performed it can be concluded that the chemical structure of shallow sediments shows that the silicon dioxide and nitric oxides are predominantly minority, but there is a well-established relation between the majority oxide and the minority ones.

Hydrotopometric survey. The works were executed in 2010. In order to determine the riverbed geometry on the Danube's extended sector located between km 730 (upstream of Bistret H.S.)– km 686+300 (upstream crossing sector) and km 684+300 (downstream of crossing sector) – km 675 (downstream of Bechet H.S.), the following data were used:

- 14 additional cross sections performed earlier for the waterway by *AFDJ-RA Galati- Waterways Dpt. Giurgiu,* in the following sections: km 730; km 726; km 722; km 719; km 715; km 710; km 707; km 704; km 702; km700; km 699; km 696; km 691; km6 75. For the areas of left bank –dike and right bank –slope, for these sections, the data were filled from the existing survey data base.
- 2 cross sections made by NIHWM (and also checked with the data from *AFDJ-RA Galati)* in the section of the hydrometric stations of Bistret km 725 and Bechet km 678+660.

Hydraulic study. The data matrices resulting from the hydraulic model are used as input data of the alluvial transport simulation model and the estimation of the changes in the riverbed morphology for the Danube's undercrossing section under consideration.
Geotechnical survey, in order to set the geotechnical conditions for the Nabucco natural gas pipeline route in the Danube's undercrossing section between Bulgaria and Romania. The geotechnical surveys along the pipeline route were based on the implementation of the following works: 2 on-shore drillings F1 and F2 and 5 off-shore drillings in the Danube riverbed: F3; F4; F5; F6; F7.

Study on the alluvial transport and the estimation of changes in the Danube's riverbed morphology in the undercrossing section.

The calculation has been done using *Mathematic model of hydraulic type HEC-RAS .*
This mathematic model is produced by the U.S. Army Corps of Engineers, Hydrologic Engineering Center, being one of the most popular and used packages of digital models on the analysis of hydrographic systems in the world.
The model can calculate the maximum rates of the free water surface curve in non-permanent and permanent movement for rivers in uniform natural or arranged hydraulic regime (according to the works included in the arrangement or design schemes) as well as for one-way riverbeds or networks of dendritic and circular riverbeds.

The adjustment of the mathematical model can be analyzed consultatively on the range of flows and levels recorded and calculated in the form of discharge rating curves during 2005-2010, at the hydrometric stations on the Danube: Bistret H.S. and Bechet H.S. (see figure A12.1 below and appendix 11).

The results of hydraulic calculations had as main object the accuracy of data obtained on the calculated levels (relegated to the flow levels recorded at Bechet Hydrometric Station), and especially the analysis of the hydraulic effect generated by the variation of hydraulic gradients and corresponding velocities which can make changes in riverbed morphology. The results of calculations were detailed on 8 specific sectors of cross sections and analytically summarized in text form (Tables no A.11.1 and A.11.2) and graphic form (Figures A12.2 and A12.3).

The conclusion of the study[29] prepared for the morphological analysis of the Danube riverbed development in the undercrossing area, is that, in general, the bed is stable, with relative aggradations phenomena and a silting rate of several centimetres per year. The section stability can last until the achievement of a uniform slope across the crossing sector (km 686+300 ÷ km 684+300) and the connection with the downstream area. In this case, the crossing will be within the mobility regime of the riverbed as studied in the period of 1981-2010 at the Bechet hydrometric station (**Appendix 11**), subject to the alternative aggradations and degradation phenomena on a mobile bed range of about 1 m.

Therefore, in order to protect the pipeline under operation, it is necessary to consider the thickness of the alluvial material likely to be eroded over time at 1.0 m below the current level of the riverbed, representing the maximum evolution of the bed mobility range.

[29] Nabucco Project 2010, *Danube Crossing: Hydraulic, hydrological, hydro-morphological and erosion study,* (Document 70223-RR-RPT-PL-0045)

Figure A12.1.: General drawing of the design area extended on the Danube, between Bistret and Bechet with the location of existing hydrotechnical works and hydrometric stations (sc.1: 100.000).

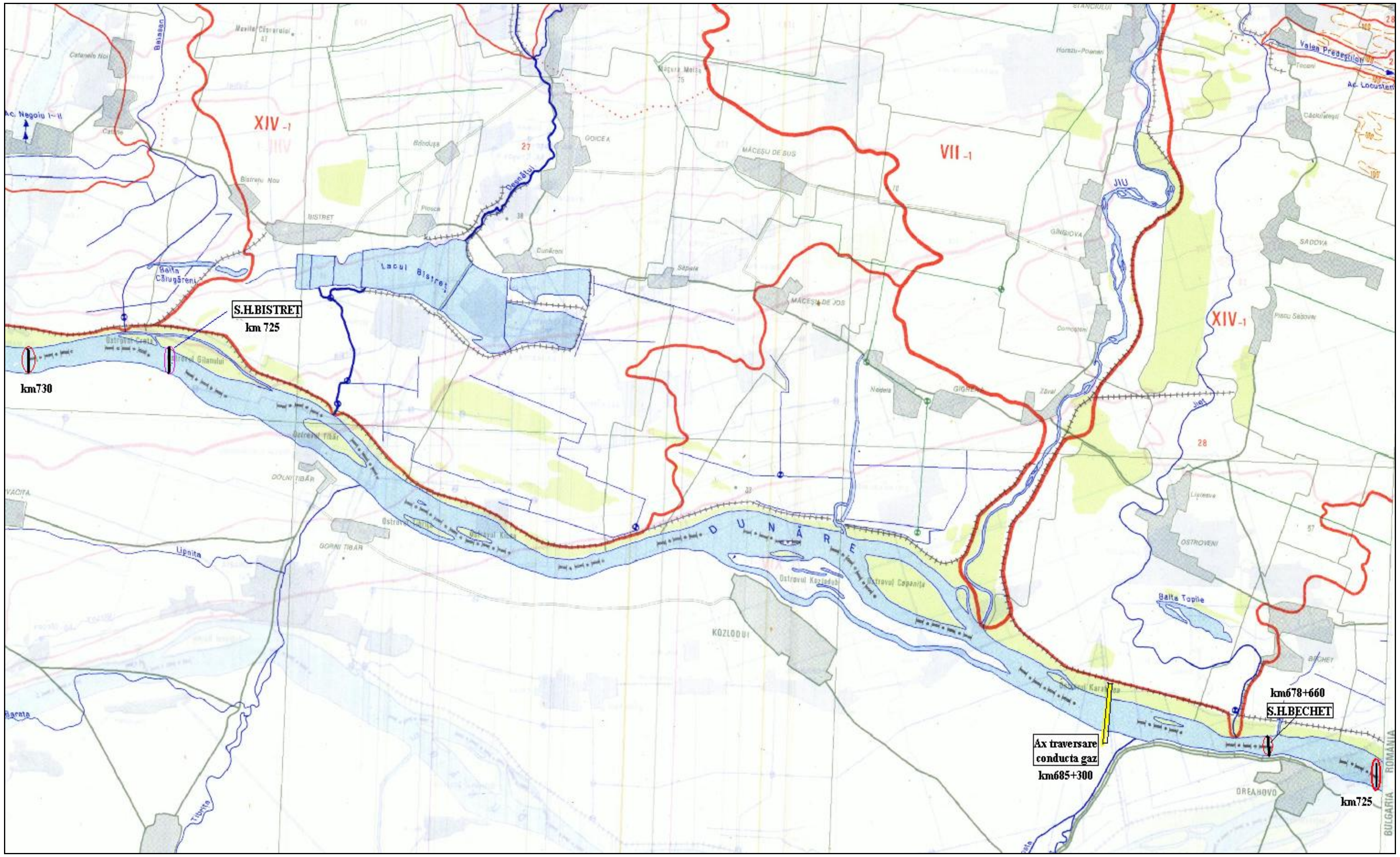


Table A12.1.: Synthetic results of hydraulic calculations, Bechet H.S. section km 685+300

