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Prepared for:

Ministry of Energy of the Republic of Georgia

DRAFT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF THE BLACK SEA REGIONAL TRANSMISSION PROJECT

Prepared by:

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1.0 INTRODUCTION AND BACKGROUND

1.1 Introduction

The Ministry of Energy of the Republic of Georgia intends to expand and upgrade country's electricity grid, and as part of this process has decided to complete a high-voltage transmission line across southern Georgia that connects Gardabani and Zestaphoni and that runs from near Akhaltsikhe to the Turkish border, where it would connect to a line on the Turkish grid. The Ministry has approached the European Bank for Reconstruction and Development (EBRD) and other lenders for financing, possibly including the European Investment Bank (EIB) and Kreditanstalt für Wiederaufbau (KfW). Under Georgian law, the potential environmental impacts of the project must be evaluated in an Environmental Impact Assessment. As part of their decisionmaking process, EBRD and other international lenders require that the proposed project be evaluated in an Environmental and Social Impact Assessment (ESIA) that meets EBRD and other international guidelines. The draft ESIA is being disclosed to project stakeholders and the public in compliance with Georgian law and EBRD guidelines. All stakeholder and public comments on the draft ESIA will be considered in developing the final ESIA, and will be considered in the final decisions made by the Ministry of Energy and then by EBRD and other lenders.

1.2 Purpose and Need for the Project

Power generation potential in the Republic of Georgia comes from both renewable sources of energy such as hydro and wind power and from thermal generating capacity. The country's hydropower potential is estimated at up to 80 billion kWh per year, of which up to 40 billion kWh may be economically attractive. The current system consists of about 60 hydropower stations with a maximum output capability of 6.8 billion kWh annually (that is, about 17 percent of the economically feasible potential) plus about 650 MW of thermal capacity at Gardabani, southeast of Tbilisi. In addition, the construction of two units (150-160 MW) of Combined Cycle Gas Turbine power plants is envisaged. Thermal generation is mostly used in winter to balance low water availability, but it would also be available for export in off-peak demand season (spring-summer).

Georgia has one 500 kilovolt (kV) transmission line that runs east to west, connecting Gardabani in the east to Ksani (northeast of Tbilisi) to Zestaphoni in the west. In the 1980s, another line was designed and partly constructed, this one connecting Gardabani and Zestaphoni by way of Alkaktsikhe, which is far south of the existing line. Over half of the foundations and towers for the new line were constructed between 1989 and 1991, when the project was abandoned.

There is a significant generation-load imbalance in the Georgian power system: two-thirds of Georgia's energy resource is located in the northwest of the country, while two thirds of domestic demand is located in eastern Georgia, and most of the potential export market is located in countries south of Georgia (for example, Turkey, Iran, and Iraq, all of which are experiencing rapid economic development and growth in electricity demand). Power delivery to any of these markets requires a reliable high voltage transmission network. At present, only one strong line connects West and East Georgia, the 500kV transmission line "Imereti" – "Kartli-II" – "Kartli-I". Any fault on this line, especially during autumn and winter, causes a large power deficit in the East, and this has resulted in frequent total system blackouts. Apart from reducing domestic grid reliability, this also limits existing and future power swap or export potential. In addition to being an exporter of electricity, Georgia wishes to seize an opportunity for acting as a transit country, notably for electricity exports from Azerbaijan to Turkey.

In recent years, the Ministry of Energy has examined the need to integrate the national grid into the regional system, both for economic and national security reasons. Fichtner (2007) completed a study for the Ministry that evaluated the concept of developing an extremely high-voltage interconnected system in Caucasus nations. The intent would be to allow easy and efficient cross-border exchanges and make better use of regional energy resources. The study considered Georgia, Armenia, Azerbaijan, Iran, and Turkey. The study recommended going forward with the two projects studied in detail, which were to develop lines to connect Armenia and Georgia, and to connect Turkey and Georgia. The study concluded that Georgia (and Armenia) would profit from and share in development momentum that would be gained by Turkey, Iran, Azerbaijan, and Russia.

The Ministry of Energy also commissioned a study (Ministry of Energy of Georgia, undated) to determine whether there is adequate demand in Turkey for electricity exported from Georgia and Azerbaijan and whether there is sufficient existing and feasible electricity generation projects in Azerbaijan and Georgia to supply the Turkish markets using a newly constructed transmission line. The study determined that this was feasible, given a competitive price and additional investment in hydropower generation facilities in Georgia. The study also noted that the hydropower investment would likely depend on there being a firm commitment to the transmission line, whereas financing for the transmission line would depend on commitments to generation projects.

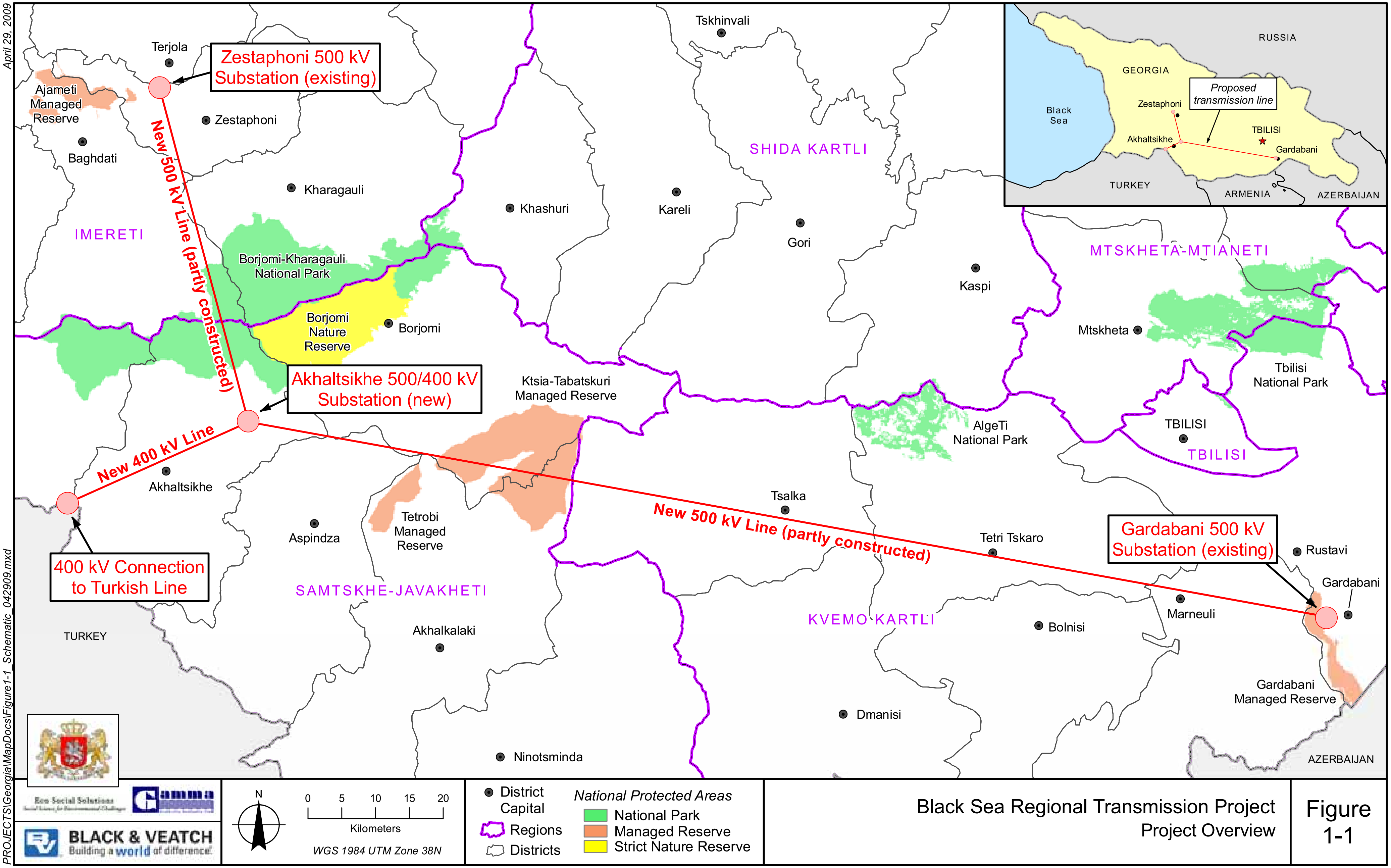
Finally, the Ministry of Energy sponsored a feasibility study funded by the United States Trade and Development Agency to determine the least-cost technical options to make power transmission more reliable in Georgia (Kuljian, 2008). Specifically, the study examined the construction of a new 500kV line that would further integrate the west and east Georgian Power System and operate in parallel with the existing Zestaphoni – Ksani – Gardabani 500kV transmission line. The study also examined the feasibility of having this new line, which would be a completion of the old Soviet-era planned line, also have a new high voltage interconnection to Turkey by way of a new substation at Akhaltsikhe. Although there has been some deterioration and scavenging, much of the constructed route remains suitable for use after some rehabilitation.

Subsequently, the Ministry of Energy made a decision to go forward with completion of the line and approached lenders for financing. The Project Execution Agency for the project is the Georgia State Electrosystem (GSE), which will be responsible for designing and constructing the line together with the Technical Consultant hired through international tender specifically for the Black Sea Transmission Project. As the project progresses, GSE may pass along responsibility as the execution agency to EnergoTrans, the daughter company (100 percent ownership), which is the legal entity that owns portions of the line that have already been acquired and will own the entire line once the right-of-way is fully acquired.

1.3 Scope of the ESIA

This Environmental and Social Impact Assessment (ESIA) evaluates the following project components, as shown on Figure 1-1:

- Rehabilitation and reconstruction of foundations and/or towers that have deteriorated or been damaged along the 260-kilometer route from Gardabani to Zestaphoni.
- Construction of foundations and towers for sections of the line that were not built on the Gardabani to Zestaphoni route and on the 30-kilometer route from Akhaltsikhe to the Turkish border.
- Conductoring (that is, placing lines to conduct electricity) the entire line.
- Slight expansions of existing 500kV substations near Gardabani and Zestaphoni.



Black Sea Regional Transmission Project
Project Overview

Figure 1-1

PROJECTS\Georgia\MapDocs\Figure1-1_Schematic_042909.mxd

April 29, 2009

- Construction of a new 500/400/220kV substation near Akhaltsikhe

In the future, additional lines may be constructed from Azerbaijan to connect to the substation at Gardabani, and from the Georgia border to a substation near Borchka, Turkey. Any potential impacts from construction and operation of these lines would be covered in future impact assessments.

This ESIA is intended to meet the requirements of Georgian law, as described in section 3, and also will have to meet requirements established by the European Bank for Reconstruction and Development and other lenders for Category A projects. Prior to making a funding decision, the lenders and the Georgian Ministry of Environment Protection and Natural Resources have to be satisfied that:

- The elements of the investment program they have been asked to help finance would meet Georgian national requirements and existing European Union, EBRD, and international financial institution standards, as described in section 3.
- The project includes all necessary mitigation measures to minimize any significant adverse change in environmental, health and safety, and socioeconomic conditions.
- Appropriate public consultation and disclosure are undertaken in line with Georgian national law as well as EBRD Environmental Policy (EBRD, 2003), thus ensuring all reasonable public opinions are adequately considered prior to a commitment for financing.

In keeping with Georgian law and EBRD requirements, the overall scope of the ESIA will include:

- Scoping and identification of key environmental and socioeconomic issues.
- Definition of baseline conditions of key environmental and social resources that could be affected by the project.
- Assessment of positive and negative impacts of the proposed project on environmental and socioeconomic resources.
- Consultation with people who may be affected by the project and other stakeholders.
- Development of design and operating practices that are sufficient to avoid, reduce, or compensate for significant adverse environmental and social impacts.
- Development of such monitoring programs as are necessary to verify mitigation is effective in accomplishing its goals, and to develop and refine the effectiveness of mitigation measures.

1.4 Methodology for the ESIA

This section describes the ESIA process in the context of the Black Sea Regional Transmission Project. The overall approach for the ESIA and reporting used the following sources of guidance

- Law of Georgia on Protection of Environment (enacted 1996, amended 2000, 2003, 2007).
- Law of Georgia on Environmental Impact Permit (adopted October 15, 1996, replaced by the law adopted in 2007).
- European Union Council Directive 85/337/EEC on the *assessment of the effects of certain public and private projects on the environment,* as amended by Council

directive 97/11/EC (Council of the European Union, 1985; 1997).

- EBRD policies, including *Environmental Policy* (EBRD, 2003) and *Public Information Policy* (EBRD, 2006).
- EIB's environmental and social requirements in their *Environmental and Social Practices Handbook* (http://www.eib.org/about/publications/environmental-and-social-practices-handbook.htmEIB, 2007)
- KfW's requirements contained in *Financial Cooperation with Development Countries* (KfW, 2003) and *Environmental Guideline for Investment Finance by KfW* (KfW, 2002).

The overall ESIA process is shown in Figure 1-2.

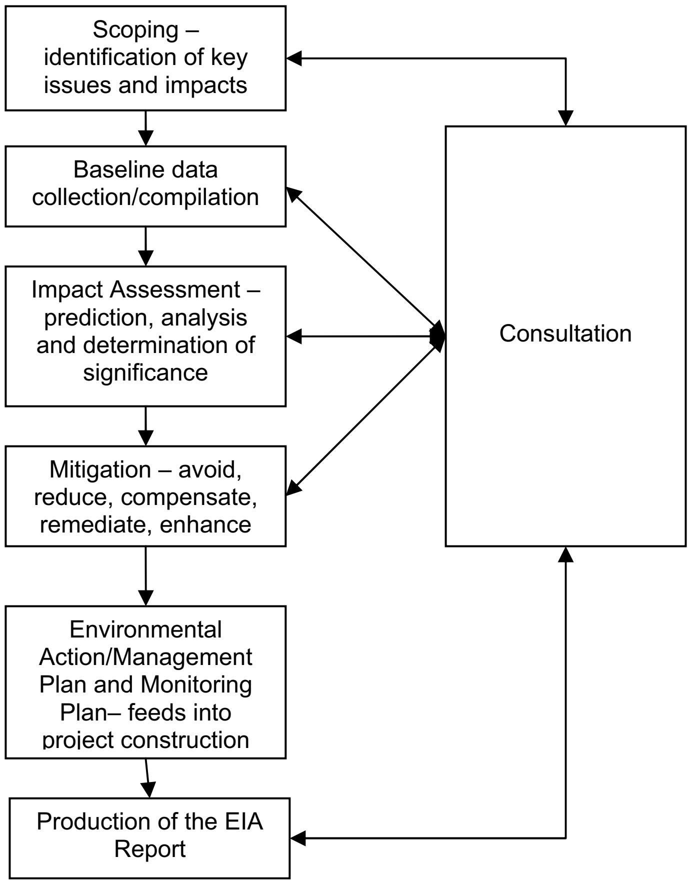


Figure 1-2. The ESIA Process

1.4.1 Scoping

The method used for scoping the potentially significant impacts of this project comprised:

- Visits by the social team in February 2009 to western sections of the line (from Marneuli to the west), to the Borjomi-Kharagauli National Park and Akhaltsikhe areas, and to the new corridor between Akhaltsikhe and the Turkish border.
- Visits by the environmental team to as much of the line as was accessible during visits in February and March 2009. These consisted of several days of observing constructed foundations and towers along the entire route, including damaged or destroyed ones, as well as observing the land and resources where the line has yet to be completed.
- Detailed reviews of other studies conducted in the areas where the line will run, including the BTC Pipeline ESIA (BTC Co., 2002) and the Samtskhe – Javakheti Roads Rehabilitation Project EIA (x xx, 2006).
- Meetings with officials in the Ministry of Environment Protection and Natural Resources, including representatives of the Agency for Protected Areas and the EIA department, as well as inquiries to the Ministry of Culture.

- Scoping meeting held in Gudauri on 27-28 March, which was attended by the Ministry of Energy, the Ministry of Environment Protection and Natural Resources, and three NonGovernmental Organizations (NGOs), including the Caucasus Environmental NGO.Network, the Informational Center of Kvemo Kartli, Geo Information Laboratory, LTD, and the Green Movement.
- Followup meetings in Tbilisi with various NGOs, including the Green Movement of Georgia and Green Alternative.
- Visits by the social team to a total of 16 villages along the transmission line corridor. These visits included presentations to 400 people as well as interviews and discussions with several dozen people. In most cases, municipal authorities were notified of the meetings but could not attend. Figure 1-3 shows discussions during a visit to a village near Gardabani.

Figure 1-3. Leaders and citizens in Ilmazlo village receiving and giving information during a visit by the ESIA social team

Government officials, NGOs, and citizens were very interested in hearing about the project, and were generally supportive, although there were some concerns. The major concerns that were raised during scoping, positive and negative, fell into several major categories:

- Environmental:
  - Concern about impacts on flora and/or fauna in Borjomi-Kharagauli National Park.
  - Concerns about the potential impacts of crossing the Kura River.
- Social:
  - Concern about potential health effects of high-voltage transmission lines on residents who live in houses near the line or other people who spend time near the lines.
  - Concern about having to relocate to a house farther away from the line.
  - Concern about damage to existing houses from derelict towers.
- Economic:
  - Concern that construction and maintenance of the line could damage crops or interfere with grazing.
  - Concern about loss of land to foundations and towers and to access roads.
  - A desire that local workers be hired for rehabilitation and construction of the foundations and towers (some people who were interviewed had worked on the original construction).
  - Concern about impacts on recreation in Borjomi-Kharagauli National Park.

- Cultural:
  - Concerns about impacts on the Ilmazlo cemetery, including damages to graves.
- Other:
  - Surprise that the line would be completed and placed into service, since some people had thought it had been abandoned permanently.
  - Concern that the Government will do whatever it wants without considering other opinions.
  - Appreciation of the benefit of linking Georgia powers grid to Turkey (a key NATO ally) and reducing the importance of linkage to the Russian grid.
  - Hope and appreciation that electricity might become more reliable and/or more affordable.

1.4.2 Baseline Data Collection

The study area was defined initially by the originally designed transmission line corridor, for which GSE provided GPS coordinates for all the foundations and towers that had already been constructed and the approximate corridor where new foundations and towers would need to be constructed. Baseline data collection for the project included a combination of desk studies and site visits. Desk studies used existing sources of information, including data available on the internet; reports and the scientific literature; recent ESIAs/EIAs for projects in areas near the corridor; data provided by the Ministry of Energy, the Ministry of Environment and Natural Resources, and the Ministry of Culture. Site visits were made from February through April 2009 to supplement and verify information provided by desk studies.

Chapter 4 of this ESIA provides information on the baseline environment, including natural processes that may affect the baseline over the course of project development. Where there are gaps or uncertainties with the baseline data, or where assumptions have been made, this is stated in the text.

1.4.3 Assessment of Impacts

Chapter 5 of this ESIA identifies potential socioeconomic impacts, determines whether the potential impact is likely to be significant, and compares the potential impacts for various alternatives. A number of criteria were used to determine whether or not a potential impact of the proposed scheme could be considered "significant." These are outlined with reference to specific environmental and social issues in the subsequent topic sections of this ESIA. Wherever possible, a quantitative assessment of the impacts was undertaken. Where this was not possible, a qualitative assessment of impacts was undertaken, based on existing information available for the corridor, and experience with other transmission line projects.

The ESIA covers the direct impacts and any indirect, secondary, cumulative, short-, medium- and long-term, permanent and temporary, reversible and irreversible, beneficial and adverse impacts of the proposed scheme.

Where relevant, the anticipated impact was compared against appropriate legal requirements and standards. Where no such standards exist, assessment methods involving interpretation and the application of professional judgement were employed. The assessment of significance in all cases took into account the impact's deviation from the established baseline conditions and the sensitivity of the environment.

1.4.3.1 Methodology for Assessing Environmental Impacts

A general method for grading the significance of environmental impacts was adopted to ensure consistency in the terminology of significance, whether for a beneficial or an adverse impact. The two principal criteria determining significance are the sensitivity of the receptor and the magnitude of the change arising from the scheme, as shown in Table 1-1.

Table 1-1 shows that the significance of impacts was classed as major, moderate, minor or none; and either positive (beneficial) or negative (adverse). This categorization is widely recognized and accepted in the field of environmental impact assessment. Where appropriate, topic-specific assessment methods and criteria for determining significance are described in Chapter 5.

Table 1-1. Determination of Environmental Impact Significance

Magnitude of change	**Sensitivity of receptor**		
	High *(e.g. international, national protection)*	***Medium*** *(e.g. regional, local protection)*	***Low*** *(e.g. no protection)*
High *(e.g. >75% of area or receptor affected)*	Major (H,H)	Major (H, M)	Moderate (H, L)
Medium *(e.g. 25-75% of area or receptor affected)*	Major (M, H)	Moderate (M, M)	Minor (M, L)
Low *(e.g. 5 to 25% of area or receptor affected)*	Moderate (L, H)	Minor (L, M)	Negligible (L, L)
Very Low *(e.g. >0, but <5% of area or receptor affected)*	Minor (VL, H)	Negligible (VL, M)	Negligible (VL, L)
No Change	None (NC, H)	None (NC, M)	None (NC, L)

Another consideration was the duration of the impact -- whether the impact would be temporary or permanent -- and if they were temporary whether they would be short-, medium-, or-long term. Defining the duration of the impact can be subjective, depending on the receptor. For instance, following construction, it may then take some time for vegetation to become fully re-established, particularly in drier areas. Although in ecological terms this period may not be a long time, for the people who use the land for orchards or pasture, this period could be significant in relation to their lifetime, and could therefore be considered permanent. Table 1-2 sets out the duration of impact used.

1.4.3.2 Methodology for Assessing Social Impacts

The objective of the social impact assessment was to identify major risks to social and economic conditions in the area of the proposed transmission line and to assess impacts of the construction and operation on socioeconomics. The impacts can be direct and indirect, intended and unintended, positive and negative. For significant impacts, the developer would implement a variety of mitigation measures, and these are discussed in Chapter 6.

Table 1-2. Duration of Impacts		
Nature of change	*Duration*	*Definition/ Description*
Temporary	Short-term	Impact continues during construction (1-2 yrs) and up to 1 year following construction
	Medium-term	Impact continues 1-5 years following construction
	Long-term	Impact continues 5-10 years after construction
Permanent	-	Due to the length of time period for human beings, impacts over 10 years can subjectively be defined as permanent.

Generally, the social impact assessment process involves the following major tasks:

- Identifying types of adverse and beneficial impacts of the proposed action.
- Assessing the level of socioeconomic risks in terms of frequency (how likely is it to happen) and consequences.
- Assessing the acceptability of the risks.
- Introducing mitigation measures to reduce risks to acceptable level.

The social impact assessment typically addresses the following issues:

- Demographics, including changes in local population size, emigration/immigration in the area, migration of people in search of work, and other issues.
- Economic issues, including supply chain impacts, local sourcing opportunities, potential impacts on local markets for goods and services, employment opportunities for construction, operation and decommissioning phases of the project.
- Health issues, including risks of new diseases to indigenous communities, impacts on health of operations personnel and local communities, impact of local diseases on workers.
- Social infrastructure, including adequacy of health care and education facilities, transport and roads, power supply, fresh water supply to support project activities and personnel as well as the local communities.
- Resources, including land use changes, increased access to rural or remote areas, use of natural resources.
- Cultural, including issues associated with sites that have archaeological, historical, religious, cultural, or aesthetic values.
- Social equity, including local social groups who will gain or lose as a result of the project or operation.

As with environmental impacts, a general method for grading the significance of socioeconomic impacts was adopted to ensure consistency in the terminology of significance, whether for a beneficial or an adverse impact. The two principal criteria used were the nature of the impact and the magnitude of the change arising from the scheme, as shown in Table 1-3.

1.4.4 Environmental Mitigation and Enhancement

Where potential impacts could be significant, mitigation measures were developed. These measures are intended to avoid, reduce, compensate, and/or remediate adverse impacts, or to enhance potentially beneficial impacts. Wherever possible, this is undertaken as part of the project design, so the measures will feed back into impact assessment. An example of this would be to include erosion control measures into the design of roads.

The mitigation and enhancement which should be undertaken as part of the project are set out as an Environmental and Social Management Plan which can then be applied in order to manage different phases of the project. For this project, the plan presented in Chapter 6.

Table 1-3. Determination of Social Impact Significance

Magnitude of change	*Nature of impact*		
	Avoidance	*Disruption/Habituation*	*Permanence*
Negligible	No avoidance needed	No noticeable under normal conditions	Not noticeable
Minor	Mitigation or design change prevents Impact(s)	No effect on daily life or routine of affected party	Ephemeral: <1 year
Moderate	Mitigation or design change reduces impact	Possible initial change on daily life/routine, rapid habituation reduces to below nuisance level	Temporary: recovery to pre-existing conditions after one or a few years (e.g., after construction)
High	Mitigation or design change cannot significantly reduce impact(s)	Requires change to daily life or routine activities	Permanent: life of transmission line, or beyond

Table 1-3 shows that impact significance has been classed as major, moderate, minor or negligible (none). As noted, impacts can be either positive (beneficial) or negative (adverse). Where appropriate, topic-specific assessment methods and criteria for determining significance are described in Chapter 5.

1.4.5 Environmental Monitoring

Where there is uncertainty over the potential significance of an impact, mitigation may include monitoring of that impact to determine whether additional measures are required. Various monitoring results will need to be reported to the Ministry of Energy, the Ministry of Environment Protection and Natural Resources, other Ministries, and/or to EBRD or other lenders. The monitoring plan for this project is described in Chapter 7.

1.5 Organization of this Report

The remainder of this report is organized as follows:

- Chapter 2 describes the proposed project and three alternatives for project development.
- Chapter 3 describes the legal and institutional framework and context in which the project is being proposed and developed.

- Chapter 4 describes the environmental setting of the transmission line corridor and the baseline environmental and socioeconomic conditions of the area.
- Chapter 5 describes the potential impacts that may result from construction, operation, and maintenance of the transmission line.
- Chapter 6 is the Environmental and Social Action Plan that will be implemented, which includes measures that are needed to prevent, mitigate, or otherwise address potentially significant impacts.
- Chapter 7 is the monitoring program that will be implemented to verify the conclusions of this ESIA and to allow refinement of future mitigation efforts.
- Chapter 8 provides references used in preparing the ESIA.
- Appendix A identifies the people who prepared the ESIA and summarizes their qualifications.
- Appendix B shows the milestones and schedule for completing the ESIA process.
- Appendix C is the Public Consultation and Disclosure Plan that was used to ensure the involvement of stakeholders in the ESIA process.

2.0 The Proposed Project Line and Alternatives

This chapter describes the proposed transmission line and several alternatives. The action alternatives include the regional project as described in Chapter 1 and also modified corridor routes to reduce impacts on protected areas. The alternatives considered include three action alternatives and the no action alternative:

- Alternative 1: completion of the 500kV line as proposed in the late 1980s and partly constructed through 1991, plus a new substation at Akhaltsikhe and a new 400kV line to the Turkish border. Construction would begin in 2010 and last through 2012.
- Alternative 2: the same as Alternative 1 except a modified route near Ktsia-Tabatskuri Managed Reserve and through Borjomi-Kharagauli National Park.
- Alternative 3: the same as Alternative 2 except a modified route that does not cross Borjomi-Kharagauli National Park.
- Alternative 4: No action. This alternative would involve not completing the line but instead leaving the foundations and towers as they are, and not completing the Black Sea Regional Transmission Project described in Chapter 1.

2.1 Alternative 1: Black Sea Regional Transmission Project

This alternative includes the following key elements as shown on Figure 1-1 in Chapter 1:

- Rehabilitation and/or construction of approximately 260 kilometers of 500kV transmission line connecting the existing 500kV substations at Zestaphoni and Gardabani.
- Construction of a new 500/400 kV and 400 kV substation at Akhaltsikhe.
- Approximately 30 kilometers of 400 kV transmission line from the new substation at Akhaltsikhe to the Turkish border (to be connected to the Borchka substation in Turkey at a later date).
- Expansion of the substations at Zestaphoni and Gardabani to accommodate the new 500kV circuit.

Work on strengthening the transmission network in the Caucasus began in the 1980s. The proposed 500 kV line that is the subject of this ESIA was originally designed as part of a larger plan to connect the electricity systems of Russia and all three Trans-Caucasian Republics, and to improve reliability of the Georgian power system. Construction of the section from Gardabani to Zestaphoni started in 1989 and continued until 1991. However, after 1992 further construction became impossible due to political events in Georgia, and sections of the line whose foundations and towers had been constructed were left unenergized and unprotected. The project that was partly constructed at that time is now proposed to be completed and extended. The proposed project would extend Georgia's main 500kV system by adding two new 500kV links from Gardabani and Zestaphoni to a new substation near Akhaltsikhe. The new Akhaltsikhe substation will be connected to the Turkish grid at Borchka using a 400kV overhead line. The 400kV line from the Georgian border to Borchka in Turkey has not yet been designed or constructed. A companion project to facilitate the transit element is the completion of a new 500kV connection between Georgia and Azerbaijan, which is also to be completed at a later date.

Before construction was ended in 1991, a total of 554 foundations and towers were constructed over the 283-kilometer corridor. Table 2-1 shows the status of the existing towers. Of these, slightly over half will need rehabilitation of some sort, ranging from complete replacement to repairs to existing tower components. The proposed project will include construction of an additional 309 foundations and towers (assuming that towers are placed 400 meters apart), and conductoring of high-voltage lines between all the towers. Figure 2-1 shows the portions of the line that have been constructed and that have not yet been constructed, and also shows the locations of the individual towers that have been constructed. Table 2-2 shows the length of the line and the numbers of towers that will be used for this alternatives and also Alternatives 2 and 3.

Table 2-1. Current Status of Foundations and Towers Constructed before 1991

Status	*Number*
Existing tower/foundation sites	554
Towers missing	118
Severely damaged, major repair required	99
Minor damage, relatively simple rehabilitation	74
Good condition, minor or no repairs needed	263
Source: Information received from GSE	

Table 2-2. Corridor length and tower status for all alternatives (all distances in kilometers)

	Alternative			
	1	*2*	*3*	*4*
Total length of line	283.1	294.3	315.2	0
Total constructed length	161.4	156.6	135	161.4
Total length not constructed	121.7	137.7	180.2	0
Number of constructed towers used	554	514	366	0
Number of towers to be abandoned	0	40	188	554
Length of Ktsia-Tabatskuri crossing	12.1	10	10	0
Length of Borjomi-Kharagauli crossing	11.5	4.7	0	0
Length of Gardabani crossing	3.1	3.1	3.1	0

2.1.1 Substations

The new Akhaltsikhe substation will include construction of new 500kV and 400kV outdoor conventional air-insulated (AIS) substations at a single site on approximately six hectares of land approximately 15 kilometers northeast of Akhaltsikhe along the existing 500kV route. The main elements of this substation will include:

- 500kV substation.
- 400kV substation.
- Back-to-back HVDC 500/400 Converter Station.
- Control and monitoring equipment (SCADA).

The civil works that will be completed as part of substation design, procurement, and construction include:

- Subsoil investigation, topographical & contour survey, as required.

- Earthworks and rock excavation including dewatering if required, filling and grading and paving as needed.
- Steel structures.
- Foundations for substation control building and structures.
- Infrastructure works such as perimeter fencing, access and service roads and paths, water supply, storm drainage, cable ducts/trenches, doors and windows, and finishing work including masonry, plastering, filing, and painting.

Design and execution will be based on applicable international regulations and standards in conjunction with Georgia norms and standards. The existing substations at Zestaphoni and Gardabani will be extended slightly to accommodate the new 500kV circuits at each location. This will require minimal additional land space since most of the new equipment will be installed within the existing substations.

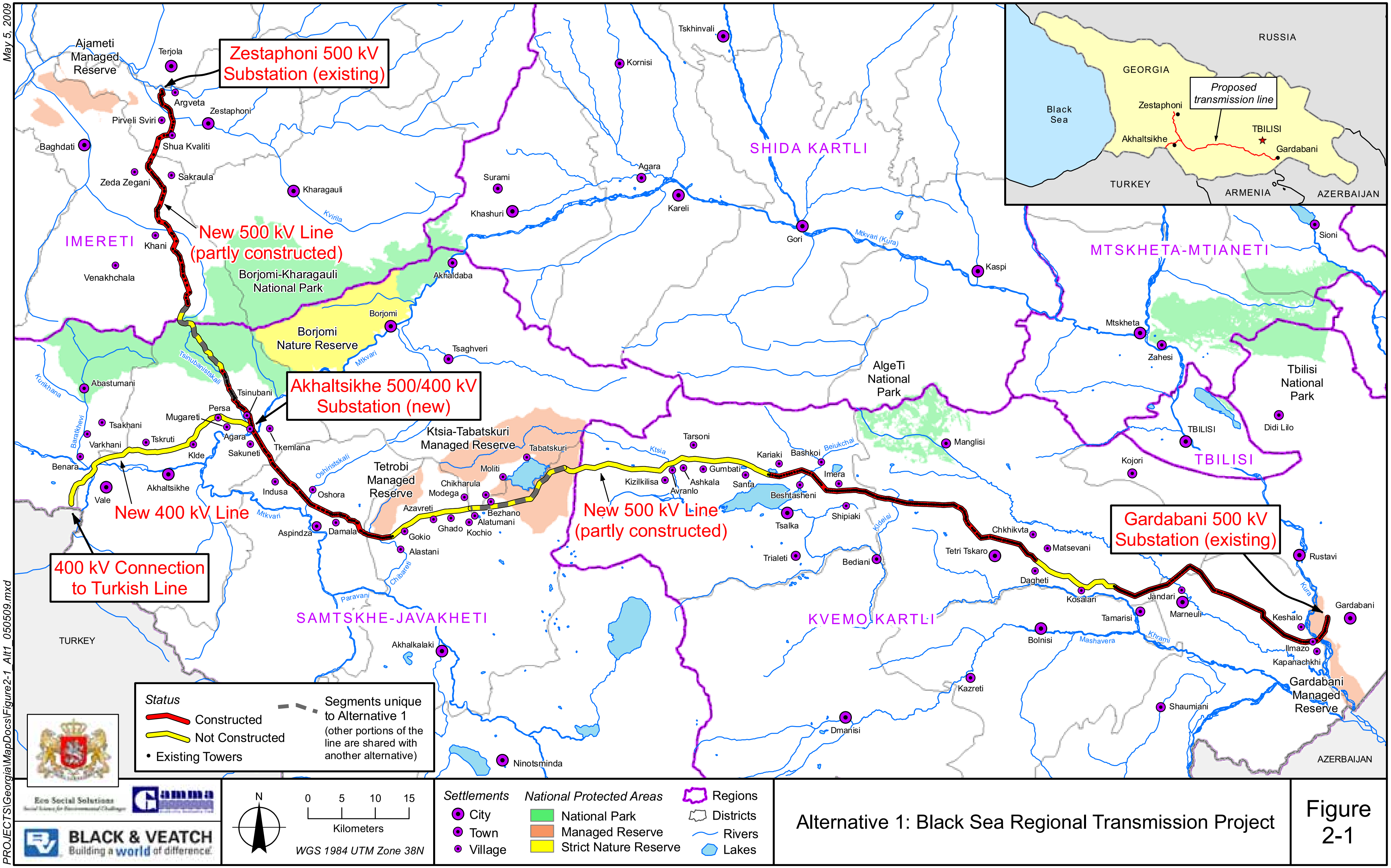
2.1.2 Transmission Lines

As mentioned previously, a transmission line has been planned on the same proposed route from Gardabani to Zestaphoni since the late 1980s. Activities including right-of-way acquisition, land clearing, construction of foundations and construction of towers were conducted between 1989 and 1991 along about 65 percent of this route. As noted above, many of these towers have been damaged or completely removed by scavengers and many foundations are in precarious condition.

The segments of the transmission line include:

- Segment 1 - Gardabani to Akhaltsikhe. Right-of-way acquisition, land-clearing, and tower construction were completed along 114.8 kilometers of this 187.5-kilometer route (61 percent) in three main areas as shown on Figure 2-1: from kilometer 0 at Gardabani to kilometer 40.4 west of Marneuli (40.4 kilometers); from kilometer 53.9 east of Tetri-Tskaro to kilometer 99.5 near Tsalka (45.6 kilometers); and from kilometer 158.9 near Alastani to kilometer 187.5 (28.8 kilometers) at the proposed Akhaltsikhe substation.[1]
- Segment 2 – Akhaltsikhe to Zestaphoni. Right-of-way acquisition, land-clearing, and tower construction were completed along 48.0 of this 61.1-kilometer route (79 percent) in two main areas as shown on Figure 2-1: from kilometer 187.5 at the proposed Akhaltsikhe substation to kilometer 197.8 (10.3 kilometers) just inside the southern boundary of what is now Borjomi-Karagauli National Park; and from kilometer 210.9 just outside the northern boundary of the Borjomi-Karagauli National Park to kilometer 248.6 at the Zestaphoni substation (37.7 kilometers). Additionally, the right-of-way that connects these two segments through the National Park was initially cleared but has since largely re-grown. Remnants of some of the access roads are still present through these areas and are used as a local access route for recreational activities such as hiking and horseback riding.
- Segment 3 - Akhaltsikhe to Borchka (terminating near Vale on the Turkish Border). No activities have previously occurred on this segment, so this will be all new construction.

1 The distance in kilometers is measured from the origin at the Gardabani substation.



Alternative 1: Black Sea Regional Transmission Project

Figure 2-1

2.1.2.1 Routing for New Construction

Detailed planning for routes and construction of transmissions line towers and lines will be required at two sections of the Gardabani to Akhaltsikhe segment, one section of the Akhaltsikhe to Zestaphoni segment, and the entire Akhaltsikhe to Turkey segment. An additional 300 or more new towers will be required. A total of about 300 new foundations and towers will need to be designed and constructed, in addition to the 554 existing ones. The route runs 11.5 kilometers through Borjomi-Kharagauli National Park, most of which will be new construction, and 12.1 kilometers through Ktsia-Tabatskuri Managed Reserve, all of which will be new.

2.1.2.2 Access Roads

Access roads will be needed to obtain access to the existing and new tower locations. During construction of the line from 1989 through 1991, access roads were used to bring workers and materials to the tower sites to conduct tree-cutting operations (where needed), construct foundations, and assemble and raise the towers. Since 1991, many of these access roads have grown over and are now not visible. Other access roads have been used by the local population and are now well-established. Some of the access roads into Borjomi-Kharagauli National Park are now used by hikers. Where needed, clearing for access roads will be 4 to 5 meters wide; in general, vehicles and equipment will travel across unprepared ground, with no preparation or road construction unless efforts are needed to control erosion or excess land disturbance.

2.1.2.3 Restoration of Previously Installed Foundations and Towers

As noted previously, foundations and towers have recently been evaluated by GSE to determine their current condition. The results were shown in Table 2-1. The existing towers are generally in areas that are largely accessible without the need for significant clearing or access roads. Where necessary, foundations and towers will be demolished or rehabilitated to meet design performance standards.

2.1.2.4 Installation of New Foundations and Towers

Clearing of trees and removal of other obstructions, where present, will occur within about 50 meters of the transmission line, forming a clear corridor about 100 meters wide.[2] Figure 2-2 shows typical vegetation clearing. Debris will be removed or burned (where allowed by authorities) so it does not present a fire hazard. In some cases, where the line traverses a valley, vegetation clearing may be limited or even unnecessary since the line may pass over existing vegetation with sufficient clearance and the towers can be accessed independently. Where the route crosses agricultural land, clearance requirements are expected to be maintained

Figure 2-2. Vegetation clearing of a narrow corridor

[2] The actual width of the corridor in which trees will be cleared will governed by a complex formula in *Rules of Installation of Electric Equipment-ПУЭ,* Annexes 1 and 2 (Ministry of Energy, undated-2). The formula is based on the distance between the outermost lines, the distance between a line and the tops of trees, the possible horizontal movement of slack lines, and tree crown radius after 25 years of growth.

easily, so there should be no restrictions on ongoing agricultural activities. In general, construction will follow the Georgia norms specified in Ministry of Energy (undated-2).