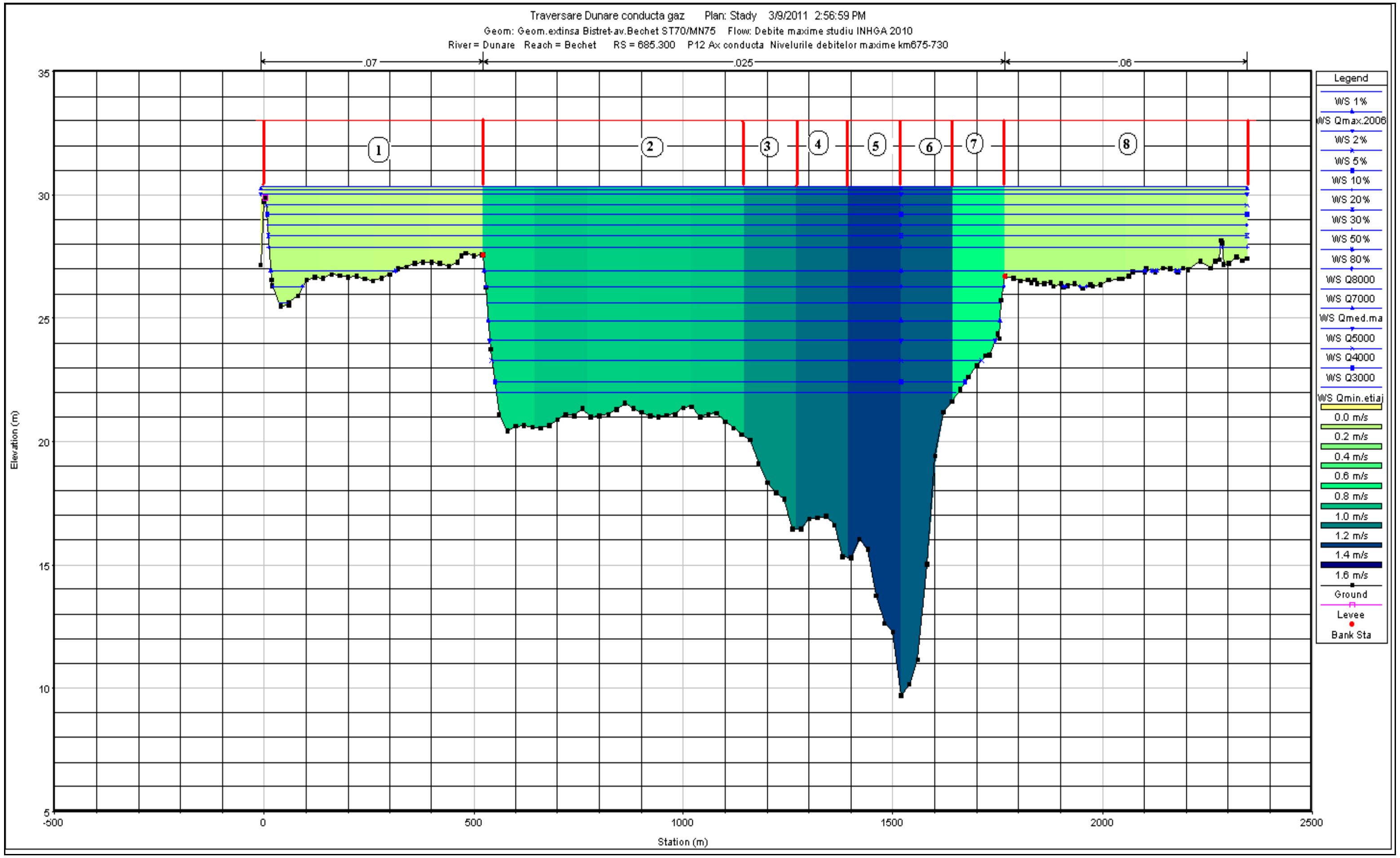
Design flows	Probab. flows	Hydraulic data	DESIGN SECTORS, sector length against marker (m) /medium riverbed bottom level (mMN75)								Medium water level (mMN75)
			0 - 522	522-1140	1140-1260	1260-1400	1400-1520	1520-1640	1640-1767	1767-1500	
mc/s			26.55	21.10	18.34	16.50	13.50	15.30	23.50	26.40	Medium velocities (m/s)
16150	Qmax.1%	Hwater(m)	3.79	9.24	12.00	13.84	16.84	15.04	6.84	3.94	30.34
		Velocity(m/s)	0.18	0.97	1.15	1.26	1.41	1.31	0.8	0.23	1.12
15900	Qmax 2006	Hwater(m)	3.69	9.14	11.90	13.74	16.74	14.94	6.74	3.84	30.24
		Velocity(m/s)	0.17	0.95	1.14	1.25	1.40	1.30	0.79	0.22	1.10
15370	Qmax.2%	Hwater(m)	3.50	8.95	11.71	13.55	16.55	14.75	6.55	3.65	30.05
		Velocity(m/s)	0.16	0.93	0.12	0.24	1.39	1.29	0.78	0.22	1.09
14290	Qmax.5%	Hwater(m)	3.04	8.49	11.25	13.09	16.09	14.29	6.09	3.19	29.59
		Velocity(m/s)	0.15	0.91	1.10	1.22	1.37	1.27	0.74	0.20	1.08
13300	Qmax.10% Qmax 2010	Hwater(m)	2.67	8.12	10.88	12.72	15.72	13.92	5.72	2.82	29.22
		Velocity(m/s)	0.14	0.88	1.07	1.19	1.34	1.24	0.71	0.18	1.05
12320	Qmax.20%	Hwater(m)	2.20	7.65	10.41	12.25	15.25	13.45	5.25	2.35	28.75
		Velocity(m/s)	0.13	0.85	1.04	1.16	1.32	1.22	0.67	0.17	1.03
11500	Qmax.30%	Hwater(m)	1.80	7.25	10.01	11.85	14.85	13.05	4.85	1.95	28.35
		Velocity(m/s)	0.10	0.82	1.02	1.14	1.30	1.20	0.64	0.15	1.01
10530	Qmax.50%	Hwater(m)	1.30	6.75	9.51	11.35	14.35	12.55	4.35	1.45	27.85
		Velocity(m/s)	0.09	0.79	0.99	1.12	1.28	1.18	0.61	0.12	0.98
9020	Qmax.80%	Hwater(m)	0.38	5.83	8.59	10.43	13.43	11.63	3.43	0.53	26.93
		Velocity(m/s)	0.07	0.73	0.96	1.09	1.26	1.15	0.54	0.06	0.95
8000	Qmed.1%	Hwater(m)	0	5.18	7.94	9.78	12.78	10.98	2.78	0	26.28
		Velocity(m/s)	0	0.70	0.92	1.06	1.24	1.12	0.49	0	0.93

7000	Qmed.10%	Hwater(m)	0	4.51	7.27	9.11	12.11	10.31	2.11	0	25.61
		Velocity(m/s)	0	0.63	0.88	1.02	1.21	1.09	0.44	0	0.89
5590	Qmed.50% Qmed.man	Hwater(m)	0	3.79	6.55	8.39	11.39	9.59	1.39	0	24.89
		Velocity(m/s)	0	0.60	0.83	0.99	1.18	1.06	0.36	0	0.86
5000	Qmed.75%	Hwater(m)	0	3.00	5.76	7.60	10.60	8.80	0.60	0	24.10
		Velocity(m/s)	0	0.55	0.78	0.95	1.15	1.02	0.28	0	0.84
4000	Qmed.97%	Hwater(m)	0	2.20	4.96	6.80	9.80	8.00	0	0	23.30
		Velocity(m/s)	0	0.44	0.71	0.88	1.09	0.96	0	0	0.80
3000	Qmed.99%	Hwater(m)	0	1.33	4.09	5.93	8.93	7.13	0	0	22.43
		Velocity(m/s)	0	0.33	0.62	0.80	1.01	0.88	0	0	0.74
2500	Qm.99.8% Qmin.low water	Hwater(m)	0	0.86	3.62	5.46	8.46	6.66	0	0	21.96
		Velocity(m/s)	0	0.21	0.56	0.74	0.95	0.82	0	0	0.71

Table no. A12.2.: Synthetic results of the hydraulic calculations, Bechet H.S. section km 678+660.

Design flows	Probab. flows	Hydraulic data	DESIGN SECTORS, sector length against marker (m) /medium riverbed bottom level (mMN75)								Medium water level (mMN75)
			0 - 410	410-500	500-580	580-870	870-950	950-1035	1035-1110	1110-1200	
mc/s			28.50	17.20	15.00	16.10	15.50	16.20	18.00	24.10	Medium velocity.(m/s)
16150	Qmax.1%	Hwater(m)	1.51	12.81	15.01	13.91	14.51	13.81	12.01	5.91	30.01
		Velocity(m/s)	0.15	1.51	1.69	1.61	1.65	1.59	1.43	1.06	1.56
15900	Qmax 2006	Hwater(m)	1.41	12.71	14.91	13.81	14.41	13.71	11.91	5.81	29.91
		Velocity(m/s)	0.12	1.50	1.68	1.60	1.63	1.57	1.42	1.05	1.55
15370	Qmax.2%	Hwater(m)	1.22	12.52	14.72	13.62	14.22	13.52	11.72	5.62	29.72
		Velocity(m/s)	0.11	1.47	1.65	1.58	1.6	1.54	1.39	1.02	1.52
14290	Qmax.5%	Hwater(m)	0.77	12.07	14.27	13.17	13.77	13.07	11.27	5.17	29.27
		Velocity(m/s)	0.09	1.42	1.60	1.52	1.55	1.49	1.33	0.97	1.47

13300	Qmax.10%	Hwater(m)	0.40	11.70	13.90	12.80	13.40	12.70	10.90	4.80	28.9
	Qmax 2010	Velocity(m/s)	0.07	1.37	1.54	1.46	1.49	1.44	1.28	0.91	1.41
12320	Qmax.20%	Hwater(m)	0	11.25	13.45	12.35	12.95	12.25	10.45	4.35	28.45
		Velocity(m/s)	0	1.31	1.48	1.41	1.44	1.38	1.22	0.86	1.35
11500	Qmax.30%	Hwater(m)	0	10.85	13.05	11.95	12.55	11.85	10.05	3.95	28.05
		Velocity(m/s)	0	1.26	1.44	1.35	1.40	1.33	1.18	0.81	1.31
10530	Qmax.50%	Hwater(m)	0	10.36	12.56	11.46	12.06	11.36	9.56	3.46	27.56
		Velocity(m/s)	0	1.21	1.38	1.3	1.34	1.28	1.12	0.76	1.25
9020	Qmax.80%	Hwater(m)	0	9.43	11.63	10.53	11.13	10.43	8.63	2.53	26.63
		Velocity(m/s)	0	1.14	1.31	1.21	1.25	1.19	1.03	0.7	1.18
8000	Qmed.1%	Hwater(m)	0	8.78	10.98	9.88	10.48	9.78	7.98	1.88	25.98
		Velocity(m/s)	0	1.09	1.24	1.15	1.18	1.13	0.97	0.65	1.12
7000	Qmed.10%	Hwater(m)	0	8.11	10.31	9.21	9.81	9.11	7.31	1.21	25.31
		Velocity(m/s)	0	1.04	1.17	1.08	1.11	1.06	0.9	0.6	1.05
5590	Qmed.50%	Hwater(m)	0	7.39	9.59	8.49	9.09	8.39	6.59	0.49	24.59
	Qmed.man	Velocity(m/s)	0	0.98	1.10	1.00	1.05	0.98	0.82	0.55	0.98
5000	Qmed.75%	Hwater(m)	0	6.59	8.79	7.69	8.29	7.59	5.79	0	23.79
		Velocity(m/s)	0	0.91	1.02	0.92	0.96	0.9	0.74	0.49	0.91
4000	Qmed.97%	Hwater(m)	0	5.77	7.97	6.87	7.47	6.77	4.97	0	22.97
		Velocity(m/s)	0	0.82	0.93	0.83	0.87	0.81	0.64	0	0.82
3000	Qmed.99%	Hwater(m)	0	4.93	7.13	6.03	6.63	5.93	4.13	0	22.13
		Velocity(m/s)	0	0.72	0.81	0.71	0.74	0.69	0.52	0	0.7
2500	Qm.99.8%	Hwater(m)	0	4.49	6.69	5.59	6.19	5.49	3.69	0	21.69
	Qmin.low-water	Velocity(m/s)	0	0.66	0.73	0.62	0.67	0.62	0.46	0	0.63


Traversare Dunare conducta gaz Plan: Stady 3/9/2011 2:56:59 PM
Geom: Geom.extinsa Bistret-av.Bechet ST70/MN75 Flow: Debite maxime studiu INHGA 2010
River = Dunare Reach = Bechet RS = 685.300 P12 Ax conducta Nivelurile debitelor maxime km675-730
.07
.025
.06
1
2
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6
7
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Elevation (m)
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Station (m)
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500
1000
1500
2000
2500
Legend
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WS Qmax.2006
WS 2%
WS 5%
WS 10%
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WS 30%
WS 50%
WS 80%
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WS Q5000
WS Q4000
WS Q3000
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0.0 m/s
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0.4 m/s
0.6 m/s
0.8 m/s
1.0 m/s
1.2 m/s
1.4 m/s
1.6 m/s
Ground
Levee
Bank Sta

Figure A12.2.: Cross section of the Danube riverbed in the undercrossing section, km 685+300 and laying-out of specific data, rates of max. design flows, medium velocities on sectors

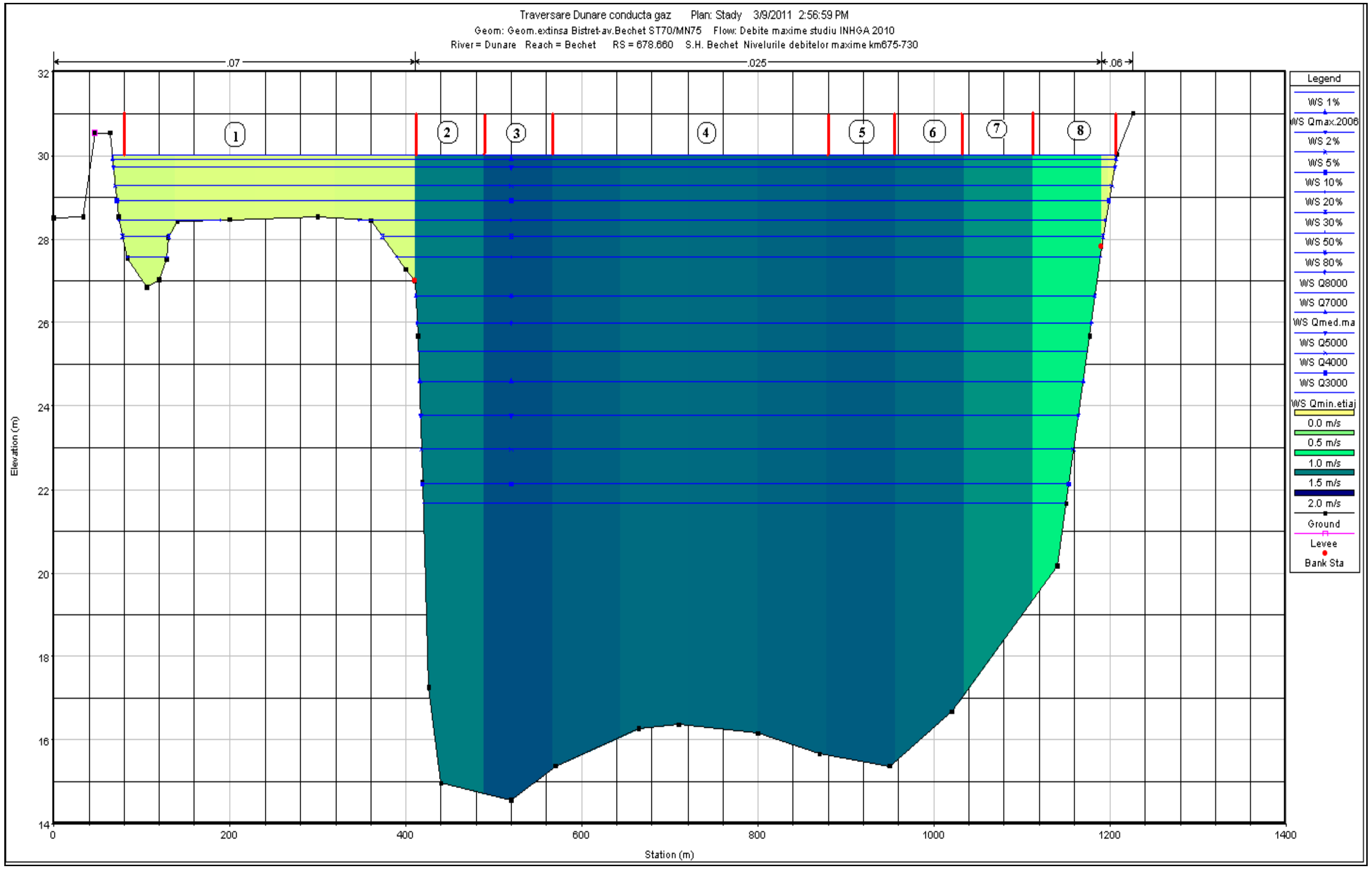


Figure A12.3.: Cross section of the Danube riverbed at Bechet H.S., km 678+660 and laying-out of specific data, rates of max. design flows, medium velocities on sectors

A12.2. Thickness of the pipeline sleeve

A protection sleeve against anchors or weights that may accidentally fall from vessels should be kept above the metal pipe.