New steel towers will be placed at intervals ranging from 400 to 1500 meters depending on topography; towers will be closer when there is little or no relief and farther apart in hilly or mountainous terrain. The interval will be determined during the design in order to ensure the line will maintain a minimum clearance of eight meters from ground obstructions, roads, or trees. In-line towers will be 35 meters high and corner towers will be 30 meters high. At the minimum interval of 400 meters, a total of 309 new towers would need to be constructed (current intervals average 290 meters, but improved methods will allow a larger average interval.) In many locations, blasting will be needed to prepare sites for installation of foundations. Figures 2-3 and 2-4 shows typical foundation and tower construction activities.

Four different types of towers may be used, depending on location, function, and availability of the towers. The types of towers are shown in Figure 2-5 and include:

- Corner towers have a triple lattice tower arrangement with 12 points of ground contact (that is, three four-legged towers), anchor wires, and a requirement of 741 square meters of area.
- Two types of H-frame structures (that is, shaped like an "H") with two points of ground contact (two "legs"), anchor wires, and a requirement of 228 square meters of area.
- A single lattice tower structure with four points of ground contact (that is, a single four-legged tower), anchor wires, and a requirement of up to 440 square meters of area.

Access to tower locations will be made by driving on unimproved access "roads" from existing road crossings over the ground to the right-of-way. Neither permanent nor temporary paved/gravel access roads are proposed in the right-

Figure 2-3. Typical installation of foundations and setting towers

Figure 2-4. Raising tower in mountainous terrain

H-Frame 2-point contact steel lattice tower. Used primarily for in-line conductors.

Single 4-point contact steel lattice tower. Used primarily for in-line conductors

H-Frame 2-point contact tower. Used primarily for in-line conductors.

Triple 4-point contact steel lattice towers. Used primarily for direction changes and high conductor stress situations.

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Types of Towers
Black Sea Regional Transmission Project

Figure 2-5

of-way. Helicopter landing/staging pads may need to be constructed in rugged terrain where helicopters may be used for construction activities.

2.1.2.5 Installation of Conductors (Transmission Lines)

In most locations, there are no line conductors between the existing towers; however, line conductors and ground conductors are present in some locations. GSE will evaluate existing conductors to determine if they are still usable. It is anticipated that most, if not all, of the line and ground conductors used will be new.

Based on the type and size of conductors used in existing 400kV and 500kV systems in Georgia, the following conductor sizes will be used to maintain uniformity in operation and maintenance practices, including maintaining optimum spare parts inventory:

- 3xAC 400/51, 3XAC 500/64 aluminum conductor steel reinforced (ACSR) line conductors per phase for 500kV transmission line.
- Two (2) 380/50 square millimeter DIN48204 rated ACSR line conductors for 400kV transmission line per phase.
- Two (2) ground conductors will be provided. One composite fiber-optic overhead ground wire will be used to serve dual function; optical fiber telecom link and ground wire on overhead transmission lines and the other will be ACSR. The optical fiber telecom link are designed with mechanical and electrical characteristics similar to conventional ground wires.

The ground wires are constructed to protect the electrical line from the effects of short circuits on the power system and lightning strikes.

Line conductor installations will be accomplished using two basic techniques. In drivable terrain, the conductors will be on rollers at the end of a section. The line conductor will be played out between the towers using a four-wheel drive vehicle with a specialized pole that will pull the line conductor from tower to tower while driving along the right-of-way. In highly rugged terrain, it is anticipated that vegetation clearing will be minimal and helicopters will be used the run the line conductor between towers. Once the line conductor is played out, it will be pulled to the required tension to maintain a minimum clearance requirement of eight meters over the highest vegetation. Figure 2-6 shows typical ground-based conductoring. In rugged terrain where vehicle access is difficult or impossible, helicopters may be used to place conductor lines.

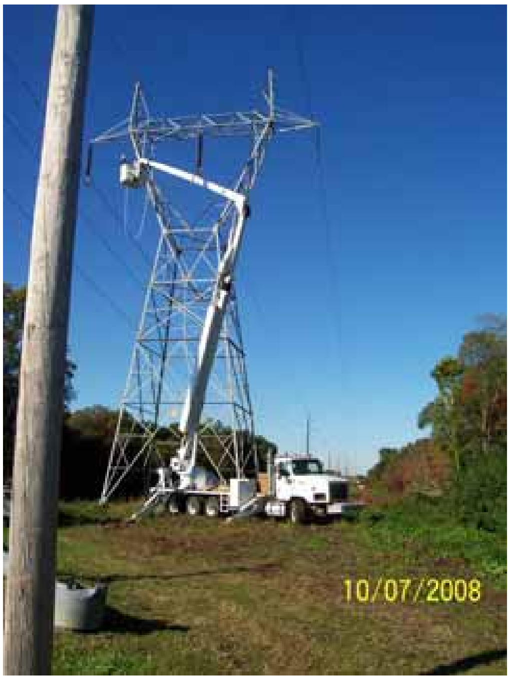


Figure 2-6. Ground-based conductoring

2.1.3 Proposed Maintenance Techniques

2.1.3.1 Substations

Ongoing operations and maintenance at substations will primarily include accessing the substations by truck or car to monitor and occasionally service equipment and the facilities. Additional maintenance activities would include landscaping activities such as grass mowing and regular mechanical weed control around the fences.

2.1.3.2 Transmission Lines

In forested areas, the right-of-way will require vegetation control measures to maintain clearance for transmission lines and to maintain access to the towers. Vegetation control will be conducted mechanically, with cutting activities occurring every 6 to 8 years. Herbicides will not be used for vegetation control. An example of a cleared corridor in forested terrain is shown in Figure 2-7.

Figure 2-7. Example of vegetation clearing for corridor maintenance in forested terrain

Access to towers locations will be achieved by driving to existing road crossings and entering the right-of-way by driving over the ground or by driving along dirt access roads (where they exist along the existing sections of the line). Neither permanent nor temporary paved/gravel access roads will be established and maintained in the right-of-way.

In some locations (including that portion of the route traversing the Borjomi-Karagauli National Park), construction and maintenance access is will be by helicopter. Vegetation control at the tower locations will be conducted manually by workers every six to eight years. Because of the placement of the towers on high points, vegetation control in these areas of the right-of-way may not always be required in order to maintain adequate clearance between vegetation and lines.

2.2 Alternative 2 – Modified Route Near Ktsia-Tabatskuri Managed Reserve and through Borjomi-Kharagauli National Park

Alternative 2 uses most of the original project route described in Alternative 1. However, Alternative 2 involves a realignment of the route near Ktsia-Tabatskuri Managed Reserve in order to reduce potential impacts to that protected area. It also involves crossing Borjomi-Kharagauli National Park at its narrowest point and at areas quite distant from recreational traffic. This alternative can also include some technological alternatives to minimize land-clearing in the National Park, which would further mitigate potential impacts. This alternative is shown in Figure 2-8.

The modified route is 294 kilometers long, about 11 kilometers longer than Alternative 1, and would involve constructing 350 or more new towers in addition to using 514 of the existing towers. It also would involve abandoning 40 existing towers. The crossing of Borjomi-Kharagauli would be 4.7 kilometers long, compared to 11.5 kilometers in Alternative 1. The crossing of Ktsia-Tabatskuri would be 10 kilometers long, compared to 12.1 kilometers in Alternative 1.

This alternative was developed based on consultations with the Agency for Protected Areas in the Ministry of Environment Protection and Natural Resources In a series of meetings, the Agency expressed concern over visual impacts to recreational bird-watching and impacts to bird species near Tabatskuri Lake, an alpine lake. As a result, this alternative creates a new alignment that roughly parallels the recently installed BTC pipeline and avoids the areas of concern to the Agency for Protected Areas. In addition, the Agency expressed concern over potential impacts in Borjomi-Kharagauli National Park, so the route was modified so it would cross the park at its narrowest point.

2.3 Alternative 3 – Modified Route in Near Ktsia-Tabatskuri Managed Reserve and around Borjomi-Kharagauli National Park

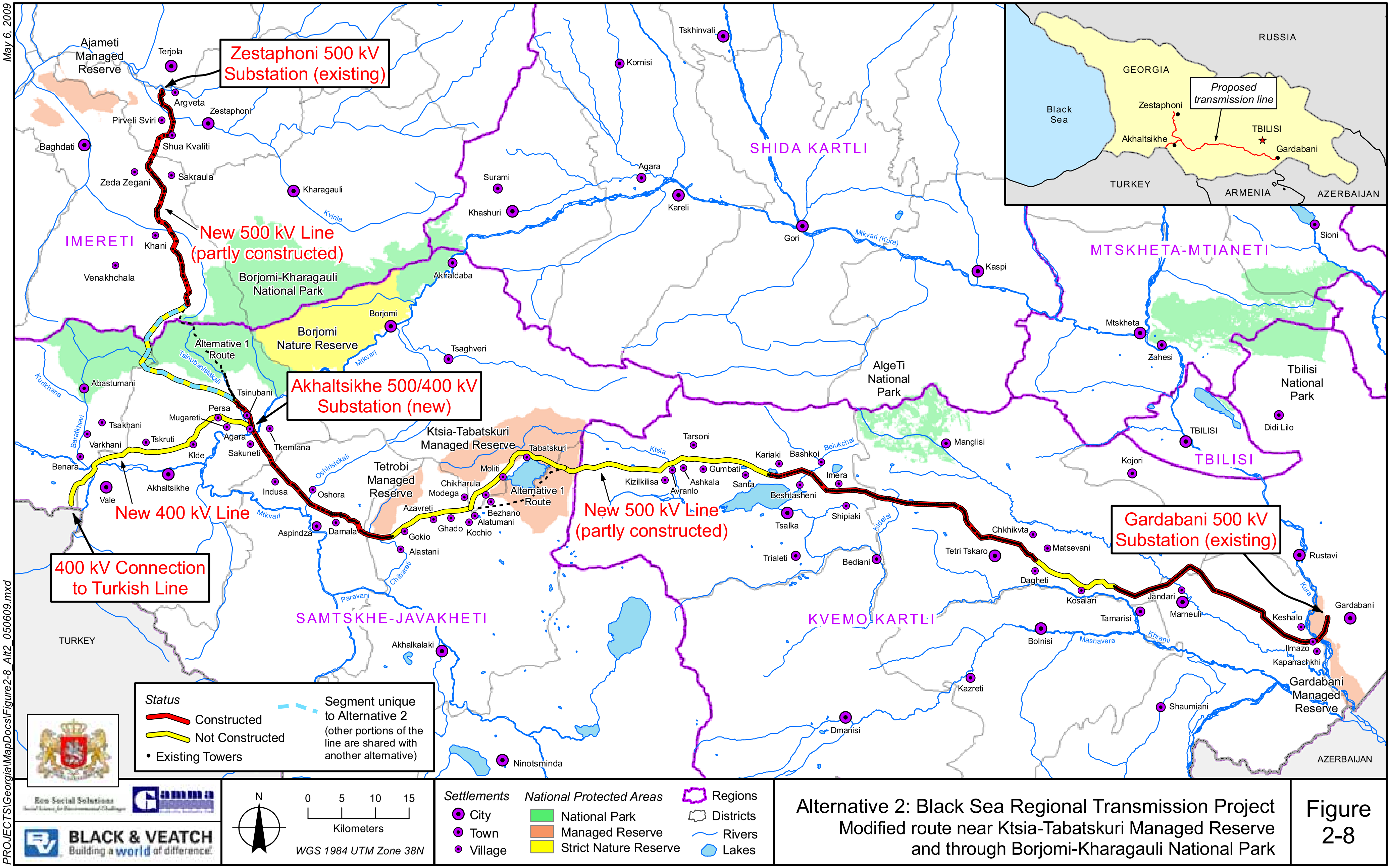
Alternative 3 uses most of the original project route in Alternative 1. However, Alternative 3 involves the same realignment of the route near Ktsia-Tabatskuri Managed Reserve as in Alternative 2. It also involves a realignment that completely avoids crossing Borjomi-Kharagauli National Park. This alternative is shown in Figure 2-9.

The modified route is 315 kilometers long, about 32 kilometers longer than Alternative 1 and 21 kilometers longer than Alternative 2. This alternative would involve constructing 400 or more new towers in addition to using 366 of the existing towers. It also would involve abandoning about 188 existing towers. There would be no crossing of Borjomi-Kharagauli since the line would go around the western edge of the park. The crossing of Ktsia-Tabatskuri would be 10 kilometers long, compared to 12.1 kilometers in Alternative 1.

Similar to Alternative 2, this alternative was developed based on consultations with the Agency for Protected Areas in the Ministry of Environment Protection and Natural Resources and based on the same concerns. As does Alternative 2, this alternative creates a new alignment that roughly parallels the recently installed BTC pipeline and avoids the areas of concern to the Agency for Protected Areas. In addition, the route was modified so it would not cross Borjomi-Kharagauli National Park at all.

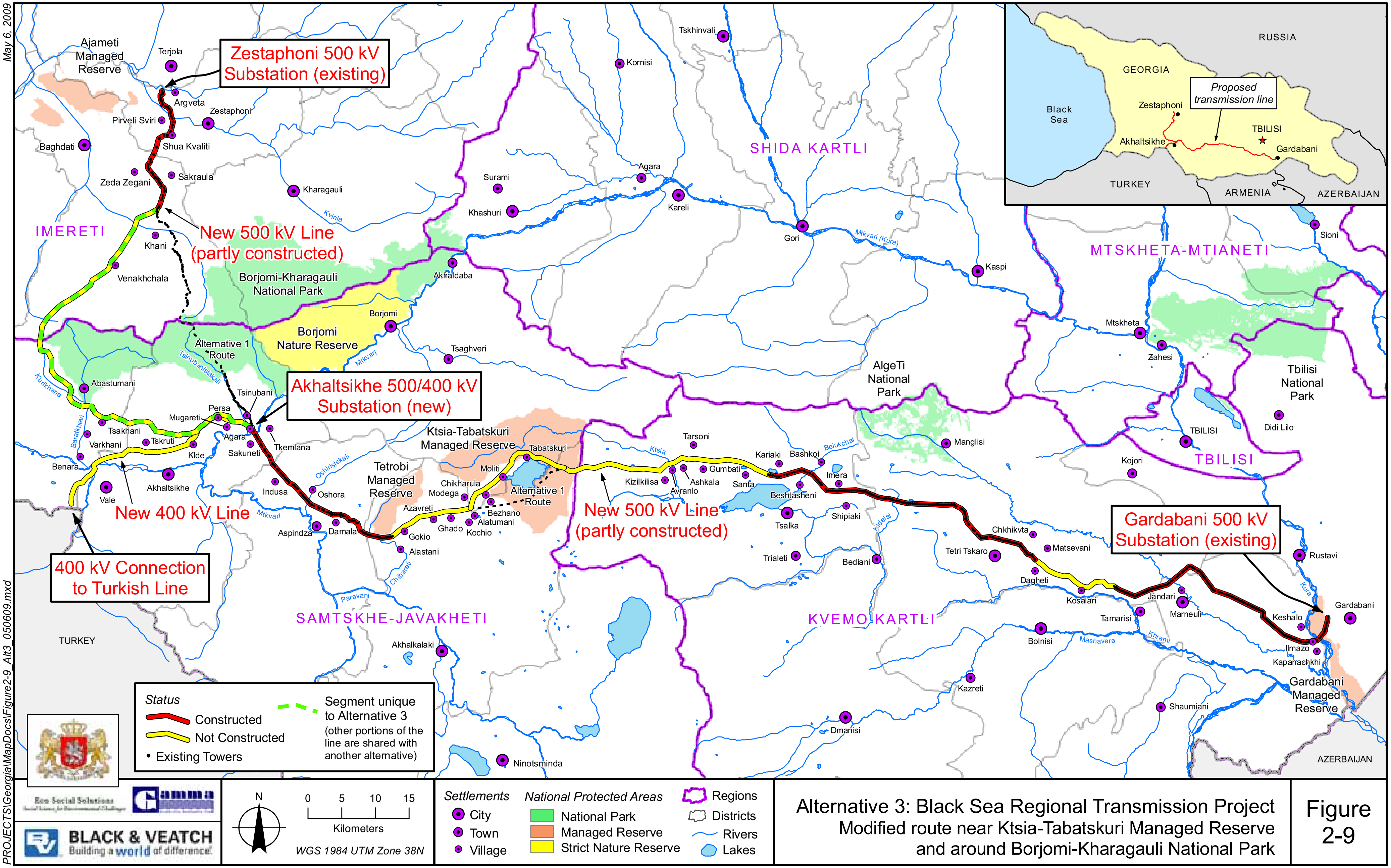
2.4 Alternative 4: No Action Alternative

The “no action” alternative does not include any additional transmission line construction and leaves the existing towers and rights-of-way as they currently exist. The “no action” alternative is a required alternative that should be considered in the development of any EIA.



Alternative 2: Black Sea Regional Transmission Project
Modified route near Ktsia-Tabatskuri Managed Reserve
and through Borjomi-Kharagauli National Park

Figure 2-8



Alternative 3: Black Sea Regional Transmission Project
Modified route near Ktsia-Tabatskuri Managed Reserve and around Borjomi-Kharagauli National Park

Figure 2-9

3.0 LEGAL AND INSTITUTIONAL FRAMEWORK

This chapter describes the national and international legal framework of the Black Sea Regional Transmission Project, including standards and policies applicable to the Project.

3.1 National Legal and Regulatory framework

The legal framework for environmental protection is based on the Constitution of Georgia. Though the Constitution does not directly address environmental matters, it does confirm the right of any person to live in a healthy environment, use the natural and cultural environment, at the same time obliging any person to take care of the natural and cultural environment (Article 37, Part 3). The Constitution also down the legal framework that guarantees public access to information, stating that an individual has the right to obtain full, unbiased, and timely information regarding his working and living environment (Article 37, Part 5).

3.1.1 Administrative framework

The Ministry of Environment Protection and Natural Resources is responsible for all environmental protection issues in Georgia. Their activities are implemented through a central office and six regional units: east central, west central, Kakheti, Kvemo Kartli, Samtskhe-Javakheti, Samegrelo and Zemo Svaneti.

The responsibilities of the Ministry as the competent authority are:

- To intermit, limit or stop any activity having or likely to have adverse impact on the environment, as well as unreasonable use of natural resources.
- To issue a series of licenses and permits (including for environmental impact).
- To control the execution of mitigation measures by the developer (in this case, GSE, the Project Execution Agency).
- To receive free and unrestricted information from the developer about the utilization of natural resources, monitoring systems, waste management etc. and explanations from authorities concerned by the Project.

The regional executive bodies perform the main administrative functions in each district.

There are several key agencies within the Ministry of Environment Protection and Natural Resources.

- *Agency of Protected Areas.* This Agency is responsible for state reserves, national parks, natural monuments, managed reserves, protected landscapes, biosphere reserves, world heritage districts and wetlands of international importance. The main tasks of the agency are to control territories of multilateral usage, to implement activities of looking after protected areas, to supervise, preserve, rehabilitate and protect them.
- *National Environmental Agency* (established 29 August 2008) is responsible for preparing informational documents, forecasts and warnings regarding to existing and expected hydro-meteorological and geodynamic processes, also environment pollution conditions in order to provide state security, existing and expected hydro meteorological forecasting of rivers, water reserves and the Black Sea territorial waters, to assess conditions of geodynamic processes, engineering and geo-ecological conditions of environment and to prepare and spread information on environmental conditions, to create database of engineering infrastructure of coastal zone, to manage united state fund information on

minerals, to establish and manage informational fund in geological, geodesic, cartographic and land resources state fund, to create and manage informational database on Georgian forest resources, to inventor and register industrial and scientific geological activities, to create and renew state balance and cadastre database on mineral deposits and exposures, to create environmental information database, to monitor coastal zone, to provide civil aviation with meteorological information.

- *Inspectorate of Environmental Protection* (established 20 September 2005). This Agency It replaced the ecological police that previously functioned under the Ministry of Internal Affairs as an agency of the Ministry of the Environment Protection and Natural Resources. The Inspectorate monitors and enforces environmental laws and permit requirements, reviews reports submitted by permittees/licensees, and plans and coordinates state control and oversight of permittees/licensees. The Inspectorate periodically issues reports on its activities. Each of the seven regional bureaus of Inspection holds a ‘Division of Early Response’ and a ‘Division of Inspection’. The Inspectorate also controls the implementation of international commitments related to environment protection
- The *Parliamentary Committee on Environment* is in charge of legislative activities.

Other departments within the Ministry of Environment Protection and Natural Resources and other Ministries that will play a role in the approval/agreement process for the Project, include but are not limited to:

- Department of Forestry, within the Ministry of Environment Protection and Natural Resources.
- Department of Protected Area, within the Ministry of Environment Protection and Natural Resources.
- Service of Land Us, within the Ministry of Environment Protection and Natural Resources.
- Service of Geology, within the Ministry of Environment Protection and Natural Resources.
- Department of Cultural Heritage Preservation, within the Ministry of Culture.
- Department of Urbanization and Construction, within the Ministry of Economy.
- Ministry of Economic Development.
- Ministry of Labor, Health and Social Affairs.
- Ministry of Agriculture.

3.1.2 Environmental legal framework

Key environmental laws and regulations in Georgia are listed in Table 3-1.

Table 3-1. Environmental Laws and Regulations in Georgia
(as of March 2008)

Year	*Law / Regulation*
1994	Law on Soil Protection (amend.1997, 2002)
1994	Law on Protection of Plants from Harmful Organisms (amend. 1999)
1996	Law on System of Protected Areas (amend.2003, 2004, 2005, 2006, 2007)
1996	Law on Natural Resources
1996	Law on Protection of Environment (amend. 2000, 2003, 2007)

Table 3-1. Environmental Laws and Regulations in Georgia (as of March 2008)	
Year	*Law / Regulation*
1997	Law on Wildlife (amend. 2001, 2003, 2004)
1997	Law on Tourism and Recreation
1997	Law on Water (amend.2003, 2004, 2005, 2006)
1997	Law on State Ecological Expertise
1998	Law on Sanitary Protection Zones and Resort Areas
1998	Law on Regulation of Forest Use
1998	Law on Hazardous Chemicals (amend. 2006,2007)
1998	Law on Pesticides and Agrochemicals
1998	Law on Establishment and Management of Kolkheti Protected Areas
1999	Law on State Complex Expertise and Approval of Construction Projects
1999	Law on Protection of Ambient Air (amend. 2000, 2007)
1999	Forest Code
1999	Law on Protection of Cultural Heritage (amend.2006)
1999	Law on Compensation of Damage from Hazardous Substances (amend 2002, 2003)
1999	Law on Licensing Design-Construction Activities
2000	National Environmental Action Plan of Georgia
2000	Law on Regulating and Engineering Protection of Coastline and River Banks
2000	Law on Special Protection of Vegetation in the Boundaries of Tbilisi and the Forest Fund (amended 2005, 2007)
2000	Law on Melioration of Lands
2001	Law on Expanding Borjomi-Kharagauli Natural Park Area
2002	Law on Environmental Impact Assessment
2003	Law on Red List and Red Book of Georgia (amend.2006)
2003	Law on Establishment and Management of Tusheti, Batsara-Babaneuri, Lagodekhi and Vashlovani Protected Areas
2003	Law on Soil Conservation and Improvement of Fertility
2005	Law on Licences and Permits
2005	Law on State Control of Nature Protection
2006	Law on Biological Reproduction
2006	Law on Mtirala National Park
2006	Law on Protection of New Species of Plants
2007	Law on Tbilisi National Park
2007	Law on Status of Protected Areas
2007	Law on Ecological Examination
2007	Law on Service of Environmental Protection
2007	Law on Environmental Impact Permit
2007	Law on Establishment and Management of Borjomi-Kharagauli National Park

Table 3-1. Environmental Laws and Regulations in Georgia (as of March 2008)	
Year	*Law / Regulation*
2008	Ministry of Environment Protection and Natural Resources Order 96 On Approval of Regulation of Protected Areas Agency
2008	Ministry of Environment Protection and Natural Resources Order 97 On approval of Typical Regulation of the Territorial Administration of the Protected Areas Agency

Environmental considerations for the Black Sea Regional Transmission project will primarily be guided by the following key laws:

- *Law of Georgia on Protection of Environment* (enacted 1996, amended 2000, 2003, 2007). This law regulates the legal relationship between the bodies of the state authority and the physical persons or legal entities (without distinction-legal form) in the scope of environmental protection and in the use of nature on all Georgia's territory, including its territorial waters, airspace, continental shelf and special economic zone. The law deals with education and scientific research in the scope of environment, environmental management aspects, economic mechanisms, licensing, standards, EIA, and related issues. The law considers different aspects on protection of ecosystems, protected areas, issues of global and regional management, protection of ozone layer, biodiversity, protection of the Black Sea and international cooperation aspects.

- *Law of Georgia on Environmental Impact Permit* (adopted October 15, 1996, replaced by the law adopted in 2007). The law gives a complete list of activities subject to obligatory ecological examination. The law sets the legal basis for issuance of an environmental permit, implementation of ecological examination, as well as public awareness and public participation in these processes. In this law, an Environmental Impact Permit is defined as perpetual authorization for implementation of the planned development. A permit is issued by the Ministry of Environment Protection and Natural Resources after review and evaluation of the documents and application presented by developer, which would include review of this ESIA.
- *Law of Georgia on Ecological Examination* (adopted on October 18, 1996, replaced by the law adopted in 2007). This law makes ecological assessment an obligatory step in the impact permit or permit issuance process. The objective of an ecological assessment is to preserve an ecological balance with consideration of environmental requirements, sound use of natural resources, and sustainable development principles. A positive conclusion of the ecological assessment is mandatory to obtain an environmental permit. Ecological assessments are the responsibility of the Ministry of Environment Protection and Natural Resources.
- *Law of Georgia on Licenses and Permits* (adopted 23 June, 2005) and subordinate legislation. The law regulates the issuance of licenses or permits, gives an exhaustive list of licenses and permits, and sets the rules for issuing, amending, and cancelling permits. The law defines three new principles for issuance of the license:
  - "One-window" principle ("one-shop stop") – this was a new concept established by this law and means that the administrative body issuing the license must ensure the approval of additional licensing conditions by the other administrative bodies.
  - "Silence gives consent" – the administrative body issuing the license is obliged to make a decision in due term after the submission of the application.

Otherwise, the license is deemed issued if a decision is not made in the determined time period.

- An "umbrella principle" – the holder of the general license is not obliged to apply for a specialized license.

In compliance with this law, the license or permit issued by a foreign country under an international agreement or law is recognized by Georgia and has a status similar to that granted to the documents issued in Georgia.

3.1.3 Environmental permit issuance procedure

The permit application/issuance procedure, including EIA coordination and establishment of the timeframes for information disclosure and public review and discussion under Georgian Law, will include the following steps for the Black Sea Regional Transmission Project:

Step 1. The GSE publishes information on the project in central and regional newspapers. The advertisement will include the project title, location, place, and deadline of the activities. It will also identify locations where the ESIA can be reviewed and where comments may be submitted.

Step 2. Within one week after publishing the information in the newspaper(s), The GSE will submit the ESIA report (paper and electronic copies) to the Ministry of Environment Protection and Natural Resources. For 45 days after publishing the information, GSE will receive public comments on the ESIA. Between 50 and 60 days after publication, GSE will hold a series of meetings to receive comments from any stakeholder, which may include government agencies, local authorities, nongovernmental organizations, or citizens. There will be a meeting in each of the three regions the line crosses (Kvemo Kartli, Samtskhe-Javakheti, and Imereti), and a meeting in Tbilisi. Within five days of the meetings, GSE will submit to the Ministry of Environment Protection and Natural Resources a summary of all comments and discussions during the meetings.

Step 3. All comments received in writing or at the meetings will be reviewed and considered in the final ESIA. GSE will prepare a document that shows every comment and the response that was taken, including whether there has been a change in the final ESIA. If a requested change is not accepted, the comment-response document will explain the reason, and the person who made the comment will be notified in writing. A draft of this comment-response document will be submitted to the Ministry of Environment Protection and Natural Resources. A copy of all written comments, the meeting summary, and the comment-response document will be included in the final ESIA as an appendix. Finally, the final ESIA will be submitted to the Ministry of Environment Protection and Natural Resources and made available to the public, along with a project location map, an executive summary, of the planned development, reports on emissions and allowable limits. The permit will then be issued or denied within 20 days from registration of the submission.

3.1.4 Land use and labor laws applicable to the project

3.1.4.1 Land use legislation

Several laws govern the use of land, including:

- Law on Land Registration of 1996.
- Law on Agricultural Ownership of 1996.
- Law on Privatization of State-Owned Agricultural Lands of 2005.

- Law on Soil Protection of 1994.

Two key laws could have direct implications for the project:

- *Law of Georgia on the Procedure for Expropriation of Property for Necessary Public Needs* (adopted 23 July 1999. The Republic of Georgia has the constitutional power to seize any property by means of expropriation for projects of imminent public necessity. The decision is made only through a Regional Court that must be preceded by a Presidential Decree justifying the imminent nature of the public necessity. The decision must include a description of the property to be expropriated and an instruction on the necessity to pay due compensation. The expropriator has to make every reasonable effort to acquire property by negotiation and is required to value the property in accordance with the fair market value before negotiations (and at its own expense). The Ministry of Energy and GSE do not intend to use this law to expropriate any lands, but will instead use other means to acquire rights-of-way that it does not already hold.
- *Law of Georgia on Payment of Substitute Land Reclamation Cost and Damages in Allocating Farm Land for Non-Farming Purposes* (adopted 2 October 1997). This law specifies requirements for compensating the government (a land replacement fee, which is fixed and variable according to location and quality of land) and affected private landowners and users for property loss, plus lost profits by the beneficiary, of an allocation of agricultural land for nonagricultural purposes. In the event that agricultural land is taken out of agricultural use, the law requires that a land replacement fee be paid to cover costs of cultivating a parcel of agricultural land of equivalent size and quality, and that the owner/user of such land be fully compensated for damages. This law could apply if GSE intends to place foundations and towers on agricultural lands, and also if agricultural land or crops are damaged during construction or maintenance activities.

3.1.4.2 Labor legislation

Two laws would apply to project-related labor and employment:

- *Labor Code of Georgia* (adopted 28 June 1973, amended in 2006) regulates labor relations between all workers and employees working in Georgia in all enterprises, institutions, and organizations, regardless of their ownership and organizational form. It supports the realization of human rights and freedoms through fair reimbursement and the creation of safe and healthy working conditions. Several provisions are stipulated in the law, including employment guarantees, working time, health and safety conditions, government social insurance, benefits and pensions. In general, foreign citizens and stateless persons living in Georgia have the rights and obligations equal to the rights and obligations of citizens of Georgia.
- *Law of Georgia on Employment* (adopted 28 September 2001) also governs employment policy. This law includes the economic, social, organizational and legal fundamentals for protecting the unemployed. The law extends to all the citizens of Georgia and stateless persons who are deemed to be on equal footing with citizens of foreign states in obtaining jobs in Georgia. Under the law, State authorities are to establish employment programs (special, local, regional and national) which give priority to “less competitive human resources” (including the unemployed, large families and single parents). The law sets forth policy on the free choice of work regardless of color, race, sex, religion, political and social status, etc.

The Ministry of Energy, the Georgian State Electrosystem (GSE), GSE's state-owned power company "Energotrans Ltd.", and any contractors who are involved in project construction or operation will comply with all Georgia labor laws.

3.1.5 Other relevant national strategies and plans

Other relevant strategies and plans include two related to environmental issues and one to energy issues. Those related to environmental issues include:

- Establishing a *National Biodiversity Strategy and Action Plan* is an obligation under the Convention on Biological Diversity (see section 3.2 below), which aims to protect its biodiversity, to ensure its sustainable use and to enable fair access to benefits of biodiversity. The Action Plan was adopted by the Cabinet of Ministers in 2005 (resolution # 27, 19.02.05). The Plan puts forward a set of national policies and plans which will be needed to meet Georgia's responsibilities under the CBD, as well as providing a framework through which to coordinate priority conservation activities, and to share information on biodiversity and key threats on the natural environment.
- The new Georgian Red List was approved in May 2006 and is legally enforceable. The new GRL has been organized in accordance with the guidelines and principles of the International Union for the Conservation of Nature.

The Black Sea Regional Transmission Project is part of the broader Energy Strategy of Georgia (Ministry of Energy, 2009), whose key goals include:

- Develop local generation sources to replace current imports.
- Replace all current thermal generation with hydropower, with the ultimate goal of having 100 percent of Georgia's electricity generated with this renewable source.
- Develop a reserve capacity of at least 10 percent.
- Provide further deregulation.
- Expand the high-voltage network. The Black Sea Energy Transmission Project will contribute to this goal.
- Increase exports of electricity. The Black Sea Energy Transmission Project will help achieve this goal.
- Rehabilitate energy infrastructure.
- Participate in regional transmission and transit projects. The Black Sea Energy Transmission Project is an important part of this goal.

3.2 International requirements

3.2.1 Requirements of International Finance Institutions

As noted above, the Government of Georgia, through the Ministry of Energy, is negotiating financing of the Black Sea Regional Transmission Project with a number of international finance institutions (IFIs). International lenders, including the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), and Kreditanstalt für Wiederaufbau Bankengruppe (KfW) all require that projects they finance be in compliance with both national standards as well as environmental and social policies and guidelines adopted by the lenders.

EBRD has adopted a comprehensive set of specific Performance Requirements that clients are expected to meet, covering a range of key areas of environmental and social impacts, occupational and public health and safety, resettlement and other issues and actions involved in the project development and operation. The policies that will apply to the project will be set out in an Environmental and Social Action Plan (ESAP) that will be included as part of the Environmental and Social Impact Assessment and in the project loan documentation.

Therefore, in addition to strictly complying with Georgian legal requirements, the project will also need to meet a number of international guidelines, regulations and policies:

- EBRD 2003 Environmental Procedures (EBRD, 2003). The project was screened before November 2008, so this 2003 policy applies.
- EBRD's 2008 Environmental and Social Policy (EBRD, 2008). Although the 2003 policy applies, the Performance Requirements in the 2008 policy will be used as benchmarks for resettlement and social engagement.
- EBRD Public Information Policy (EBRD, 2008a).
- The EU Environmental Impact Assessment Directive (1997).
- EBRD Energy Operations Policy (EBRD, 2006).
- EBRD Strategy for Georgia (November, 21, 2006)
- KfW Bankengruppe Environmental Guideline for Investment Finance by KfW (KfW 2002).
- KfW Bankengruppe. Financial Cooperation with Development Countries (KfW, 2003).
- European Investment Bank Environmental and Social Practices (EIB, 2007).

These are all specific policies, procedures, strategies and regulations designed for promoting sustainable development. These procedures include a detailed environmental review process prior to final approval of financing for the project, detailed environmental guidelines, detailed health and safety requirements, procedures for social impact assessment and public consultation and information disclosure and many other issues, associated with project construction and operation.

3.2.2 International conventions and agreements

Environmental agreements and conventions to which Georgia is party include:

- United Nations Framework Convention on Climate Change (acceded by the Resolution #302 of the Cabinet of Ministers of Georgia).
- Convention on Biological Diversity (acceded 1994).
- Convention on the Conservation of Migratory Species of Wild Animals (date of entry into force 01/06/2000).
- Agreement on the Conservation of Bats in Europe (EUROBATS) (ratified 2001).
- Agreement on the Conservation of African-Eurasian Migratory Waterbirds (ratified 2001).
- Kyoto Protocol to UNFCCC (acceded by the Parliamentary Resolution #1995).
- Montreal Protocol on Substances That Deplete the Ozone Layer (and it's London, Copenhagen and Montreal Amendments) (acceded by Resolution #711 of the Cabinet of Ministers of Georgia, acceded to London, Copenhagen and Montreal amendments by Parliamentary Resolutions #376, 377, 378).

- Vienna Convention on the Protection of the Ozone Layer (acceded by the Resolution #711 of the Cabinet of Ministers of Georgia).
- Geneva Convention on Long-Range Transboundary Air Pollution (acceded by the Presidential Decree #8).
- Ramsar Convention on Wetlands of International Importance Especially as Wildfowl Habitat (acceded by the Parliamentary Resolution #201, as amended by the Parliamentary Resolution #1039).
- UN (Rio) Convention on Biological Diversity (ratified by Parliamentary Resolution).
- Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) (acceded by Presidential Decree #524).
- Paris Convention on the Protection of the World Cultural and Natural Heritage (acceded by Parliamentary Resolution).
- European Convention on the Protection of the Archaeological Heritage .
- Convention for the Protection of the Architectural Heritage of Europe.
- Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters. Georgia was an original signature to the Convention in 1998 and ratified it on 11 April 2000. NonGovernmental Organizations are very active in using the Aarhus Convention to protect their rights to access information and the decisionmaking process. There are several Aarhus Centers in the towns and provinces crossed by the proposed line, including Gardabani, Rustavi, and Marneuli in the Kvemo Kartli province.

4.0 Baseline Environmental and Socioeconomic Conditions

This chapter describes existing conditions in the districts along the transmission line route. Section 4.1 describes various environmental conditions, and section 4.2 describes socioeconomic conditions. Figure 4.0-1 provides an overview of major features along the transmission line route.

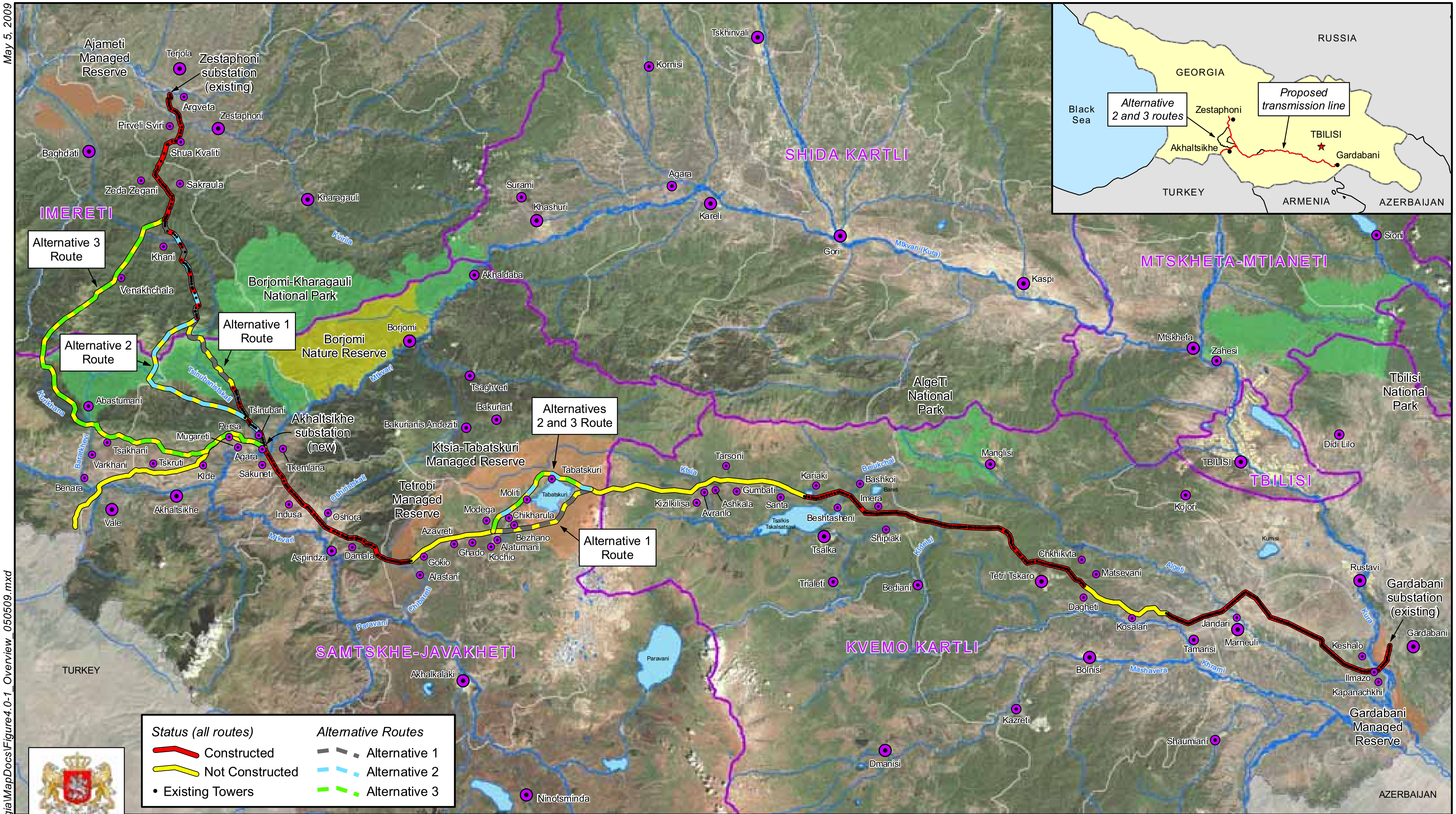
4.1 Environmental Baseline

4.1.1 Meteorology and Climate

Overview. The climate in Georgia is diverse, with two distinctive climatic zones: humid subtropical in the west of the country and dry subtropical transiting to continental in the east. The Greater Caucasus Range plays an important role in the climatic regime, preventing intrusion of cold air from the north and producing a warmer regime with a small number of extreme meteorological events. Another significant factor in climate formation is the Black Sea in the west, which contributes to increased humidity in western Georgia. This influence is softened toward eastern Georgia by the natural barrier of the Surami and the Adjara-Traleti Ranges. Since humid air masses predominantly transfer from west to east, orographic lifting makes excessive moisture precipitate on the west slopes of these mountains. Consequently, the eastern side of the mountain ranges experience lower precipitation and lower relative humidity, resulting in a transition to a dry-subtropical climate eastwards, which are also affected by the dry plains of Azerbaijan.