A12.2.1. Protection from anchors

The ship anchors are of several types and their composition differs mainly in respect of the arms and the execution mode (according to STAS 13.073/92 Sea ships. Speck. Anchor). These arms can be hinged or fixed, two or four etc.

The tensile force of an anchor can reach a size of up to eight times its weight depending on the composition. The tensile force depends on the anchor weight, size and shape of the arms, angle and plunging depth in the ground.

The maximum vessels that can move in the undercrossing area from km 685+300 are inland vessels and river convoys of up to 18,000 tonnes (6 barges x 3000 t). For these types of vessels, there result anchor weights up to 1.5 t (Pool type) or 2.1 tonnes (Hall or Speck type).

These anchors can be plunged into the riverbed bottom ground down to 0.75 m:
$H = Long_{anchor} \times \cos 45 = 1.05 \text{ m} \times 0.707 = 0.74 \text{ m}$

The crawling distance on the riverbed bottom ground can reach 16 m:
$D = (10 \div 15)\ A = 10.5 \div 15.75$ m.

The highest assumption triggers a maximum 0.75 m protection sleeve maintained up to the pipeline upper below the erosion depth expected to occur during the pipeline operation.

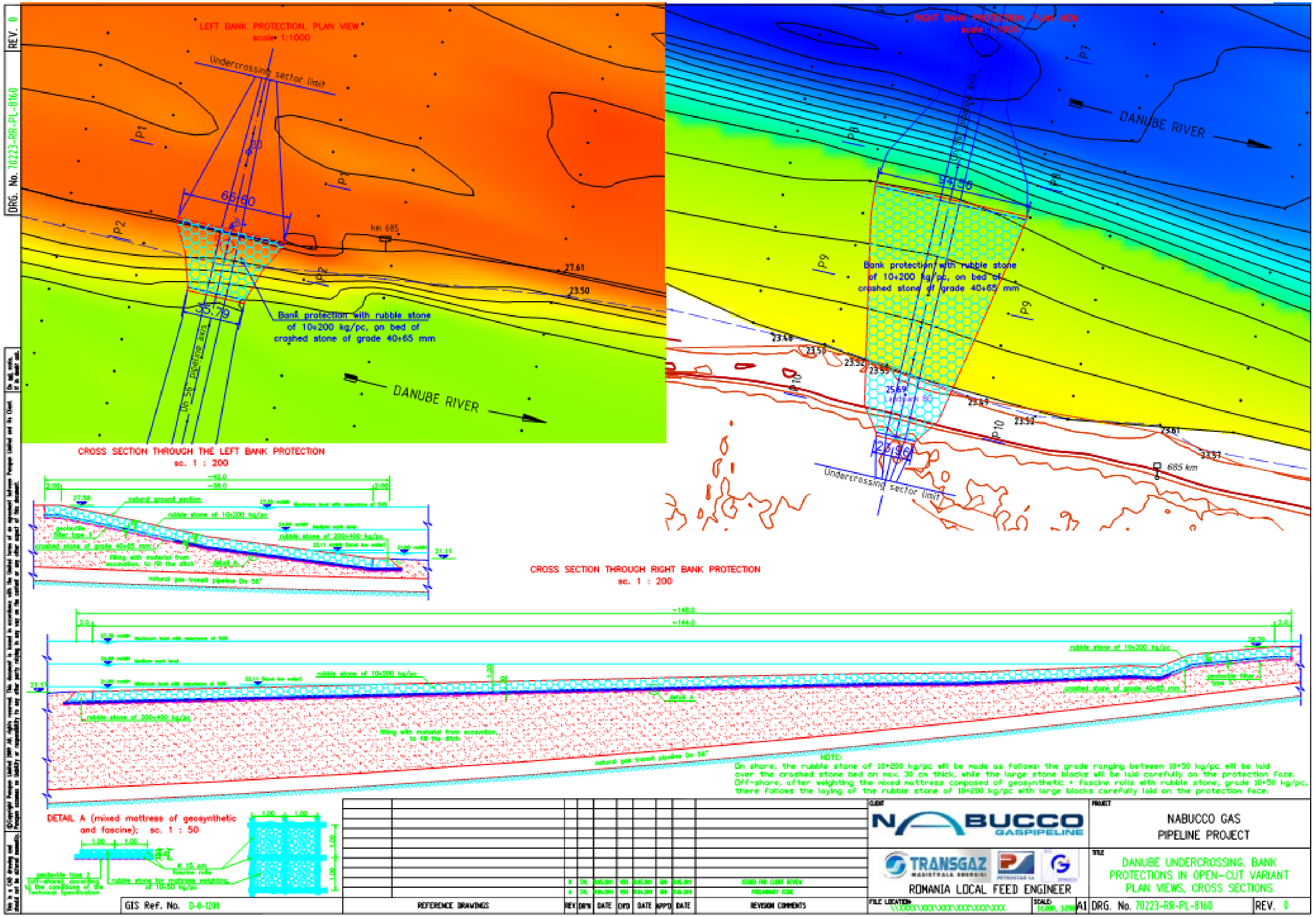
A12.2.2. Effect of accidental fall of weights into the water over the pipeline

The accidental fall of weights such as drilling rigs, containers, metal profiles, anchors, etc, can cause serious damage to the pipelines.
The literature shows that these situations can be encountered in sailing and water activities, and the impact energy reaches values of 260 kNm, in the case of freight weighing 1tf., The necessary protection sleeve thickness is 1.0 m against the fall of a spherical object with impact energy of 300 kNm.

The above mentioned shows a sleeve thickness of 1.0 m in the waterway area above the upper sleeve of the pipeline. This thickness is sufficient to take over the effect generated by throwing anchors or accidental fall of weights into water, even along the pipeline route.

Moreover, for additional safety, the anchoring of vessels in the area will be forbidden up to a distance of at least 200 m from the pipeline centreline. This provision does not exclude the need to assess the riverbed profile in the pipeline area over time in order to determine the safety level at all times and to take, if necessary, all required protective measures.
In conclusion, the burial depth of the pipeline under the current level of the riverbed is set at a minimum of 2.0 m (1.0 m + 1.0 m).

APPENDIX 13: Bank protection works proposed at the Danube


LEFT BANK PROTECTION. PLAN VIEW
scale 1:1000
Undercrossing sector limit
DANUBE RIVER
Bank protection with rubble stone of 10÷200 kg/pc, on bed of crashed stone of grade 40÷65 mm
RIGHT BANK PROTECTION. PLAN VIEW
scale 1:1000
CROSS SECTION THROUGH THE LEFT BANK PROTECTION
sc. 1 : 200
CROSS SECTION THROUGH RIGHT BANK PROTECTION
sc. 1 : 200
NOTE:
On shore, the rubble stone of 10÷200 kg/pc will be made as follows: the grade ranging between 10÷50 kg/pc will be laid over the crashed stone bed on max. 30 cm thick, while the large stone blocks will be laid carefully on the protection face.
Off-shore, after weighting the mixed mattress composed of geosynthetic + fascine rolls with rubble stone, grade 10÷50 kg/pc, there follows the laying of the rubble stone of 10÷200 kg/pc with large blocks carefully laid on the protection face.
DETAIL A (mixed mattress of geosynthetic and fascine); sc. 1 : 50
NABUCCO GAS PIPELINE PROJECT
DANUBE UNDERCROSSING. BANK PROTECTIONS IN OPEN-CUT VARIANT PLAN VIEWS, CROSS SECTIONS
ROMANIA LOCAL FEED ENGINEER
GIS Ref. No.
REFERENCE DRAWINGS
REVISION COMMENTS
DRG. No. 70223-RR-PL-8160
REV. 0

APPENDIX 14

JIU RIVER CROSSING

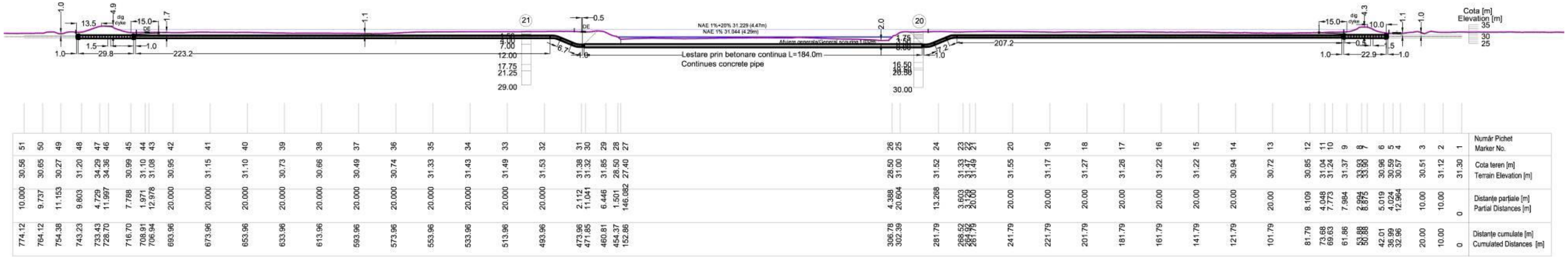


Figure A.14.1: Jiu river crossing. Longitudinal profile in open cut option – red line: trench route

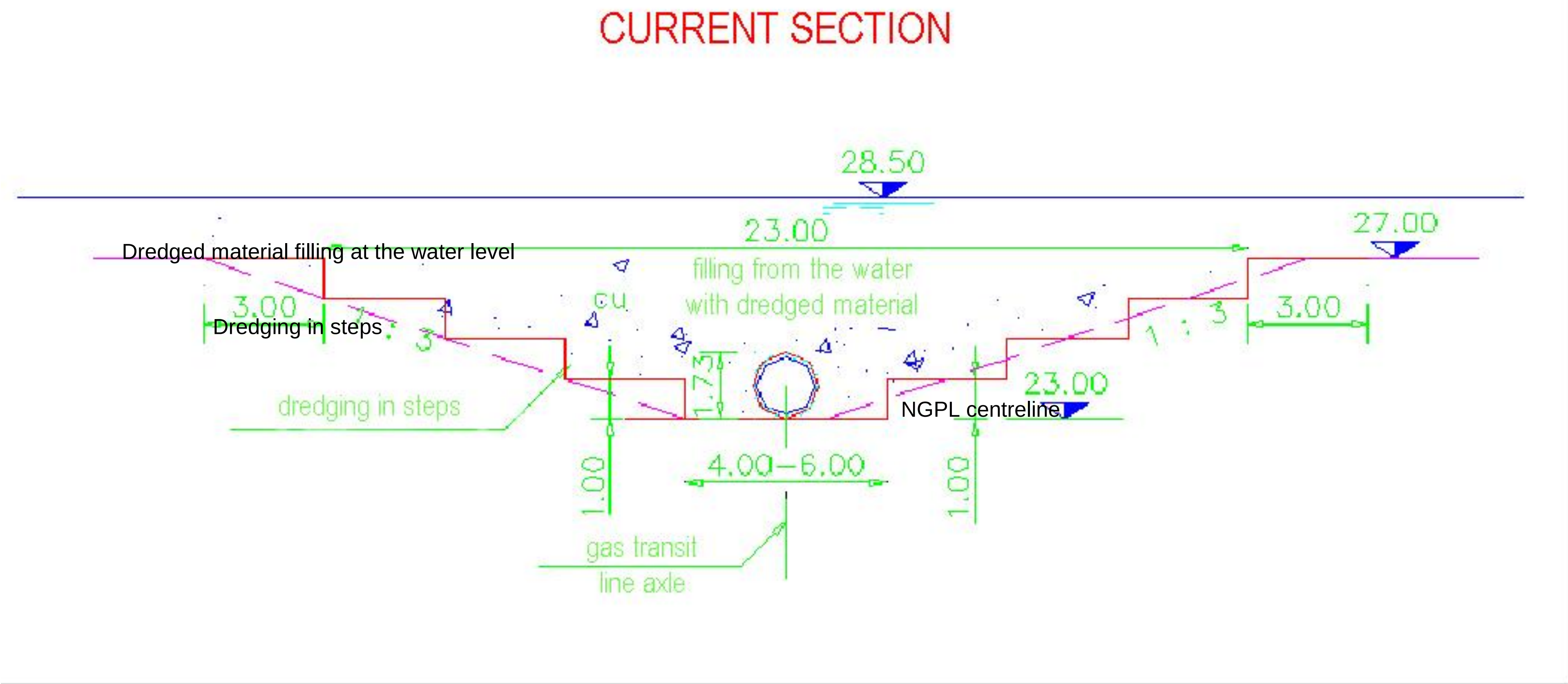


Figure A14.2..: Jiu river crossing. Current section in open cut option – red line: trench route

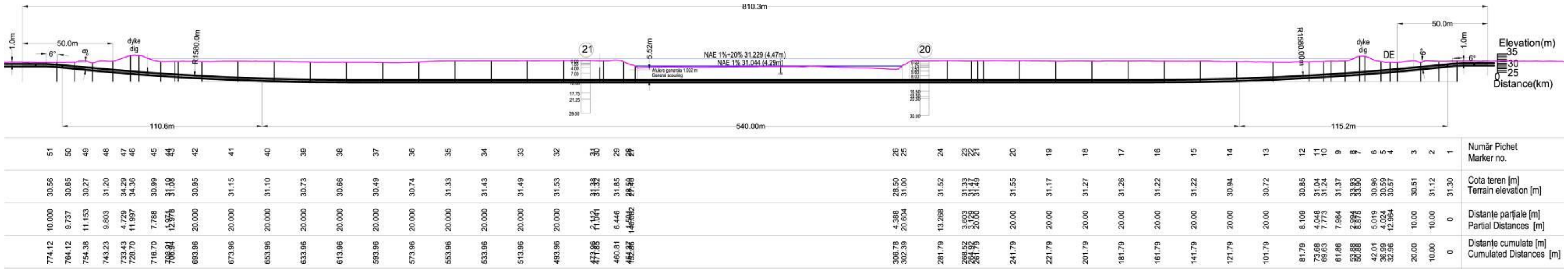


Figure A14.3.: Jiu river crossing. Longitudinal profile in TRENCHLESS OPTION
Legend: red colour: riverbed bottom

APPENDIX 15: Reinstatement plan

The constructor must reinstate the affected land to the condition it had prior to the work execution.
When executing the diggings within the working strip, the thick topsoil (0.3 m in the case of the Romanian bank and 0.5m for the Bulgarian bank) shall be separately stored in order to be recovered and brought back when reinstating the land to its agricultural use.

a) Reinstatement of Cultivated Land or Grassed Areas

Reinstatement of cultivated or grassed areas shall only be carried out when the weather and ground conditions are suitable.

Prior to the spreading of topsoil, the subsoil shall be cultivated with a winged-tine cultivator with tines spaced at 450mm maximum, mounted on a suitable vehicle, to provide a minimum 400mm depth of penetration (measured from the subsoil surface) along and across the Working Width with sufficient passes to break the subsoil.

At locations where benching, side cutting, grading or major rutting of the running track has occurred the subsoil shall be cultivated as described above, prior to the reforming of original ground contours up to subsoil level. When formation is completed the subsoil shall then be tined as described above.