Climate along the route may be further sub-divided into several climatic regions, mainly owing to the different relief features, large variation of altitude, and proximity to the Black Sea. These subregions, beginning from the east at Gardabani, include:

- Dry-subtropical climate with warm summers (> 22°C) and mild winters (approximately 0 to -3°C) in the west near the Azerbaijan-Georgia border. It is characterized by a notably warmer and drier climate compared to the rest of the route. The climate becomes increasingly humid as the pipeline route approaches the Bedeni Plateau.
- A transitional climate between the dry-subtropical in the east, and the humid-subtropical mountainous steppe climate to the west, over the area spreading from the Bedeni Plateau to the feet of the Trialeti Range. Altitude gradually increases by approximately 800 meters over a short distance, which causes lower temperatures and higher wind speeds. Generally, the region experiences cold and occasionally snowy winters, and long mild summers. Precipitation along this section is the highest along the route.
- The humid-subtropical mountainous climate with cold winter (<-5°C) and cool summer (< 20°C), located in the Trialeti and Samsari Mountain ranges. The altitude of approximately 2,500 meters accounts for the lower temperatures in this region.
- A semi-dry subtropical mountainous or semi-continental climate from the Tetrobi Plateau and the Erusheti Range to the Meskheti Range. Winters are cool (below -5°C) and summers are warm (> 20°C). The climate is similar to the transient climatic zone, spread over the area between the Trialeti and the Samsari Mountain Ranges, though more moderate due to lower elevation and proximity to the Black Sea.
- A very humid subtropical warmer climate after crossing the Meskheti Range to Zestaphoni, when the route transits to the Western Georgia. The climate of the region is dominated by influences of the Black Sea and mountainous relief.



Black Sea Regional Transmission Project

Figure 4.0-1

May 5, 2009

PROJECTS\Georgia\MapDocs\Figure4.0-1_Overview_050509.mxd

A more detailed description of the climate along the proposed transmission corridor is provided below. The climate is characterized in terms of historical data on ambient air and soil temperature, wind speed and direction, relative humidity and precipitation.

Temperature. Temperatures on the transmission route are strongly affected by the elevation, which ranges from 280 to 2500 meters, and by local relief features and prevailing flow of air masses.

The eastern end of the transmission route is relatively low elevation and is influenced by Azerbaijan dry plains due to mainly north-west winds (Chart 6). These factors lead to generally warmer temperatures and low precipitation throughout the year. Average air temperature ranges from 25.3°C in July to 0.3°C in January in the lowlands, and from 10°C in July and -50C in January in mountainous areas. Mean annual air temperature is 13°C for lowlands and 5-60C for uplands. Average annual precipitation reaches 400 mm.

The next zone extends from the Bedeni Plateau to the eastern slope of the Javaketi and Samsari range. Here, the route gradually rises to approximately 2,300 meters above sea level. High elevation and air masses moving from south and east make this a transition zone between the semi-dry subtropical climate in the east and the cold mountainous climate to the west. Summers are temperate and winters are long and harsh. Mean temperature is estimated at 12°C, with a maximum monthly average of 20-23°C in August, and a minimum monthly average of -5/-9°C in January; with an absolute minimum of -34°C and maximum of +33°C in Tsalka Plateau. This route section is relatively humid, with about 700 millimeters of precipitation, compared to the eastern zone.

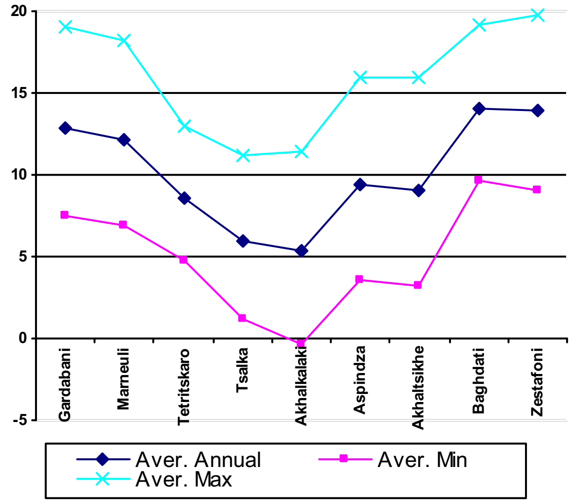
Further west, the proposed line enters the high-mountain region of the Javaketi, Samsari, and Trialeti Range, with the highest point along the route reaching 2,900 meters in the Samsari Range. The high-mountain profile of the area accounts for its extreme climatic conditions. The estimated mean annual temperature for the area is about 5°C, with an estimated average of –11.8°C in January and 23.8°C in August.

After the Samsari Range to the Erusheti Range, up to Georgia-Turkey border and the Meskheti Range, relief of the corridor is relatively low. This section may be called a transitional climatic zone as the climate changes from semi-dry sub-tropical to the east (Aspindza) to semi-continental (Akhaltsikhe). The temperature gradually increases, owing to lower altitude and increasing proximity to the Black Sea. The temperature is estimated to be similar to those experienced in the transitional climate zones: average annual air temperature is approximately 9°C, with an average winter temperature of – -6°C and average summer temperature – 26-28°C.

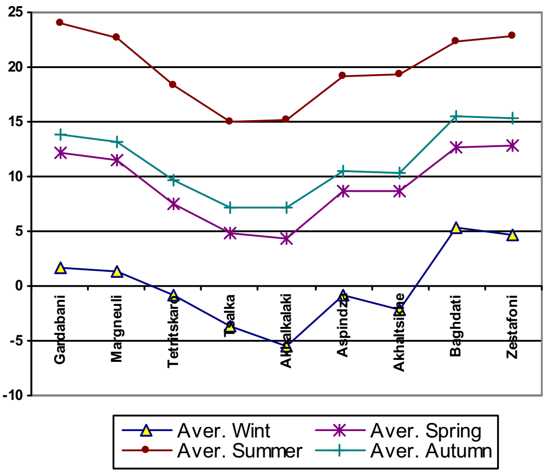
Approaching the Mestkheti Range and especially after crossing it, the route passes through a zone of excessively humid sub-tropical climate. Average annual precipitation is 1100-1300 millimeters and has almost uniform seasonal distribution. Despite high mountainous relief, temperatures are warmer, with an average annual temperature of about 14°C and annual average maximum of 30°C in August and average minimum of 1°C in January.

Figure 4.1-1 shows temperature profiles along the proposed transmission line. Although approximate, it shows the clear transition between various climatic sub-zones and seasonal variation of air temperature.

*Soil Temperature. S*oil temperature along the transmission corridor generally correlates with air temperature, as shown by comparing Figures 4.1-2 and 4.1-1. .Annual average ground surface temperature in the east (on the left of Figure 4.1-2) is 15°C, and ranges from 6°C in winter to 32°C in summer .



Multiyear Average Annual Temperature, °C



Multiyear Seasonal Average Temperature, °C

Figure 4.1-1. Air Temperature Profile along Transmission Line

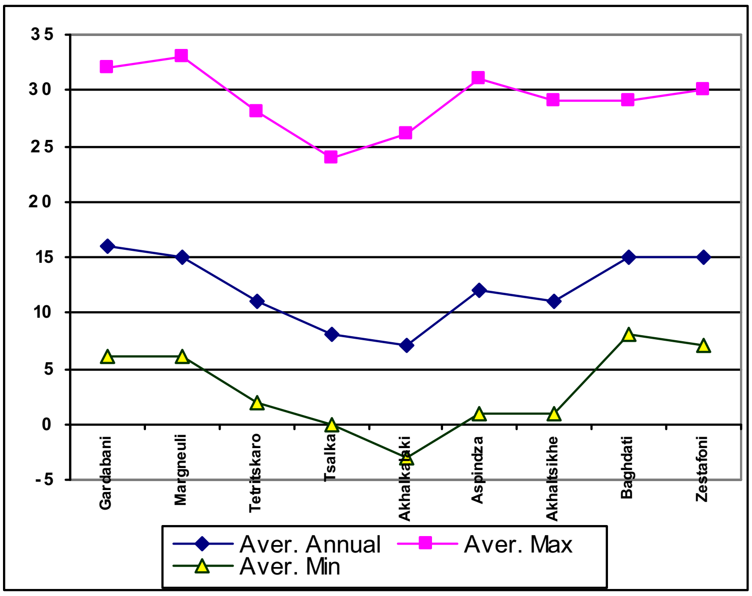


Figure 4.1-2: Multiyear Average Annual Soil Temperature, °C

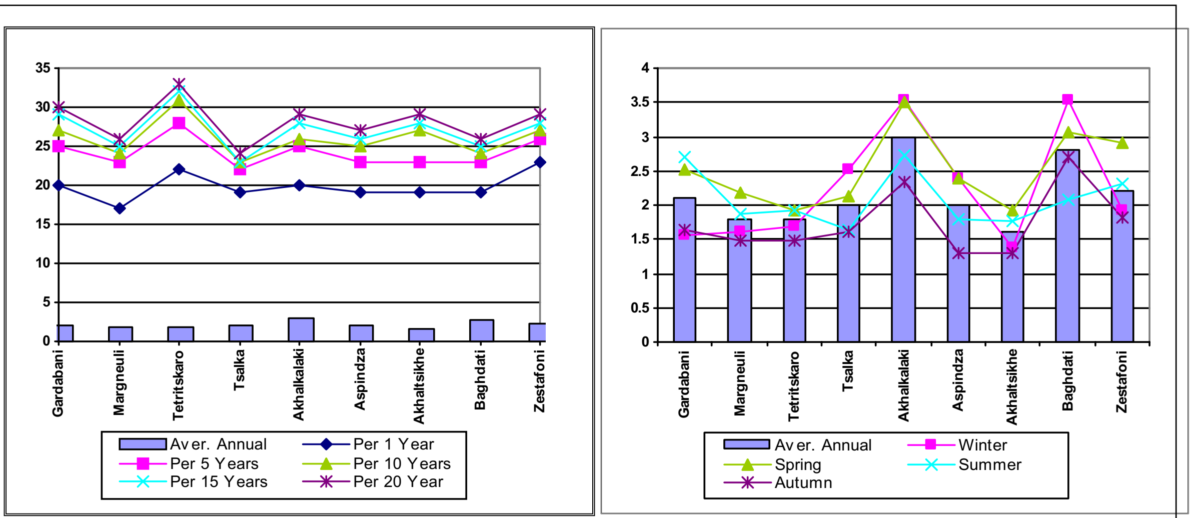
For the transitional section of the pipeline route between east and west, where the area between the Bedeni plateau and the Javaketi Range lies, the annual mean ground surface temperature is 13.2°C. The annual mean ground surface temperature farther west decreases to 7-8°C, owing to generally cooler air temperatures in these climatic regions. Then, soil temperature rises further to the west.

Precipitation. There is a distinct increase in the amount of annual precipitation from the east to the west of the country, as shown in Figure 4.1-3. At the Azerbaijan-Georgia border average monthly rainfall is 35 mm, which is well distributed round the year. Winter, with 16-17 millimeters, is the driest period. Average annual precipitation is below 400 millimeters.

Mean annual precipitation in the transitional climate region is approximately 700 millimeters, with a maximum in spring and summer. Further to the west (to the right of figure 4.1-3), precipitation decreases to abut 500 mm until the corridor reaches higher elevations in the west, where it abruptly increases to 1300 millimeters annually. Compared to the east, where maximum precipitation falls in spring and summer, in the western Georgia major precipitation occurs in autumn and winter.

In general, wind speeds along corridor range vary between an average minimum of 1 meters per second (m/sec) to an average maximum of 3.8 m/sec. Akhaltsikhe district has the lowest winds, with an average speed of 1.6 meters per second (m/sec). Akhalkalaki and Baghdati districts are the windiest, with average speeds of 3 m/sec and 2.8 m/sec respectively. Along the eastern section of the route, winds are more intensive in spring and summer, while the remainder of the route is windiest in winter and spring (see the right chart in Figure 4.1.1-4)..

Maximum wind rates are 10-15 times the average speed: maximum wind rates of 17-20 m/sec (left chart in Figure 4.1-5) may occur along the route perhaps once a year, while much higher wind speeds, up to 33 m/sec, may occur at much longer intervals.



Maximum Wind Rate in Expectance Period

Average Annual and Average Seasonal Wind Rate

Figure 4.1.1-4. Average Annual and Maximum Wind Speed (m/sec)

4.1.2 Major Landscapes and Ecosystems

The ecosystems of the entire Caucasus area are highly diverse and include a broad range of landscapes, from semi-deserts and arid shrublands to mesophylic relict broadleaf forests and alpine grasslands. These landscapes and ecosystems harbor a variety of plant and animal species representing a mixture of Mediterranean, Eastern European, and Near Eastern floras and faunas, combined with a high proportion of regional endemics (reaching 20-30 percent of the total species number in certain taxonomic groups) (UNDP, 2007)

The Caucasus Ecoregion has been identified by Conservation International as one of the world's 25 biodiversity hotspots due to high species diversity and significantly threatened local ecosystems (UNDP, 2007). This demonstrates the ecological importance and fragility of this area. This diversity of the ecoregion is well-reflected over the corridor of the transmission line which passes through three administrative regions and nine administrative district as it covers 283 kilometers as it runs from semi-arid Gardabani lowland through high-mountainous Javakheti until it reaches the humid subtropical mountains of Baghdati and Zestaphoni in western Georgia.

The first subsection below describes many of the ecosystems and sensitive sites along the transmission line route, from east to west[3]. The second subsection (4.1.2.2) describes the three protected areas crossed by the line.

[3] This section relies heavily upon BTC Co. (2002) for details of ecosystem and plant assemblages in each District.

4.1.2.1 Overview of the transmission line route

The principle landscapes and ecosystems of the Gardabani district, are dry subtropical and relatively low zone, which are characteristic of subtropical plains, moderately dry plateaus, and moderately humid mountainous forests. Among them are landscapes of:

- Semi-deserts and dry steppes spread over plains (including Gardabani plain) and plateaus. They are sparsely covered by xerophytes (plants that can tolerate dry periods).
- Foothills mainly covered by shrubs and sparse woods.
- Sparse mountain forests characterized by oak (*Quercus* spp.), oak-hornbeam (*Quercus- Carpinus*), and hornbeam (*Carpinus*) communities that grow on hillsides. Also present are beech (*Fagus* spp.), ash (*Fraxinus* spp.), maples (*Acer* spp.), and other hardwoods. In addition, the Mtkvari valley accommodates riparian (tugai) forest.
- Mountain meadows containing marshes around lakes where grow wetland maple, lime-tree, and oak with shrub substory.

The easternmost part of the route begins at the edge of Gardabani Managed Reserve in the floodplain of the Kura River. The Reserve is known for its riparian forests that provides habitat to many floral and faunal species with conservation value. As the line runs west, it passes to semi-desert and arid steppes landscapes, which at higher elevations interchange with mountainous-forest and mountainous meadows, covered with shrubby, sparse woods and other arid and semi-arid natural landscapes.

Figure 4.1-5. Marneuli area

Most relief around Marneuli is characterized by higher land at 270-400 meters above sea level that lies between the valleys of the Algeti, Khrami and Debedi Rivers. North of the plain is the Ialguja Range, which rises to 760 meters. The primary landscapes of the district are related to the dry subtropical plain and moderately humid mountains (Figure 4.1-5). They are similar to Gardabani and include:

- Dry steppes and semi-deserts formed by a complex of brown and salty soils that support xerophytes and ephemeral formations.
- Foothills covered hornbeams-oak groves and meadow shrubberies, grown over brown forest soils.
- Mountain landscapes presented by hornbeam-oak in lower zone and beech in upper.
- Remnants of riparian (tugai) forest on the river banks.

Sensitive sites that fall within the transmission corridor includes the environs of Kumisi Lake, with beard-grass steppes rich in biodiversity, and in the vicinity of village Jandari, which has high-value and high-density natural riparian forests of White willow (*Salix alba)*, Black poplar

(*Populus nigra*) Gray poplar (*Populus canescens)*, Common Sea-buckthorn (*Hippophaë rhamnoides*).

The relief of Tetritskaro district is mainly hilly and mountainous (Figure 4.1-6). Elevations there range between 1400-1900 meters. The primary landscapes are to dry and moderately humid subtropical plains and foothills, upland steppes, and temperately humid mountainous forests, including:

Figure 4.1-6. Typical view of Tetritskaro region mountains and foothills

- Dry steppe plain with shrubbery and thorns.
- Foothills covered by shrubbery and forests of oak, hornbeam, etc.
- Hilly plateau with shrubbery, oak, thorns and steppe grasses.
- Mountain forest of oriental oak, beech and coniferous (fir, pine) groves.
- Mountainous steppe-meadows and subalpine meadows with forests and xerophytes.

Figure 4.1-7. Typical view in Tsalka Area

In the outskirts of Tetritskaro, the forests of oak, oak-hornbeam and beech have medium and high value; they are continuous in sections and supports faunal diversity including endangered species of large mammals such as the brown bear.

The Tsalka district (Figure 4.1-7) is characterized by high mountains, mainly characterized by mountain steppes and meadows, including:

- Lava plateau with mountain steppe vegetation.
- Foothills with steppe meadows.
- Mid-mountain zone with mixed forests, mostly beech mixed with oak, hornbeam, and maple. The forests are mostly found in the valley of the Khrami River.
- Subalpine and alpine meadows.

There are several sensitive and high-value habitats along this section of the transmission corridor. The Bedeni plateau has high mountain meadows of high conservation value that support abundant floral biodiversity. The areas around the lakes of Cherepanovskoe and Bedeni are characterized by tussock sedge and aquatic plant communities, including several rare plants of Georgia, such as Lesser bladderwort (*Utricularia minor*) and bogbean (*Menyanthes trifoliata*). The area around Tsalka reservoir and the nearby villages Shipiaki, Kariaki and Santa supports middle-density artificial pine forest that are important for soil protection and water regulation. Finally, the area around villages Kariaki, Shua Kharaba, and Santa, including the area near Lake Baretskoe, supports mountainous sedge wetlands.

Akhalkalaki district occupies volcanic plateau of Javakheti, having wavy surface and containing hills and canyon-like gorges. Most of the area has only grassy vegetation. Major landscapes include:

- Canyon-like gorges.
- Lava plateaus with mountainous steppe vegetation.
- Foothills with steppe-meadows.
- Complex of wetlands and meadows on the banks of lakes, or former lakes, with water and wetland vegetation.
- Subalpine and alpine meadows with grass located over 2200 meters.

Figure 4.1-8. Winter in Tabatskuri Lake area

Along this section important landscapes include Ktsia-Tabatskuri Managed Reserve, which encompasses Lake Tabatskuri (Figure 4.1-8.), wetlands of high-conservation value (Nariani Veli and Ktsia wetlands), and Mt. Tavkvetili. These areas provide habitat to rich biodiversity and endemic species of flora and fauna, including many important nestling and migratory birds. This section also includes Tetrobi Managed Reserve, which supports ecosystems and biodiversity similar to those of Ktsia-Tabatskuri. The areas around the lakes of Panishgel and Jamushgel, and near the nearby village Kizilkilsa, are characterized by high-mountain sedge-dominated wetlands. Finally, there are a few groves of artificial pine forest intended for soil protection and water regulation near village Kizilkilsa.

The rugged relief of Aspindza district is richly vegetated by tree and grass plants, forming the following landscapes:

- Terrace bottom of river valleys with mountain steppes and shrubs.
- Middle-mountains with oak-hornbeam, beech, mixed deciduous-coniferous (pine-beech-dark coniferous) and pine forests. Oak and beech characterize the lower forests, pines the upper forest.
- Subalpine and alpine meadows with steppe grasses.

Sensitive sites in this section in Aspindza district include the outskirts of the villages of Damala and Oshora, where the line crosses forested areas.

The main landscapes of Akhaltsikhe district are moderately dry sub-tropical plains, humid and moderately humid mountain forest, mountain steppe, and subalpine zones. These include:

- River floodplains with riparian (tugai) forests.
- Terraced river valleys, with mountain steppe and phryganoid vegetation.
- Middle mountains with hornbeam-oak and beech forests.

- Volcanic mountains with beech-coniferous and pine forest
- Subalpine meadows.

In Akhaltsikhe district the route crosses the expansion zone of Borjomi-Kharagauli National Park, inhabited by arboreal plant communities of high conservation value.

Other important ecosystems include an area south of Atskuri, which has a high abundance of populations of Sea buckthorn (*Hippophae rhamnoides*), which is listed in the Georgian Red Data Book. IN addition, the surroundings of village. Klde support riparian natural forests of Tamarisk, or Salt cedar (*Tamarix ramosissima*) White willow (*Salix alba), Sea buckthorn,* Black poplar, and Gray poplar. The Akhaltsikhe (Meskheti) Depression near Skhvilisi is an area of high endemism that is regarded as the local centre for species formation; it supports numerous endemic and relict species and communities. Finally, the area near Vale town has riparian forest of black poplar, willow, salt cedar, white willow, and other species. In addition, Globe Daisy (*Globularia trichosantha*), a Georgian Red Data Book species, and Eastern thorn *(Crataegus orientalis*), a regionally rare species, both occur here.

The Baghdati district occupies high, middle and low mountainous areas, including the Meskheti Range. The primary landscapes are of subtropical plains, humid mountainous forests and mountainous meadows, including:

- Low plain with Colchic vegetation and oak forests.
- Foothills with Colchic vegetation.
- Colchic middle mountains with beech, beech-dark coniferous forests, with evergreen understorey.
- Caucasian upper-mountain landscape with beech and pine forests.
- Caucasian sub-alpine landscapes with combination of meadows, high-herb communities, elfin woods and thickets.
- Alpine meadows.

Zestaphoni district is characterized by humid subtropical plains, foothills, and mountains, in particular:

- Humid subtropical floodplains with meadow-forest vegetation (alder tree)
- Sloped terraced low-plain and foothills with polydominant Colchic forests of hornbeam, oak, beech, zelkova, chestnut, alder-tree with evergreen and deciduous substorey (ilex, nut, hawthorn, lianas)
- Humid subtropical hilly plateau with oak-hornbeam forests
- Humid low mountains with beech forests.

4.1.2.2 Protected areas

The corridor of the proposed transmission line passes through three protected areas: Borjomi-Kharagauli National Park and two managed reserves, Gardabani and Ktsia-Tabatskuri. Each is described below, again from east to west.

4.1.2.2.1 Gardabani Managed Nature Reserve

Managed reserves are defined by the Law of Georgia on Protected Areas System (see Chapter 3). The law gives details regarding their management plans and activities permitted in protected areas. According to the law, activities permitted within Managed Reserves comprise manipulative management to maintain or improve the value. Non-permissible activities are those negatively altering the environment, exploitation of natural resources, damaging via contamination, introduction of exotic species, transportation of explosive or toxic material into the area, and any other activities prohibited by the Management Plan. Under the Law on Protected Area Systems, designated Managed Reserves correspond to IUCN Category IV Habitat/Species Management Areas (that is, protected area managed mainly for conservation through management intervention).

Figure 4.1-9. Unmaintained road through Gardabani Managed Reserve

Established in 1996, Gardabani Managed Nature Reserve covers an area up to 3,484 hectares. The Reserve is located in Gardabani and Marneuli districts, Kvemo Kartli Region, near the Azerbaijan border. Gardabani Managed Nature Reserve (Figure 4.1-9) was designated in order to protect and improve forest, groves and their inhabitants. As described in section 4.1.6, the main floral value of Gardabani Managed Reserve is riparian forests, where generally grow Gray poplar *(Populus hybrida)*, Black poplar *(Populus nigra*), White willow *(Salix alba),* Aspen *(Populus tremula),* riparian long-stalk oak *(Quercus longipes)*, Wych elm *(Ulmus glabra)* and Field elm *(Ulmus minor)*. In sub-forests grow the hawthorn, tamarisk, cornel-elder and Butcher's broom; among lianas there are Clematis, Silk vine and Common hop. Adjacent to the riparian forests are steppe plants, mainly fragments of nipplewort.

As described in more detail in section 4.1.7, many vertebrates inhabit Gardabani Managed Nature Reserve, including:

- *26 species of mammals,* including wild boar, hare, jackal, Red fox, Jungle cat, badger, marten and Red deer *(Cervus elaphus)*; the latter is included in the Red List of Georgia;

- *135 species of birds,* including Hoopoe, Magpie, Blackbird, Chafffinch, Goldfinch and Nightingale. Among Georgia's Red List species are White-tailed eagle *(Haliaeetus albicilla),* Imperial eagle *(Aquila heliaca),* Egyptian vulture *(Neophron percnopterus),* Greater spotted eagle *(Aquila clanga),* Levant sparrow hawk *(Accipiter brevipes)* and Saker falcon *(Falco cherrug).*

- *21 species of fish,* including Silver bream *(Blicca bjoerkna transcaucasica Berg),* carps (*Cyprinus carpio*) breams *(Abramis brama),* Wels catfishes *(Silurus glanis)*, Caucasian goby *(Gobius cephalarges constructo Nordmann)*, barbell *(Barbus barbus)*; as well, Georgian Red List entries: Wels catfishes *(Silurus glanis),* Black Sea Roach *(Rutilus frisii)* and Aral Spined loach *(Cobitis aurata).*

- *4 species of reptiles,* including lizards, Greek tortoise, viper, Grass snake, Four-striped snake *(Elaphe quatuorlineata*).

4.1.2.2.2 Ktsia-Tabatskuri Nature Managed Reserve

Ktsia Valley, Lake Tabatskuri and the associated wetlands are all part of the proposed Ktsia-Tabatskuri Managed Reserve. The Reserve is situated in Borjomi and Akhalkalaki districts, in Samtskhe-Javakheti Region. It is part of the Support Zone of Borjomi-Kharagauli National

Park. The Reserve was proposed by the resolution (No. 447, 1995) of Georgian Cabinet of Ministers on Creation of Borjomi-Kharagauli National Park and Activities Facilitating Establishment of Protected Areas System.

The site is currently not listed on the IUCN international list of protected areas although the Ministry of Environment Protection and Natural Resources states that it is intended to be included on the IUCN list. BirdLife International puts Lake Tabatsuri on the list of Important Bird Areas. Some areas of the Reserve may also be proposed as a Wetland Site of International Importance under the Ramsar Convention due to their high-conservation value wetland ecosystems. A number of the species recorded for the site are noted on the Red Lists of endangered/rare species of IUCN and Georgia.

Resolution No. 447 allowed for the definition of temporary boundaries for the proposed Reserve with the expectation that the boundary would be formally defined following the elaboration of a Management Plan. In 2006-2008, BTC Company provided funding for development of the management plan and a draft was prepared in 2008 (IUCN *et al*., 2008).

The proposed area covers 22,000 hectares and includes high-mountainous wetlands in the vicinity of Lake Tabatskuri (Narianis Veli wetlands) and headwaters of the River Ktsia (Ktsia Valley wetlands) at 2,000 to 2,800 meters above sea level. Lake Tabatskuri, at 1991 meters above sea level, is the largest waterbody in the area, with an area of 14.2 square kilometers. The Ktsia-Nariani wetlands system is severely modified and only a few fragments of semi-natural wetland remain there due to heavy anthropogenic impacts.

The wetlands of Narianis Veli and Ktsia have high protection value because they provide important habitats for breeding waterfowl and serve as a staging post to migratory birds. The management objectives for the site are:

- Protection of unique high-mountainous wetlands located in the vicinity of the River Ktsia (Figure 4.1-10).
- Protection of fresh water ecosystem of Lake Tabatskuri, which provides refuge to migratory birds.
- Protection of bird species (black stork (*Ciconia nigra*), white stork (*Ciconia ciconia)*, grey crane (*Grus grus)*, mute swan (*Cygnus olor*), whooper swan (*Cygnus cygnus)*, great white egret *(Egretta alba)*) and their habitats, including the unique mountain wetlands along the headwaters of the River Ktsia and around Lake Tabatskuri.

Figure 4.1-10. Wetlands along river meander near Nariani

Vegetation of the Reserve is unusual and differs from floristic species of other Georgian regions, as described in more detail in section 4.1.7. There grow plant communities characteristic to wetland, upland steps and meadows, as well as shrubs and remnants of relict forest. Forests are composed of sub-alpine crooked beech, aspen, and mountain oak. The latter is on the Red List of Georgia. Shrubby plants include rhododendron (*Rhododendron caucasicum)* and cowberry, over large areas. Rhododendron and fragments of mountain oak forest have especially high conservation value.

Wetland landscapes are common in the Managed Reserve. These wetlands mostly associate with Lake Tabatskuri and Ktsia-Nariani hydrographic system. Special attention should be given to the wetlands dominated by *Carex wiluica,* as belonging to rare cenoses of the Caucasus and spreading only in Javakheti upland.

Caucasian endemic vegetation of the Reserve include Squill (*Scilla rosenii*) and Chervil (*Chaerophyllum humile*), highly ornamental Fritillary (*Fritillaria lutea*) and Saffron (*Colchicum speciosum*), and representatives of the orchid family - Coeloglossum viride and *Dactylorhiza urvilleana.*

As described in more detail in section 4.1.7, animal populations are especially abundant, including:

- *45 species of mammals*, including Brown Bear (*Ursus arctes*), Lynx (Linx linx), Wild Cat (*Felis silvestris*), Wolf (*Canis lupus*), Red Fox (*Vulpes vulpes*), European Hare (*Lepus europaeus*), as well as different species of voles and moles. Seven of these 45 species are on the Red List of Georgia, including Brown Bear and Marbled Polecat (*Vormela peregusna*), both of which are classified as endangered); Common Otter (*Lutra lutra*), Nehring's Mole Rat (*Nannospalax nehringi*), Brandt's Hamster (*Mesocricetus brandti*) and Grey Hamster (*Cricetulus migratorius*), classified as vulnerable; and Lynx (*Linx lynx*), classified as Critically Endangered.
- *Nearly 150 species of birds*, with waterfowl and birds of prey especially abundant. Nearly 150 species can be found there seasonally. These include Corn Crake *(Crex crex)*, Caucasian Black Grouse *(Tetrao mlokosiewiczi*), Common Quail *(Coturnix coturnix),* Grey Partridge *(Perdix perdix),* Great White Pelican *(Pelecanus onocrotalus),* Dalmatian Pelican *(Pelecanus crispus)*, Imperial Eagle (*Aquila heliaca*), Greater Spotted Eagle (*Aquila clanga*), the above mentioned black stork (*Ciconia nigra*), white stork (*Ciconia ciconia)*, crane (*Grus grus)*, mute swan (*Cygnus olor*), whooper swan (*Cygnus cygnus)*, great white egret *(Egretta alba),* etc. Imperial Eagle, Caucasian Black Grouse and Greater Spotted Eagle are on the Georgian Red List as well as the IUCN Red List of Threatened Species.
- Six amphibian and ten reptile species, with amphibians represented by Southern Crested Newt (*Tryturus karelini*), Caucasian Parsley Frog (*Pelodytes caucasicus*), Green Toad (*Bufo viridis*), European Tree Frog (*Hyla arborea*), Eurasian Marsh Frog (*Rana ridibunda*) and Long-legged Wood Frog (*Rana macrocnemis*). Out of these Caucasian Parsley Frog (Pelodytes caucasicus) is endemic. Two reptile species - Adjar Lizard (*Darevskia mixta*) and Giant Green Lizard (*Lacerta media*) - are on the Red List of Georgia.

4.1.2.2.3 Borjomi-Kharagauli National Park

Borjomi-Kharagauli National Park was designated in 1995 under Resolution No. 447 of Georgian Cabinet of Ministers. At present its area comprises some 50,400 hectares and is supplemented with more 150,000 hectares of the so-called Support Zone. In 2007 the Borjomi-Kharagauli National Park became a member of European network of Protected Areas – PAN Park.

In December 1998, the governments of Germany and Georgia signed a bilateral agreement regarding financial co-operation for the project concerning "Environment and Protection of

Natural Resources Borjomi-Kharagauli National Park”4. The German government provides funds for three programs in the Park: implementation of infrastructure, training/education, and a Support Zone development program.

The main purpose of the designation is the conservation of existing ecosystems; restoration of degraded areas; facilitation and control of sustainable use of renewable resources; public awareness / educational activities and ecotourism. Based on the level of protection and purpose, the Park is divided into a number of zones, including: natural strict protection zone, natural managed protection zone, visitors’ zone, restoration zone, historical and cultural zone, administrative zone, and traditional use zone. There is a support zone that reaches into the five districts sharing common boundaries with the Park. The transmission line would run through the natural managed protection zone.

The National Park occupies the central part of the Lesser Caucasus, namely the central sub-zone of Achara-Trialeti range. The area is mainly formed with what is known as Borjomi flysch sediments of lower Eocene (marl clays, marls, limestone sandstones and marl limestones). Formations also include Oligocene and Neogene deposits and volcanic rocks.

Borjomi-Kharagauli contains primary forest and sub-alpine meadows typical of the central region of the Lesser Caucasus and supports a good variety of flora and fauna including several rare, endangered, relict, and endemic species.

Figure 4.1-11. Montane forest in Borjomi-Kharagauli National Park

The National Park contains dark coniferous, deciduous and mixed forests. Mixed deciduous forests (Figure 4.1-11) are characterized by chestnut *(Castanea sativa)*, beech *(Fagus orientalis)*, hornbeam *(Carpinus orientalis)*, Caucasian lime *(Tilia begoniifolia)*, Colchis oak *(Quercus hartwissiana)*, Caucasian rhododendron *(Rhododendron caucasica)* and ash *(Fraxinus excelsior)*. Highland forests of the park are mainly formed by dark coniferous groves of spruce and silver fir, in particular Oriental spruce *(Picea orientalis),* Nordmann fir *(Abies nordmanniana)* and pine *(Pinus sosnowskyi).* The sub-alpine zone is presented by sub-alpine forests, shrubberies and meadows vegetated by abundant sub-alpine high grasses.

Between vegetation of the Park distinguished are chestnut *(Castanea sativa),* Colchis oak *(Quercus hartwissiana)*, yew *(Taxus baccata),* Steven’s peony *(Paeonia steveniana)* and Vinogradov’s iris *(Iridodictyum winogradowii)*, as put on Georgia’s Red Data Book because of their rarity and endemicity.

Fauna of Borjomi-Kharagauli is diverse as well. Large mammals include Gray wolf (Canis lupus), lynx *(Lynx lynx)* and Brown bear *(Ursus arctos)*, Roe deer *(Capreolus capreolus),* Caucasian Red deer *(Cervus elaphus)* and Wild boar *(Sus scrofa)*. Most of the large mammals of the Park are Georgian Red List entries. Among small mammals several species of mice, dormouse, weasel, Pine marten, Stone marten, Caucasian squirrel. Nearly everywhere can be found Red fox *(Vulpes vulpes)* and hare *(Lepus europaeus).*

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4 Details may be found in the Decree of the President of Georgia (13th July 2001) on “Coordinated Planning and Implementation of Ongoing and Prospective Programs of Borjomi-Kharagauli National Park and Support Zone”.

Many reptiles are found in the National Park, including the Caucasian agama (*Laudakia caucasica*) and Greek Tortoise (*Testudo graeca*). Birds include the rare species of Golden eagle *(Aquila chrysaetos)*, Griffon vulture *(Gyps fulvus),* Black vulture *(Aegypius monachus)* and Caucasian Black grouse *(Tetrao mlokosiewiczi).*

The Support Zone includes all districts that border the National Park and is considered for various land uses and accommodates agricultural, industrial, and infra-structural lands and natural and semi-natural habitat. Land and resource use in the Support Zone needs to be compatible with the conservation objectives for the Park. The rationale for the establishment of the Support Zone is to ensure the sustainable protection of the Park. To achieve this, economic support and assistance is delivered to the Park's neighbors, sacrificing certain user rights for areas converted to the National Park. In addition, the neighbors, are involved in the Park's planning and management processes. The Support Zone does not correspond to an IUCN category and as such is not listed on the IUCN international list of protected areas.

4.1.3 Geology/geomorphology

This section describes the geology and geomorphology of the districts the line crosses, from east to west. Map 4-4 shows the geology of the various areas. Topographical relief is shown in Figure 4-1 (at the end of the chapter). Geological formations along the route are shown on Figures 4.1-4a through 4.1-4i (also at the end of hte chapter.

4.1.3.1 Gardabani district

Stratigraphy. The geological structure of this region is represented by rock complexes from Upper Jurassic to Quaternary sediments. Characteristics of them are given in Table 4.1-1.

Tectonics. This region belongs to the East immersion zone of Georgian lump and includes tectonic substage of Gare-Kakheti. The substage is characterized by narrow, south-inverted and tectonically transgressed anticlines and suppressed plate-shaped synclines. Structures are aligned in deep and received monocline shapes.

The folds of the subject region and nearby regions include the Faldo syncline, Katar-Kali anticline, Ole syncline, Naomari syncline and other.

Geomorphology. The north part of the region is represented by the Tsivgombori ridge, which is directed from north-west to southeast and reaches steppe of Didi Shiraki. To the south is a denudation plateau at elevation of 800-900 meters. Relief decreases to the southeast. The

Table 4.1-1. Geological structure of Gardabani region

#	*Age*	*Index*	*Lithology and spreading*	*Depth (m)*
1	Upper Jurassic	I_3	limestones, coarse and fine Breccias	400-500
2	Cretaceous	K	Terrigenous and carbonate facies limestones, marls, rarely clays	450
3	Oligocene-Lower Miocene-Upper Eocene	$N_1^1+P_2^3$	Dark, gray, brownish clays with sandstone stuff, rarely marly clays with concretions of carbonate sandstones	600-1000
4	Miopliocene	$N_21-N_1^3$	Sandy-Clayey sediments with conglomerate stuff, conglomerates (at south part and right bank of Iori River)	1600-1900

Table 4.1-1. Geological structure of Gardabani region

#	*Age*	*Index*	*Lithology and spreading*	*Depth (m)*
5	Apsheron-Aghchagil stage	N_2^3ak-ap	Gray sandstone clays, boulder, boulder-pebbles, coarse-grained conglomerates	700-900
6	Non-parted Quaternary	alQ_{1+3}	Alternate of clays, sands, boulders and conglomerates (south of Mughanlo village and Iori River bank)	5-100
7	Recent Quaternary	alQ_4	Alluvial sediments – pebbles, rarely with sands and sand lenses; Deluvial-Proluvial sediments – clay soil and clays with boulder stuff and lenses; Deluvial-Eluvial sediments - clay soil with sandy and gravel stuffs.	3-7 10-60 2-5

Sagarejo syncline is sharply marked out by morphology and is crossed by Iori River. The lowland width is 10 kilometers and length is 20 kilometers and it is constructed with the Shiraki layer, Sarmat and Aghchagil-Apsheron sediments.