The tined subsoil shall then be lightly graded such that hard pan is not reintroduced into the ground.

Stones in excess of 50mm ring shall be removed from the top 100mm depth of subsoil.

The topsoil shall then be spread across the working width. Where topsoil was stripped in separate layers, then the topsoil shall be replaced in the same separate layers.

The entire working width shall be further cultivated by a minimum of two passes with a tined cultivator to a depth of 450mm below original ground level, working along or across the working width such that the tined direction shall be at 45 to the contours. Care shall be taken to ensure that cultivation coincides with any existing or post construction drainage system but does not damage said drains.

Stones in excess of 50mm ring shall be removed from the top 150mm depth of topsoil over the whole of the working width and removed from site. In areas of excessive stoniness, the Contractor may propose the use of flail type stonecrusher as an alternative to stone picking but the approval of the Employer’s Representative and the landowner shall be required before such a proposal could be considered as accepted.

Imported topsoil shall be from an approved source. It shall match the existing soil and the Contractor shall provide a full analysis of both the existing soil and the proposed source in seeking such approvals.

Topsoil shall not be taken from adjacent fields to make up any deficiency in other fields.

If the land crossed by the pipeline was a pasture, seeds shall be manually spread. Then, seeds shall be buried by rake and garden roller. Water needed for spraying the areas shall be carried by tank car.

b) Reinstatement of Hedges

Stock proof or rabbit proof protective fences for permanent reinstatement of gaps in hedgerows shall be erected on both sides of the hedge line where required.

Where hedge lines are to be reinstated at road crossings the fence on the road side of the hedge line shall comprise 1.3 metre high posts with four rails of the face-mounted type.

Reinstatement of hedges shall be carried out with container grown plants in good condition, which shall match the existing species as specified and recorded in the Record of Conditions.

All plants shall be free from disease or damage. Details of the origin of the stock shall be provided. Samples of the specified plants shall be submitted for approval prior to planting. All other stock supplied shall be true to the original samples provided.

All container grown plants shall have been grown in weed free containers for at least one complete growing season and shall exhibit a well developed fibrous root system and bushy, vigorous top growth. Container grown plants which are not planted on or shortly after arrival at the Contractor's compound shall be properly lined out and watered frequently to prevent drying out. Immediately prior to planting, container grown stock shall be well watered. During planting operations care shall be taken not to break up the root ball and where plants have become pot bound the roots on the outside of the ball shall be carefully eased out.

Whips shall be in the size range 900-1200mm height. The plants shall be non-refrigerated stock with adequate fibrous root development. Tree species should exhibit a clear leader and shrubby species should be multi-stemmed.

Transplants shall be within the size range 450-600mm. They shall be two years old stock once transplanted or undercut. The plants shall exhibit adequate fibrous root systems and be multi-stemmed.

To ensure early establishment of hedge plants the Contractor shall supply and lay to a depth of 500mm within the double fence limits a layer of best quality top soil. Tree planting compost from an approved source shall be incorporated into topsoil at a rate of 2 litres per plant and the hedgerow plants planted at 300mm centres in two staggered rows.

Plants shall be pit planted. The pits shall be large enough to accommodate the root mass without distortion. Soil shall be carefully returned and firmed in around the root mass. The area shall be mulched with 250mm bark mulch spread over the hedgerow area.

All hedgerow planting shall be well watered in.

c) Reinstatement of Ditches

Watercourses and ditches shall be reinstated in accordance with the Drawings. The type of reinstatement will be determined by the relevant authorities, and the Contractor shall liaise with the relevant Authority at an early date to agree the exact requirements.

d) Access to Working Strip After Reinstatement and/or Testing

Upon commencement of hydrostatic testing of sections of pipeline, all further access required by the Contractor to such sections shall be subject to Work Permit Procedures and may require the full-time presence of an inspector.

Such restrictions to access by the Contractor shall also apply after completion of topsoil reinstatement.

The Contractor shall give the Employer’s Representative at least two working days notice of his intention to work or to move vehicles within such a restricted access location.

e) Reinstatement of Roads not being a Highway and Footpaths

The Contractor shall notify the Employer’s Representative of his intention to work on or use any road or footpath not being a highway as agreed with the National and Local Highway Authority and shall agree and record its condition prior to such work or use. The Contractor shall subsequently permanently reinstate the road or footpath to the satisfaction of the affected parties. The Contractor shall provide for such work all hardcore, tarmac, asphalt and other materials as required.

Where the trench is in any made or unmade road or footpath, after the backfill has been completed the Contractor shall provide, place and compact a 300mm thick layer of self-binding gravel (road sub-base) or similar approved and reinstate the surface of the trench line to a standard equivalent to the existing construction, or in accordance with the Drawings where specified therein.

Where roads or footpaths have been damaged by Contractor's plant or vehicles outside of the trench line the base course and wearing course shall be reinstated over the full extent of the damaged area.

f) Parking Areas, Storage Areas, Working Areas and Accesses

The Contractor shall reinstate the surface of all parking areas, storage areas, working areas and access routes on or adjacent to the Site and the Construction Base and Pipe Storage Area to a condition not less than equal to that existing before the commencement of the Work and to the satisfaction of the affected parties.

g) Road Verges

Grass verges within or adjacent to the Working Width and where crossed by the pipe trench or where damaged by Contractor's vehicles or plant shall be fully reinstated to their original condition. Where necessary additional topsoil, to a minimum depth of 150mm, shall be imported and the whole area grass seeded. Grass seed shall be a tested mixture approved by the highways authorities

h) Land Drains

Damage to existing land drainage systems should be kept to a minimum during the works by the Contractor. Should it be identified that there is a requirement to install either a pre-construction or post-construction land drainage scheme this shall only be undertaken following discussions and acceptance by the landowner and the Employer’s Representative. To minimise impact of the pipeline, the drainage design should where possible run parallel with the pipeline trench and drains crossing over the pipeline should be minimised. Drainage outfalls should where possible outfall on a field by field basis.

Where a pre-construction drainage scheme is installed this should be maintained and protected by the Contractor throughout the works.

i) In case of **forest clearings**, the areas occupied by trees shall be replanted within the protected area in the zones indicated by the administrator/curator of the area or by the forest administrator.

j**) Construction camp**, with some modifications can be reused by the local public administration for arranging social housing, recreational sites, business park or shall be demolished and the land reinstated to its initial use.

APPENDIX 16 : QUESTIONNAIRE

Photograph description		
Photograph	Photo number	1.
	Date	10.03.2011
	Time hour/min	11.54
	Photographer	Cristea Ion
	GPS location	N 43^{o} 45' 56''; E 23^{o}51' 71''
	Point KM	
	Direction	South from the natural protected area
	Subject Category	The Danube channel in the Jiu-Danube Confluence zone
	Location	RO SPA 0023 Jiu-Danube Confluence
	Photograph Reason	Landscape/habitat assessment
	Comment	An islet on the Danube is seen on the left side of the image

Photograph description		
Photograph	Photo number	2.
	Date	10.03.2011
	Time hour/min	12.01
	Photographer	Cristea Ion
	GPS location	N 43° 45' 91''; E 23°50' 70''
	Point KM	
	Direction	South from the natural protected area
	Subject Category	Habitat/landscape description
	Location	RO SPA 0023 Jiu-Danube Confluence
	Photograph Reason	Landscape/habitat assessment
	Comment	Islet on the Danube with a flooded vegetation

Photograph description		
Photograph	Photo number	3
	Date	10.03.2011
	Time hour/min	12.04
	Photographer	Cristea Ion
	GPS location	N 43° 45' 41''; E 23°53' 45''
	Point KM	
	Direction	South from the natural protected area
	Subject Category	Forest habitat on the right bank of the Danube in the pipeline crossing zone
	Location	RO SPA 0023 Jiu-Danube Confluence
	Photograph Reason	Habitat/landscape description
	Comment	

Photograph description		
Photograph	Photo number	4
	Date	10.03.2011
	Time hour/min	12.05
	Photographer	Cristea Ion
	GPS location	N 43° 44' 82''; E 23°52' 86''
	Point KM	
	Direction	South from the natural protected area
	Subject Category	Forest habitat on the right bank of the Danube in the pipeline crossing zone
	Location	RO SPA 0023 Jiu-Danube Confluence
	Photograph Reason	Habitat/landscape description
	Comment	

Photograph description		
Photograph	Photo number	5
	Date	10.03.2011
	Time hour/min	12.09
	Photographer	Cristea Ion
	GPS location	N 43° 45’ 98’’; E 23°52’ 86’’
	Point KM	
	Direction	South from the natural protected area
	Subject Category	Avifauna-Pelecanus crispus and Phalacrocorax carbo
	Location	RO SPA 0023 Jiu-Danube Confluence
	Photograph Reason	Fauna species inventory
	Comment	

Photograph description		
Photograph	Photo number	6
	Date	10.03.2011
	Time hour/min	12.11
	Photographer	
	GPS location	
	Point KM	685
	Direction	South from the natural protected area
	Subject Category	Forest habitat at km 685, on the left bank of the Danube
	Location	RO SPA 0023 Jiu-Danube Confluence
	Photograph Reason	Habitat/landscape description
	Comment	

Photograph description		
Photograph	Photo number	7
	Date	10.03.2011
	Time hour/min	12.15
	Photographer	Cristea Ion
	GPS location	
	Point KM	686
	Direction	South from the natural protected area
	Subject Category	Forest habitat at km 686, on the left bank of the Danube
	Location	RO SPA 0023 Jiu-Danube Confluence
	Photograph Reason	Habitat/landscape description
	Comment	

Photograph description		
Photograph	Photo number	8
	Date	10.03.2011
	Time hour/min	12.29
	Photographer	Cristea Ion
	GPS location	
	Point KM	688
	Direction	South from the natural protected area
	Subject Category	Fish fauna species: Aspius aspius, Carassius auratus, Cyprinus carpio, Barbus barbus, Abramis brama, Scardinius erithrophthalmus
	Location	RO SPA 0023 Jiu-Danube Confluence
	Photograph Reason	Fish species inventory
	Comment	

Photograph description		
Photograph	Photo number	9
	Date	09.03.2011
	Time hour/min	14.22
	Photographer	Cristea Ion
	GPS location	
	Point KM	
	Direction	Southwest from the natural protected area
	Subject Category	Fishing equipment – portable electrofishing
	Location	RO SCI 0045 Jiu Corridor
	Photograph Reason	Equipment description
	Comment	

Appendix 17.: Results of surveys undertaken on the Danube on 15.09.2007 downstream of Calafat (on main channel) and on 17.09.2007 upstream of Turnu Magurele (mixed), regarding the fish species populations[30]

No	Longitude	Latitude	Site Name	Upstream Drainage Area	Former Sediment Size	Sampling Location	Species Name	Total number run1	Number Length Below 150	Number Length Over 150
1.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Alburnus alburnus	606	606	0
2.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Carassius gibelio	92	53	39
3.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Rutilus rutilus	70	69	1
4.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Leuciscus idus	23	3	20
5.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Scardinius erythrophthalmus	3	3	0
6.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Chondrostoma nasus	1	1	0
7.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Lepomis gibbosus	21	21	0
8.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Rhodeus amarus	11	11	0
9.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Perca fluviatilis	7	3	4
10.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Pseudorasbora parva	14	14	0
11.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Neogobius fluviatilis	7	7	0
12.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Abramis bjoerkna	2	2	0
13.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Aspius aspius	4	2	2
14.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Leuciscus cephalus	2	2	0
15.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Gymnocephalus cernuus	1	1	0
16.	22.885238	43.970268	Downstream	595090	Gravel/Pebble/	Main	Gymnocephalus	2	2	0

[30] Data supplied by the National Administration “Apele Romane” upon SC IPTANA SA. request

No	Longitude	Latitude	Site Name	Upstream Drainage Area	Former Sediment Size	Sampling Location	Species Name	Total number run1	Number Length Below 150	Number Length Over 150
			Calafat		Cobble	channel	schraetser			
17.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Romanogobio vladykovi	1	1	0
18.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Abramis brama	38	30	8
19.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Esox lucius	15	0	15
20.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Cyprinus carpio	1	0	1
21.	22.885238	43.970268	Downstream Calafat	595090	Gravel/Pebble/ Cobble	Main channel	Silurus glanis	1	0	1
22.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Alburnus alburnus	547	540	7
23.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Carassius gibelio	86	64	22
24.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Sander lucioperca	6	5	1
25.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Aspius aspius	17	14	3
26.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Perca fluviatilis	53	53	0
27.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Neogobius fluviatilis	8	8	0
28.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Neogobius melanostomus	13	13	0
29.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Abramis brama	19	12	7
30.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Lepomis gibbosus	4	4	0

No	Longitude	Latitude	Site Name	Upstream Drainage Area	Former Sediment Size	Sampling Location	Species Name	Total number run1	Number Length Below 150	Number Length Over 150
31.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Neogobius kessleri	4	4	0
32.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Gymnocephalus cernuus	1	1	0
33.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Pseudorasbora parva	32	32	0
34.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Vimba vimba	1	1	0
35.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Rutilus rutilus	22	22	0
36.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Leuciscus cephalus	2	2	0
37.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Chondrostoma nasus	4	4	0
38.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Rhodeus amarus	3	3	0
39.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Cyprinus carpio	5	5	0
40.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Leuciscus idus	5	3	2
41.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Barbus barbus	4	4	0
42.	24.840991	43.714971	Upstream Turnu Magurele	608283	Sand	Mixed	Cobitis taenia	1	1	0
43.	24.840991	43.714971	Upstream Turnu	608283	Sand	Mixed	Abramis bjoerkna	27	14	13

No	Longitude	Latitude	Site Name	Upstream Drainage Area	Former Sediment Size	Sampling Location	Species Name	Total number run1	Number Length Below 150	Number Length Over 150
			Magurele							

APPENDIX 18. Data concerning the ichtyo-fauna and bottom macro-invertebrate fauna (Macrozoobenthos) in the riverside area of the Danube river as well as accompanying information about the parameters of the environment in the section between river km 686 and 685.

(According to a contract № 212-041/03.09.2012)

The scope of the provided information includes:

- Description of the methods for sample collection;
- Lists with identified fish taxons and bottom macro invertebrates;
- Data concerning the abundance/richness of the ichtyo-fauna and Macrozoobenthos;
- Lists contaning the species of conservation importance (listed in the annexes of Biodiversity act and Habitat Directive 92/43/EEC);
- Data concerning accompanying physicochemical environment parameters: water temperature (C^o), active water reaction (pH), dissolved oxygen (mg/l), oxygen saturation (%) and electrical conductivity (µS/cm);
- Assessment of the state of species of conservation concern (if such have been identified) and also quality of their habitats.

A18,1. Bottom macroinvertebrate fauna (Macrozoobenthos)

A18.1.1. Methods for sample collection

There have been represented data from two sample collections in the riverside area of the Danube river, within the section between river km 686 and 685. They were held in the autumn (October-November) of 2011.

During the collection of macrozoobenthos samples an adapted variant was applied (Cheshmedjiev et al., 2011)[31] of methodology for multi-habitat sample collection according to AQEM/STAR (Barbour et all., 1999): AQEM/STAR methodology).The collection of benthos samples is made in accordance with the following European standards:

- EN ISO 10870 Water quality - Guidance on the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters.
- EN ISO 5667-1:2006/AC:2007 Water quality - Sampling - Part 1: Guidance on the design of sampling programmes and sampling techniques (ISO 5667-1:2006)
- EN 27828:1994 – Water Quality – Methods of biological sampling – Guidance on handnet sampling of aquatic benthic macro-invertebrates
- ISO 9391:1993 – Water Quality – Sampling in deep waters for macroinvertebrates – Guidance on the use of colonization, qualitative and quantitative samplers).