4.1.4.2 Marneuli district

The larger part of the center part of this area is occupied by the Marneuli accumulated plain, which ranges in altitude from 270-400 meters and is constructed by quadruple sediments, conglomerates, sand, and clay. Recent alluvium -- pebbles and sands -- are observed along the river valley. On the same area there is the tail of volcanic rocks flown from Javakheti plateau. The surface of the plain is flat and is divided by the valleys of the Algeti, Khrami, and Debedi rivers. Erosive necks and natural bridges are formed in some places in clayey soil.

The northern part of the region is occupied by the Iagluja highland, which is 17 kilometers long, 10-11 kilometers wide and at an elevation that averages 300-400 meters. The northern part of the highland forms Iagluja Peak. A plateau bisected by dry ravines is located in the southern part. The southern and eastern slopes of the Iagluja highlands are also bisected by dry gorges.

Loki ridge and Babakari peak are located in the southern part of Marneuli region. A part of the northern slope of the Loki ridge is also located within the region territory (Shulaveri river basin). The altitude of the ridge is under 1400 meters above sea level. It is constructed with Cretaceous age limestone, tuff-breccias, tuff-sandstone and porphyry. The lower part is partitioned by the valleys of Shulaveri River tributaries. The eastern part from River Debeda is also presented by Cretaceous limestones and volcanic rock formations; the southern slope is very fractured and cut with gorges, and typical badlands can be observed here. An important natural resource of the Marneuli region is Sadakhlo marble.

4.1.4.3 Tetritskaro district

The Tetritskaro region is mostly mountainous. The part of corrugated Trialeti ridge of middle height is located in the northern part of the region, which is constructed by middle Eocene volcanogenic rock. The flattened landscape of the southern pediment of the region is located in the Tetritskaro region. The middle southern part is occupied by the Kvemo Kartli plateau, which consists of upper Pliocene dolerites. The height of the plateau increases from east (450 meters above sea level) to west (1400 meters) and is crossed by the canyon of the Khrami River.

Upper Cretaceous volcanic and sedimentary formations are located in the southwestern part of the Tetritskaro region as well as the Shua Khrami mountain complex formed by old crystalline rocks. Bedeni massive is the biggest with branches spreading to the south and west, including Gelindagi, Tavshishvela and Gomeri. The Iragi grotto is located between Tavshishvela ridge and Kvemo Kartli lava plateau. The bottom of the Irago grotto is formed by argillaceous soil and gravels.

4.1.4.4 Tsalka region

This regions has diverse landscape, ranging from mountains, high ridges, volcanic cones, grotto, flatlands, canyon-type ravines, and other landscape types. The asic orthographic unit is the Samsari (abul-samsari) meridian volcanic ridge, which is constructed from neogenic quadruple effusive rock, lava of multiple composition, tuff-breccias and tuffs. Peaks include Tavkvetili (2583 meters), Shavnabada (2930 meters), and Samsar (3285 meters).

The southern part of the Javakheti meridian volcanic ridge is located in this region. Volcanic peaks located on the ridge include Dalidalo (2661 meters), Biketi (2277 meters), Chochiani (2417 meters). Tikmatashi pass is located in the lowest part of the ridge (2178 meters) Another large orthographic unit is Tsalka grotto (plateau), which is surrounded by the Trialeti ridge from the south and by Samsari and Javakheti ridge from the west. Its upper level is at 1500-1800 meters range and is divided into several small grottos, of which Beshtasheni is the larges and is used as Tsalka water reservoir. The Chochiani plateau-grotto is located on the eastern pediment of Javakheti ridge. The eastern part of the region is occupied mostly by the southern pediment of Trialeti ridge which is fractured with ravines of the following rivers and their tributaries: Beshtashenis Tskali and Gumbati (Khrami basin). Noteworthy landscape forms are canyon-type ravines, including Avranlo canyon.

4.1.4.5 Ktsia-Tabatskuri area

The Ktsia-Tabatskuri Managed Reserve is located in the south, partly central subzone of the Lesser Caucasus. Notable features include Samsari ridge, Tavkvetili cone, Savnabada volcanic massif, patara Shavnabada, Shuamta, volcanic cones of Mshrali Mta, and Trialeti ridge.

The east periphery of the reserve is represented by crest and west slopes of the Samsari ridge. The area also includes the north part of the ridge. The ridge is 42 kilometers long in meridianal directionm with a total area of 920 square kilometers. Volcanoes of the ridge form 22 massifs with elevations from 2500 to 3300 meters. The heighest (3301 meters) is Didi Abuli peak.

North to the Samsari ridge is Tavkvetili massif. The massif is located between the west end of Kamechi meadow and the Ktsia River gorge and the saddle. The massif consists of two peaks: Didi Tavkvetili on the east at 2587 meters, and Patara Tavkvetili cone to the west at 2340 meters.

North of the Patara Tavkvetili is the Nariani lowland, which divides Samsari and Trialeti ridges. South to the Tavkvetili is Shavnabada volcano massif, separated from the Tavkvetili by the Kamechi Meadow depression. The massif consists of two base-joint cones sited on one the same meridian line. The basis of the north, the Didi Sahvnabada cone (absolute height 2929 meters, relative height 950 meters, basis diameter 3 kilometers) is composed of Goderdzi suite dacites. Its north and west slopes is gullies , inclination 30-35^0.

Patara Shavnabada (2798 meters above sea level) is a flat, truncated cone with a ctaret-like hollow. Northeast of Savnabada massif and close to the study area is Beberdagi (Egeisari) volcanic massif. It consists of three extrusive domes with elevations from 2400 to 2513 meters. North and north-east of Lake Tabatskuri are volcanic cones (Shuamta at 2381 meters and Mshrali mta at 2405 meters) with the Ktsia river in between, with some waterlogged areas.

Trialeti ridge forms the east part of the Adjara-Trialeti system. The higest peak of the Trialeti ridge is Shavi Klde (2853 meters) belonging to the Tsikhisjvari branch (the peak is located near village Tsihisjvari). Other peaks are 2500-2800 meters high, including Arjevani, Sakvelosmta, Kodiana, Oshora, Tskhratskaro, Ortavi.

The main watershed of the Trialeti ridge starts in the Mtkvari River gorge (village Minadze). In this section it is directed east-south-west, and farther out it turns and becomes transversal. The north slope of the Trialeti ridge is divided by the rivers Toseli, Dviri, Chobiskhevi, Borjomula and Gujaretis Tskali.

4.1.4.6 Adigeni district

Adigeni district is located at the west part of the Akhaltsikhe cavity. The region is crossed by the Kvabliani River, whose tributaries are the Otskhe, Ghadzvi and Dzindze. The Akhaltsikhe cavity (Samtskhe cavity) represents a tectonic erosive intermountain cavity in the upper basin of the Mtkvari River. From the north it is limited by Meskheti ridge, from the south by Erusheti ridge, on the west by Arsiani ridge slopes, and from the east bounded by the wester edge of Trialeti ridge. The bottom of the cavity are at 900 to 1000 meters above sea level.

Cavity slopes are formed with Mid Eocene volcanogenic sediments; and the central part is formed with Upper Eocene gypsum sandy-clayey layer, Oligocene clays and sandy-clayey sediments and also Mio-Pliocene Tuffogenic (Goderdzi) layer. Quaternary sediments are distributed at the bottoms of Mtkvari River and its tributary valleys.

In the center of the cavity a flat terrace is located. On the rocks (1200-1300 m above sea level) hilly erosion landscape is developed mainly with soft relief forms; relief is rocky on volcanogenic layers. Above 1200-1300 m sufficiently breaking up mountain-valley relief of Meskheti, Erusheti and Arsiani ridge slopes is developed.

The Meskheti ridge is mainly formed with Eocene volcanogenic layers. Western part of the ridge is limited by more recent rocks; to the south with Neogene lavas. Slopes are jagged with deep valleys of Khanistskali, Suloria, Sufsa, Natanebi, Kintrishi, Chakvistskali and other rivers.

The Arsiani ridge is formed with shales, sandstones, Upper Tertiary Goderdzi layers and Eocene volcanogenic sediments. Slopes of the ridge are deeply incised with valleys of Chorokhi, Adjaristskali, Kvabliani, Potskhovi and other rivers. At the top there are signs of old glaciation.

4.1.4.7 Akhaltsikhe district

Middle and Upper Eocene sediments are the most distributed in Akhaltsikhe district. Middle Eocene (P_2^2b) is represented with massive rough fragmented volcanic breccias, tuff, lava layers, mostly sub-alkaline, alkaline and limy base basaltoides, rarely andesites and andesite basaltoides, dolerites, trachytes, tuff conglomerates, olistostromes, tephrite and sandy-aleuritic turbidites and also dellenites.

Upper Eocene (P_2^3) is represented by foraminiferal and lirelepic marl, rough grained quartz-arkose and graywacke sandstones, clay (carbonized, bituminized, shale), conglomerate middle layers, conglomerate-breccias, marl, andesite basalt, limestone, sub-alkaline basalt, tracyites, lava and pyroclastolites.

Quaternary sediments are represented mostly by boulder-pebbles and are characterized by high water content. The Uraveli River basin is formed mostly with recent Quaternary and Eocene age so-called Kisatibi (Goderdzi) layers and lava and tuff formations. These sediments are presented by (form bottom to top):

- Psammite tuffs with insertions of red conglomerate lenses.
- Andesite-basalt and basalt layers.
- Conglomerates, andesite-dacite tuffs.
- Thick layers of tuff-breccias, tuff-conglomerates and tuff ashes.
- Thick layers of andesites and andesite-dacites.

4.1.4.8 Baghdati district

Stratigraphy. The geological structure of this area is represented by meso-Cainozoic and Quaternary thick terrigenous, carbonaceous and effusive formations. The Quaternary and Cainozoic sediments have the widest distribution. Lower Cretaceous (K_1) rocks have transgressive overlapping over the Jurassic sediments and they are represented with dolomites, limestones, marls, and clays over 600 meters deep. Upper Cretaceous (K_2) sediments outcrop in foothills and mountainside banks of Adjara-Trialeti ridge. They are represented with limestones, guffogenes and others to a depth of 500-600 meters.

Paleocene (P) system is represented with Paleocene-Lower Miocene (P_1-P_2), Mid Eocene (P_2^1), Upper Eocene (P_2^3) and Oligocene-Lower Miocene (P_3-N_1^1) rocks. First three stages are represented with Clayey Limestones, Marls, Tuffs and Clays in general, with overall depths about 1500 m; and the Oligocene-Lower Miocene – with non-carbonaceous layered Clays with depths of 600 meters.

The Neogene (N) system is represented with all stages of Eocene and partly with Pliocene. These layers are formed with compact sandstones, calcareous sandstones, clays and limestones with an overall depth of 1000 meters.

Quaternary sediments (Q) have a wide distribution in the region and represent continental formations. They are described with facial changes and miscellaneous geological-structural and geomorphologic features.

The depth of Quaternary sediments decreases from west to east and ranges from several meters to 300 meters. Recent sediments are divided into River, Alluvial, Prolluvial and Delluvial formations by genetic features.

Recent Quaternary sediments (aQ_{IV}) are distributed in river valleys and represented with riverbed and floodplain facieses; their depth is changing within 2-20 m limits. These decrease from east to west. Delluvial-Prolluvial sediments ($d\text{-}aQ_{IV}$) are distributed at the bottoms of banks and represented with pebbles-detritus clays and clayey soil. Finally, Elluvial-Delluvial sediments ($e\text{-}aQ_{IV}$) are distributed in watersheds and hillock banks and clays and sandstones one to two meters deep.

Tectonics. This region belongs to Georgian lump and Adjara-Trialeti fold system contact zone. In the territory of Georgian lump, the Kolkheti lowland and Imereti submountain bend are delineated. The Kolkheti lowland is the most submerged structure of Georgian lump, which is filled with thick Quaternary formations. Its fundament is parted with deep tectonic fractures. The Adjara-Imereti submountain bend is the south sequential of Kolkheti lowland. It includes sediments from Upper Cretaceous to post Pliocene. It is characterized by linearly extended brachyfolds and arch boosts.

Geomorphology. This region belongs to the Kolkheti sector of the Georgian intermountain immersion zone. Here, Kolkheti accumulative (Alluvial) lowland area and South Kolkheti hilly line region are marked out. The Kolkheti accumulative lowland covers a wide area, relief is plain and its elevation is less than 200 meters above sea level.

4.1.4.9 Zestaphoni district

Four orographic zones are represented in the Zestaphoni district. The Kolkheti lowland includes the Kvirila river adjacent zone from the railway station Adjameti to the west. The elevation of this area ranges from 90 to 200 meters. To the south and east, the hilly zone has elevations of 200 to 250 metres. The upper Imereti plateau is located to the west and to the south the watershed ridge separates the water basins of Kvirila-Sakreula rivers (peaks include Safishlis tavi at 1088 meters and Kvitsqnari at 1013 meters). The north slope of the ridge is in Zestaphoni region.

Alluvial sediments are presented primarily on the lowland territory, which is generated by River Kvirila as shallow terraces. The relief is crossed by large number of gorges and river channels. Oligocene and Miocene clays, sandstones, and marls are present on the hilly zone. The surfaces are crossed by the tributaries of the Kvirila River. Many landslides are present on the slopes of hills. The plateau is developed on the crystalloid massif of the Dzirula River, which is presented on the right bank of Kvirila River until the river Dzusa. The plateau within the borders of Zestaphoni region is present by crystalline slates and granite type rocks of Cambrian and Paleozoic age. The south part of the plateau is represented by Liace age volcanogenic rocks and sediments, porphyries, tuffs, and tuff-breccias.

The top layer of crystalline and Jurassic sediments is cut by narrow rocky gorges 250 to 300 meters deep, narrow. The watershed ridge is mainly presented by Eocene age tuff-breccias and marvels. The geology of the region is mainly represented by early and recent Quaternary rocks. The early Quaternary sediments are present as sand, gravel, and clays and are found on the upper terraces of the Kvirila River. Old terraces of Kvirila River are present up to an elevation of 300 meters, and are about 10 to 15 meters deep.

4.1.4 Hydrology/Hydrogeology

The transmission line will cross many of Georgia’s rivers. In summary, the number of crossings will include:

- For Alternative 1, 12 river crossings, including Kvirila, unknown name, Mtkvari (Kura), Oshiristskali, Chibareti, Ktsia, Beiukchai, Kldeisi, Algeti, Mtkvari (Kura), Tsinubanistskali, Koblianichai.
- For alternative 2, 14 river crossings, including Kvirila, unknown name, Baratkhevi, Tsinubanistskali, Mtkvari (Kura), Oshiristskali, Chibareti, Ktsia, Beiukchai, Kldeisi, Algeti, Mtkvari (Kura), Tsinubanistskali, Koblianichai.
- For Alternative 3, 18 river crossings, including Kvirila, unknown name, unknown name, Kurikhana (3 time), Baratkhevi, Tsinubanistskali, Mtkvari (Kura), Oshiristskali, Chibareti, Ktsia, Beiukchai, Kldeisi, Algeti, Mtkvari (Kura), Tsinubanistskali, Koblianichai.

4.1.4.1 Gardabani district

A shallow aquifer in this area comprises floodplain alluvial sediments (pebbles, sand, and clay) of the Iori River and its outfall. Most springs flow at 0.2 to 2 liters per second, although a group of springs on the left bank of the river 15 kilometers southeast of Sagarejo have a total flow of over more than 200 liters per second. Alluvial sediments of the Lakbe River valley are characterized with water-rich flows and represented with pebbles with sand. Flows of springs range from 8 to 10 liters per second.. Both these aquifers recharge from precipitation and river flows.

Another aquifer in Quaternary sediments is widely distributed in the region. It ranges from 5 to 100 meters deep and represent river terraces and valley trains. Again, recharge is primarily from precipitation.

Figure 4.1-12. Khrami River gorge

Between the Shibliani and Dedoplistskaro meridians at the south bank of Kakheti ridge are sporadically productive Apsheron-Aghchagil marine sediments that are largely unconfined. There are a large number of downstream springs that are not too productive, at 0.1 to 0.4 liters per second.

Another limited aquifer is in Lower Miocene-Oligocene waterproof rocks in a line from the Krasnogorski village to the south part of Ialno ridge. This aquifer reaches 300 meters deep and flows up to 0.2 liters per second.

An aquifer used widely as drinking water is in upper Jurassic carbonate sediments. Withdrawal rates can reach 2 to 10 liters per second.

4.1.4.2 Marneuli district

The Marneuli district is rich with rivers, the biggest being Mtkvari and Khrami rivers. River Khrami forms some islands on its way, while the Debeda river, which is the right tributary of the Khrami, is a typical ravine river. The Marneuli plateau is also crossed by Algeti River (the right tributary of Mtkvari), the Shulaveri River (the right tributary of Khrami), and Banoshistskali River (the right tributary of the Debedi). Flooding is observed during the spring while low water levels occur mostly during summer and winter. The rivers supply water for irrigation.

4.1.4.3 Tetritskaro district

Underground waters in this district are seen in the Eluvial zone of denuded rock. Eluvial sediments of upper cretaceous carbonate rocks are characterized with high water content. Groundwaters useful for drinking water are also widely spread in the sand-gravel sediments of river groves. These waters are characterized by good drinking properties. Deeper groundwaters are mostly in middle Eocene and upper cretaceous sediments.

In the places, where upper cretaceous rocks are close to the surface, mostly in natural landscape depression areas, artesian springs that flow from 4 to 5 liters per second. The springs are related with groundwater from above mentioned rocks, they have artesian pressures and flows in the range of 4-5 liters per sec and is often carbonated.

4.1.4.4 Tsalka District

This area is rich with water resources. The Khrami is the main river, and is known as Qtsia River in its upper part (Figure 4.1-12). Its right tributaries are the Chochiani, Beiukderesi, Mirzaoglikhrami, Aiazmidere, and Nardevani, among others. Left tributaries are the Tarsoni, Sulakhi, Gumbati, and Tusrebi. The Beshtashentskali and Korsu rivers flow directly into the Tsalka water reservoir.

There are a few lakes in this region, including Bashkoi, Uzungioli, Janmushgioli, Khadiki, Leliani, Grdzeli, and others. Floods occur mostly during spring and early summer. Low water levels are observed during the winter. Rivers in this region are widely used for hydropower energy generation.

4.1.4.5 Ktsia-Tabatskuri area

The primary water feature in this region is Lake Tabatskuri. The lake covers 14.2 square kilometers and reaches a depth of 40.2 meters, with an average depth of 15.5 meters. Lowest water levelis are seen from Jabuary to March. The increase in water level in spring coincides with spring thaw and snowmelt, with highest inflows in June. Tabatskuri is a young oligotrophic lake that is oxygen-rich and nutrient-poor, and is used for drinking water and irrigation. The lake is a major tourist attraction, and it is reported to be at risk from uncontrolled activities of local communities.

4.1.4.6 Adigeni area

The Akhaltsikhe cavity is traversed by the Mtkvari River and its tributaries: Potskhovi (with Kvabliani tributary), Uraveli, Tsinubnistskali and other rivers. In addition, there are Tsunda and Satakhve lakes. Mineral springs have been developed in Abastumani (Otskhe), Akhaltsikhe, Aspindza, Uraveli and other places.

4.1.4.7 Akhaltsikhe district

This basin is located in structure-morphological depression of the same name and is surrounded by Meskheti, Trialeti and Arsiani ridges. The region is not rich with underground waters due to low humidity and the small amount of precipitation. Slightly more resources are concentrated in recent Quaternary sediments, andesite-basalt depleted upper zone and eluvial formations of volcanogenic rock.

4.1.4.8 Baghdati district

This area is within the southern periphery of the Tskaltubo artesian water basin. By the stratigraphical-genetic signs, chemical composition and circulation type of groundwater divides into several aquifer and complex. Aquifers include recent alluvia sediments, recent deluvial proluvial sediments, and non-parted Quaternary alluvial sediments.

Comparatively high mineralized water is found in a complicated circulation zone. Upper Cretaceous sediments with carbonic and thermal waters show mineralization up to 17 g/l. Chemical composition of water in this zone is various, but chloride-sodium, chloride-hydro carbonate-sodium and hydro carbonate-chloride-sodium are common.

4.1.4.9 Zestaphoni district

This district is part of the River Kvirila crystalline massive fractured and fractured-cavern type groundwater region. The region also is rich with rivers, with the principal ones being the Kvirila, Dzirula, Cholaburi, Chkherimela, and their tributaries. River flow is highest in spring, with flooding occurring mostly in summer and autumn periods. Most groundwater is in shallow alluvial sediments less than 2 meters deep.

4.1.5 Geohazards

4.1.5.1 Types of geohazards

Geohazards identified along the proposed corridor include: processes caused by gravity transport of weathering products (slope erosion (gullying), mudflows, debris flows, scree or rock avalanches and landslides caused by the mass movements of unstable materials) and seismic hazards. Other potential geohazards such as solifluction, swamping and salinisation have been noted in the area, but owing to their limited importance they are not consider to be a significant concern.

Gullying is caused when surface runoff of unconsolidated materials such as silt rich soils, shales, and marls occurs in concentrated flow paths. The runoff in these paths may cause erosion (washes and wash outs) and finally form channels that collapse to form gullies. This gullying process occurs mainly in alluvial-proluvial and alluvial-lacustrine deposits. Gullying has been noted to occur in the vicinity of Lake Jandari to Akhali Samgori, where the depths of gullies reach 3 to 5 meters in some places.

Mud & debris flows occur when large quantities of water disrupt the soil or clay to water ratio, causing the mud or rock to flow. These flows usually occur suddenly, have a high velocity, and are highly efficient eroding agents that may transport large boulders considerable distances before settling and forming a cohesive deposit. Mudflows have been noted in dry gorges along the proposed route. Well-defined mudflows are noted in the vicinity of Samgori and Gamarjveba, on the slopes of Ialghuja and in the vicinity of Krtsanisi. Figure 4-8 shows areas that are susceptible to mudflows.

Rock /scree slides & falls occur following the de-stabilising of a mass of rock or scree fragments, generally as a result of gravity or a sudden excess of water. The rate of displacement will vary from slow creep to rapid movements (for example, mudslides) to sudden collapses (for example, rockfalls). Volcanogenic, carbonaceous and terrigenous formations are vulnerable to destabilisation primarily owing to mechanical weathering caused by freezing and thawing of interstitial water weakening the rocks internal structure. Chemical weathering is common in volcanic rocks along the pipeline corridor where hydrothermal changes result in deposits become more clayey in character. Loose rock and scree is noted on slopes along the pipeline route and rock falls have been observed on the western slopes of Ialghuja Ridge, the Trialeti range and on the slopes of the Javakheti volcanic mountainous massif.

Landslides that cause ground displacement form when a sliding movement of a mass of rock or soil takes place on a definite plane. This displacement may occur along a structural plane such as bedding, joints or schistosity or along a curved shear plane causing rotation, heave or slumping of the ground. Landslides commonly occur following movement along a lubricated bedding plane, often at the interface of permeable and impermeable rock types. Slumping in clays involves a rotary movement along a curved shear surface. The ground movement may be initiated by gravity; tectonic effects or water and the rate of displacement may vary from slow creep to a sudden event. Landslide processes are particularly frequent in the areas where the geological underground is formed by Eocene and Oligocene clay layers, which are specifically sensitive to the interaction between high precipitation rates, frost and unsuitable anthropogenic land-use.

Landslides are common in rock deposits that are fairly unstable, on slopes such as lacustrine alluvial deposits, scree slopes, and eroded slopes. Numerous landslides occur in areas of outcrop with visible landslides observed on the right bank of the River Mtkvari, and in the middle reaches of the Rivers Khrami and Mtkvari. Landslides also occur on the banks of the River Algeti and on the left bank of the River Khrami. The landslides are observed in proximity to Tabatskuri, Vest to Vale, in some sections along the Algeti. Figure 4-7 (at the end of this chapter) shows areas most at risk of landslides.

4.1.5.2 Gravity processes

The transmission line crosses Imereti, Samtskhe-Javakheti, Shida and Kvemo Kartli regions of Georgia. Geohazards from gravity process in each region are characterized in this subsection.

Kvemo Kartli region in southeast Georgia includes Tetritskaro, Marneuli, and Tsalka districts along the transmission line corridor. In this region erosion, landslide and mudflow processes, rock and scree avalanches and floods are not common, although risk is uneven across the region. There is active erosion along rivers. Development of hazardous geological processes in the region is not uniform. Hillsides and mountains, as well as agricultural and pasture lands, are subject to severe erosion and gullying. In addition, wind erosion can be severe around Bolnisi district.

In the middle zone of the Kvemo Kartli erosion-gravitation processes are observed. In the mountain and high mountain zones - dominating are Scree and rockfalls occur along Bolnisi-Kazreti and Manglisi-Tsalka roads and in river headwaters. Landslides in the area are triggered by heavy precipitation, with peaks in early spring and summer. Erosion is seen along the riverbeds of the Mtkvari tributaries, Algeti river (Akhalsopeli khevi, Enegeti khevi) and Khrami river basins, and the south slopes of Iagluja mountain.

The area has zero to medium mudflow risk area (risk category 0; medium 0.3-0.1) and zero to low risk of landslides (risk category 0; low 01-0.01).

Samtskhe-Javakheti region includes three districts cross by the line, including Aspindza, Akhalkalaki, and Akhaltsikhe. In Akhaltsikhe and Aspindza districts there have been observed hazardous geological processes including landslides, mudflows, erosion, flooding, scree and rock avalanches, and gullying. The diversity and widespread nature of the risks is the result of the complex geological - tectonic composition of the region and geomorphological conditions in the area. The geological processes that dominate the area include landslides, which are mainly observed in the river gorges. In addition, within riverbeds there are frequent mudflow, erosion ,and flooding processes. In the Velikhevi, Kvibiststskali, Likanistskali, Borjomula, Gujaretistskali, Chobiskhevi and Oshora ravines there is accumulating a large amount of material, which is creating a risk of mudflow processes occurring. In addition, riverbanks are actively eroding, with erosion of banks observed in practically all riverbeds.

Jabvakheti is less hazardous in terms of geological processes and related damage, again the result of morphology, stability of rocks, and climate in the region. Here, risks are mainly related to earthquakes, since the area belongs is an 8-9 seismic risk zone. Earthquakes activate scree and rock avalanches, and other kinds of soil surface deformation. Other processes include slope erosion and flooding, with flooding causing the most significant impact on the region.

The area belongs to mudflow risk area from significant to very low (risk category significant 0.5-0.30; medium 0.3-0.1; very low <0.01) and high to limited risk of landslides (risk category high 0.9-0.7; limited 0.1-0.01).

Imereti region is the northwest region along the route and includes the districts of Baghdati and Zestaphoni. Hazardous geological processes in the region include landslides, gullying, bank erosion, erosion, scree and rock avalanches, mudflows, flooding, karst, avalanches, earthquakes. For purposes of geohazards, the region can be split into three geomorphologic zones: 1) east Kolkheti lowland, 2) hilly foothills, 3) low and medium mountain zone. In the lowland zone, scouring, flooding-accumulation dominate, while landslide and gullying processes are negligible. In the hilly foothills the major processes are landslide and erosion. In the low and medium mountains a zone-wide spectrum of geodynamic processes can be observed.

The risk of earthquakes is high in this region, with seismic activity in the 7-8 magnitude zone (Dzirula crystalline massif, Adjara-Imereti ridge, Okriba mountain massif). Landslides poses serious risks to industrial and economical activities in the region, with the landslide damage coefficient for Imereti estimated as 0.7-0.9.

Bank erosion (scouring) is observed in 229 areas in the region, with a total length of 527kilometers. Erosion affects arable lands, roads, bridges, irrigation hydrotechnical and bank protection facilities, oil and gas pipelines, and cause damages to some. Gullying is registered in 484 areas, with a total length of 257.3 kilometers.

Rock and scree avalanches (16 and 254 units respectively), are mainly concentrated in the mountain regions in river headwaters and rocky areas of the ravines, as well as along the slopes cut during road construction. Mudflows are less frequent, with 136 mudflow gullies having been observed. Activation of the mudflow processes endangers some residential areas including Chiatura and Sachkhere, as well as Baghdati, Sairme, Baghdadi- Sakreula, Bagdati-Khani , Shorapan-Salieti, Sestaphoni-Rikoti, Khvani, Sachkhere road sections, Tsipa-Lashi, Shorapan-Chiatura individual sections of the railroad, where stone-mud flows hinder traffic.

Flooding and accumulation processes (spring-autumn) are observed in separate sections of Sachkherte, Kolkheti and Akhalsopeli lowlands. There are 32 sections subject to flooding in the region,. Floods damage arable lands, irrigation and hydrotechnical facilities, pipelines, roads, protective engineering constrictions, industrial objects, settlements (including Sachkhere, Zestaphoni, Kutaisi, Vani, and Samytredia residential areas and infrastructure). In total flooded areas may reach hundreds of hectares.

In areas with carbonate rocks, karst processes are observed, with 121 units with different forms of karst processes being registered in Khoni, Tskhaltubo, Terjola, Tkibuli, Chiatura, Sachkhere and Kharagauli. They are rare in Vani and Samtredia areas.

Avalanches are occasionally observed in unpopulated high mountain areas of Kharagauli, Badati, Vani, Tkibuli, Chiatura and Sachkhere regions. The area belongs to medium mudflow risk (risk category 0.3-0.1) and high risk of landslides (risk category 0.9-0.7).

4.1.5.3 Seismic hazards

The Greater and Lesser Caucasus form the central Asian segment of the ‘Alpine-Himalayan Fault and Fold Belt’Akhaltsikhe Basin. This belt extends from the Swiss Alps in southern Europe to the Himalayan ranges of India and Nepal. The region is actively being deformed by the collision of the African, Arabian, and Indian tectonic plates with the southern margin of the Eurasian continent. The east-west trending faults are characterized by compressive thrust movements. The north-east or north-west trending faults generally exhibit lateral strike-slip movements.

Two types of fault movement are commonly observed along the study area, namely Reverse and Thrust Faulting. Both are compressive styles of faulting and involve one fault block pushing up and over the second fault block. The ‘thrust’ and ‘reverse’ designations are distinguished by the dip angle of the fault plane. Thrust faults are characterized by dip angles of less than 45 degrees, and Reverse faults exhibit dip angles of greater than 45 degrees.

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The proposed route crosses several tectonic faults. The faults that are deemed active based on the interpretation of existing literature, topographic maps and aerial photos include:

- Rustavi fault: a reverse fault with NNW-ESE surface orientation and an estimated potential vertical displacement during a seismic event of 0.9 meters.
- Manglisi fault: a reverse fault with a NNW-ESE surface orientation and an estimated potential displacement of 0.6 meters.
- Tsalka-Bedeni fault: a reverse fault with W-E orientation and an estimated potential displacement of 0.9 meters.
- Vale fault: a reverse fault with a W-E surface orientation and an estimated potential displacement of 2.0 meters.

According to the seismic zoning map of the Georgia the line will be located in 7-8 magnitude zone. Seismic zones are shown in Figure 4-9 (at the end of this chapter).

4.1.6 Flora and vegetation

This section describes flora and vegetation within a corridor that extends within about five kilometers on either side of the transmission line corridor, with particular attention to the area within 250 meters of the route, to allow sensitive communities and habitats to be identified. The section is based on literature review and field surveys. It is noted that published materials concerning the immediate corridor were scarce or nonexistent in some cases, so several brief field visits were made to ensure full coverage of the route

The transmission line corridor crosses a number of different botanic-geographic regions (Gardabani, Kvemo (Lower) Kartli, Trialeti , Javakheti, Kartli, Meskheti and Imereti) with a great diversity of flora and vegetation due to geological, geomorphological, hydrological, climate and soil conditions. In particular, the corridor steppes, semideserts, spiny-shrubwood steppes, low mountain broadleaved forests, middle mountain broadleaved forests, mountain broadleaved forests, mountain mixed forests, subalpine forests (park forests), subalpine tall herbaceous vegetation, mountain steppes of southern Georgia, high mountain grasslands and shrubs, subalpine meadows, sedge and grasses marshes (bogs), agricultural lands, and many other more or less transformed areas.

Along the transmission line corridor, there are many communities and species of different conservation value (designated herein as Georgian Red List-**GRL**, **RDB**, endemic, rare) as well as economic plants (medicinal, aromatic, wild fruits, fibers, rootcrops, ornamental, beverages, timber, fuel wood, forage (fodder) and pasture, wild relatives of crop species, etc.). In addition, there are several orchids that are CITES species: *Corallorhiza trifida, Dactylorhiza euxina, Gymnadenia conopsea, Neotia nidus-avis,* as well as *Dactylorhiza urvilleana*; *Dactylorhiza latifolia.*

Figures 4-6a through 4-6h (at the end of Chapter 4) show the various types of agricultural and other vegetation zones that are crossed by the line, from east to west. In addition, Figures 4-11a through 4-11h (also at the end of Chapter 4) show areas of medium and high sensitivity as a result of their vegetation and ecosystems. Finally, Figures 4-2a through 4-2h (also at the end of the chapter) show the different types of ecosystems in the vicinity of the transmission line corridor.

4.1.6.1 Gardabani plain to Jandari Lake-Jagluja Hills

Three figures show aspects of vegetation and flora in this section: Figure 4-2a shows ecosystems, Figure 4-6ba shows various types of agricultural and other vegetation zones, and Figure 4-11a shows areas of medium and high sensitivity. All these figures are at the end of Chapter 4.

4.1.6.1.1 Gardabani Managed Reserve

The transmission line crosses a narrow part of Gardabani Management Reserve very near the line's origin at the Gardabani substation. The zone of significant ecological risk is associated with the floodplain forests in the Managed Reserve, which include relict mature floodplain forests formed either by floodplain oak (*Quercus pedunculiflora*), poplar (*Populus hybrida*), or both species. Associated components of the forests are comprised of approximately 30 species of trees and shrubs including many relict species, such as ivy (*Hedera helix, H. pastuchowii*), wild vine (*Vitis sylvestris*), greenbrier (*Smilax excelsa*), common privet (*Ligusrrum vulgare*), etc. Figure 4.1-13 shows an example of this forest.

Such relict floodplain forests are very rare in Georgia. As a result, the forest in Gardabani Managed Reserve has the highest conservation value in the entire lowland. Apart from main components forming the forest being relicts (upper layer - *Quercus pedunculiflora, Populus hybrida P. nigra, Ulmus minor, Salix wilhelmsiana, Crataegus curvisepala, C. pentagyna*; lower layer - *Hedera pastuchowii, H. helyx, Smilax excelsa, Vitis sylvestris, Clematis vitalba, Tamarix ramosissima, Cornus mas, Prunus spinosa, Ligustrum vulgare, Lonicera caprifolium, Elaeagnus angustifolia*), the forest itself is unique in phytocoenological terms.

Figure 4.1-13. Tugai forest in Gardabani Managed Reserve

It is important to note that foundations for the line in the Managed Reserve were constructed from 1989 to 1991, so foundations should already exist in this area, and possibly towers as well. The Reserve is considered to be of high sensitivity (Figure 4-11a at the end of this chapter), but no other areas in this section are considered to be high or medium sensitive.

4.1.6.1.2 Other lowland and foothill areas

The lowland areas of Gardabani and Kvemo Kartli section of the Project Corridor are represented mainly by agricultural lands and their associated irrigation systems (canals-Marini canal).

The natural vegetation in these areas is very changed and reduced due to agricultural activities. The semidesert wormwood *(Artemisia fragrans)* communities are dominant here. Together with pure and mixed variants of worm-wood communities there also occur intermediate types mixed diffusely or completely with the variants of saltwort *(Salsola spp.)* desert. From other components one can see here *Agropyron cristatum, Alhagi pseudalhagi, Bothriochloa ischaemum, Kochia prostrata, Limonium meyeri, Salicornia europaea, Salsola dendroides,* etc.

Wormwood communities with ephemers are found in Gardabani and Marneuli districts. They are dominated by the following ephemers: *Adonis aestivalis, Astragalus brachyceras, Koelpinia linearis, Medicago minima, Queria hispanica (Minuartia hamata),* etc. The foothill landscapes of Rustavi and Marneuli environs as well as eastern part of Trialeti region are characterized by semidesert, steppe vegetation and partly fragments of open woodlands ("light forests"). Present-day expansion of steppes is due to the anthropogenic influence on forests arid light forest and even on secondary shrubwoods (Sakhokia, 1961). The dominant species of steppe vegetation is beard-grass, *Bothriochloa ischaemum (Andropogon ischaemum)..*

Beard-grass steppes are composed of 150-200 species of higher plants (Ketskhoveli, 1960; Gagnidze et al., 1996) and they are typologically very diverse. In pure beard-grass steppes the co-dominant positions are occupied by *Eryngium campestre, Festuca valesiaca (F. sulcata), Cynodon dactylon, Glycyrrhiza glabra, Teucrium chamaedris, Teucrium polium, Thymus tiflisiensis, Galium verum,* etc.

Figure 4.1-14. Altered steppe near Marnueli

The Gardabani plain foothill areas are *Bothriochloëta–Festuceta* steppe, distinguished with greater species diversity (figure 4.1-14). In this community the co-dominant species are *Festuca valesiaca, Medicago caucasica, Teucrium polium.* There also occur *Scorzonera eriosperma, Eryngium campestre, Thymus tiflisiensis, Onobrychis radiata, Medicago minima, Sideritis montana,* etc. Undulate plain near Kvemo Samgoris Arkhi (Kvemo Samgori Canal) are represented by beard-grass (*Bothriochloa ischaemum*) – spear-grass (*Stipa capillata, S. lessingiana*) steppe and Shibliak. Besides, there are fragments of hemixerophilic shrubwoods dominated by the single trees and shrubs (*Celtis caucasica* **(GRL, RDB)**, *Pyrus salicifolia, Rhamnus pallasii, Ulmus carpinifolia, Spiraea hypericifolia,* etc.). From herbaceous components there are also *Festuca valesiaca, Stipa lessingiana, S. stenophylla, Astragalus microcephalus, Gypsophila acutiloba,* etc.

Together with *Celtis caucasica* are found single **GRL, RDB** plants, *viz. Pistacia mutica, Celtis glabrata* and *Astragalus caucasicus.* Fragments of *Festuceto (Festuca sulcata) – Bothriochloëta* communities, which are restricted to the slopes of hills, remain only at Jagluja (Nakhutsrishvili, 1999). In addition, hemixerophilic shrubwoods (like shibliak) fragments and almost semidesert wormwood (*Artemisia fragrans*) communities occur here. Leading species in these communities, *Artemisia fragnans,* is associated by the following perennials: *Salsola dendroides, Bothriochloa ischaemum, Elytrigia repens, Agropyron cristatum, Glycyrrhiza glabra, Cynodon dactylon, Petrosimonia brachiata, Daucus carota, Falcaria vulgaris, Limonium meyeri,* etc. The geophytes are represented by the species of *Iris, Tulipa, Gagea, Allium.* Among the **RDB** plants, *Iris iberica* and *Tulipa biebersteiniana* are notable.