A18.1.1.1. Sampling methods

For the needs of the present survey the multi-habitat approach (Barbour et al., 1999) was used following the AQEM/STAR methodology in accordance with approved European Standards:

- EN ISO 10870 Water quality - Guidance on the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters
- EN ISO 5667-1:2006/AC:2007 Water quality - Sampling - Part 1: Guidance on the design of sampling programmes and sampling techniques (ISO 5667-1:2006)

[31] (Cheshmedjiev, S., Soufi, R., Vidinova, Y., Tyufekchieva, V., Yaneva, I., Uzunov, Y., E. Varadinova *Multi-habitat sampling method for benthic macroinvertebrate communities in different river types in Bulgaria*. Water Research and Management, Vol. 1, No. 3 (2011) 55-58)

- EN 27828:1994 – Water Quality – Methods of biological sampling – Guidance on handnet sampling of aquatic benthic macro-invertebrates.
- ISO 9391:1993 – Water Quality – Sampling in deep waters for macroinvertebrates – Guidance on the use of colonization, qualitative and quantitative samplers.

It has to be pointed that EN 27828:1994 is one of the most practicable approaches for sampling from river in Europe. This method permits to obtain comparable results during routine monitoring and is used for rivers in compliance with Water Frame Directive 2000/60/EC (Annex V) and Regulation for water monitoring (№ 1/2011) requirements.
At each sampling point the sampling approach was specified depending on the distance to the gas-pipeline, on the site accessibility and on the expert judgment consistent with the potential effect of the construction over the river biota. Samples from standing water bodies were not collected as far as the pipeline does not cross any.

The subsamples are collected according the proportions of local micro-habitats (bottom substrates) within the surveyed river zones (such as: boulders, big stones (> 6-20 cm), small stones (2-6 cm), rubble, sand, mud, wood debris etc.). On each sampling points the number of collected samples was dependent on the percentage of the presented bottom habitats (The number for each location is given in the field recording sheets). Twigs, leaves and larger stones are removed and pre-attached organisms are collected. The collected material was accumulated into one sample representative for the surveyed site. Applied methods are standard for the purposes of ecological assessment according WFD.

A18.1.2. Storage and treatment of the benthos material

The collected biological material is fixed in field, in a mixture of alcohol and formalin in the ratio 3:1. The field treatment and storage of the collected benthos samples has been made according to the requirements of the Guidance on the preservation and handling of water samples (EN ISO 5667-3:2003/AC:2007 Water quality - Sampling - Part 3: Guidance on the preservation and handling of water samples).
The laboratory treatment of the benthos samples includes sorting on systematic groups, followed by stereo-microscopic separation of the invertebrate organisms up to the recommended taxonomic levels according to the adopted methodology as well as listing of the bottom invertebrate organisms, which have been found.

A18.1.3. Conservation and processing the collected benthos samples

The collected benthos samples were fixed and preserved with mix of ethyl alcohol and formalin in the ratio 3:1. Both the processing and conservation of samples in field were done according the Standard EN ISO 5667-3:2003/AC:2007 Water quality - Sampling - Part 3: Guidance on the preservation and handling of water samples.
The laboratory processing of benthos samples included separation of the items by taxonomic groups, subsequent division of invertebrate organisms to the recommended taxonomic ranks using stereo-microscope and counting the bottom invertebrates found.

A18.1.4. Composition and abundance of the macrozoobenthos

Totally 21 taxa of bottom macroinvertebrates were presented in the studied site including shells of the Zebra mussel (*Dreisena polymorpha)*.
Species of conservation concern (listed in the Habitat Directive 92/43/EEC and/or in the Bulgarian Biodiversity Act) were not found in the current survey.
The total abundance of the macrozoobenthos for the survey is calculated as 622 ind./m^2.
List of the taxa identified in the composition of the bottom macroinvertebrate fauna:
Oligochaeta
Limnodrilus claparedeanus

Limnodrilus udekemianus
Limnodrilus profundicola
Isochaetidses michaelseni
Paranais friči
Psammoryctides albicola fr.
Crustacea
Dikerogammarus haemobaphes
Bivalvia
Anodonta cf. subcircularia
Dreisena polymorpha - shells
Corbicula sp.
Gastropoda
Fagotia auricularis
Fagotia esperi
Lithoglyphus naticoides
Theodoxus danubialis
Theodoxus fluviatilis
Radix auricularia
Amphimelania holandri
Hippeutis sp.
Odonata
Gomphus sp.
Enalagma cyathigerum
Diptera
Chironomidae larvae

A18.2. Ichthyofauna

A18.2.1 Sampling methods

- *Sampling with electricity*
  The fish samples for the survey were collected by electrofishing following the European Standard EN 14011 “Water quality – Sampling of fish with electricity”. Portable backpack apparatus of pulsating direct current will be used. Two persons (one operator and one assistant) work at each sampling point. Sampling area covers the representative habitats within littoral area with depth ≤ 0.8 m. Sampling was performed during the daylight hours by wading.

- *Sampling with seine net*
  This method is applicable within shallow sites (< 1.5 m depth) with sandy bottom near the shores. The sampling area encloses with the net, which is then downloaded to the coast collecting all fish caught in the sampled area. This is a quantitative method since both the numbers and biomass of the fish caught are calculated per unit area within the sampling site.

A18.2.2. Fish processing

The fish caught were processed at the sampling site and after processing were released back in the river. After species identification of fishes their total length (L) was measured and both the total number and weight of each species were determined. The abundance of ichthyofauna was calculated for 1 ha.

A18.2.3. Composition and abundance of the ichthyofauna

Totally 16 fish species of 5 families were identified in the surveyed area, as follows:

Fam. Cyprinridae
Abramis brama
Alburnus alburnus
Aspius aspius
Blicca bjoerkna

Chondrostoma nasus
Pseudorasbora parva
Squalius cephalus
Fam. Cobitidae
Cobitis elongatoides
Fam. Esocidae
Esox lucius,
Fam. Percidae
Perca fluviatilis
Fam. Gobiidae
Neogobius fluviatilis
Neogobius gymnotrachelus
Neogobius kessleri
Neogobius melanostomus
Proterorhinus semilunaris
Benthophilus stellatus.

Eight species (*A. alburnus, P. parva, S. cephalus, N. gymnotrachelus, N. fluviatilis, N. melanostomus, P. fluviatilis, C. elongatoides*) were presented in the samples with juvenile and adult individuals, some 5 species (*A. brama, A. aspius, B. bjoerkna, C. nasus, E. lucius*) were presented only by juveniles and 3 species (*N. kessleri, P. semilunaris, B. stellatus*) – only by adult fishes.
The mean total abundance of the ichthyofauna (summarized data from the catches with electricity and with seine net) in the surveyed area was calculated as 1050 ind./ha, the mean total biomass – 7.780 kg/ha.
The bleak *A. alburnus* prevails in numbers while the Pike *E. lucius* – in the biomass.
In the region are practiced commercial and recreational fishing of moderate intensity.
Two of the fish species founded are listed in the Habitat Directive and in the Bulgarian Biodiversity Act:
Aspius aspius – Habitat Directive (Annex II), BBA (Annexes 2 & 4). This is a common species in the region (and in the Bulgarian Danube sector as a whole). The adults take mainly the open waters but the juveniles keep the littoral areas.
Cobitis elongatoides – Habitat Directive (Annex II), BBA (Annex 2). The population in the studied area is of low density.
Moreover, according the information from local fishermen the Zingel (*Zingel zingel)* (HD – App. II, BBA – App. 2 & 4) also occurs in the region as a rear species.
The area is a part of the migrating corridor of the *Alosa immaculata (= Alosa pontica)*. This species appears during the spawning upstream migrations. The Young-of-the-Year occurs in the littoral zone along their downstream migration in summer.

A18.3. Environmental parameters

The basic physicochemical parameters of water (i.e., water temperature (C^o), pH, dissolved oxygen, oxygen saturation and conductivity) were measured once along the biological sampling using calibrated field devices (WTW, Windaus Labortechnik) according the Standards pointed in the Table A18.1 below.

Table A18.1. : Standards for measurement of physical-chemical parameters

Parameters	**Method/Standard**	**Limit of detection of the method**
pH	ISO 10523	0,00
Conductivity (µS/cm)	EN 27888	0,0
Dissolved oxygen (O_2 mg/l) / Oxygen saturation (O_2 %)	EN25814	0,00

The values of the parameters measured are shown at the next Table A17.2.

Table A18.2.

Parameter	Value
Temperature	14,5°C
O_2 mg/l	12,39
O_2 %	101
pH	7,2
Conductivity	270 µS/cm

The substrate composition in the studied area is presented by silt (40%), clay (20%), sand (20 %) and rubble (20%)