The components of the xerophilic and hemixerophilic shrubwoods include such drought-resistant species as *Paliurus spina-christi, Spiraea hypericifolia, Rhamnus pallasii, Astragalus microcephalus, Lonicera iberica, Caragana grandiflora.*

4.1.6.2 Jagluja Hills – Tetritskaro

In this section, the corridor passes from steppe vegetation influenced by humans to oak-hornbeam broadleaved forests. Three figures show aspects of vegetation and flora in this section: Figure 4-2b shows ecosystems, Figure 6b shows various types of agricultural and other vegetation zones, and Figure 4-11b shows areas of medium and high sensitivity. All these figures are at the end of Chapter 4. As can be seen, a small length of the corridor east of Tetritskaro passes through an area considered to be of medium sensitivity.

4.1.6.2.1 Fragments of steppe vegetation and arid open woodlands

Isolated fragments of steppe vegetation here, with some thorn steppe and arid open woodlands (Figure 4.1-15), are found up to near Tetritskaro and particularly on the Disveli watershed plateau, between the Ktsia and Algeti rivers, where more notable are **GRL, RDB** species: *Acer ibericum, Celtis caucasica* and single individuals of *Pistacia mutica (*Ketskhoveli, 1960).

Figure 4.1-15. Tetritskaro upper edge forest

4.1.6.2.2 Thorne steppe with forest elements

These communities are considered to be derivative of forests. They are developed on the area between the foothills north-west of Kumisi village to near Tetritskaro (Durnuki plateau). *Paliurus spina-chisti* is the dominant species. Other components of this vegetation are *Acer ibericum, Celtis caucasica, Pistacia mutica, Crataegus pontica, Amygdalus georgica* (**GRL, RDB** species), *Rhamnus pallasii, Crataegus monogyna, Spiraea hypericifolia, Catoneaster spp., Cerasus incana, Carpinus orientalis, Quercus iberica, etc. H*erbaceous plants include *Bothriochloa ischaemum, Festuca sulcata, Stipa capillata, Thymus tiflisiensis, Artemisia fragrans* and other steppe species.

4.1.6.2.3 Oak and hornbeam forests

Oak forests, dominated by Georgian oak, *Quercus iberica* from about Tsintskaro village to the Tetritskaro section, the area with significant indications of the anthropogenic impact. According to Ketskhoveli (1960), floristic composition of one of the variants of oak forests (Tetritskaro environs, Nachivchavebi, 1100 meters above seal level) includes *Quercus iberica, Carpinus caucasica, Carpinus orientalis, Fraxinus excelsior, Acer campestre, Pyrus caucasica, Malus orientalis, Sorbus torminalis, Cerasus avium, Prunus divaricata, Prunus spinosa, Grossularia reclinata, Cornus mas, Swida (Cornus) australis.* Northeast of Tetritskaro between villages Bogvi and Chkhikvta, at 800 meters above sea level, the same author described oak forest stand as being very changed by man's intervention. As a result of degradation of this natural stand the components of arid open woodlands, viz. *Paliurus spina-christi, Rhamnus pallasii, Spiraea hypericifolia,* etc. were admixed.

In this area there are also well developed oak-hornbeam forests. As an example the following floristic composition can be shown (Korkhrami, left tributary of the Ktsia river): *Carpinus caucasica, Quercus iberica, Acer campestre, Fraxinus excelsior, Acer ibericum, Sorbus graeca, Pyrus caucasica, Malus orientalis, Celtis caucasica, Crataegus curvisepala, (as C. kyrtostyla,) Crataegus pentagyna, Cornus mas, Cornus (Swida) australis, Rosa canina, Prunus divaricata.*

In the area of the upper Korkhrami River, where climate conditions are more humid, oriental beech (*Fagus orientalis*) appears. The floristic composition of this forest includes *Carpinus caucasica, Fagus orientalis, Quercus iberica, Fraxinus excelsior, Acer campestre, Acer platanoides, Sorbus graeca, Pyrus caucasica, Malus orientalis, Sorbus aucuparia (as S. caucasigena), Corylus avellana, Tilia begoniifolia (as T. caucasica), Sambucus nigra, Salix caprea, Ostrya carpinifolia, Ulmus scabra, Crataegus monogyna, Crataegus pentagyna,* *Cerasus avium, Lonicera caprifolium, Lonicera iberica, Philadelphus caucasicus, Cornus mas, Euonymus europaea, Swida australis, Crossularia reclinata, Mespilus germanica,* etc.

Hornbeam forests of the territory under review differ from other types of Georgian hornbeam forest in having in its floristic composition such **GRL, RDB** trees as *Celtis caucasica* and *Acer ibericum.* The following is the original variant of hornbeam forest described in the environs of Samshvilde village situated in the Ktsia river gorge: *Carpinus caucasica, Acer campestre, Acer ibericum, Celtis caucasica, Fraxinus excelsior, Rhus coriaria, Cornus mas, Crataegus pentagyna* (as *C. melanocarpa), Crataegus monogyna, Swida (Cornus) australis, Mespilus germanica,* etc.

There are also hornbeam forests that have been changed due to man's activity. As a result of such changes, oriental hornbeam *(Carpinus orientalis),* Georgian oak *(Quercus iberica)*, as well as Christis thorn (*Paliurus spina-christi*) and other xerophilic shrub species appear.
4.1.6.2.4 Oriental oak mixed broadleaf forests

Northwest of Tetritskaro town the transmission line corridor passes through mixed broad-leaved oak forest massif covering the area from Tetritskaro-Tsalka road north side to Bedeni plateau at altitudes of about 1150-1700 meters.

GRL, RDB species include oriental or high mountain oak, with *Quercus macranthera* dominant. Other **GRL, RDB** species are elms, *Ulmus glabra, Ulmus elliptica.* Iberian hazel-nut, *Corylus iberica* may also be found here.

In addition to *Quercus macranthera,* the main woody species of the areas include hornbeam, *Carpinus caucasica,* oriental beech, *Fagus orientalis,* oriental hornbeam, *Carpinus orientalis,* Georgian (Iberian) oak, *Quercus iberica* (sometimes referred to as *Q. petraea subsp. iberica* (Karagöz, 2001)). Other broad leaved species include *cer campestre, Acer laetum, Acer trautvetteri, Fraxinus excelsior, Betula pendula, Populus tremula. S*ome others have scattered distribution but are nevertheless valuable for their structural-functional role in the species-mixed forest ecosystem.

Flora in this forest area is also remarkably rich in biodiversity and contributes to an ecosystem of high conservation value. The transmission line route follows the bank of the gorge of river Chiv-chavi from Tetritskaro to Bedeni plateau. The upper vertical zone of the Chiv-chavi gorge (800-1,300 meters above sea level) supports middle mountainous zone forests, which are dependent on microrelief and slope exposure and are comprised of Georgian oak (*Quercus iberica*), hornbeam (*Carpinus caucasica*), field maple (*Acer campestre*), etc. In floodplain forests, white willow (*Salix alba*) communities have a fragmentary distribution although typical floodplain forests are not developed in this gorge.

4.1.6.3 Bedeni Plateau to Ktsia upper reaches

Several figures show aspects of vegetation and flora in this section: Figures 4-2b and 4-2c show ecosystems, Figures 4-6b and 4-6c show various types of agricultural and other vegetation zones, and Figures 4-11b and 4-11c show areas of medium and high sensitivity. All these figures are at the end of Chapter 4. As can be seen, an area just west of Tetritskaro is considered to be highly sensitive, as are areas farther west, near Tsalka Reservoir.

4.1.6.3.1 Bedeni Plateau wetland area

As the corridor reaches Bedeni plateau at altitudes 1690-1730 meters, orchid species distinguish about 5 hectares of sensitive wetlands of high conservative value. *Dactylorhiza urvilleana* (In soviet botanical sources (Flora, 1941; Identification guide, 1969; Cherepanov, 1981), *Dactylorhiza urvilleana* is referred to as *D. triphylla, Orchis amblyoloba (O.*

carthaliniae), O. triphylla) occurring in this area in large population are unique in Georgia. Single individuals of another orchid, *Orchis coriophora* also occurs here.

From the Chiv-chavi gorge the corridor ascends Bedeni volcanic plateau, passing in the vicinity of Cherepanov, Bedeni, Barevskoe lakes, and enters the Tsalka basin. Sedge (including tussock sedge) and aquatic plant communities characteristic of the southern volcanic plateau are developed on the shores of these lakes. *Carex dichroandra* is a dominant species of the tussock sedge wetlands. In addition, the following species occur: *Carex diandra, Carex disticha, Carex vesicaria*. Apart from the sedges, the following species are present: *Poa palustris, Valeriana officinalis, Calamagrostis neglecta, Polygonum amphibium, Alopecurus aequalis, Ranunculus flammula, Triglochin palustre*, etc. *Lemna trisulca* is found in some places between the tussocks.

Relatively dry types of the lacustrine wetlands support mesophilious meadow and wetland species such as *Luzula spicata, Polygonum carneum, Geum rivale, Ranunculus lingua, Caltha palustris, Epilobium palustre*, etc.

Bedeni plateau vegetation cover is mostly represented by secondary meadows such as meadows with Lady's mantle and brome (*Brometum variegatal Alchemillosum),* grass forb meadows with Lady's mantle (*Alchimilletum-graminoso-mixtoherbosum*), sedge meadows with Lady's mantle and brome (*Brometum-alchemilloso-caricosum*), etc.

4.1.6.3.2 Bedeni Plateau to Tsalka Reservoir mountain steppes and secondary meadows

Mountain steppes are found only in south Georgia. They cover the high volcanic plateau of Trialeti, Gomareti, Dmanisi and Bedeni. Steppe vegetation in this extensive area develops mainly on chernozems and chernozems-like soils and is distinguished by its phytocenotic diversity. The polydominant grass-forb steppes prevail here. More characteristic species of these communities are: *Festuca ovina, F. sulcata, Stipa tirsa, S. pulcherrima, Bothriochloa ischaemum, Filipendula hexapetala, Falcaria vulgaris, Galium cruciatum, Koeleria macrantha, Medicago hemicycla, Phleum phleoides, Polygala anatolica, Thymus caucasicus,* etc.

In addition, there are secondary meadows, in some cases overgrazed, that have developed mainly on sites once occupied by primary forests. Like previous communities these meadows are mainly composed of variants of polydominant grass-forb vegetation with participation of *Agrostis planifolia, Alchemilla erythropoda, Brachypodium sylvaticum, Bromopsis variegata, Calamagrostis arundinacea, Centaurea salicifolia, Dactylis glomerata, Lotus caucasicus, Trifolium ambiguum, T. canescens,* etc. From monodominant meadows can be mentioned communities (variants) with such dominant species as *Nardus glabriculmis (*dzigviani in Georgian), *Anemone fasciculata (*frintiani*), Agrostis planifolia (*namikrephiani*), Brachypodium sylvaticum (*barseliani*), Bromo psis variegata (*shvrieliani*),* etc. (Kvachakidze, 1996).

4.1.6.3.3 Tsalka Reservoir to Khando village

This section of the corridor is primarily agricultural. The natural herbaceous vegetation of Tsalka depression and adjacent areas has been transformed and is represented by various modifications of secondary steppe meadows and mountainous polidominants steppes. Steppefied meadows are comprised of *Carex humilis, Festuca valesiaca, F. ovina, Filipendula hexapetala, Polygala anatolica, Stipa tirsa*, etc. Secondary post-forest meadows are dominated by *Agrostis planifolia, Alchemilla erythropoda, Bromopsis variegata, Calamagrostis arundinacea, Dactylis glomerata, Geranium sylvaticum, Lotus caucasicus, Ranunculus caucasicus, Trifolium canescens*, etc. The southern slopes are occupied by polydominant steppes mainly formed by grasses *Festuca ovina, F. valesiaca, Stipa* *pulcherrima, Stipa tirsa, Koeleria macrantha, Phleum phleoides*. Forbs are represented by *Filipendula hexapetala, Cruciata laevipes, Medicago hemicycla, Thymus rariflorus*, etc.

From Bedeni plateau to Ktsia-Tabatskuri Managed Reserve the secondary herbaceous vegetation comprises communities dominated by Lady's mantle (*Alchemilla erythropoda, A. sericata, A. caucasica*, etc), brome (*Bromus variegatus*), sedge (*Carex huetiana, C. humilis, C. dacica*, etc), fescue (*Festuca valesiaca*, *F. woronowii*), koeleria (*Koeleria cristata, K. caucasica*), mat nardusgrass (*Nardus stricta*), false hellebore (*Veratrum lobelianum*), anemone (*Anemone fasciculata*), clover (*Trifolium*), alfalfa (*Medicago*). The characteristic plant communities of this zone are described below:

- Bedeni plateau, flat mesorelief, 1,600 meters above sea level, coverage is 95 percent meadow with Lady's mantle, koeleria and brome (*Brometum koelerioso-alchemilosum*)
- Vicinity of Tsalka, right bank of river Ktsia, 1,700 meters above sea level, western exposure, coverage is 90-95 percent grass forb meadow with sedge and Lady's mantle (*Alchemilletum-caricoso-mixtoherbosum*)
- Vicinity of Tsalka, right bank of river Ktsia, 1,700 meters above sea level, western exposure, coverage is 85-95 percent grass forb meadow with sedge (*Caricetum-mixtoherboso- graminosum*)
- Vicinity of Tsalka, right bank of river Ktsia, subalpine zone, vicinity of Tikmatasheni pass, northern-eastern exposure, coverage is 95 percent grass forb meadow with bentgrass (*Graminetum-mixtoherbosum*)
- Mt. Dali Daghi (Tsalka area), northern-eastern slope, coverage is 95 percent, grass forb subalpine meadow (*Graminetum-mixtoherbosum*)
- Upper reaches of Ktsia river, vicinity of Tabatskuri (Mt. Mtirala), northern mesoslope, 1,900 m AMSL, coverage is 90 percent forb meadow with koeleria (*Koelerietum-mixtoherbosum*)
- Northern slope of Mt. Mtirala, coverage is 90 percent grass forb subalpine meadow with false hellebore (*Veratrumetam-graminoso-mixtoherbosum*)
- Northern shore of Tabatskuri lake, eastern slope, coverage is 95 percent subalpine grass forb meadow (*Latifolio mixtoherbetum -graminosum*)

The transmission line corridor route passes in the vicinity of forests only in a few locations along this section. West of Tsalka forest vegetation is entirely comprised of pine (*Pinus kochiana*) plantations (average age 25-30 years).

Javakheti upland was formerly covered by forests, but only minor fragments of these subalpine forests survive, mostly on northern slopes of high mountainous areas. These fragments are formed by species typical for Caucasian subalpine forests: Litvinov's birch (*Betula litwinowii*), mountain ash (*Sorbus caucasigena*), goat willow (*Salix caprea*), Bieberstein's rock currant (*Ribes biebersteinii*), alpine currant (*Ribes alpinum*), in some areas - European aspen (*Populus tremula*), etc. Litvinov's birch and mountain ash form communities over small areas in the rocky relief of the Ktsia lower reaches. Rhododendron scrub (*Rhododendron caucasicum*) is frequent in southern Caucasus, but is declining.

The Tsalka area is rich in small lakes of volcanic origin (Bashkoi, Uzungel, Jamushgel, Khadiki, Karagel, Tba, tec). The shores of the lakes support wetland vegetation associations. The corridor passes through the Imera, Bareti, Kariaki, Santa environs wetlands, which are be considered as of high conservation value.

According to K. Kimeridze (1966, 1975) wetland vegetation is of highest significance on the Javakheti volcanic upland. Tussock sedge (Cariceta) formation communities are found on silty or coarse-peat wet substrata, which are frequently waterlogged. The surface water level changes considerably by seasons and years. Peat formation process is fairly intensive in most tussock sedge formations. This process is characterized by certain peculiarities in wetlands located in Javakheti volcanic upland, namely - at the early stages of wetland formation of this type organic mass is mostly accumulated at the roots of evenly distributed main coenotype (sedge - Carex), gradually forming tussocks. Tussock height is dependent on the duration of swamping and maximum waterlogging level of the surface. Having reached this level, tussock height does not increase and organogenic material is mainly accumulated between the tussocks. Tussock sedge communities are characterized by mosaic structure due to formation of microrelief. This demonstrates the uniqueness of the natural properties idiosyncratic to the eutrophic and oligotrophic wetlands developed on Javakheti volcanic upland. Javakheti wetlands are unique ecosystems.

4.1.6.4 Ktsia-Tabatskuri Managed Reserve

Several habitat types encompassing various plant communities are found in the Ktsia-Tabatskuri reserve. In some cases a habitat type coincides with a high rank syntaxon, for example, habitat of Rhododendron caucasicum refers to the scrub community comprised of Caucasian rhododendron. Two general habitat categories were defined for the purposes of this ESIA, aquatic and terrestrial and, which include qualitatively different habitat types. Section 4.1.6.4.1 describes aquatic habitats and 4.1.6.4.2 through 4.1.6.4.4 describes terrestrial habitats.

Three figures show aspects of vegetation and flora in this section: Figure 4-2d shows ecosystems, Figure 6d shows various types of agricultural and other vegetation zones, and Figure 4-11d shows areas of medium and high sensitivity. All these figures are at the end of Chapter 4. Much of this area is considered to be of high sensitivity.

4.1.6.4.1 Aquatic habitat

There are extensive as well as fragmented wetlands with associated mosaic plant communities in this area. For the purposes of this ESIA, plant communities associated with shallow water and moist substrate are considered within these habitat types along with hyper-humid habitats proper. In general, the swamps existing within the study zone are not diverse typologically, although peat lands, sedge dominated wetland communities, horsetail dominated wetland communities and other swamp complexes can nevertheless be distinguished.

Meadow vegetation, which is entirely of secondary origin and represented by diverse modifications, occupies the largest area on the studied territory. The following meadow types have the principal structural-functional importance: communities of lady's mantle (*Alchemilla erythropoda*), sheep's fescue (*Festuca ovina*), mat-grass (*Nardus stricta*), tufted hair-grass (*Deschampsia cespitosa*), bent (*Agrostis planifolia*, *Agrostis tenuifolia*), sibbaldia (*Sibbaldia semiglabra*), broad-leaved herbaceous plant and forbs (Latifoliomixtohorbosa). In most cases these species form meadows jointly where they are present in a great number of syntaxonomic variants (Figure 4.1-16).

Figure 2.1-16. Tabatskuri east

Lady's mantle meadows are found on almost all the exposures and relief forms. These meadows are one of the most widespread formations. They are of secondary origin and have been for an extended period of time The main cenotype of the formation – cenoses of lady's mantle (*Alchemilla erythropoda*) -- mostly occurs on smooth relief forms. Often the principal species shares its leading role with flat-leaved bent (*Agrostis planifolia*), variegated brome (*Bromopsis variegata*), sheep's fescue (*Festuca ovina*), sibbaldia (*Sibbaldia semiglabra*), mat-grass (*Nardus stricta*), and with cowberry (*Vaccinium vitis-idaea*) in mesophilous variants; frequently it forms cenoses with green mosses. The Lady's mantle meadows are spatially best pronounced on the south-facing macro-slope of the Trialeti range: on Tskhratskaro and Sakvelo mountain massifs as well as on slopes of Mts. Shuana Mta, Tavkvetili, Shavnabada, etc. These meadows are found between 2100 and 2700 meters above sea level on relief that is often slightly undulating or flat. Although of secondary original, they can be significant in aspects of both agriculture and biodiversity, and they have a positive function in soil protection against erosion.

Sheep's fescue meadows are found mostly on dry south-facing slopes between volcanic boulders. They are fragmentarily distributed in the form of patches all along this section of the corridor, mainly eastwards of Tabatskuri Lake, from slopes of Mt. Shavnabada to the abandoned village Merenia. The vertical distribution profile of the sheep's fescue meadows covers an area between 2200 and 2500 meters above sea level. The communities usually develop on hilly relief, on east- and south-facing micro-relief forms. Slope inclination is different and varies from 10 to 40°.

Mat-grass meadow is one of the more widespread formations, occurring in fragmentarily distributed patches throughout this section of the corridor. The largest occurrences are formed on Tskhratskaro and Sakvelo mountain massifs: from the foothills of Mt. Chareli (southwards from Tskhratskaro Pass) to the meridian of Mt. Tavkvetili and on the southwest-facing slopes of Mt. Tavkvetili itself. Mat-grass meadows are found from 2000 to 2400 meters above sea level. Smooth relief forms and plain places are characteristic to the distribution area of the community. The closed-canopied mat-grass cenoses cover large areas at the sources of the river Ktsia. The communities are fragmentarily distributed on the eastern side of Tabatskuri Lake.

Wide distribution of mat-grass meadows within the proposed Managed Reserve and generally in the southern mountainous region of Georgia has been caused by century-old anthropogenic press; however, this plant community has a significant role in erosion prevention in high mountainous regions of the Caucasus.

Bentgrass meadows occupy fairly large areas, especially in humid habitats. They occur on almost all vertical steps of this section of the corridor, but form independent cenoses only on the lowlands and at slope bases. Bentgrass is one of the important constituents of shrub communities. The bent meadows are characteristic of northern and western exposures. They mostly dominate on plain and concave relief forms between 2000 and 2500 meters above sea level. The meadows have high agricultural value as both pastures and hay-fields. The bent meadows are mostly of secondary origin and develop well in areas formerly occupied by woody plants. They are dominated by *Agrostis tenuifolia.* A community similar to these Bentgrass meadows is characterized by another species of bentgrass, *Agrostis planifolia.*

Sibbaldia cenoses occur on the upper vertical step of this section of the study areas, primarily on mountain ridges and upper part of adjacent slopes at 2500 to 2700 meters above sea level. They can be found on flat as well as undulating relief forms on almost all exposures. Sibbaldia is a constant component of alpine carpets, but in mountainous regions where the vegetation structure is severely disturbed due to long-term anthropogenic impact, the species occupies even uncharacteristic habitats at the lower vertical step (for example, occurs in patches even in the complexes of tall herbaceous vegetation). A similar phenomenon is observed on the studied territory of Ktsia-Tabatskuri: fragments of sibbaldia cenoses are found at the slope bases and even in depressions.

The sibbaldia formation is most pronounced on the Trialeti range: massifs of Mts. Chareli, Tskhratskaro and Sakvelo. It is fragmentarily distributed in degraded and eroded habitats throughout this section of the corridor. Due to strong root system, sibbaldia has a special role in prevention of erosive processes in the high mountains.

Subalpine broad-leaved forb meadows are found in the northwestern parts of Mts.Tavkvetili and Sakvelo. They are fragmentarily distributed in complexes of volcanogenic boulders and skeleton substrate at 2100 to 2400 meters above sea level, usually on the western and northern exposures and develop on downhill (25-35°) as well as undulating and concave relief forms.

4.1.6.4.2 Terrestrial habitats

Terrestrial habitats are widespread on the territory of the Ktsia-Tabatskuri reserve. The following terrestrial habitats are found on the study area: meadows/grasslands and mountain steppes; shrubbery; and forest.

In addition to the above habitat types, subalpine tall herbaceous vegetation, volcanogenic boulders and scree and man-made habitats are found in the Ktsia-Tabatskuri reserve; however, they have no landscape value and are represented only by isolated fragments. For the purposes of Ktsia-Tabatskuri reserve management planning only those habitats are objects of studies that cover more or less large areas on the study area and/or have high conservation value.

4.1.6.4.3 Mountain steppes

Mountain steppes occur in fragments in this section, mainly on the south- and east-facing micro-relief forms, on downhill and rocky ecotopes, soil weathering crust and complexes of volcanogenic boulders. Volga fescue (*Festuca valesiaca*) is the dominant species. Feather grass (*Stipa*), which is the edificator of the mountain steppe in the southern part of the Javakheti upland, does not occur here.

Fragments comprising Volga fescue can be found on slopes of Mts. Tavkvetili and Shavnabada and east of Tabatskuri Lake, at 2200 to 2600 meters, on complex relief forms and frequently inaccessible exposed rocks. Volga fescue mountain steppe has insignificant distribution in this section of the corridor.

4.1.6.4.4 Shrub communities

Caucasian rhododendron communities are found on north- and west-facing slopes of Mt. Tavkvetili as well as the plateau of this mountain (in a complex of volcanic basalt “avalanches” on relatively smooth relief forms) and Trialeti range, Mt. Sakvelo massif, and sources of the left tributary of the river Ktsia. The community occupies a comparatively small area on the right bank of the river Ktsia, on a slope of Mt. Shuana Mta. Caucasian rhododendron communities are usually formed on the northern and northwestern exposures between 2200 and 2400 meters, on undulating meso-relief. Rowan-birch communities with a Caucasian rhododendron sub-layer form complexes with pure Caucasian rhododendron communities over large areas. Pure Caucasian rhododendron communities with floristic composition similar to the above occur on relatively large areas.

Cowberry communities occupy large areas, in complex with Caucasian rhododendron communities as well as independently. Cowberry forms cenoses principally with lady’s mantle (*Alchemilla erythropoda*) and mosses on north-facing slopes between 2200 and 2500 meters, mainly on smooth relief forms (inclination 20-30°). Within this section of the corridor, cowberry communities are pronounced on massifs of Mts. Tavkvetili and Sakvelo as well as the north-facing slope of Mt. Shuana Mta. Cowberry fruitage is robust, yielding a rich harvest of berries.

Other shrub communities are also fragmentarily distributed on volcanogenic boulders and skeleton scree. The communities are mostly xerophytic and comprise different floristic components such as wayfaring-tree (*Viburnum lantana*), Georgian barberry (*Berberis iberica*), raspberry (*Rubus idaeus*), dog-rose (*Rosa pimpinellifolia*), mountain currant (*Ribes alpinum*), juniper (*Juniperus hemisphaerica*), wild cherry (*Cerasus avium*), bridewort (*Spiraea hypericifolia*), honeysuckle (*Lonicera caucasica*), etc.

4.1.6.4.5 Forest ecosystem

Fragments of the subalpine forest vegetation still survive in this area, and they be regarded as remnants of forests once widespread in the southern mountainous region of Georgia. As a result, they are considered to be of high conservation value.

Subalpine crooked beech forests occur at the sources of river Ktsia and on the north-facing slope of Mt. Tavkvetili. It borders onto volcanic boulders and Caucasian rhododendron communities. Tall herbaceous vegetation that grows at the forest edges include Inula orientalis, Veratrum lobelianum, Vicia balansae, Heracleum asperum, Chamerion angustifolium, Aconitum orientale, Symphytum caucasicum, Polygonum carneum, Rumex alpinus, etc.

High mountainous oak forests are found in three stands in this section. A field survey conducted for this ESIA found for the first time that regeneration of oak is satisfactory (saplings as well as seedlings were found) between Tabatskuri Lake and Mt. Tavkvetili, in the complex of volcanic boulders, at 2100 meters above sea level. The species is included in the Red List of Georgia and all three fragmentary habitats of the oak forest have a high conservation value.

Fragments of the subalpine forest can also be found on the southern side of Tabatskuri Lake and the slope of Mt. Shavnabada. The forests mainly comprise high mountain maple (*Acer trautvetteri*), sallow (*Salix caprea*), birch (*Betula litwinowii*) and rowan (*Sorbus aucuparia*) with understorey formed by currant (*Ribes biebersteinii*), raspberry (*Rubus idaeus*), wayfaring-tree (*Viburnum lantana*), wild cherry (*Cerasus avium*), etc.

A large poplar stand occurs (80 X 20 meters) in the surroundings of the Bezhano swamp, on southwestern exposure of the elevated terrain. Regeneration was observed to be satisfactory, with seedlings of different age present.

4.1.6.4.6 Wetand vegetation [5]

Hyper-humid landscapes comprised of mosaic plant communities are widespread on the territory of Ktsia-Tabatskuri Managed Reserve. They are mostly associated with Tabatskuri Lake and Ktsia-Nariani hydrographic system.

The Northern and northwestern sides of Tabatskuri Lake are swamp: the wetland ecosystem occupies a large area between dry land and lakeside dune. Pure communities of *Equisetum heleocharis* as well as *Caricetum vesicariae purum* are formed within the shoreline of the wetland ecosystem. The species that constitute the communities include *Alisma plantago-aquatica, Heleocharis eupalustris, Utricularia vulgaris, Scolochloa festucacea, Lemna trisulca, Potamogeton heterophyllus*, etc.

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5 Wetland vegetation survey is based on unpublished data of Dr. Kukuri Kimeridze, late Georgian botanist, outstanding expert in the wetland flora and vegetation, the data were kindly provided by his daughter Dr. Mariam Kimeridze, Candidate of Biology.

Cariceta dichroandrae predominates in the wetland. *Caricetum dichroandrae purum*, in association with large hillocks, is more common in this complex. It is accompanied by *Caricetum dichroandrae equisetoso-caricosum vesicariae*. Both associations are floristically and structurally similar. Horsetail and *Carex vesicaria* mostly occur between hillocks.
Thickets of *Digraphis arundinacea* skirt the lakeside dune in a narrow line, while horsetail community predominates with admixture of fairly abundant *Scolochloa festucacea* and *Carex vesicaria* in places. *Scolochloa festucacea* forms pure thickets or is accompanied by admixture of horsetail, *Carex vesicaria, C. dichroandra, Alisma plantago-aquatica*, etc.

In the northwestern part of the hyper-humid complex, pure horsetail association and *Scolochloetum festucaceae purum* are found over the large area. In places with deeper water the associations are substituted by two species of the genus *Potamogetonetum*; *Polygonum amphibium* is admixed to the community.

In the eastern part of the lake, pure common reedbed community is found on a small area of one hectare. In the shoreline *Carex vesicaria* is admixed to the community from the wetland site. *Scolochloetum festucaceae purum*, *Equisetetum heleochariae purum* and *Heleocharietum eupalustre purum* are developed on a fairly large area on the eastern side. *Potamogetonetum natansae purum* with admixed *Polygonum amphibium* occupies large area. Scolochloetum festucaceae potamogetonosum and *Equisetetum heleocharis potamogetonosum* can also be found in some areas.

East of Tabatskuri lake, the wetland encroaches between mountains in a form of a narrow line (~400 meters wide), where *Scolochloetum festucaceae purum*, horsetail dominated wetland community and spike-rush dominated community are mainly formed. The surface water is deep, about one meter. In places, pondweed (*Potamogeton*) groupings are found in the deep-water part.

In the swampy southern-western bay of Tabatskuri Lake, *Caricetum elatae purum* is formed in the shoreline part of the wetland. The sedge community covers a fairly large area and is topologically associated with *Caricetum elatae caricosum* vesicariae and *Caricetum vesicariae purum*. pure sedge community with hillocks predominated by *Carex wiluica*, afairly rare community for Georgia and, in general for the Caucasus, is developed on peat inside the wetland area.

In the deep-water part of the bay, opposite the village Moliti, a pure common reed community (with predominance of *Phragmites communis*) is developed on a small area of about 0,5 hectare. The water depth is about one meter on average. The plot adjoins *Potamogetonetum* comprised of *Potamogeton perfoliatus*. The species is also admixed in low abundance to the common reed community. In this part of the lake another type of *Potamogetonetum* is also developed, which is made up of *Potamogeton heterophyllus, P. gramineus*. *Potamogeton lucens, Batrachium trichopyyllum* are admixed. *Equisetetum heleochariae purum* is also developed there.

The above horsetail association is replaced by *Caricetum elatae purum* on one side and *Scolochloetum festucaceae purum* on the other. *Potamogetonetum perfoliatus purum* is developed towards the lake.

Nariani valley wetlands (Figure 4.1-17) are used to grow hay. Ground water is observed on the surface seasonally in the southern-western part of the wetlands.

Figure 4.1-17. Nariani veli wetland in September

Sedge dominated community with hillocks is found on a fairly large area southwest of the Nariani valley wetland complex. *Ligularia sibirica* is quite abundant (Cop^1-Sp^3) in the community. Height of the hillocks is 70 centimeters on average and they are entirely formed by sedge. *Sphagnum platyphyllum, Calliergonella cuspidata* occur in low abundance between hillocks. Calamagrostietum glaucae caricosum (*C. glauca, Carex wiluica*) is directly associated with the sedge dominated community; the former association is hillocky and structurally similar to the pure sedge community. *Geranium palustre* is abundant there. *Festuca rubra, Aconitum nasutum* are present in lower numbers. Herbage is quite dense. The hillocks are narrow at base and open in the upper part. There is no water between the hillocks. *Deschampsia cespitosa, Sanguisorba officinalis*, etc. are also constituents of the described sedge dominated community. The described sedge communities are usually floristically poor.

In the vicinity of the associations described above Caricetum-inflatae purum occurs in the deep-water part of the wetland with abundant herbage. *Lemna minor* – Cop^2, *Utricularia vulgaris* – Sp^1 are among the constituents. This sedge dominated community adjoins Caricetum dichroae purum. Surface water level is 3-5 cm on average. The surface is almost completely covered by *Lemna minor*. *Deschampsia cespitosa, Festuca rubra, Carex elata,* etc. are present in low numbers. Both associations are floristically poor. Height of herbage is 50 cm and coverage 85% in the latter association, which includes a sub-layer.

Similar to the above sedge-dominated comunities, *Caricetum elatae purum*, struclurally and floristically similar to the described ones, is fairly widespread in the same part of the wetland. *Caricetum vesicariae purum* occupies much more limited area and is fragmentarily distributed in lower depressions, where surface water persists for the major part of the vegetation period. This is indicated by participation of *Potamogeton heterophyllus* and *Potamogeton lucens* in the association.

A horsetail-dominated community made up of *Equisetum heleocharis* occupying minor areas are frequent on the bank terraces of the river Ktsia. At the base of the east- and northeast-facing slopes of Mt. Tavkvetili, in the place of a former lake, a peatbog is developed at 2370 meters above sea level. *Sphagnetum polytrichosum* occupies the major part of this peatbog.

In places only moss cover is developed with the predominant synusia of *Vaccinium vitis-idaea.* Sphagnum (*Sphagnum papillosum*), a mat-grass community covering the entire surface, forms a complex with the above association. In places, fescue (*Festuca supina*)–polytrichum–sphagnum community is formed with a similar floristic composition. Sedge (*Carex canescens*) -sphagnum (with admixed *Sphagnum centrale*) can also be found. All the associations are floristically similar.

Sphagnetum eriophorosum vaginatae occurs in the complex with *Sphagnum cuspidatum* forming moss cover. *Taraxacum stevenii, Ranunculus oreophilus, Carum caucasisum, Alchimilla* sp., are present in low abundance.

On minor areas, mainly depressed reief, sphagnum (*Sphagnum platyphyllum*)–sedge (*Carex inflata*) association and *Caricetum inflatae drepanocladiosum* (*Drepanocladus exannulatus,* with participation of *Dicranum bonjeanii, Sphagnum papillosum*) are developed. *Comarum* *palustre* is present in all the associations in different abundance. Wetland elements are found in higher abundance in sedge-dominated communities occurring in places of former wetlands.

Flat hills mainly covered by fescue (*Festuca supina*) are located around the wetland. Other elements of the alpine meadows such as lady's mantle, caraway, etc. occur between the hills. Mosses, including *Polytrichum gracile, Aulacomnium palustre* and sometimes lichens are also found on the hills. Caucasian rhododendron occurs at the hill bases in some areas. This type of the peatbogs is rare not only in the Minor Caucasus, but also the Greater Caucasus.

In slow-flowing sections of river Ktsia Batrachietum purum (*Batrachium divaricatum*) is abundant with admixed groups of *Potamogeton lucens*. The latter species forms pure community in places or is admixed to Potamogetonetum natansae purum in quite high abundance or in groups. Equisetetum heleochariae purum (*Equisetum heleocharis*) is also frequent on silty substrate of the shoreline. The association is characterized by tall herbage and fairly closed canopy. *Carex inflata, Polygonum amphibium* are admixed in low abundance.

The above associations, as well as *Caricetum inflatae purum* fragmentarily distributed along the shoreline, are floristically and structurally fairly simple. *Heleocharietum eupalustrae purum* also occurs in patches on the lake shores. All the associations are formed on silty substrate characterized by presence of surface water over the majority of the vegetation period.

A sedge-dominated complex occupying about 2 hectares is developed on the second order terrace of the left bank of river Ktsia. Substrate is made up of silt-coarse peat and is seasonally covered by surface water. The following two associations are found: *Caricetum dichroandrae purum* and *Caricetum vesicariae purum*. Both associations are characterized by ample herbage: they form monotypic associations, but mix with each other at low extent.

Potamogeton heterophyllus, Equisetum heleocharis, etc. are admixed to the above association in low numbers. Thin water layer remains in places, while surface of the first association is almost dry. meadowsweet (*Filipendula ulmaria*) is admixed in fairly low abundance (Sol). Groups of rush (*Juncus filiformis*) can be found in some places. Mosses: *Calliergonella cuspidata, Drepanocladus aduncus* occur on elevated micro-relief.

The above described associations are typologically related to prairieficated wetland and meadows developed on moist soils.

A small (about 1,5 hectares) sedge swamp is found in the place of a former lake on Nariani valley, on the third order terrace of the left bank of river Ktsia at 2100 meters above sea level. It has a horseshoe shape. *Cariceta inflatae* predominates in the swamp with Caricetum inflatae drepanocladosum (*Drepanocladus aduncus, Dr. exannulatus*) being dominant from this formation. Caricetum inflatae purum, Caricetum inflatae sphagnosum (*Sphagnum platyphyllum*) are fragmentarily distributed. *Carex canescens* is fairly abundant (Sp^3) in the latter. Caricetum caespitosae hypnosum can be found in some places along the shoreline. The wetland is surrounded by a narrow strip of mat-grass comminity, which adjoins the subalpine meadow with sphagnum. *Sphagnum, Comarum palustre, Carex caespitosa* and other mosses occur between the mat-grass comminity and swamp.

Caricetum diandrae hypnosum (*Calliergon richardsonii, Drepanocladus sendtneri*) covers small areas in the shoreline zone. Caricetum wiluicae hypnosum is also present on a small area. Sedge tussocks are usually low here, while fairly high hillocks can be found in some parts of the shoreline. The moss synusia of this association is comprised of the following species: *Hypnum lindbergii, Fissidens adiantoides, Cratoneurum decipiens, Drepanocladus* *sendtneri. Aulacomnium palustre, Climacium dendroides, Drepanocladus aduncus* can be found in lower abundance.

Caricetum canescenti sphagnosum platyphyllum occurs on a fairly limited area in the described wetland complex. *Calliergom richardsonii* participates in low abundance in the moss synusia along with sphagnum. The association is two-layered. The herbage synusia is comprised of the following species: *Comarum palustre, Carex diandra, Carex inflata, Nardus glabriculmis, Calamagrostis neglecta, Filipendula ulmaria*, etc.

Cariceta inflatae appears to be substituted by *Carex lasiocarpae* in the process of peat accumulation. *Swertia iberica* occurs at the wetland developed in the vicinity of the ground water outlet on the shoreline of the swamp found in the place of the former lake.

A circular wetland with Caricetum inflatae drepanocladiosum (*Dr. exannulatus, Dr. aduncus*) occupying the major part is developed in the place of a former lake. The substrate is coarse peat-silty of over one meter thickness. Caricetum inflatae sphagnosum platyphyllum (*Sphagnum platyphyllum*) covers smaller area. Mat-grass also participates in the herbage synusia. *Caricetum inflatae purum* and is present in the deep-water part of the wetland. The association is replaced by those of hypnosa order, which are in turn substituted by sphagnum-sedge associations. This wetland is located on the second order terrace of the left bank of river Ktsia near the river. It is formed in the peripheral part of Nariani valley, where river Ktsia flows in a narrow gorge. Communities of *Deschampsia* and meadows developed in the place of former wetlands are found on the second order terrace of the left bank of river Ktsia.

4.1.6.4.5 Summary for Ktsia-Tabatskuri Managed Reserve

The natural vegetation of Ktsia-Tabatskuri Managed Reserve area is severely modified due to the influence of both anthropogenic and natural factors, which makes it especially important to identify and preserve areas where natural and near-natural vegetation survives. The ecosystems in the basin of the Ktsia River are unique in Georgia in terms of scale and structure.

4.1.6.5 Ktsia-Tabatskuri Managed Reserve to Tkemlan

The corridor passes through the Samtskhe-Javakheti region, which is a distinct geomorphological formation, as described in section 4.1.3. It represents a crossroads of geographical-genetic elements characteristic to the Mediterranean, Iran-Turkish and northern hemispheric ancient flora. This landscape-geobotanical zone comprises wetlands, unique lakes and marshes, various modifications of mountainous steppes, mountainous xerophyte shrublands, dry and mesophillous meadows and relict remnants of forests once common in Javakheti upland, etc. (Sosnovski, 1933, Ketskhoveli, 1959). Sensitive zones are shown in Figures 4.1-11d, 4.1-11e, and 4.1-11f (all at the end of this chapter). .

Two floristically distinct regions have been described in Samtskhe-Javakheti by A. Doluchanov (1989): Adigeni-Borjomi region and Javakheti upland. The first includes north-west slopes of Trialeti range, southern slopes of Meskheti range, Akhaltsikhe depression and river Kvabliani gorge. River Mtkvari above v. Khashuri divides Adjara-Trialeti mountain system into two ranges, Trialeti and Meskheti. Elevation in this section ranges from 750-800 meters above sea level to 2700 (2900) meters above sea level Most prominent part of Mtkvari valley represents Akhaltsikhe depression. Elevation at the base of the depression near Akhaltsikhe is 950 to 1000 meters above sea level. It increases to the south to Turkish border.

The following biomes are distinguished in Samtskhe-Javakheti: Riparian forests in floodplains (800-1150 meters above sea level), xerophytic shrublands and semi-deserts

(800-1200 meters above sea level), Oak–Oriental Hornbeam and Oak-Hornbeam forests (900-1200 meters above sea level), Beech-coniferous forest (1100-2050 meters above sea level), treeline ecotone (2050-2200 meters above sea level), tall herbaceous vegetation and subalpine meadows (2100-2500 meters above sea level) in the subalpine zone (Figure 4.1-18); azonal rock vegetation, and alpine meadows (2500-2900 meters above sea level) and snowbed communities in the alpine zone. The boundaries of biomes and vegetation zones vary considerably depending on precipitation and slope exposition.

Figure 4.1-18. Subalpine meadow near Samsari Ridge

The Javakheti volcanic upland supports the following biomes: pine forests, xerophytic shrublands, high-mountain steppes of South Georgia, subalpine and alpine meadows, rock vegetation and wetlands. A small area of subnival vegetation above 2900 meters is characteristic of high peaks of Abul-Samsari range (Nakhutsrishvili, 1966).

4.1.6.5.1 Mountain xerophytic shrublands and arid vegetation

Mountain xerophytic vegetation is widely distributed in Samtskhe-Javakheti region from 900 up to 2200 meters above sea level. It mainly occurs in the River Mtkvari gorge and other gorges of Meskheti. They are characteristics of limestone Plateau Tetrobi in Javakheti. There are tragacanthic, phryganoid, shibliak and semi-desert communities (Khintibidze, 1990). Tragacanthic community is represented by edificator species: *Astracantha microcephalus, Acantholimon armenum, A. glumaceum*, and elements of shibliak: *Paliurus spina-christi, Rhamnus pallasii, Cotinus coggygria, Berberis vulgaris, Atraphaxis caucasica, Cotoneaster integerrimus, Crataegus orientalis, Amelanchier ovalis, Lonicera iberica* etc. (Ivanishvili, 1973; Khintibidze, 1990).

Middle montane and upper montane types of tragacanthic communities are distinguished (Khintibidze, 1990). The first with 199 species of vascular plants is spread along the Mtkvari River (900-1300 meters above sea level) and in gorges of rivers Uraveli, Otskhe, Potskhovi, Kvabliani and Tsinubnistskhali. Tragacanthic vegetation enters pine forest in vicinity of v. Damala. This plant community contains rare species *Astragalus arguricus, A. raddeanus, Onobrychis sosnowskyi, Vicia akhmaganica, Salvia compar, Scutellaria sosnowskyi, Psephellus meskheticus* etc. In some places tragacanths enter oak forest. The following rare species occur in this community: *Dianthus calocephalus, Silene brotherana, Erysimum caucasicum, Coronilla orientalis, Satureja spicigera, S. laxiflora, Teucrium polium, T. nuchense, T. orientale, Sideritis comosa, Bupleurum exaltatum, Convolvulus lineatus, Campanula hohenackeri,* etc.

Phryganoid communities support species *Ephedra procera* and *Tanacetum argyrophyllum* and are spread in eastern part of Akhaltsikhe depression. Peculiar population of *Ephedra procera* occurs in the vicinity of village Khertvisi. Other characteristic species of this community are *Cytisus caucasicus, Caragana grandiflora, Dianthus calocephalus, Hedysarum turkewiczii, Onobrychis meskhetica, Teucrium polium, Thymus sosnowskyi, Stachys atherocalyx, S. iberica, Festuca valesiaca, Campanula hohenackeri, C. raddeana, C. alliariifolia, Artemisia sosnowskyi, Stipa capillata, S. pulcherrima, Koeleria cristata, Elytrigia elongatiformis, E. trychophora, E. caespitosa, Agropyron repens* var. *subulatus, Valerianella plagiostephana.*

Semi-desert plant communities are present in R. Mtkvari gorge near v. Rustavi and v. Aspindza. Outstanding species in this community is **GRL, RDB** species *Nitraria schoberi* with other 39 species of the community *Reaumuria kuznetzovii, Astragalus cyri, A. kozlowskyi, Caccinia rauwolfii* var. *meskhetica, Ceratocarpus arenarius, Ceratoides papposa, Gamanthus pilosus, Kochia prostrata, Camphorosma monspeliaca, Limonium meyeri, Picnomon acarna, Sterigmostemum torulosum, S. tomentosum, Tragopogon meskheticus, Stizolophus coronopifolius, Callicephalus nitens, Crepis pannonica* etc. (Bobrov, 1946; Kikodze, 1967; Khintibidze, 1990). Many species of the genus *Artemisia* are characteristics for this type of vegetation.

Shibliak is widespread in middle montane zone mixed with tragacantic vegetation. Dominant species are *Cotinus coggygria, Atraphaxis caucasica, Rhamnus pallasii, Cytisus caucasicus, Paliurus spina-christi,* etc.

Yellow blue-stem grass (*Bothriochloa ischaemum*) community presents mainly secondary vegetation developed in disturbed areas replacing natural vegetation. Associated species are *Veronica orientalis, Galium verum, Achillea micrantha, A. millefolium, Cleistogenes bulgarica, Elytrigia repens, Festuca valesiaca, Koeleria macrantha, Poa pratensis* etc.

4.1.6.5.2 Forests

Riparian forests. The habitat along the rivers Mtkvari, Potskhovi, Kvabliani, Tsinubnistskali and Otskhe is characterized by a primary riparian forest and partly by relict tugai forest (Kikodze, 2002). These forests are extensively fragmented and do not constitute a continuous habitat. They are significantly degraded and not particularly vulnerable to additional anthropogenic activities given the existing level of disturbance. In addition large areas of forest have been cleared for orchard or agricultural crops. Dominant species in riparian forest is *Alnus barbata* associated with *Quercus pedunculiflora, Populus hybrida, P. nigra, Crataegus monogyna, C. pentagyna, Cornus mas, Prunus spinosa, Ligustrum vulgare, Lonicera caprifolium,* etc. (Gvritishvili, Kimeridze, 2001).

4.1.6.5.3 Oak and Hornbeam Forests

Oak forests, dominated by Georgian oak (*Quercus iberica)* occupy western and northern slopes of middle montane zone (Dolukhanov, 1989; Khintibidze, 1990). It occurs in slopes of Meskheti range, in R. Uraveli and R. Kvabliani gorges. Oak in some areas is mixed with Hornbeam (*Carpinus betulus)* and in others mainly occurs with Oriental Hornbeam *Carpinus orientalis.* The other characteristic species are *Acer platanoides, Cornus mas, Corylus avellana, Crataegus pentagyna, C. monogyna, Malus orientalis, Pinus kochiana, Pyrus caucasica, Swida australis, Ulmus glabra,* etc*.* Outstanding peculiarity of oak forests in Samtskhe is the fact that in upper boundary of this type of forests hornbeam is substituted by European Hop hornbeam – *Ostrya carpinifolia*, such forest occupies considerable territory in R. Uraveli and R. Kvabliani gorges. The components of shibliak, such as *Paliurus spina-christi, Rhamnus pallasii, Spiraea hypericifolia* etc., are admixed on lower boundary of the oak forest, as a result of degradation of this natural stand. *Lonicera iberica* is rarely found in the oak forest.

4.1.6.5.4 Beech-coniferous forests

Beach forests (*Fagus orientalis)* with elements of Kolkhic flora are well developed in the west of Meskheti in upper areas of River Kvabliani gorge of the Arsiani range and on the eastern slopes of Meskheti range. It forms subalpine krummholz in Goderzi Pass reaching elevation of 2100 meters above sea level (Khintibidze, 1990). A small population is found on Oshora range above v. Damala (Mukbaniani, 1976). Western and northwestern regions of Meskheti are characterized by dark coniferous forests (Dolukhanov, 1989) in upper montane zone representing by *Picea orientalis* and *Abies nordmanniana* mixed with beech. Almost virgin dark coniferous forest occurs in Abastumani along the road to the observatory.

Pine forests (*Pinus kochiana*) are usually developed on southern slopes of Meskheti, Adjara-Imereti and Trialeti ranges (Khintibidze, 1990). Pine forest has more limited distribution than spruce forests, although, pine frequently occurs in spruce forests on the northern slopes (Khintibidze, 1990). Pine forests on Erusheti and Tetrobi-Chobareti ranges (1800-2000 meters above sea level) have little distinguished composition.

Mountain steppes are peculiar to South Georgia, and cover the Javakheti volcanic plateau. Steppe vegetation is represented by different plant communities. Most characteristic species of polydominant grass-forb steppes are: *Festuca ovina, F. sulcata, Stipa tirsa, S. pulcherrima, Bothriochloa ischaemum, Filipendula vulgaris, Falcaria vulgaris, Cruciata laevipes, Koeleria cristata, Medicago hemicycla, Phleum phleoides, Polygala anatolica, Thymus caucasicus,* etc.

There are also secondary meadows, principally on sites once occupied by primary forests. Like previous communities, these meadows are composed by the variants of polydominant grass-forb vegetation with participation of *Agrostis planifolia, Alchemilla erythropoda, Brachypodium sylvaticum, Bromopsis variegata, Calamagrostis arundinacea, Centaurea salicifolia, Dactylis glomerata, Lotus caucasicus, Trifolium ambiguum, T. canescens,* etc. From monodominant meadows can be mentioned communities with such dominant species as *Nardus stricta (*dzigviani in Georgian), *Anemone fasciculata (*frintiani*), Agrostis planifolia (*namikrefiani*), Brachypodium sylvaticum* (berseliani), *Bromopsis variegata* (shvrieliani), etc. (Kvachakidze, 1996).

Subalpine Vegetation. The zubalpine zone is represented by krummholz, subalpine shrublands, tall herbaceous vegetation and polydominant subalpine meadows. Subalpine krummholz is represented by *Betula litwinowii* and *B. pendula, Acer trautvetteri, Sorbus caucasigena, Salix caprea* etc. Shrubland is composed of Caucasian Rhododendron - *Rhododendron caucasicum, Vaccinium myrtillus, Empetrum caucasicum* etc. Subalpine birch and maple forests are found on the northern slopes while pine forests are developed on the southern slopes at about 1800 to 1900 meters above sea level

Only minor fragments of the former Javakheti subalpine forests survive, mostly on northern slopes of the high mountainous areas. These fragments are formed by species typical for the Caucasian subalpine forests, including Litvinov's birch (*Betula litwinowii*), mountain ash (*Sorbus caucasigena*), goat willow *(Salix caprea*), Bieberstein's rock currant (*Ribes biebersteinii*), alpine currant (*Ribes alpinum*), and in some areas European aspen (*Populus tremula*) and others. Litvinov's birch and mountain ash form communities that cover areas of rocky relief.

Tall herbaceous vegetation is composed of 3-4 meter-high herbs, mainly dicots (Nakhutsrishvili, 1999). Typical species forming subalpine tall herbaceous vegetation are as follows: *Anemone fasciculata, Geranium ibericum, G. platypetalum, G. psilostemon, G. ruprechtii, Scabiosa caucasica, Senecio rhombifolius, Stachys macrantha, Campunala latifolia, Cephalaria gigantea, Doronicum macrophyllum, Aconitum nasutum, Gadellia lactiflora, Delphinium flexuosum, Heracleum wilhelmsii, Grossheimia macrocephala, Lilium szovitsianum,* etc.

Subalpine grass and grass forb meadows are found in the subalpine forest complexes. Grass meadows are formed by *Festuca ovina, F. woronowii, Bromopsis variegata, Calamagrostis arundinacea*. These species form coenoses both independently and in co-dominance. The subalpine meadows occur above the subalpine forest zone, at the altitudes of 2100 to 2200 meters above sea level

Alpine vegetation is composed of *Festuca valesiaca, F. ovina, F. woronowii*, *Alchemilla erythropoda, A. caucasica, Sibbaldia semiglabra, Cirsium arvense*, sedge - *Carex tristis*, mat nardus grass - *Nardus stricta*, and various grasses. Snowbed communities support *Carex meinshauseniana, Festuca supina, F. woronowii, Minuartia circassica, Corydalis alpestris, Senecio taraxacifolius, Matricaria caucasica* etc.

Rock – scree vegetation in Samtskhe-Javakheti reveals properties of xerophytic vegetation. It is found in Akhaltsikhe depression (900 to 1500 meters above sea level) and in Tetrobi Plateau (1800 to 2000 meters). A total of 80 species are present in this biome, including *Erysimum szowitzianum, Campanula crispa, Veronica livanensis, Centaurea bella, Minuartia micrantha, Jurinea carthaliniana, Matricaria rupestris* etc.

4.1.6.6 Borjomi-Kharagauli National Park

Three figures (all at the end of the chapter) show aspects of vegetation and flora in this section: Figure 4-2g shows ecosystems, Figure 4-6g shows various types of agricultural and other vegetation zones, and Figure 4-11g shows areas of medium and high sensitivity. All these figures are at the end of Chapter 4. As shown on Figure 4-11g, the entire corridor through the National Park is considered to be highly sensitive.

The transmission line corridor passes through subalpine polydominant meadows, subalpine bushes (thickets) of Caucasian rhododendron, *Rhododendron caucasicum*. Also present are crowberry, *Empetrum hermaphroditum* and single individuals or groups of mountain ash, (*Sorbus aucuparia*) scattered between subalpine meadows vegetation (Figure 4.1-19).

Figure 4.1-19. Wet meadow in Borjomi-Kharagauli National Park

The areas at lower altitudes are covered by subalpine tall herbaceous vegetation and park forests with significant participation of species of meadow and tall herbaceous vegetation. Woody species are represented by high mountain maple (*Acer trautvetteri)* birch *(Betula litwinowii, Betula pendula),* goat willow (*Salix caprea*), and wild rose (*Rosa sp.)*.

The area is occupied by subalpine forest and broadleaf and broadleaf-coniferous mixed forests composed of *Fagus orientalis, Betula litwinowii, Acer trautvertteri, Populus tremula, Quercus iberica, Pinus kochiana, Pyrus caucasica, Corylus avellana, Salix spp.,* etc. This forest is considered to be of high conservation value.

The mixed forest may be the most environmentally, and main woody species include *Fagus orientalis, Picea orientalis, Pinus kochiana (Pinus sosnowskyi), Abies nordmanniana, Carpinus caucasica, Quercus macranthera, Acer trautvetteri.* Other trees and shrubs include *Acer campestre, Acer platanoides, Acer laetum, Cerasus avium, Corylus avellana, Euonymus latifolia, Ligustrum vulgare, Lonicera caucasica, Malus orientalis, Populus tremula, Pyrus caucasica, Prunus divaricata, Ribes sp., Rosa canina, Salix caprea, Sambucus nigra, Viburnum opulus,* and *Viburnum orientale*. In addition to *Quereus macranthera*, another **GRL, RDB** species, *Ulmus glabra*, is noteworthy.

The upper limit of this forest massif is represented by the fragments of subalpine forests (*Acer trautvetteri, Betula litwinowii, Betula pendula, Salix caprea)* together with subalpine tall herbaceous vegetation and subalpine meadow that is intended for mowing and grazing combined use and is rich in biodiverrsity.

4.1.6.7 Sakire vicinity to Mtkvari River crossing

Three figures show aspects of vegetation and flora in this section: Figure 4-2e shows ecosystems, Figure 4-6e shows various types of agricultural and other vegetation zones, and Figure 4-11e shows areas of medium and high sensitivity. All these figures are at the end of Chapter 4. More than half of this section crosses areas considered to be highly sensitive.

The area from Kodiani mountain to Sakire village is occupied by coniferous forest with oriental spruce (*Picea orientalis*) and pine (*Pinus kochiana*, *Pinus sosnowskyi*), coniferous-broadleaf mixed forests with such broadleaf components as *Acer trautvetteri, Betula pendula, Pyrus caucasica, Malus orientalis, Corylus avellana, Ulmus glabra*, etc.

West of Sakire village up to a nameless pass the corridor an agricultural landscape, after which coniferous (spruce and pine) and coniferous- broadleaf forests occur southwest of Tiseli village. Broadleaf species include *Fagus orientalis, Carpinus caucasica, Quercus macranthera, Quercus iberica, Acer campestre, Fraxinus excelsior, Cerasus avium, Corylus avellana, Euonymus europaea, Crataegus orientalis, Swida australis, Prunus divaricata, Lonicera caucasica*, etc.

After this forested area are intermittent agricultural lands with scattered fragments of forests and single trees and shrubs. An area of high conservation value is at the Mtkvari (Kura) river gorge southwest of Atskuri village between Tkemlana and Tiseli villages. This is the edge of the forest on the north slope, with significant concentrations of such **GRL, RDB** woody species as high mountain oak (*Quercus macranthera*), in the lower point of its distribution, and sea-buckthorn (*Hippophaë rhamnoides).* Other trees and shrub species include *Acer campeste, Berberis vulgaris, Cornus mas, Corylus avellana, Crataegus sp., Fraxinus excelsior, Ligustrum vulgare, Picea orientalis, Prunus divaricata, Prunus spinosa, Pyrus caucasica (Pyrus communis), Rosa canina, Salix caprea, Viburnum opulus* (rare species).

4.1.6.8 Mtkvari River crossing near Tsnisi to Turkey border

Three figures show aspects of vegetation and flora in this section: Figure 4-2f shows ecosystems, Figure 4-6f shows various types of agricultural and other vegetation zones, and Figure 4-11f shows areas of medium and high sensitivity. All these figures are at the end of Chapter 4. Figure 4-11f shows that over 15 kilometers of this section of the corridor crosses areas considered to be highly sensitive.

Within this section the corridor passes through hemixerophilic and xerophilic complexes of vegetation, *viz.* steppes, xerophilic shrubwoods, fragments of arid open woodlands, tragacanthic communities. Agricultural landscapes cover much of this area.

The eastern slope of a foothill close to the irrigation canal west of Vale supports a sensitive habitat of high conservative value. This area is populated by the **GRL, RDB** sea-buckthorn, (*Hippophaë rhamnoides*) in association with rare species *Ceratoides papposa* as well as *Berberis vulgaris, Rhamnus spathulifolia, Rhamnus cathartica, Crataegus sp., Cotoneaster sp., Pyrus salicifolia, Rosa canina, Ligustrum vulgare, Glycyrrhiza glabra,* etc.

Another two sensitive sites in this section are noteworthy. The first is at the Potskhovi river crossing north of Vale town and the second is the Potskhovi river crossing near Naokhrebi village. Both areas have floodplain forest fragments dominated by poplar-willow and willow communities (*Populus spp., Salix spp.).* It should be noted that these communities are distinguished by occurrence of **GRL, RDB** species, sea-buckthorn (*Hippophaë rhamnoides*).

4.1.6.9 Zemo Imereti plateau

This area has two main parts, the Dzirula crystal massif with the Surami ridge and the Chiatura plateau with a maximum elevation of 1,200 meters on the Surami Ridge. The primary vegetation is broad-leaf forest, although most of the area, particularly in the west, it is reduced due to settlements, agricultural activities, and the development of secondary scrub and meadows. The area is known to be rich in relict and rare species.

A total of six figures show aspects of vegetation and flora in this section: Figures 4-2g and 4-2-h show ecosystems, Figures 4-6g and 4-6h show various types of agricultural and other vegetation zones, and Figures 4-11g and 4-11h show areas of medium and high sensitivity. All these figures are at the end of Chapter 4. The line crosses one areas of medium sensitivity, as shown on Figure 4-11g.

Fagus orientalis forest is mainly on the Surami ridge. The forests of the plateau are a mixture of *C. caucasica* with *Cytisus hirsutissimus* with *Hypericum orientale* understories and *Q. iberica,* with some *Q. imeretina* (Red List of Georgia, **RDB**) and, on limestone, azalea *Rhododendron luteum* understory.

On the Chiatura plateau, in the Nigozeti limestone canyons, the rare Imeretian calciphytes and endemics *Delphinium colchicum*, *Potentilla imerethica* and *Symphyandra pendula* are found.

On the left bank of the river Budja there is a forest area consisting of *C. caucasica* with chestnut (*Castanea sativa*) (Red List of Georgia, **RDB** Georgia) and *R. luteum*. There are also areas of red-soil oakwood with *Q. imeretina* (Red List of Georgia, **RDB** Georgia), *Dorycnium graecum*, *D. herbaceum*, *Ruscus ponticus* and *Pteridium tauricum*.

The pimary understory plants of dry ecotopes in the area are *Corylus avellana*, *R. luteum*, *Crataegus* spp. and *Staphylea* spp. In humid areas these are replaced by *Laurocerasus officinalis*, *Ilex colchica* and *Frangula alnus.*

The gorges located within the Borjomi- Kharagauli zone also lie within the impact zone. In addition to the presence of coniferous and mixed coniferous-deciduous forests of high conservation value, this area supports numerous endemic, rare and relict taxa.

4.1.6.10 Kolkheti foothills and lowlands (Zestaphoni vicinity)

Here, the south Imereti foothills join with the northern slopes of the Achara-Imereti ridge and the Guria and Imereti hills. Humidity is lower and the seasonal distribution of precipitation is more Mediterranean. The railway corridor passes through the Kolkheti lowland and Rioni basin. Along the railway corridor there are patches of natural vegetation, including fragments of secondary *Carpinus* spp. woodland, mixed broad-leaf woodland and *Q. imeretina* (Red List of Georgia, **RDB**) and *Zelkova carpinifolia* (Red List of Georgia, **RDB** Georgia) forests. There are large areas of forest preserved on the left bank of the river Rioni.

Three figures show aspects of vegetation and flora in this section: Figure 4-2h shows ecosystems, Figure 6h shows various types of agricultural and other vegetation zones, and Figure 4-11h shows areas of medium and high sensitivity. All these figures are at the end of Chapter 4. Only one small area (about two kilometers) is considered to be of medium sensitivity, and it is located just south of Zestaphoni substation near the river Rioni.

4.1.6.11 Summary of sensitive areas

On the base of literature review and field survey, several areas that would be particularly sensitive to disturbance were identified. Figures 4-11a through 4-11h show the areas of medium and high sensitivity, from east to west. Areas considered to be highly sensitive include:

- *Gardabani Managed Reserve*: Relict mature floodplain forests formed by floodplain oak (*Quercus pedunculiflora*) or poplar (*Populus hybrida*).
- *Tetritskaro-Bedeni plateau forest massif*. Forest ecosystem of high conservative value, with **GRL, RDB** species high mountain oak (*Quercus macranthera*), elms (*Ulmus glabra* and *U. elliptica*). Herbaceous cover in this forest area is also rich in biodiversity.
- *Bedeni plateau wetland habitat*. Sensitive wetland area rich in rich in biodiversity (about 150 species), with orchid species (*Dactylorhiza urvilleana* and *Orchis coriophora*) occurring in numbers unique in Georgia.
- *Tsalka reservoir environs.* Highly sensitive area due to its importance as water reservoir. High mountain wetland ecosystem with sedge grasses marshes and peat-bog communities.
- *Nariani valley (Narianis veli).* Wetlands with sedge and grass marshes and subalpine wet meadow. Vegetation over large areas of Ktsia-Nariani massif are typologically very diverse and rich in species biodiversity (150-200 species).
- *Tabatskuri lake environs.* Water and bog marsh vegetation. A pure sedge community dominated by Carex juncella (*C. wiluica*) has developed in the inner part of the peat-bog
- *Borjomi-Kharagauli National Park*. Polydominant meadows, subalpine bushes, tall herbaceous vegetation, park forest and mountain forest ecosystem with **GRL, RDB** species high mountain oak (*Quercus macranthera*) and elm (*Ulmus gla*bra)
- *West of Vale town*. **GRL, RDB** sea-buckthorn (*Hippophaë rhamnoides*) in association with rare species *Ceratoides papposa*.
- *Damala environs*. Tragacanthic vegetation enters pine forest in vicinity of v. Damala, with rare species *Astragalus arguricus, A. raddeanus, Onobrychis sosnowskyi, Vicia akhmaganica, Salvia compar, Scutellaria sosnowskyi, Psephellus meskheticus*, etc.
- *Idumala-Oshora area*
- *Indusa (from Idumala up to Sakuneti) environs*
- *Xanistskali (xani) section*.
- *Zekari environs, section.*
- *Zemo Imereti plateau*. Forests are a mixture of *C. caucasica* with *Cytisus hirsutissimus* with *Hypericum orientale* understories and *Q. iberica* with some *Q. imeretina* (Red List of Georgia, **RDB**) and *Rhododendron luteum* understory.

Areas of moderate sensitivity include:

- Banks of Algeti River banks. Floodplain forest fragments and meadows.
- *Tsintskaro-Khando villages environs.* Oak and hornbeam forests, with **GRL, RDB** woody species *Celtis caucasica* and *Acer ibericum*.
- *Bedeni plateau.* High mountain steppes and meadows.
- *Mtkvari river crossing near Tsnisi*.(near Agara). Floodplain trees.

- *Potskhovi river banks*. Floodplain forest fragments and agricultural lands.
- *Sakraula river crossing*. Floodplain forest fragments.
- *Kvirila river crossing*. Floodplain forest fragments.

4.1.7 Fauna

This section describes animals and birds in Georgia, and their habitats, with emphasis on species of special concern that could be affected by the transmission line.

Many natural habitats provide important environmental services such as improving water availability for irrigated agriculture, industry, or human consumption; reducing sedimentation of reservoirs, harbors, and irrigation works; minimizing floods, landslides, coastal erosion, and droughts; improving water quality; filtering excess nutrients; and providing essential natural habitat for economically important aquatic species. Although such environmental services are important to humans and thus economically valuable, they are often undervalued and overlooked. Maintaining such environmental services is almost always much less expensive than replacing them with remedial measures after natural habitat conversion. It is also important to note that natural habitats can also provide important environmental products, including fish and other wildlife, wild foods, forest products, or grazing lands." Finally, it is an axiom all endangered species that are protected by Georgian law or international conventions should be considered without regard to taxonomy, size, or other features.

A total of 135 species and 4 subspecies of animals are protected by Georgia law (Red data list of Georgia, 2006). If those protected by international agreements are considered, the total number of protected species could up to 200. Perhaps 75 percent of those can be found along the transmission line.

From the physical-geographic point of view, the transmission line starts in the Transcaucasian depression. This area is located between mountain ridges of the Great Caucasus and the Lesser Caucasus that are bordering from the North the large region of Middle East Uplands (Museibov et al., 1986; Devdariani, 1986).

Georgian territory spreads on almost all biogeographic regions represented throughout the Caucasus isthmus. Borders between faunistic regions represented throughout Georgia cannot be clearly delineated because of the mutual penetration of species among them. A complicated and sometimes a mosaic-like spatial structure of biological communities that represent different biogeographic regions is common in the Caucasus, which makes accuracy of range maps within the country problematic.

In contract to other Caucasian countries, a significant part of Georgia is occupied by communities of mixed origin which cannot be delineated within a specific area. Relief causes relatively clear borders between some biogeographic districts, but these borders remain conditional.

The transmission line crosses many different regions, as described in sections 4.1.2 and 4.1.6. The characteristics of these regions affect the creatures that live, breed, or pass through these regions. The following paragraphs describe main types of ecosystems along the transmission line route.

Rural and agricultural landscapes ("open lowland") cover a large part of the territory crossed by the transmission line route. The largest tracts of arable lands are located in Lower Kartli and on Tsalka Plateau in South Georgia. There are some orchards and kitchen-gardens on this section, as well as pasturelands. The towers of the transmission line are generally not located directly in the cultivated lands, but in the ecotone ecosystems located between agrocoenosis and natural landscape. In such ecosystems, there is often a high diversity and density of animal species. In this area, the transmission line route crosses the home range of several rare and threatened species that dwell mostly on mostly on cultivated lands (for example, Brandt's hamster (Mesocricetus brandti) and Common Tortoise (Testudo graeca)).

Brandt's hamster lives in a colonial mode of life. It is everywhere rare and very sensitive to human impact, since a colony may occupy an area no larger than a single tower.

Cultivated lands are a feeding place for many animals, especially for birds nesting in forest strips and migrating birds. These areas are not diverse and numerous, but they provide constant support.

Even on pastures and measures that are mown there can be protected species (including species in reduced numbers). Species on the Javakheti upland, for example, are everywhere sensitive, because of strong human impact

Also, pastures and arable lands are important for birds of prey. These areas often support small birds and mammals which serve as prey for these larger birds. They also attract migrating raptors for feeding and for thermals they use for soaring. Migrating and resident raptors in these areas would use towers as roosts and hunting perches, and resident birds may nest on towers.

As noted in section 4.1.6, the transmission corridor passes and/or crosses wetlands in several areas, including forest swamps in Gardabani district, swampy lake in Tsalka district, and peat bogs near Tabatskuri Lake. All wetlands contain a number of rare and endemic vertebrate and invertebrate species and coexist with a very vulnerable community of animals. They are important for many species as shelter, feeding places, and stopover sites during migration and wintering.

Ecosystems of mountain and foothill deciduous and mixed (coniferous with deciduous) forests These ecosystems cover a large portion of the Trialeti ridge that is twice crossed by the transmission corridor, mainly in the eastern part, in the Tetritskaro district *(“Tetritskaro forest”)*, in the crossing of Borjomi-Kharagauli National Park, and up to village Argveta in the Zestaphoni district *(both “Mountain forest”).*. Mountain forest is the richest ecosystem with high diversity and a large number of endemic game and endangered species. At the same time, animal communities of these ecosystems are very sensitive for human impact.

Foothills and hills covered with xerophytic bush vegetation. Ecosystems of this type are quite diverse with regard to bush vegetation and species composition of plants and animals, and cover a significant part of territory crossed by the transmission line route in the Gardabani district on the slopes of Yagluja mountain and between Marneuli and Tetritskaro (see also section 4.1.6). They are important for many species as shelter and feeding places in the surrounded steppes, but less sensitive to the impact of the transmission line construction. Animal communities of these ecosystems can be significantly affected only if large areas of shrub will be destroyed (for example, from an accidental fire).

Freshwater ecosystems: ecosystems of current waters and freshwater lake ecosystems. Invertebrate species and amphibian species occur in floodplains and surface water. These species are especially sensitive in eastern Georgia in semiarid and arid habitats but also can be sensitive at nearly any river crossing or lake edge.

River bank ecosystems are usually different from their surrounding landscapes by the higher humidity, less developed soil layer, higher density of shelters, more developed bush vegetation, and less covered with agricultural landscapes. These ecosystems usually form narrow belts along rivers up to several hundred meters wide. The most important riverbank ecosystems are the tugai forests, located in valleys of large rivers surrounded with arid or semiarid landscapes; one such ecosystem is crossed by the (already-constructed) transmission line corridor at Gardabani Managed Reserve. In this forest live 31 species of mammals, of which six are endemic to the Caucasus and five are endangered (Red deer, Wild boar, breeding Pheasant, Black stork and White-tailed eagle). The well-being of all of them depends on the stability of this forest. In addition, small remnants of tugai vegetation remain on the Algeti river near the corridor, close to the village Agara on Mtkvari river and on the river Potskhovichay close to the village Arali. .

Open grassy habitats in mountain areas (*"Mountain open landscape*"), mountain steppes, meadows, wetlands, xerophilous bushes and pine wind-breaking strips between the eastern-most edge of Bedeni plateau and edge of forest in Borjomi-Kharagauli National Park (Kp Z-5) are on the mail route of the transmission line. The entire 400 kV line, from the Akhaltsikhe substation to the Turkish border, and part of Alternative route 2, from the starting point to the forest edge in the vicinity of the Abastumani, are situated within the range of this complex.

Overall, the areas along the transmission line corridor that are most important for general biodiversity are shown on Table 4.1-2 and Figure 4-15 (the figures are at the end of this chapter)

Table 4.1-2 Most important areas for biodiversity preservation along the transmission line corridor

Location number (Figure 4-15)	*Locations and environmental receptors*	Level of importance (see note)
1	Floodplain forest in Gardabani Managed Reserve (natural tugai forest, about 3000 hectares). Habitat of Red Deer (Cervus elaphus - RDB of Georgia), the Black Stork (Ciconia nigra - RDB) and many other species.	I
2	Open lowland in Lower Kartli from Yagluja Mountain up to Tetritskaro area of migration and wintering of many vulnerable to electro power line bird species. Habitat of the Brant's hamster	I
3	Tetritskaro vicinity. Territory covered with forest. Sensitive complex of mammals and birds.	II
4	Samsari Rodge – mountain open landscape, area of nesting and migration of many protected bird. Alpine meadows and Rhododendron shrubs on mountains. A sensitive complex of the alpine species. Habitat of the Caucasian Black Grouse (Tetrao mlokosiewiczi).	I
5	The shore and the bay of the Tabatskuri Lake. Water is partly is covered with sage and other water plants. Resting spot for migrating waterfowl. The Red-crested Pochard (*Netta rufina*) and Ferruginous Duck (*Aythya nyroca*) are nesting here. A trout species (*Salmo trutta)* species is proposed to be included on the Red List of Georgia. The Narianis Veli. Very sensitive wetland in upper course of the river Ktsia - a subalpine bog in the flood-land of the river. This territory is a home range of the Otter (*Lutra lutra*) and the Common Crane (*Grus grus*).	I
6	Forest edge close to Tetrobi Managed Reserve.	II

Table 4.1-2 Most important areas for biodiversity preservation along the transmission line corridor		
Location number (Figure 4-15)	*Locations and environmental receptors*	Level of importance (see note)
7	The Borjomi-Kharagauli NP and forest behind border of the park. The subalpine landscapes forests, meadows and rhododendron shrubs; the alpine meadow. The summer pastures. Habitat of large mammals: Roe Deer (*Capreolus capreolus*), Brown Bear (*Ursus arctos*), Red Deer (*Cervus elaphus*) and Chamois (*Rupicapra rupicapra*). The home range of the Caucasian Black Grouse (*Tetrao mlokosiewiczi*). Includes habitat of the endemic Rock Lizards (genus Darevskia), having narrow ranges).	I
Category of importance for biodiversity preservation: I = most important II = important on the local level		

4.1.7.1 General Characteristics of Animal Species Composition

Mammals. 108 species of mammals occur in Georgia. These species are associated in 64 genera of 28 families that belong to 7 orders. Perhaps four are no longer found in Georgia. Seven species were acclimatized in Georgia or came to the country after acclimatization on adjacent territories. (Bukhnikashvili, Kandaurov 1997, 2002; Gurielidze, 1997). Significant parts of key habitats of several endangered species lie along the corridor: *Ursus arctos, Lutra lutra, Mesocricetus brandti* and several species of bats that are included the Red Data List of Georgia. During the last decades, habitat range and population substantially decreased for all the following species: *Lynx lynx, Cervus elaphus, Capreolus capreolus, Rupicapra rupicapra, Sciurus anomalus, Cricetulus migratorius, Mesocricetus brandti, and Meriones libycus.* (Badridze 1995). It should be noted that all bats that occur in Georgia are included in the Appendix II of Bonn Convention and protected under EUROBATS Agreement.

Birds. There are approximately 390 bird species recorded for Georgian avifauna. (Boehme Et Al., 1987; Abuladze, 1997, Zhordania R.G., 1979). More than 220 of these species breed regularly or incidentally in Georgia, others appear in the country only during migrations or in wintertime (Abuladze 1997). Among the larger birds are raptors, storks, and other wading birds.

The most important places for breeding birds along the transmission line are:

- Tugai forest on Gardabani lowland.
- Mountain deciduous forest on the Trialeti ridge nearby of Tetritskaro.
- Mountain forest on the Meskheti ridge, especially in Borjomi-Kharagauli National Park.
- Open landscapes (bogs, swamps and meadows) on Javakheti Upland, especially in Ktsia Tabatskuri Managed Reserve.
- Southern endpoint of the Trialeti ridge.

Georgia is important to Western Palaearctic birds, particularly for raptors, passerines, wading birds, waterfowl, gulls, terns, as well as for the Common Quail and the Black Stork, etc. either as a stopover site on passage and as wintering habitat.

The south-eastern coast of the Black Sea is one of the most important pathways of Western Palaearctic birds' migration. Area includes the south-western part of the Colchic Lowland, seacoast, coastal lowland from Paliastomi Lake and left bank of Rioni River, in north, to Chorokhi River Valley, in south, foothills and pre-mountain area of the western slopes of the Meskheti Ridge. The corridor does not run through this area.

Another migration pathway runs from Kakheti across Iori Tableland, along the Mtkvari river valley and the slopes of Trialeti and Surami ridges to South Georgia and Javakheti Highland. This pathway is important for raptors (including scavengers, waterfowl, cranes, and bustards, especially in the spring. The corridor does cross this pathway.

The entire east-west transmission line corridor crosses the predominantly north-to-south (autumn) and south-to-north (spring) pathways that most migrating birds follow, as can be seen by Figure 4-13, which shows risk to migrating along most of the route. Although the entire east-west sections will present some risk for birds, the most important migration pathways crossed by the transmission line corridor include the following:

- Wetlands and meadows in the upper reaches of the Ktsia River and Tabatskuri Lake
- Vicinities of Tsalka reservoir and wet meadows on Bedeni plateau
- Mtkvari river valley near Gardabani and near villages Sakuneti and Agara.
- Rivers Khrami and Algheti valley and southern slopes of the mountain Yagluja from village Dagheti.

Reptiles. A total of 54 species of reptiles were recorded for Georgia (Bakradze & Chkhikvadze, 1992; Tarkhnishvili et al., in press for the most recent review) and 38 reptiles occur along the transmission line corridor. Among them are five rare species (*Elaphe longissima, Malpolon monspessulanus, Eirenis collaris, Vipera kaznakovi* and *Vipera erivanensis*), which have not been documented in the corridor are but could be expected from the distribution of appropriate landscapes (Bakradze, 1969, 1975; Muskhelishvili, 1970; Tarkhnishvili & Gokhelashvill, 1999). The other species have been recorded throughout the corridor (Darevsky, 1967; Muskhelishvili, 1970; Bakradze et al., 1987; Chatwin et al., 1996; Tarkhnishvili & Gokhelashvili, 1999; Tarkhnishvili et al., in press). However, the importance of populations that are found throughout the Corridor strongly differs between the species.

Most reptile species are restricted in their distribution to southeastern in the vicinity of Gardabani and some distance west. Some have very restricted habitat, particularly in rocky areas, and the range of several has been reduced in recent decades (Tarkhnishvili *et al*. 2002). Areas of high reptile diversity include the slopes of Yagluja Mountain and the eastern shore of Lake Tabatskuri and adjacent parts of Samsari mountains.

Amphibians. There are 12 species of amphibians found in Georgia (Tarkhnishvili, 1995, 1996). Eleven of them are in the districts crossed by the transmission line corridor . Three of these species (*Mertensiella caucasica, Pelodytes caucasicus, Bufo verrucosissimus)* are endemic to the Caucasus and most of their habitat ranges lay in Georgia. One local endemic species (*Mertensiella caucasica*) is found exclusively in the central part of Georgia (Meskheti ridge, Borjomi gorge area). There are three notable species from the corridor of interest that are represented in Georgia by narrow-ranged subspecies. In particular, subspecies *Triturus vulgaris lantzi* and *Hyla arborea schelkownikowi* are regional endemic of the Caucasus. Especially high concentrations of Caucasian and Mediterranean endemic species are observed around the Lower Kartli (two species) and on the Trialeti Ridge (six species).

Of particular interest is one amphibian species, the Caucasian salamander (*Mertensiella caucasica Waga, 1876*). The range of this species is the most severely fragmented and narrowest among Caucasian amphibians. This species is distributed in the humid and warm forests along Meskheti and Shavsheti ridges in Georgia, as well as western foothills of Trialeti ridge (easternmost local population in the Borjomi Gorge) and in north-eastern Turkey (Nikolsky, 1913; Bannikov et al., 1977; Atatur & Budak, 1982; Tarkhnishvili, 1994; Tarkhnishvili, in press). The main reason for decline is the cutting of trees along the stream bank and destroying of habitat as a result of logging. The transmission line corridor crosses the area of its habitat.

The two areas with the most diverse amphibian fauna include:

- Lake Tabatskuri and adjacent parts of Samsari mountains that provide important habitats for the endemic frog *Rana macrocnemis camerani.*
- Forested areas on Meskheti ridge that provides important habitats for large populations of *Mertensiella caucasica, Triturus vittatus, T. vulgaris, T. karelinii, Pelodytes caucasicus, Bufo verrucosissimus, Hyla arborea* schelkownikowi, and *Rana macrocnemis macrocnemis.*

Freshwater Fish. The present ichthyofauna of Georgia comprises 167 species, 109 genera, 57 families, 25 orders and 3 classes. Among them 61 are freshwater inhabitants, 76 live in marine water and 30 species are anadromous (Ninua N., Japoshvili B., 2008). Although the corridor will cross several rivers (section 4.1.4) and pass by several lakes, no towers will be placed in water bodies.

Invertebrates. Invertebrates, particularly insects, are a new group that has been included in the Red Data Books in last decades. Thousands of invertebrates species occur in Georgia and most of them are very poorly studied. There is only fragmented bibliography on most of them. Even taxons such as a classes or orders are not entirely investigated in Georgia. Among poorly studied taxons are free-living flat-worms (*Plathelminthes)*, other aquatic free-living worms, Miriapoda *(Myriapoda)*, aquatic snails. Conservation status of the most of species can be characterised as DD, except narrow-ranged forms, which are *a priori* threatened.

4.1.7.2 Species of most concern

The Caucasus region has very high concentrations of endemic species, exceeding those in nearly all other non-tropical regions. The total number of regional endemic species varies between 20-30 percent for fish, amphibians, reptiles, and mammals (Tarkhnishvili & Kikodze, 1986; Chatwin et al., 1986) and is possibly even higher for some groups of invertebrates. This is explained largely, by the presence of Pliocene forest refugia in the western Caucasus, where many species that are currently absent from elsewhere in the world survived both the sharp decrease of humidity five million years ago and the Ice Age (Tuniyev, 1990; Tarkhnishvili, 1996, 2004; Tarkhnishvili et al., 2000, 2001).

The westernmost section of the transmission line corridor lies in the Western Lesser Caucasus. This region, with its extremely high humidity level and landscapes similar to the North American temperate rainforests, has the highest diversity of forest plants and animals in the ecoregion and harbors a high proportion of the regional endemics, including Pliocene relict species. Those include 11 endemic species of insectivores and rodents, 1 bird, 11 to 14 reptiles, 3 amphibians, and 4 fish. This is nearly 50 percent of the vertebrate species endemic to the Caucasus ecoregion. The list of the Caucasian endemics found in the Western Lesser Caucasus includes 12 species enumerated in the IUCN Red List.

Of the 73 Red List species recorded within the districts along the transmission line route, there are 15 mammals: two are Critical Endangered (CR), three Endangered (EN) and ten Vulnerable (VU). Among 23 birds, there are one CR, seven EN, and 15 VU. One reptile is EN and seven VU. One amphibian is VU. There are two VU fish species and finally there are five EN and 19 VU invertebrate species. Table 4.1-3 lists the name of each species (Latin, English, and Georgian), the Red List status, and its occurrence in the major habitats.

4.1.8 Environmental pollution along the line route

4.1.8.1 Introduction

In general, the transmission line corridor runs through rural and lightly populated areas of southern and western Georgia, where existing environmental pollution is very limited. In southeast Georgia, however, the line passes near a few villages and populated areas.

4.1.8.2 Ambient air quality

Data are very limited regarding ambient air quality along the corridor. Three stations monitor meteorological variables (temperature, precipitation, wind): in Marneuli, close to Gardabani, in the east; in Tsalka, about midway between Gardabani and Akhaltsikhe; and in Akhaltsikhe. There were also stations that historically measured air quality: in Rustavi, Akhaltsikhe and Zestaphoni, the most industrially developed cities near the corridor. The historical data cover from 1988 and 1994, and data show relatively poor air quality at the time. Although data are very limited, air quality has clearly improved since 1991, with reduction in industrial activity and in vehicle traffic. Reliable measurements of air quality after 1994 are not currently available.

A series of air quality studies were conducted for the BTC ESIA to characterize baseline air quality conditions across the pipeline route, which roughly runs parallel to the transmission line corridor. At that time, measurements at different sections of the route showed the values in Table 4.1-4, which represent very good air quality (that is, very low concentrations of pollutants.

Table 4.1-4 Baseline air quality, c. 2001	
Polllutant	*Range of measured values, micro g/m3*
NO2	1-6
SO2	2-4
Benzene (ppb)	0.1 -1.5
Source: BTC Co., 2002	

The Ministry of Environment Protection and Natural Resources approved a methodology for assessing baseline air pollution in rural areas where monitoring data are not available. The manual for calculation permissible limits for emissions to atmosphere air (ministry of Environment protection and Natural resources of Georgia. The suggested methodology is used for calculation atmosphere air baseline pollution levels based on number of population. Table 4.1-5 gives suggested benchmark values in case of different population.

Table 4.1-5. Benchmark values of for pollutant concentrations based on population				
Population, (1,000 inhabitants)	*Background concentration, mg/m3*			
	NO2	*SO2*	*CO*	*PM*
250-125	0 .03	0 .05	1 .5	0 .2
125-50	0 .015	0 .05	0 .8	0 .15

50-10	0 .008	0 .02	0 .4	0 .1
<10	0	0	0	0

4.1.8.2.1 Gardabani to Tetritskaro

The principal source of emissions in this section is the Gardabani power station at the eastern end of the transmission line. The tallest stack at the plant is 270 meters high. A nearby CCTV station is one kilometer from the power station. In addition, there is a cement plant in Rustavi about five kilometers from the power station.

Emissions data are not available, but data from the Ministry of Environment Protection and Natural Resources for Rustavi is presented in Table 4.1-6.

Table 4.1-6. Concentrations of air pollutants in Rustavi, 1999 to 2002					
Pollutant	*Concentration, mg/m3[3]*	*Years*			
		1999	*2000*	*2001*	*2002*
NO2	Daily average	0,07	0,07	0,07	0,07
SO2	Daily average	0,43	0,42	0,40	0,44
CO	Daily average	3,0	3,0	3,0	3,0
PM	Daily average	0,3	0,3	0,3	0,3

There are limited sources in the remainder of this section, primarily wood-burning in homes and very limited vehicle emissions on highways

4.1.8.2.2 Tetritskaro to Agara

Most of this section of the line will run through relatively unpopulated areas, and there are no major sources of air pollutants.

4.1.8.2.3 Agara to Zestaphoni

This section mostly passes through forested mountainous areas along or across deep gorges. Population centers are relatively small and there is little industry or other sources of air pollution for most of the route. In Zestaphoni city, ambient air has relatively elevated levels of combustion gases and particulates, however. Besides vehicle emissions, there are a few industrial sources of air pollutants in or near Zestaphoni, including the Ferro-Alloys smelting plant. Figure 4.1-20 shows pollutant levels in Zestaphoni air from 2001 to 2006. It should be noted that the line terminates 10 kilometers from Zestaphoni.

4.1.8.3 Noise and vibration

Because most of the line runs through forested or agricultural lands, ambient noise levels are very low except near highways or larger population centers. As part of the Samtskhe Javakheti road rehabilitation ESIA study (WYG Internationale, 2007) , noise levels were measured near the road; these areas are not unlike the transmission line route. There were very low levels even near roads. In populated areas, noise levels have been measured in Tsalka and near Akhaltsikhe, with noise levels below 50dB. Similarly, BP measured noise levels in Akhaltsikhe, Vale, and Tetritskaro in 2001. Noise levels were very low, uniformly under 40dB (BTC Co., 2002).

Table 4.1-3. Likely occurrence of Red List fauna along the transmission line corridor

#	*Latin name*	*English name*	*Georgian name (qarTuli dasaxeleba)*	*National status*	*Habitat type*				
					Tugai	*Open lowland*	*Tetrit-skaro forest*	*Mountain grasslands*	*Mountain forest*
			Mammals (ZuZumwovrebi)						
1	*Myotis bechsteinii*	Bechstein's Bat.	grZelyura mRamiobi	VU					V
2	*Barbastella barbastellus*	Western Barbastelle	evropului maCqaTela	VU			R		R
3	*Sciurus anomalus*	Persian Squirrel	kavkasiuri ciyvi	VU			R		C
4	*Nannospalax nehringi*	Nehring's Mole Rat	bruca	VU				R	
5	*Cricetulus migratorius*	Grey Hamster	nacrisferi zazunela	VU		R		U	R
6	*Mesocricetus brandti*	Brandt's Hamster	Amierkavkasiuri zazuna	VU		R		R	
7	*Prometheomys schaposchnikovi*	Long-Clawed Mole-Vole	promeTes memindvria	VU					V
8	*Clethrionomys glareolus ponticus*	Pontian Bank Vole	wiTuri memindvria	EN					V
9	*Meriones tristrami*	Turkish Jird	mcireaziuri meqviSia	VU		V			
10	*Felis chaus*	Jungle Cat	Lelianis kata	VU	R				
11	*Lynx lynx*	Lynx	focxveri	CR			?		R
12	*Lutra lutra*	Otter	wavi	VU	R			R	R
13	*Ursus arctos*	Brown Bear	muri daTTvi	EN			V	V	C
14	*Cervus elaphus*	Red Deer	iremi	CR	R				R
15	*Rupicapra rupicapra*	Chamois	arCvi	EN					R
			Birds (frinvelebi)						
16	*Podiceps grisegaena*	Red-necked Grebe	ruxloyela murtala	VU	VN			VN	
17	*Pelecanus onocrotalus*	Great White Pelican	vardisferi varxvi	VU				RN	
18	*Pelecanus crispus*	Dalmatian Pelican	qoCora	EN				VN	
19	*Ciconia ciconia*	White Stork	laklaki	VU				CB	

Table 4.1-3. Likely occurrence of Red List fauna along the transmission line corridor

#	Latin name	English name	Georgian name (qarTuli dasaxeleba)	National status	Habitat type				
					Tugai	Open lowland	Tetrit-skaro forest	Mountain grasslands	Mountain forest
20	*Ciconia nigra*	Black Stork	yaryati	VU	VB		V?	RB	RB
21	*Anser erythropus*	Lesser White-fronted Goose	patara RerReti	EN	VN			VM	
22	*Tadorna ferruginea*	Rudy Duck	Witeli ixvi	VU	VN			RB	
23	*Melanitta fusca*	White-winged Scoter	garieli					RB	
24	*Haliaeetus albicilla*	White-tailed Eagle	Tetrkuda fsovi	EN	RN	VN		VN	
25	*Accipiter brevipes*	Levant Sparrowhawk	qorcqviTa	VU	RM			VB	
26	*Buteo rufinus*	Long-legged Buzzard	velis kakaCa	VU	UB	UB	RB,CM	UM	VB,UM
27	*Aquila heliaca*	Imperial Eagle	begobis arwivi	VU	VB	VB	VM	UM	
28	*Aquila chrysaetos*	Golden Eagle	mTis arwivi	VU	VM	RM	VN	RB,RM	VB
29	*Neophron percnopterus*	Egyptian Vulture	faskunji	VU	RN	RB,RM	RN	RB, RM	RB
30	*Gypaetus barbatus*	Lammergeyer	batkanZeri	VU		VN		VN	VN
31	*Aegypius monachus*	Black Vulture	svavi	EN	VN	RN,RM	VN	RN,RM	RN,RM
32	*Gyps fulvus*	Griffon Vulture	Orbi	VU	VN	RN,RM	VN	RN,RM	RN,RM
33	*Falco cherrug*	Saker Falcon	Gavazi	CR	VW	VW	VM	VM	VM
34	*Falco vespertinus*	Red-footed Falcon	TvalSava	EN	VM	VM	VM	RB	VM
35	*Aegolius funereus*	Boreal Owl	Woti	VU			UB		UB
36	*Tetrao mlokosiewiczi*	Caucasian Black Grouse	kavkasiuri roWo	VU				RB	CB
37	*Grus grus*	Common Crane	Ruxi wero	EN	RM	UM		RN,CM	?
38	*Panurus biarmicus*	Bearded Parrotbill	ulvaSa wivwiva	VU	VB				
			Reptiles (Qvewarmavlebi)						
39	*Testudo graeca*	Mediterranean tortoise.	xmelTaSuazRveTis ku	VU	C	C	U	R	R
40	*Ophisops elegans*	Snake-eyed Lizard	koxta gvelTava	VU		R			
41	*Darevskia dahli*	Dahli's Rock Lizard	dalis xvliki	VU			R		

Table 4.1-3. Likely occurrence of Red List fauna along the transmission line corridor

#	Latin name	English name	Georgian name (qarTuli dasaxeleba)	National status	Habitat type				
					Tugai	Open lowland	Tetrit-skaro forest	Mountain grasslands	Mountain forest
42	*Darevskia mixta*	Adzharian Rock Lizard	aWaruli xvliki	VU				R	C
43	*Eryx jaculus*	Western Sand Boa	dasavluri maxrCobela	VU	V	R			
44	*Eirenis collaris*	Collared Dwarf Racer	sayeloiani eirenisi	VU	R	R			
45	*Malpolon monspessulanus*	Montpellier Snake	xvlikiWamia gveli	VU		V			
46	*Vipera kaznakovi*	Caucasian viper	kavkasiuri gvelgesla	EN					R
			Amphibians (amfibiebi)						
47	*Mertensiella caucasica*	Caucasian Salamander	Kavkasiuri salamandra	VU					R
	Fish (Zvliani Tevzebi)								
48	*Salmo fario*	Brook Trout	mdinaris kalmis	VU			V	C	C
49	*Sabanejewia aurata*	Golden Spined Loach	winaaziuri gvelana	VU	R	R			
			Invertebrates (Uxerxemloebi)						
50	*Phassus shamil*	Schamyl's Ghost Moth	Kavkasiuri wmindadgaxviara	EN					R
51	*Eudia pavonia*	Small Night Peacock Butterfly	Ramis mcire farSevangTvala	VU					R
52	*Perisomena coecigena*	Rose Peacock Butterfly	mkraTvalebiani farSevangTvala	VU				R	
53	*Manduca atropos*	Death's Head Sphinx	sfinqsi mkvdarTava	EN		R		R	?
54	*Rethera komarovi*	Komarov's Sphinx	komarovis sfinqsi	VU		V		V	?
55	*Deilephila nerii*	Oleander Sphinx	oleandris sfinqsi	EN					R
56	*Callimorpha dominula*	Tiger Moth	daTunela hera	VU			R	V	R
57	*Parnassius apollo*	Appolo	apoloni	VU					R
58	*Parnassius nordmanni*	Nordmann's Appolo	kavkasiuri apoloni	EN					R
59	*Anthocharis damone*	Eastern Orange Tip	amierkavkasiuri aisi	VU				R	R

Table 4.1-3. Likely occurrence of Red List fauna along the transmission line corridor

#	*Latin name*	*English name*	*Georgian name (qarTuli dasaxeleba)*	*National status*	*Habitat type*				
					Tugai	*Open lowland*	*Tetrit-skaro forest*	*Mountain grasslands*	*Mountain forest*
60	*Erebia hewistonii*	Hewistoni's Mountain	hevistonis xaverdula	VU				R	R
61	*Erebia iranica*	Iranian Brassy Ringlet	iranuli xaverdula	VU				V	
62	*Tomares romanovi*	Romanoff's Tomares	romanovis cisfera	VU				V	V
63	*Polyommates daphnis*	Meleager's Blue	cisfera meleagri	VU				V	V
64	*Apocolotois smirnovi*	Smirnov's Looper Moth	smirnovis mbogela	VU		R			
65	*Bombus fragrans*	Big Steppe Humble-bee	velis didi bazi	VU		V		?	
66	*Bombus eriophorus*	Stone Humble-bee	bazi erioforusi	VU			R	R	R
67	*Bombus alpigenus - (B.wurflenii)*	Wurfleni Humble-bee	alpuri bazi	VU				R	R
68	*Bombus persicus*	Persian Humble-bee	iranuli bazi	VU				R	
69	*Xylocopa violaceae*	Violet Carpenter bee	iisferi qsilokopa	VU				R	R
70	*Rosalia alpina*	Rosalia Longicorn	alpuri xarabuza	EN					R
71	*Onychogomphus assimilis*	Dark pincertail	msgavsi nemsiylapia	VU	R	R	R	R	R
72	*Calopteryx mingrelica*	Banded Agrion	samegrelos turfa	VU	R	R	R	R	R
73	*Helix buchi*	Beech Snail	buxis lokokina	VU					R

Notes:
Red List status: CR - Critical Endangered, EN - Endangered and VU - Vulnerable
Status on the corridor: V – very rare; R - rare; U – uncommon; C – common; A – abundant; ? – status unknown. In addition character of occurrence for birds: B – breeding bird (bird breeds within the site); M – migratory species; W – wintering species; N – nomadic visitor or vagrant; National status according to the Criteria of Red Data List of Georgia:

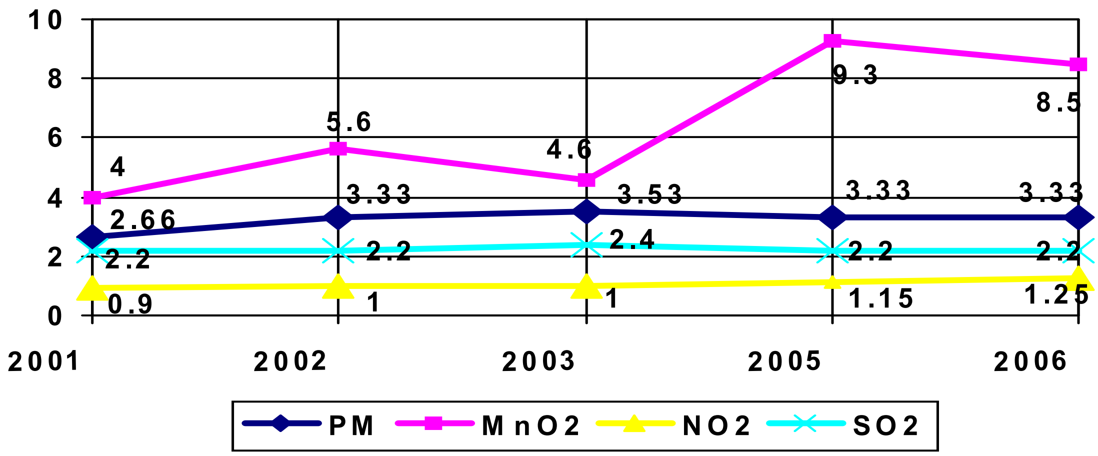


Figure 4.1-20. Concentrations of major air pollutants in Zestaphoni, 2001 to 2006

4.1.8.4 Soil and groundwater pollution

There are no known areas where soil or groundwater have been contaminated. The may not be the case at gasoline stations or other fuel storage facilities, but the lack of industrial activity in the largely rural transmission corridor suggests there are no contamination issues along the route.

4.2 Baseline Socioeconomic Conditions

The area along the route of the transmission line ranges from pastoral lowlands to high mountains. The human settlements along the route are relatively sparse with small agricultural communities that have an average population of 1150 people. The population is a mix of ethnicities, including Azeris, Georgians, Armenians, Meskht, and Greek. Some of the communities were settled more than 600 years ago, others were settled as recently as 1944. Agricultural activities range from cattle, sheep, and goats to short crops such as tomatoes, cucumbers and eggplant, to cereals such as wheat and maize, to more deep-rooted crops such as fruit trees and vineyards. Most agriculture is subsistence, with additional sales at local, and regional markets. Much of the area is economically disadvantaged, with basic infrastructure in need of repair. Many in the younger generations have often migrated to the cities, primarily Tbilisi or abroad, in search of more economic opportunities.

The administrative regions that are crossed by the line are Kvemo Karli, which includes the districts of Marneuli, Tetriskaro, and Tsalka; Samtshke-Javakheti, which includes the districts of Borjomi and Akhaltsikhe; and the Imereti Region, which includes the Zestaphoni district. Information for this baseline characterization draws primarily on the following sources:

- Visits to a range of communities along the route. Communities were selected based on proximity to the line, representative ethnicity, geographic location and characteristics and community size.
- UN Human Development Report 2008 (UN 2008)
- National Statistical Office, Ministry of Economic Development of Georgia
- Baku Tbilisi Ceyhan Pipeline ESIA (BTC Co., 2002)
- Ministry of Culture
- Supplemental information from the Ministry of Energy.

The following sections will describe demographics, social infrastructure, health, and economics.

4.2.1 Demographics

Demographic data described here include population, age distribution, ethnic makeup, literacy and education rates, and migration rates.

Population. The transmission line route tends to avoid more densely populated areas, and as a result, the population density of the districts along the transmission line route is relatively low, as shown in Figure 4.2-1. The area along the line is overwhelmingly rural in nature, and the total population of districts along the route is about 323,700, just over seven percent of the approximately 4,382,100 people in Georgia for 2008 (Table 4.2-1).

Table 4.2-1. Population of Regions and Districts along the proposed transmission Corridor

Georgia	*Kvemo Kartli Region*			*Samtskhe-Javakheti Region*		*Imereti Region*
	Marneuli (District)	*Tetritskaro (District)*	*Tsalka (District)*	*Borjomi (District)*	*Akhaltsikhe (District)*	*Zestaphoni (District)*
4,382,100	122,500	25,800	21,700	31,700	46,800	75,200
Source: Ministry of Economic Development of Georgia, 2009						

The communities that lie closest to the line are listed in Table 4.2-2. The table also shows the distance from the center of the community to the centerline of the transmission line corridor. Shaded communities are those that were visited during scoping.

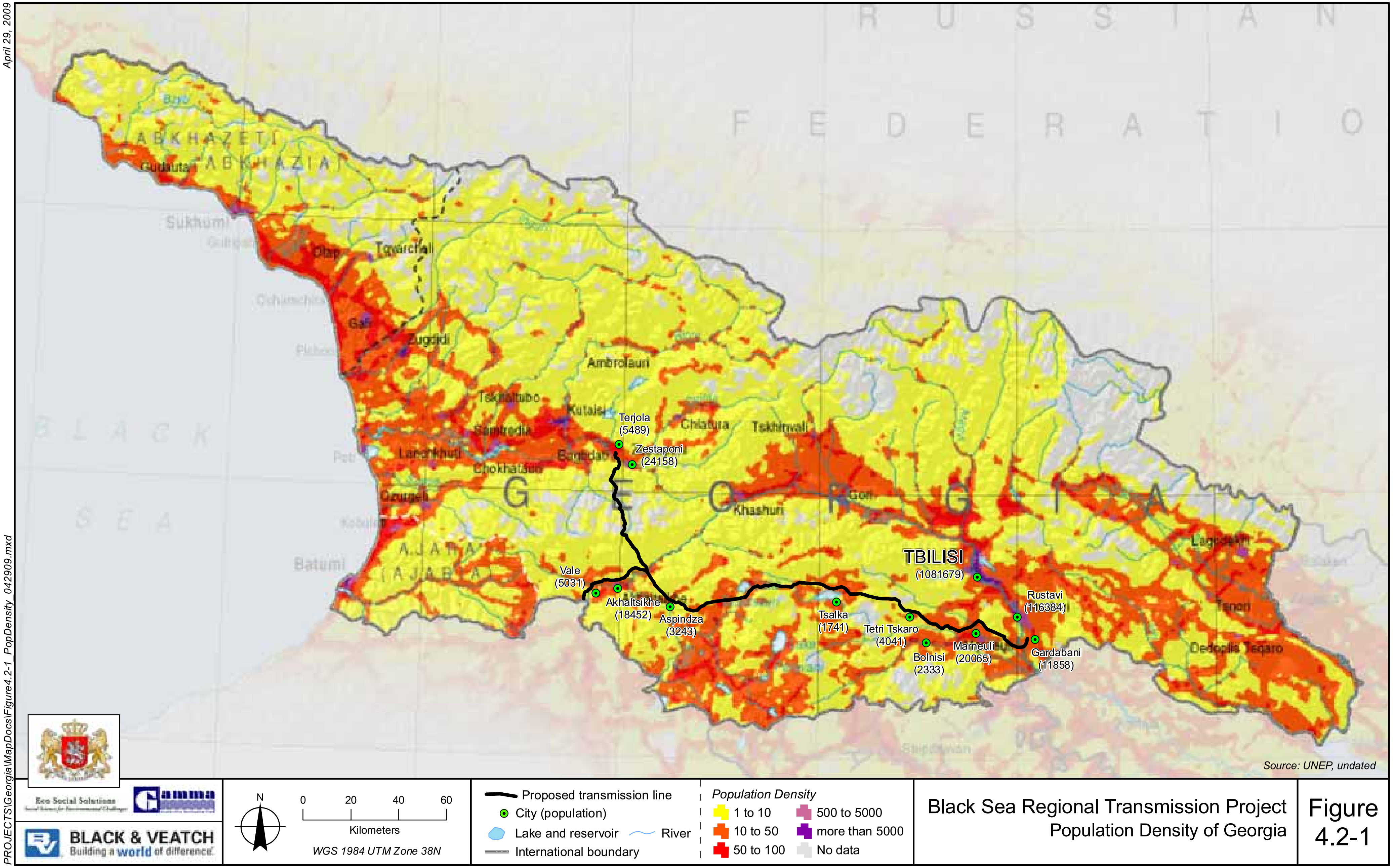
Table 4.2-2. Population of communities within three kilometers of the transmission line corridor

Settlement	*Distance*	*population*
Agara	0.30	350
Alastani	2.31	1,133
Alatumani	1.22	606
Argveta	1.82	1,692
Ashkala	1.40	2,043
Aspindza	2.60	1,941
Avranlo	1.02	717
Azavreti	0.79	1,491
Bashkoi	2.25	207
Beshtasheni	2.17	373
Bezhano	0.72	997
Chikharula	1.81	299
Chkhikvta	2.47	221
Dagheti	1.35	235
Damala	1.24	1,984
Ghado	1.07	1,491
Gokio	0.63	549
Gumbati	1.39	471

Table 4.2-2. Population of communities within three kilometers of the transmission line corridor		
Settlement	*Distance*	*population*
Ilmazlo	0.13	1,033
Imera	1.05	72
Indusa	1.49	0
Jandari/Marneuli	1.99	20,065
Kapanachkhi	1.60	1,283
Kariaki	1.88	152
Keshalo	2.02	3,322
Khani	2.28	817
Kizilkilisa	1.58	1,848
Kochio	2.02	540
Kosalari	0.67	860
Matsevani	2.38	110
Modega	1.76	259
Oshora	1.63	637
Pirveli Sviri	1.53	3,068
Sakraula	2.07	433
Sakuneti	1.40	593
Santa	1.54	84
Shipiaki	2.29	35
Shua Kvaliti	0.51	3,500
Tamarisi	2.40	434
Tarsoni	2.03	9
Tetritskaro	2.54	4,041
Tkemlana	2.24	Not determined
Tsinubani	0.32	425
Zeda Zegani	2.09	146
Source: Ministry of Economic Development of Georgia, 2009		

Age Distribution. The 2008 UN Human Development Report states the age distribution for Georgia as a whole is trending upward, with a decline in birthrates since 2000. Some 17.5 percent of the population is under 15 years of age, 67.9 percent is from 15 to 64 years, and 14.7 percent is over 64 years As of 2007, the average life expectancy at birth is 70.8 years, with life expectancy of 75.5 years for women and 67.0 years for men. The probability of not surviving past age 40 is 7.9 percent, according to the UN Human Development Report. (UNDP, 2009)

The population across the region spanned by the transmission line is also aging, according to extensive surveys conducted for the BTC ESIA (BTC Co., 2002). Data show an aging population in Marneuli and Akhaltsikhe districts, 30 percent above retirement age in Tetriskaro, and Tsalka. The number of live births per woman is 1.5 for Georgia as a whole, which is contributing to the aging demographic of the country. The replacement rate is 2.2 live births per couple, so the population is aging rapidly (UNDP, 2009). Across the transmission line corridor area, the only area where population is believed to be increasing is in the Marneuli district, which has 25 percent of the population under the age of 15. It is believed that the overall aging is due to migration by younger people combined with (and contributing to) lower birthrates. (BTC Co. 2002) Therefore the population in the



Black Sea Regional Transmission Project
Population Density of Georgia

Figure 4.2-1

April 29, 2009

PROJECTS\Georgia\MapDocs\Figure4.2-1_PopDensity_042909.mxd communities near the transmission line is older, in general, and would be familiar with more traditional styles of decision making and government interventions in daily life, including disturbances for infrastructure projects.

Ethnicity. The ethnicities of the communities along the transmission line corridor reflect the complexity of the Caucasus. Areas along the eastern portion of the line are inhabited by predominantly ethnic Azeris who speak the Azeri language, with Georgian and Russian as second languages. This includes the communities of Ilmazlo, Algetis Meurneoba, and Kosalari, and the larger communities of Marneuli and Gardabani. These populations are predominantly Muslim and tend to adhere to more traditional social norms. The middle and northern portions of the lines are predominantly ethnic Georgians. This includes areas around Zestaphoni, Pirveli, and Kvaliti. They speak Georgian as a first language and older populations may speak Russian. The Georgians are Georgian Orthodox. Communities in the southernmost areas along the central portion of the route are ethnic Armenian. This includes the community of Tskurti, and portions on Militi and Tabatskuri. They speak Armenian as their primary language, with Georgian and Russian as second languages. They adhere to the Armenian Orthodox religion and tend, like the Azeris, to adhere closely to their own ethnic traditions and social norms. In the communities of Persa the people are Meskhs who were forcibly settled there in 1944 during the Stalinist period, after being moved from the Georgian coast of the Black Sea near Turkey. They have Turkish roots, speak Georgian and Turkish, and are Sunni Muslim (Conquest, 1991).

Literacy rates/education rates. One legacy of the Soviet system is that literacy rates for Georgia are exceptionally high, with official rates are set as high as 99.8 percent nationally, and even lower estimates do not range much below 95 percent (UNDP, 2009).

Migration. As in the rest of the world, the urbanization of Georgia is occurring as many people from the countryside come to the larger towns in search of economic opportunities. Currently, the percent of population living in urban areas is 52.2 percent, and it is expected to rise to 53.8 percent by 2015 (UNDP, 2009). There is significant migration to the cities from the areas along the route of the transmission line. The BTC ESIA surveys indicate that approximately 30 percent of surveyed households along the BTC route (which runs parallel to a sizeable part of the transmission line corridor) have had at least one member of the household leave to settle elsewhere. The reasons for leaving are to find employment in another country (48 percent), to get married (40 percent), to work in Tbilisi or another part of Georgia (15 percent), and for educational opportunities for themselves and their children (9 percent) (BTC Co. 2002).

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Table 4.2-3. Ethnicity of Georgia and of Districts along the transmission line corridor						
Georgia total	*Kvemo Kartli*			*Samtskhe-Javakheti*		*Imereti Region*
	Marneuli (District)	*Tetritskaro (District)*	*Tsalka (District)*	*Borjomi (District)*	*Akhaltsikhe (District)*	*Zestaphoni (District)*
Georgian -83.8%, Abkhaz – 0.1%, Ossetian – 0.9%, Russian – 1.5%, Ukrainian – 0.2, Azerbaijanian – 6.5%, Armenian – 5.7%, Jewish – 0.1%, Greek – 0.3%, Kurd – 0.5	Azeri - 100%	Georgian – 34%, Armenian - 34% and other ethnicity	Greek - 43%, Georgian and Armenian – 56%	Georgian - 70%, Armenian and Greek – 30%	Georgian – 60%, Armenian – 40%	Georgian – 100%
Sources: BTC Co., 2002 *and* Ministry of Economic Development of Georgia, 2009						

4.2.3 Infrastructure

Roads. Secondary roads in the area along the route are generally in poor condition, with better-maintained and more traveled primary roads crossing the line near larger towns and where the line crosses routes between major towns. The roads that parallel the lines themselves are rarely paved and are generally in poor condition. If the secondary roads have been asphalted in the past, they have not been well-maintained and have been degraded by weather and excessive use. Often the asphalt has become so degraded that vehicles travel on paths along the road. This creates erosion and wear on the terrain, and additional subsequent paths are taken, resulting in large barren swaths of land up to 500 meters wide that consists of vehicle tracks that are no longer suitable for any other types of use. (See figure 4.2-2). In several cases, in fact, attempts to visit communities were hindered by poor road conditions, and this was exacerbated by bad weather.

Additional roads are being built in the southern portion of Georgia, funded by the U.S. through Millennium Challenge Georgia. The Samtskhe-Javakheti Road Rehabilitation Project aims at restoring the road and transport network in the region. With a total budget of USD 183,6 million, the project envisages rehabilitation of the 223.9 kilometer road in Kvemo Kartli and Samtskhe-Javakheti regions. (Bochorishvili, 2009) The transmission line will cross this road around Tsalka. (MCG, 2007)

Figure 4.2-2. Typical secondary road along the transmission line route. Original paved route has been abandoned for successive unpaved tracks.

Other main roads and railways that will be crossed by the line

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include the Tbilisi Baku Road near Ilmazlo, Tbilisi Yerevan Road and the Tbilisi Yerevan railway line north of Marneuli, the railway line from Tbilisi to Akhalkalaki near Tsalka, the Borjomi to Akhaltsikhe to Yerevan road at Aspindza and again near Agara. It will also cross the Tbilisi to Vale railway near Agara. Gokhelashvili, Ramaz, 2008

Access to energy. People who were interviewed during scoping reported they generally have regular energy supplies. Though there is concern among some residents that the towers are worn, and often vulnerable to falling due to storms and high winds. In several communities, existing power lines (not the towers constructed for the line being studied here) were precariously leaning over homes and other structures. Additionally, residents have voiced concern about the condition of existing towers for this line that have been scavenged and are not in workable condition at the moment.

While energy is officially available in 99 percent of households in Georgia (UNDP 2009) the main source of heating in many rural areas is firewood, according to those interviewed during scoping for this ESIA. Both gas and electricity are felt to be too expensive to heat with. It is noteworthy that there are environmental impacts associated with heating with wood due to deforestation, which leads in turn to land and mud slides and long term soil degradation. It is also noteworthy that the interview subjects did not foresee using electricity for heating in the future.

Hospitals. There are no hospitals within 5 kilometers of the corridor of the transmission line corridor. According to the BTC ESIA, hospitals are in larger towns and cities, with medium sized towns having clinics. The smaller communities that are located closest to the line may have clinics, and some may be served by mobile clinics (BTC Co. 2002).

Schools. The survey of the communities nearest the transmission line did not identify any school buildings near the corridor. School buildings were built in accordance with Soviet standards and not near high voltage lines. Additionally, efforts were apparently made to avoid locating lines near school facilities.

4.2.4 Economic conditions

The overall economic conditions in Georgia are improving (UNDP 2009) but largely vulnerable to fluctuations in the world market (UNDP, 2009). Since the August 2008 conflict with Russia, significant amounts of foreign assistance have come into the country to restore and improve infrastructure and provide support to internally displaced people. The resulting economic “boom” has been fueled by construction and foreign investment, combined with increased government spending and improved tax collection mechanisms.(US Central Intelligence Agency, 2009)

Gross domestic product (GDP) and employment. The GDP rose by close to 10 percent in both 2006 and 2007 before slowing to less than 7 percent in 2008, with an anticipated decline in 2009 due to the global economic conditions. The growth rate in the economy is reflected in the increase in *per capita* GDP, adjusted for Purchasing Power Parity which climbed from US$4000 in 2006 to US$4700 in 2008 (US Central Intelligence Agency, 2009).

GDP sectoral composition in 2008 was weighted heavily toward the service sector, with 58.8 percent of GDP being derived from services. Agriculture accounted for 12.8 percent and industry for 28.4 percent. This contrasts with sectoral employment, which is 53.4 percent in agriculture, 10.5 percent in industry, and 36.1 percent in the services sector. This is presented in Table 4.2.4. Each sector is described below.

Table 4.2-4. Georgia economic and employment contributions by sector		
Sector	*Percent of GDP*	*Percent of total employment*
Agriculture	12.8	53.4
Industry	28.4	10.5
Services	58.8	36.1
Sources: Ministry of Economic Development of Georgia, 2009 and U.S. Central Intelligence Agency, 2009		

The discrepancy of the agricultural sector accounting for 53.4 percent of the employment, but contributing only 12.8 percent of the GDP reflects the prevalence of subsistence farming. This probably contributes to what was reported in the UN Human Development Reports, which is that 54.5 percent of the population was living below the poverty line in Georgia between 1990-2004. (UNDP 2009)

The national employment rate is 86.7 percent of which 31.8 percent are hired workers and 54.9 percent are self-employed. The rates of unemployment in the rural areas are much higher. The national unemployment rate is 13.3 percent, whereas in the areas impacted by the transmission line, the unemployment rates range from 30 percent to 39 percent, as shown in Table 4.2-5. (Ministry of Economic Development , 2009)

Table 4.2-5. Unemployment rates by administrative region/district near transmission line	
District	*Unemployment rate*
Georgia	13.3%
Kvemo Kartli	
Marneuli	36%
Tetritskaro	35%
Tsalka	34%
Samtskhe-Javakheti	
Borjomi	39%
Akhaltsikhe	30%
Imereti Region	
Zestaphoni	N/A
BTC Co. 2002 *and* Ministry of Economic Development of Georgia, 2009.	

Communities along the transmission line route where scoping interviews were held were dependent almost wholly on agricultural activities and on income sent from family members working in cities or abroad. Agricultural activities included farming short crops such as vegetables and melons, livestock breeding and herding, cereals production, vineyards, and fruit orchards. Livestock included cattle, sheep and goats. Horses and donkeys are used as beasts of burden, and bred as well. The lands directly under the planned route of the completed transmission line were often cultivated near communities, and nearly all land near communities were heavily grazed. A significant portion of the farming appeared to be subsistence level, with some crops grown for sale in the neighboring towns and cities.

Table 4.2-6. Principal income sources in selected communities near transmission line	
Community	*Main economic activities*
Ilmazlo	Field crops
Algetis Meurneoba	livestock
Kosalari	livestock
Jandari area	farming and livestock
Tetritskaro	Farming; livestock
Azavreti	livestock
Aspindza (Damala)	livestock
Pirveli Sviri	maise wheat and soy
Kvaliti	Vineyards and wheat
Moliti	livestock
Tabatskuri	livestock
Persa	cultivation
Klde	cultivation
Tskruti	cultivation
Benara	farming; cultivation
Agara	Vineyards and wheat/ livestock
Source: scoping interviews	

The cultivation of arable lands near and beneath the proposed line is illustrated in Figures 4.2-3 and 4.2-4. Figure 4.2-4 shows how some towers have been scavenged.

The southeastern portion of the proposed route runs through the Kvemo Kartli region. The towns of Gardabani, Marneuli, and Bolnisi are all within a few kilometers of but not directly on the proposed transmission line corridor. Between 2005 and 2007, there was a marked increase in the economic productivity of Kvemo Kartli, as measured in output by region, including subsidies. Industrial employment has remained constant, but overall employment levels dropped by 16 percent between 2005 and mid-2008 (Ministry of Economic Development of Georgia, 2009).

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The northwest portion of the route is in the Imereti Region, with Zestaphoni being the main town. Between 2005 and 2007, there was a slight decrease in the economic productivity of this region. Industrial employment dropped slightly, and overall employment dropped by 11 percent between 2005 and mid-2008.(Ministry of Economic Development of Georgia, 2009).

The southwestern portion of the route is in the Samtskhe-Javakheti region. It includes the towns of Borjomi, Alkhalkalaki, and the province capital of Akhaltsikhe. The poverty rate is estimated to be 60 percent. Between 2005 and 2007, there was a marked decrease in the economic productivity of Samtskhe-Javakheti, and industrial employment declined by almost

Figure 4.2-3. Cultivated land under proposed line near Ilmazlo. Towers at left are for the proposed line, towers on right support existing lines.

Figure 4.2-4. Cultivated land near proposed corridor. Debris in left foreground is vandalized/scavenged remains of foundation/tower for proposed line. Existing tower and line in rear are not part of the proposed line.

one-third. In this region employment levels dropped by 33 percent between 2005 and mid 2008. Statistical data by towns shows populations have declined from 1989 to 2008 in most of the towns along the route, decreasing by up to a third This is believed to be due to emigration of workers and in some cases their families. (Ministry of Economic Development of Georgia, 2009)

In the area near Jandari, there is a newly constructed basalt processing plant. This plant is located approximately 75 meters from the centerline of the transmission line corridor. The ownership of the plant is not known, and it is possible that some areas of the plant are closer to the line. The ESIA team was not permitted to enter the area near the plant, which is shown in Figure 4.2-5.

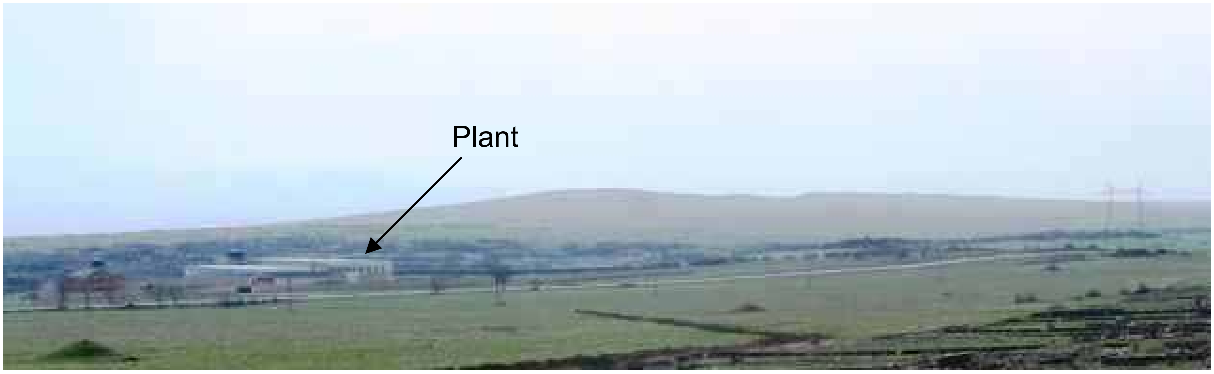

Figure 4.2-5. Basalt processing plant near proposed transmission line (plant is at left center, tower for proposed line visible at right)

The services sector in the area along the route includes traders and merchants, shopkeepers, mechanics, teachers, administrators, etc. The services sector in Georgia is predominantly centered in Tbilisi and larger towns.

4.2.5 Health

The health of the population of Georgia is improving based on global standards set by the United Nations Development Programme. Overall, the major threat to public health is poverty rates. Health care is increasingly expensive, especially when compared to the Soviet era. Private expenditures on health care (as percent of GDP) are now almost 2.5 times the public expenditures. Despite this, 95 percent of one-year-olds are fully immunized against tuberculosis, and 92 percent against measles. The population that is undernourished has dropped significantly, from 44 percent in 1990-1992 to nine percent in 2002-2004. This is mainly due to increased economic and political stability in the region. (UNDP, 2009)

Average life expectancy at birth is 70.7 years, which is high for a medium-developed country. There are 409 physicians per 100,000 people. Birthrates have dropped to 1.5 per woman. Married women are using contraception at the rate of 47 percent, and 92 percent of births are attended by skilled health professionals. The HIV rate for the population aged 15-49 years is 0.2 percent for 2005 (UNDP, 2009).

4.2.6 Cultural Resources

Figures 4.1-19a through 4.1-19h show various types of cultural resources along the transmission line corridor. Cultural resources near the transmission line corridor include historic sites, churches, prehistoric and historic archaeological sites, caves, and other sites. There are 30 such sites within 0.5 kilometer of the centerline of the transmission line corridor (that is, within a one-kilometer corridor centered on the transmission line). These sites are shown in Table 4.2-7. There are an additional 33 sites, for a total of 63, within one kilometer of the centerline.

Table 4.2-7. Cultural resources within 0.5 kilometer of transmission line corridor centerline

Cultural resource at risk	*Distance to centerline (meters)*	*Which alternative(s)?*	*Nearest settlement*
Muslim cemetery	9	Main powerline 500KV	Ilmazlo
Medieval settlement	15	Main powerline 500KV	Kizil-ajlo
2 smal burial mounds	57	Alternatives 2 and 3	mt. Mshrali Mta. Moliti
Burials	61	Main powerline 500KV	Ksovreti
Burials	70	Main powerline 500KV	Shua Khareba
cyclopean castle	77	Main powerline 500KV	Avranlo north west
Medieval settlement	80	Main powerline 500KV	Dageti
Church and tower	80	Main powerline 500KV	Kosalari
Graves, burials	100	Main powerline 500KV	Shua Khareba
Antic period settlement remains	117	Alternatives 2 and 3	Tabatskuri
Church and caves	141	Main powerline 500KV	Avranlo north
Medieval settlement	216	Main powerline 500KV	Jandari
Transfiguration chrurch	250	Main powerline 500KV	Avranlo north
Ruins of Cyclopean fortification	253	Main powerline 500KV	mt. Aia-Ilia, Beshtasheni
Burial	256	Main powerline 500KV	Tetritskaro
Bieti Church	290	Alternative 3	Tsinubani
Bronze Age agricultural fields	303	Main powerline 500KV	mt. Aia-Ilia, Beshtasheni
Middle bronze age structure remains	310	Main powerline 500KV	Shua Khareba
St. Nicholas church	329	Main powerline 500KV	Shua-Kharaba east
Burial Mound, Stone Piles	346	Main powerline 500KV	mt. Bedeni, Iragi

Table 4.2-7. Cultural resources within 0.5 kilometer of transmission line corridor centerline			
Cultural resource at risk	*Distance to centerline (meters)*	*Which alternative(s)?*	*Nearest settlement*
Monument (N/A)	379	Main powerline 500KV	TetriTskaro north west
Cave	415	Main powerline 500KV	Sakuneti south east
Two minor caves (Boordza)	425	Main powerline 500KV	Bolordza
Aqueduct	460	Alternatives 1, 2, and 3	Tskurti
Church	486	Alternatives 1, 2, and 3	Agara north
Church	487	Main powerline 500KV	Kosalari
Ascension church	489	Main powerline 500KV	Shua-Kharaba
St. Peter and Paul church	491	Main powerline 500KV	Santa north
Church	501	Main powerline 500KV	Ksovreti
Church	508	Main powerline 500KV	Gumbati north
Source: shapefiles received from Geo Information Laboratory Ltd.			

During scoping, the ESIA team identified three cemeteries close to the line, only one of which was on the list of cultural resources shown in Table 4.2-7.

One cemetery that is on the list lies directly under the line near the Azeri village of Ilmazlo. This cemetery lies on an eroding bluff above the Kura River and was reported by nearby residents to be over 200 years old. One corner of the cemetery is being eroded into the floodplain, and some graves have already been eroded away. However, there are approximately 50 marked graves remaining which are in the area that will be directly under the line. The cemetery is reported to be over 200 years old and is not used for new graves. Figure 4.2-6 shows headstones in the foreground and towers in the background.

Figure 4.2-6. Old Muslim cemetery under proposed transmission line near Ilmazlo. The three towers on the left, and the double towers in the distance behind those, are part of the proposed line. Towers and lines on right are a different line.

The second community with a cemetery close to the corridor is Kosalari. This cemetery was not on the list of cultural resources, however. It is also an Azeri community, though the cemetery has been used more recently. The conditions of the towers in this community are so poor that residents feel it would be advisable to build new lines around the village so it is not clear if the lines will actually cross this cemetery.

The third community where it appears there may be an impacted cemetery is Azavreti. This is estimated from aerial photographs; the cemetery does not appear on the list. It was not possible to confirm its location or distance because travel to this Armenian community during scoping was not possible due to bad weather.

4.2.7 Tourism

The system of protected areas in Georgia is relatively new. The Borjomi-Kharagauli National Park was established in 1995, with the formal opening in 2001. It has been described as one of the best Protected Areas of Europe.(Ministry of Environment Protection and Natural Resources, 2009) In 2007, the Borjomi-Kharagauli National Park became a member of the European network of Protected Areas – Pan Park, which is a guarantee of the highest level protection of these Protected Areas and focuses on the sustainable development of tourism, according to the Georgian Agency for Protected Areas (Ministry of Environment Protection and Natural Resources, 2009).

The Agency for Protected Areas within the Ministry of Environment Protection and Natural Resources actively promotes development of protected territories. Tourist infrastructure within the park system is best developed in the Borjomi-Kharagauli National Park, with comfortable shelters to host visitors in its different sectors, including Merelisi (Imereti sector), Atskuri (Samtskhe area), Likani and Kvabiskhevi (Borjomi area).

As described previously, the corridor will also cross two other protected areas, the Ktsia-Tabatskuri Managed Reserve and the Gardabani Managed Reserve. Both of these have visitor centers/offices, and are open to the public. They are listed as Manages Natures Reserves to protect areas for conservation through management intervention. (Gokhelashvili, Ramaz, 2008).

Public enjoyment of protected areas has been increasing since the establishment of the park and managed reserve system. The tracking of visitors to protected area (Figure 4.2-7) demonstrates an almost tenfold increase in attendance rates for all areas in Georgia.

The majority of visitors to protected areas are Georgian citizens, according to tracked information available for 2009 (Ministry of Environment Protection and Natural Resources, 2009). Prime visitation periods to parks are expected to be in summer.

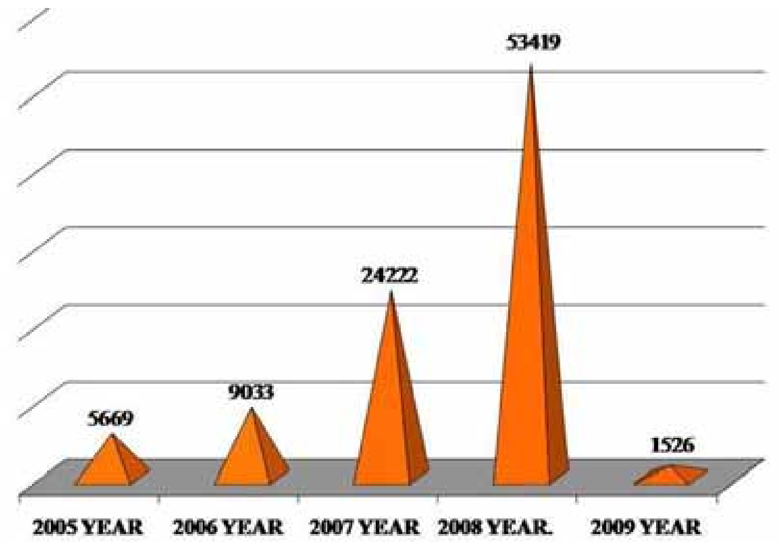

Figure 4.2-7. Visitors to protected areas of Georgia
Source: http://www.dpa.gov.ge/?site-id=15&page=1&id=278

5.0 POTENTIAL ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS

This chapter assesses the significance of the potential environmental and social impacts that would be expected to occur from construction and operation of the project. The assessment follows the methodology described in section 1.4.3. In order to identify potential environmental impacts, the activities and elements of each project alternative as described in Chapter 2 are applied to the existing environment (Chapter 4). A description of the likely impacts arising from each alternative is also included in each subsection, in addition to whether the assessment of significance is likely to change if an alternative is adopted.

The assessment of significance is a function of both the sensitivity of the receptor and magnitude of the impact. Significance can then be determined by using Tables 1.-1 and 1-3 in section 1.4.3. The following subsections follow this method and a summary of potential impacts is provided in Table 5-3-1 in section 5.3. Where significant adverse impacts are predicted to arise, measures to avoid, reduce, or mitigate impacts have been identified throughout this chapter and in the Environmental and Social Management and Monitoring Plan in Chapter 6.

Decommissioning of the project has not been assessed in detail, due both to lack of information about the process (and hence the magnitude of the impact) and the future timing of decommissioning, at which point sensitivity of receptors may have changed (see the discussion in Chapter 2). The environmental and social impacts would be generally similar to those of project construction.

5.1 Potential environmental impacts

5.1.1 Potential impacts on land use

This section describes the potential impacts of the project and each alternative on existing land uses. The existing land uses are described in section 4.1.2. The sensitivity of the land uses has been assessed as part of the impact assessment methodology described in section 1.4.3 in Chapter 1. The sensitivity has been defined according to the criteria in Table 1.1-2.

According to Table 5.1-1, the sensitivity of the land uses at the substation sites and along the majority of the route of the transmission lines (and access roads) is assessed as medium. The landscapes near the protected areas of Gardabani, Ktsia-Tabatskuri, and Borjomi are assessed as high sensitivity. Urban areas near Gardabani and Zestaphoni are assessed as low sensitivity.

Table 5.1-1. Land Use Sensitivity to Change

Sensitivity	*Criteria*	*Areas*
High	National designation or importance	Special Protected Areas at Gardabani, Ktsia-Tabatskuri, and Borjomi-Kharagauli
Medium	Regional and economically important land uses	Forested areas, shrub lands, pasturelands, and agricultural lands.
Low	Degraded and urban land uses.	Areas of urban intrusion or uncontrolled development in the open countryside

5.1.1.1 Activities with the Potential to Affect Land Use

All of the project alternatives include the use of sections previously built and where changes to land use from the towers themselves have already occurred. The proposed action consists of the construction of approximately 86 kilometers of new transmission line in three sections within the original transmission corridor, plus 34 kilometers of new transmission line extending from the original corridor at a new substation near Akhaltsikhe to the Turkish border. Ultimately, new 400 or 500 kV conductor (line) will be installed along the entire project route, which will result in a moderate construction impact for land use. Project activities with the greatest potential to impact land use include:

- Construction and maintenance of a 100-meter-wide corridor for new sections of the right-of-way and 4.5-meter-wide access roads.
- Clearing and maintenance of the 100-meter corridor for previously constructed and overgrown sections of the right-of-way and 4.5-meter-wide access roads.
- Construction and maintenance of a new substation, expansion of two existing substations, and construction of towers and transmission lines that would change the uses of the lands on which they are built.

5.1.1.2 Potential Impacts from construction, rehabilitation, and conductoring

The most significant impact to land use will be from possible changes in land use in areas under the transmission line route or access roads. Impacts will be most significant in forested areas, where trees and understory species will need to be cleared for the entire right-of-way width to support the project. Open grasslands and shrublands, meadows, and agricultural areas (including lands planted for crops or maintained as pasture) will not be as significantly impacted because those land uses can still be used for those purposes under the transmission lines. Impacts to these areas will be limited to the lost use of the land associated with access roads, towers, and substation improvements. As described in section 5.2, owners or farmers will be compensated for lost use and lost income.

Table 5.2-2 summarizes the impacts to main categories of land use associated with the project alternatives. Alternative 1 has the least impact on overall land use and Alternative 3 has the greatest. Impacts to forested land uses account for at least 75 percent of all land use impacts. Alternative 1 affects the least amount of forested area (534 hectare) while Alternative 3 affects most (647 hectares).

Table 5.1-2. Land uses affected by the transmission line route

Land use type	*Impacted Route Length*	*Access Road Impact*	*Tower Impact*	*ROW Clearing/ Maintenance Impact*	*Substation Impact*	*TOTAL Impact*
	(km)	*(ha)*	*(ha)*	*(ha)*	*(ha)*	*(ha)*
Alternative 1						
Forests (1)	53.43	26.72	10.29	534.30	n/a	534.30
Meadow	5.76	2.88	1.61	n/a	n/a	4.48
Mixed Meadow/Agricultural	98.76	49.38	16.86	n/a	n/a	66.24
Agricultural	60.58	30.29	11.12	n/a	2.00	43.41
Open Arid Lands	64.04	32.02	13.24	n/a	5.43	50.68
Grand Total	282.55	141.28	53.12	n/a	n/a	699.12

Table 5.1-2. Land uses affected by the transmission line route						
Land use type	*Impacted Route Length*	*Access Road Impact*	*Tower Impact*	*ROW Clearing/ Maintenance Impact*	*Substation Impact*	*TOTAL Impact*
	(km)	*(ha)*	*(ha)*	*(ha)*	*(ha)*	*(ha)*
Alternative 2						
Forests [(1)]	64.06	32.03	13.06	640.60	n/a	640.60
Meadow	7.85	3.92	2.20	n/a	n/a	6.13
Mixed Meadow/Agricultural	101.18	50.59	17.61	n/a	n/a	68.20
Agricultural	60.58	30.29	11.12	n/a	2.00	43.41
Open Arid Lands	60.12	30.06	13.33	n/a	5.43	48.81
Grand Total	293.79	146.89	57.31	n/a	n/a	807.15
Alternative 3						
Forests [(1)]	64.66	32.33	17.01	646.60	n/a	646.60
Meadow	6.04	3.02	2.11	n/a	n/a	5.13
Mixed Meadow/Agricultural	101.18	50.59	17.37	n/a	n/a	67.96
Agricultural	60.58	30.29	11.12	n/a	2.00	43.41
Open Arid Lands	82.15	41.07	20.31	n/a	5.43	66.83
Grand Total	314.61	157.31	67.93	n/a	n/a	829.93
[(1)] In calculating total forest land use impacts, the impacts for towers access roads were not included because they are already impacted in the overall right-of-way clearing.						

In addition, the project crosses land that is legally protected under Georgian law and so will affect land use in these areas. Table 5.2-3 summarizes the impacts to each of these protected areas. Alternative 3 results in the least impact on protected areas (9.09 hectares) and Alternative 1 the greatest (125.66 hectares). Impacts to Gardabani Managed Reserve are the same for all alternatives. Impacts to Ktsia-Tabatskuri Managed Reserve are least for Alternatives 2 and 3. Impacts to Borjomi-Kharagauli National Park are reduced by nearly two-third under Alternative 2 and to zero by Alternative 3.

5.1.3. Land affected in protected areas						
Protected Area	*Impacted Route Length*	*Access Road Impact*	*Tower Impact*	*ROW Clearing/ Maintenance Impact*	*Substation Impact*	*TOTAL Impact*
	(km)	*(ha)*	*(ha)*	*(ha)*	*(ha)*	*(ha)*
Alternative 1						
Borjomi	11.50	5.75	2.94	115	0	115
Ktsia-Tabatskuri	12.14	6.07	3.03	0	0	9.10
Gardabani	3.11	1.56	0	0	0	1.56
Total protected	26.75	13.38	5.98	0	0	125.66

5.1.3. Land affected in protected areas						
Protected Area	*Impacted Route Length*	*Access Road Impact*	*Tower Impact*	*ROW Clearing/ Maintenance Impact*	*Substation Impact*	*TOTAL Impact*
	(km)	*(ha)*	*(ha)*	*(ha)*	*(ha)*	*(ha)*
Alternative 2						
Borjomi	4.73	2.37	0	47.30	0	47.30
Ktsia-Tabatskuri	10.02	5.01	2.53	0	0	7.54
Gardabani	3.11	1.56	0	0	0	1.56
Grand Total	17.86	8.93	3.72	0	0	56.39
Alternative 3						
Borjomi	0.00	0.00	0	0	0	0.00
Ktsia-Tabatskuri	10.02	5.01	2.53	0	0	7.54
Gardabani	3.11	1.56	0	0	0	1.56
Grand Total	13.13	6.57	2.53	0	0	9.09
(1) In calculating total Borjomi land use impacts, the impacts for towers access roads were not included because they are already impacted in the overall right-of-way clearing.						

5.1.1.3 Potential impacts from operation and maintenance

Ongoing operation and maintenance activities associated with the towers, access roads, transmission line, and substation improvements will generally not change land use except temporarily. Ongoing maintenance activities associated with vegetation control in forested areas will be required to prevent the re-establishment of tall trees in the cleared right-of-way areas. However, the areas affected by ongoing vegetation management in former forest areas are the same as during construction. In most areas, clearing is expected to be required every two to three decades.

5.1.1.4 Impact summary and significance

The significance of potential impacts to land use associated with this project is summarized in Table 5.1-4.

Forested areas, open grasslands and shrub lands, meadows, and agricultural areas (including lands planted for crops or maintained as pasture) are considered to be of medium sensitivity due to their economic importance. All land uses in protected areas are considered to be of high sensitivity due to the national importance of these areas.

The magnitude of change for all alternatives is greater than 0 but less than 5 percent of the overall land use for each category. Additionally, the area of land use that will be affected relative to the overall size of each protected area is 0.16 percent or less. As a result, the significance of the environmental impacts to land use is classified as minor for work sections in protected areas and negligible for work in all other sections in Alternatives 1, 2, and 3. Alternative 4 would have no impacts on land use.

Table 5.1-4. Summary of Significance of Potential Impacts to Land Use				
Type of land	*Significance*	*Potential Impact*	*Magnitude and duration*	*Impact significance*
Alternative 1: Proposed Route				
Protected areas	High	Removal of 115 ha of trees and understory shrubs within 11.5km right-of-way in Borjomi-Kharagauli National Park. Loss of 10.66 ha of land use due to areas lost to access roads, towers, and substation improvements in Ktsia-Tabatskuri (12.1km) and Gardabani (3.1) Managed Reserves	Very low Permanent as long as vegetation in right-of-way is controlled.	Minor adverse
Other areas	Medium	Loss of 584.12 ha of land use due to right-of-way clearing in forested areas and areas lost to access roads, towers, and substation improvements.	Very low (locally moderate) Permanent	Negligible adverse
Alternative 2: Reduce Crossings of Borjomi-Kharagauli National Park and Ktsia-Tabatskuri Managed Reserve				
Protected areas	High	Removal of 47.3 ha of trees and understory shrubs within 4.7km right-of-way in Borjomi National Park. Loss of 9.09 ha of land use due to areas lost to access roads, towers, and substation improvements in Ktsia-Tabatskuri (10km) and Gardabani (3.1km)	Minor, Permanent as long as vegetation in right-of-way is controlled.	Minor adverse
Other areas	Medium	Loss of 759.85 ha of land use due to right-of-way clearing in forested areas and areas lost to access roads, towers, and substation improvements.	Very low Permanent	Negligible adverse
Alternative 3: Avoid Borjomi-Kharagauli National Park and Reduce Crossing of Ktsia-Tabatskuri Managed Reserve				
Protected areas	High	Loss of 9.09 ha of land use due to areas lost to access roads, towers, and substation improvements in Ktsia-Tabatskuri (10km), and Gardabani. (3.1km)	Minor, Permanent as long as vegetation in right-of-way is controlled.	Minor adverse
Other areas	Medium	Loss of 829.93 ha of land use due to right-of-way clearing in forested areas and areas lost to access roads, towers, and substation improvements.	Very low Permanent	Negligible adverse
Alternative 4- No Action				
All areas	Medium to High	None	None	None

5.1.2 Potential impacts on air quality

This section examines potential changes to air quality from the proposed project. In general, where air quality is degraded (for example, due to local emissions), the air quality is likely to be of higher sensitivity to additional impacts than where air quality is good. This is because air quality thresholds and standards (for example, WHO, 2000) may be exceeded and impacts may arise on human health or vegetation. Section BASELINE describes the air quality of the project area. Assumptions on the sensitivity of air quality are shown in Table 5-X-1 below.

Table 5.1-5. Air Quality Sensitivity to Change		
Sensitivity	*Criteria*	*Examples*
High	Poor air quality, where existing emissions (SO2, CO2, PM10, etc) are likely to exceed international thresholds	Urban areas, where emissions from coal-fired power plants and traffic are likely to cause impacts on human health.
Medium	Acceptable air quality, where sources of emissions are present, but not likely exceed international standards	Towns where there are home heating fires and low levels of industrial emissions.
Low	Good air quality	Areas of open countryside where there are few permanent sources of emissions.

This section also examines climatic factors, the most important being contributions of greenhouse gases that contribute to global warming. The sensitivity of the global climate is assessed as being high. Potential impacts arising from the proposed project are discussed in further detail below and are summarized in Table 5.1-6.

5.1.2.1 Activities with Potential to Impact Air Quality

Transmission line facilities do not include combustion sources that are characteristic of many other industrial facilities. Therefore, the primary air quality impacts associated with transmission lines occur during construction due to the release of fugitive dust emissions and pollutant emissions from vehicles and equipment. Pollutant emissions can also occur during project maintenance activities due to vehicular traffic on access roads and the operation of equipment (for example,, gas-powered grass trimmers; lawn mowers; work vehicles; etc.). A third and more minor source of air pollution could be the leakage of sulfur hexafluoride (SF6) from electrical switching equipment and in cables, tubular transmission lines, and transformers.

5.1.2.2 Construction Impacts

Construction impacts to air quality will be limited in extent and duration. These impacts are summarized below.

Sources of Fugitive Dust. Construction activities, including material moving activities, site preparation, and vehicle traffic, if not properly monitored and controlled, have the potential to generate large amounts of fugitive dust. Right-of-way preparation, tower construction activities, and conductoring will likely take no more than several days at each tower site. Substation construction at Akhaltsikhe may take several months but will be confined to the project construction site. The dust-generating construction activities associated with the transmission line may be generally broken down into the following three phases as related to generating fugitive dust:

- Debris removal. Debris removal consists of removing any man-made or natural (for example, trees and brush) obstructions from the transmission line corridor. Under certain circumstances, this phase of construction may require blasting in order to clear the site and/or, in the case of repairing or replacing existing towers, mechanical dismemberment of the structures. This phase will likely also involve material loading/unloading, small disturbed areas, and vehicular travel on unpaved surfaces.
- Site preparation. In the case of transmission lines, “sites” generally include the tower locations and substation locations. Site preparation includes the general site grading and soil stabilization techniques used to bring the site to a final or near final grade. These techniques will typically include cut-and-fill and, in the case of substations and certain access roads, aggregate surfacing operations. Typical fugitive dust emission sources in this phase include movement of earthmoving equipment (for example, scrapers and dozers) over disturbed surfaces, material/aggregate loading and unloading, and vehicular travel on unpaved surfaces.
- General construction. The construction phase is the final, and generally the longest, phase of the construction activities. This phase includes foundation work, structural steel erection, conductor deployment, electrical work and final landscaping. In contrast to the debris removal and site preparation phases, fugitive dust emissions during general construction are somewhat sporadic in nature, depending on the delivery schedule of parts and materials, with many simultaneous operations throughout the construction area.

Within each of the major construction phases described above, there may be one or more specific construction activities occurring that can be a source of fugitive dust. The fugitive dust emissions sources resulting from these construction activities are typically assigned into one of four categories, including disturbed surface areas, open storage piles, earthmoving, and vehicular traffic. The following subsections describe each of these fugitive dust emissions sources as applicable to the construction area.

- Disturbed surface areas. Many of the construction activities will result in temporary disturbed surface areas within the transmission line corridor, particularly at tower locations and at substations. Disturbed surfaces are more subject to wind erosion. A disturbed surface refers to a portion of the earth’s surface that has been physically moved, uncovered, destabilized, or otherwise modified from its undisturbed natural soil condition, thereby increasing the potential for emissions of fugitive dust. Disturbed surfaces do not include those areas which have been restored to a natural state such that the vegetative ground cover is similar to any adjacent natural conditions, or which have been paved or covered by a permanent structure.
- Storage piles. A storage pile is any accumulation of bulk material that is not fully enclosed or otherwise covered or chemically stabilized. The storage pile may be composed of soil, stored temporarily during cut and fill operations, or composed of aggregate used in foundation work and construction materials. Storage piles of this nature are typically left uncovered because of the frequent need to transfer material into and out of storage. Fugitive dust emissions may occur at several points in the storage pile cycle, including material loading or unloading (material handing), and dust entrainment in wind currents on the exposed slopes of the storage pile.
- Earthmoving. Earthmoving refers to a broad range of construction activities using heavy equipment to clear land. The activities may directly expose soil material to wind erosion through excavation, hauling, loading, transferring, and other material moving activities.
- Vehicular traffic. Vehicular traffic associated with the construction activities will likely include worker vehicles, equipment deliveries, and heavy construction vehicle traffic

over unpaved surfaces. When a vehicle travels on an unpaved surface, the force of the wheels on the surface causes the material on the road to become lifted, dropped, and then entrained into the turbulent air currents caused by the velocity of the vehicle. As such, the vehicle's speed and size, silt content of the road surface, and material moisture content all play a role in determining the magnitude of the fugitive dust emissions from unpaved roads.

Vehicle Emissions. Transmission line construction typically involves the use of gasoline- or diesel-fueled vehicles and equipment to transport workers, remove debris from the work area, conduct earthwork, erect structures, deploy conductor, and other activities. The operation of such vehicles and equipment result in emissions of carbon monoxide, NOx, SO2, hydrocarbons, and particulate matter. Total contributions of vehicle emissions are expected to be minor and temporary.

5.1.2.3 Operation and Maintenance Impacts.

Impacts to air quality during operation and maintenance will include vehicle emissions as part of regular maintenance and emergency response activities, emissions of SF6 from electrical equipment (if used), and beneficial decreases in to regional greenhouse gas generation . These impacts are summarized below:

- Vehicle Emissions. Transmission line maintenance activities involve gas-powered trucks, lawn mowers, grass trimmers, and other equipment. The operation of such vehicles and equipment result in emissions of carbon monoxide, NOx, SO2, hydrocarbons, and particulate matter. These impacts will be short-term and temporary. Vegetation control along the ROW will occur once every 5 to 8 years. Ongoing maintenance of towers will be in response to tower damage and would be expected to be very limited in frequency and duration.
- Sulfur Hexafluoride Emissions. Sulfur Hexafluoride (SF6) is a greenhouse gas with a significantly higher global warming potential than CO2 and is typically used as a gas insulator for electrical switching equipment and in cables, tubular transmission lines, and transformers. It is currently unknown if SF6 will be used at any of thru project areas. Use of SF6 should be minimized and only used in equipment with a low leakage rate (<99 percent).
- Beneficial Impacts to Greenhouse Gas Emissions. An important beneficial impact of operating this transmission line is that the project allows electricity generated from hydropower facilities to be delivered to the trans-Caucasus region marketplace, reducing greenhouse gas emissions associated with traditional power generating facilities. This cannot be quantified at present, but is likely to be significant on a regional scale.

5.1.2.4 Impact Summary and Significance

The significance of the impacts to air quality associated with this project are the same for all alternatives (except the no action alternative) and is summarized in Table 5.1-6.

Air quality in the project area is generally good as the project in not located in urban centers and is, on the whole, mostly traversing open countryside. On this basis, air quality was classified as low sensitivity. The magnitude of change, as described in Table 5.1-6 for all alternatives is low. As a result, the significance of the environmental impacts to air quality with this project are classified as "Negligible" for Alternatives 1, 2, and 3 and "None" for Alternative 4.

Table 5.1-6. Summary of Significance of Potential Impacts to Land Use				
Environmental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Magnitude of Impact and Duration*	*Significance*
Alternatives 1, 2, and 3				
Residents	Low	Fugitive dust generation during construction and maintenance	Low Temporary and short-term	Negligible adverse
		Vehicle emissions during construction and maintenance	Low Temporary and short-term	Negligible adverse
		SF6 emissions during operation of project	Low Permanent	Negligible adverse
		Makes hydropower-generated electricity more available to the trans-Caucasus region, reduces reliance on combustion generation	Medium Permanent	Minor beneficial
Alternative 4- No Action				
Residents	Low	No impacts	No change	None

5.1.2.5 Mitigation of potential impacts

Although there are not expected to be any significant impacts on air quality, there are a number of straightforward and inexpensive practices that can reduce nuisance dust and vehicle emissions. Indeed, the planning required for some of them (reducing the "footprint" of land-clearing, for example) could lead to project efficiencies that result in lower cost.

Table 5.1-7. Mitigation of potential air quality impacts	
Substation and transmission line construction activities	
Fugitive dust emissions	*Vehicular/equipment pollutant emissions*
Minimize surface clearing to minimum required for operations. Restrict unnecessary traffic. Near homes, apply water. Wet surfaces before blasting. Revegetation with grasses. Minimize size of material/spoil storage piles. Minimize offsite hauling of debris. Use truck bed covers when hauling materials.	Implement regular vehicle maintenance and repair procedures; utilize fuel efficient equipment and vehicles; utilize emission control devices such as catalytic converters
Transmission line O&M activities	
Restrict unnecessary traffic and ensure that exposed ground is reseeded or otherwise stabilized	Implement regular vehicle maintenance and repair procedures; utilize fuel efficient equipment and vehicles; utilize emission control devices such as catalytic converters
Substation operation SF6 emissions	
Develop and implement SF6 control strategy	

5.1.3 Potential impacts on geology, soils, and geohazards

This section describes the direct and indirect impacts associated with the project on the geology and soils. GIS-based maps were evaluated to identify geology issues and assess soil types along the study area for each alternative. Soil types are shown on Figures 4-5a through 4-5h, which cover the transmission line corridor from east to west.

The main impacts on soils and geology are likely to arise during the various site preparation and construction activities associated with the proposed project. However, soils will also be vulnerable during the operation and maintenance phase. Section 4.1.3 describes the geology and presents maps showing soils of the project area. Soils are assessed as a high sensitivity receptor due to their value as a natural resource.

This section also describes the impacts that the project may have in areas that are prone to geohazards including earthquakes, landslides and mudslides. Section 4.1.5 describes the geohazard areas within the project area. Most of the project area has a high sensitivity for earthquakes, as shown on Figure 4-9, with the highest potential intensity areas located just east of Tabatskuri Lake. The area just south of the Zestaphoni substation and the area between the Akhaltsikhe substation and Aspindza both have a high sensitivity for landslides, as shown on Figure 4-7. The areas between Gardabani and Marneuli have a high sensitivity for mudslides, as shown on Figure 4-8.

5.1.3.1 Activities with Potential to Impact Geology, Soils, and Geohazards

Project activities with the greatest potential to impact geology and soils include clearing and grubbing of vegetation for transmission line ROW and access roads, excavation for tower and substation foundations, and ongoing operations and maintenance. These activities are described below.

- Clearing and grubbing. Clearing of trees and shrubs make the soil more susceptible to erosion and dust generation as the soils under these plants are now exposed to wind and precipitation. ROW and access road clearing also increase sedimentation carried in stormwater runoff. As a result, these areas may also become susceptible to landslides and mudslides over time.
- Excavation. Excavation for transmission tower and substation foundations removes grass and vegetation, exposes soil and makes it prone to erosion from wind and rain. Disturbance potential is greatest during excavation for transmission line tower structures since these can be up to 10 meters deep, while substation foundations are more shallow and impact less volume of soils. Blasting may be required to set tower foundation in rocky terrain. Blasting activities produce seismic waves which could locally produce rockslides, landslides, or mudslides in areas that are geologically unstable. Blasting activities occurring in mountainous terrain during the late winter and early spring could also set off avalanches in areas of a heavy snow pack.
- Operations and maintenance. There is a potential impact for soil erosion and compaction associated driving maintenance vehicles over the ROW during operations and maintenance. Additionally, there is a potential for soil contamination during this activities associated with leaks of insulating oils from transformers and fuel and oil spills from maintenance vehicles.

5.1.3.2 Soil Erosion Impacts

Loss of vegetation and soil compaction increases the vulnerability of the soils to erosion. It is difficult for vegetation to re-colonize bare and compacted areas, so once vegetation is lost, the areas affected by erosion tend to spread through the effects of wind and rain. Soils will be particularly vulnerable during wet weather or after snowmelt, when vehicle traffic is likely to cause the greatest damage.

Erosion of exposed soil and the resulting sediment that is produced can occur from project development, causing air (from dust) and water pollution (from sedimentation). As indicated above, earthmoving activities such as vegetation clearing, grading and grubbing for site preparation, and heavy equipment hauling over unpaved ground, may loosen soils and cause fugitive dust and particulate matter to become airborne. Soil erosion can adversely affect water quality and biological communities in receiving water bodies due to increases in turbidity and rates of sediment deposition. The potential risk for erosion is increased by siting project components in areas with steep slopes, unstable soils such as peat, humus and alluvial soils, and clays which are fine-grained and susceptible to dust and erosion in dry conditions. Additionally, the potential risks to water quality are increased with proximity to stream, rivers, and lakes.

Figure 5.1-1 shows the vulnerability of site soils. This figure shows damage observed during the site visit in March 2009 that had been caused by off-road vehicle movement. Where roads are unsurfaced, rutting and gully erosion eventually makes the roads unpassable so that vehicles drive off the track and the area affected by erosion continually widens.

Figure 5.1-1. Area showing affected soil from off-road traffic

Damage to soils has further effects on land-use. When soil is compacted, it cannot support the native grasses, and this in turn reduces the pasturage that can be used by the livestock of local herders. In addition, the loss of grass affects biodiversity, since grassland is a food source for small mammals, which in turn provide food for predators.

5.1.3.3 Soil Contamination Impacts

Soil contamination can occur from the use, improper handling, and spills of hazardous materials, such as insulating oils, wood preservatives, paints, herbicides/pesticides, and other toxic substances which could be used during the construction, operation, or maintenance of the project. Substations will use transformers and may also use treated wood poles. Paints, fuel, and other hazardous materials are often stored at substations as well in maintenance shops. Vegetation control methods at substations and along rights-of-way may use herbicides and pesticides.

The towers and conductors should not present a significant impact with respect to soil contamination. The conductors are aluminum, which is a naturally occurring element in soils. The towers are made of steel, a composite of iron and carbon which are both also naturally occurring elements. Additionally, the leaching potential for these elements from these structures is extremely low. Paint, if used on the towers, could present a potential impact to soil, if spilled or applied improperly.

- Insulating oils. Polychlorinated Biphenyls (PCB) were widely used as a dielectric fluid to provide electrical insulation, most commonly found in transformer equipment. Although their use has been largely discontinued due to potential harmful effects on human health and the environment, some of the equipment for this project could contain PCB insulating oils. The Ministry of Energy reports that PCBs are not used at the Gardabani and Zestaphoni substations and will not be used at the new Akhaltsikhe substation.

- Wood pole preservatives. While wood preservatives should not pose a risk along the transmission route due to the use of steel tower structures, there may be some soil contamination impact from leaching of preservative treated wood used at the substations. Poles are typically treated with creosote or chromated copper arsenate.
- Petroleum fuels and lubricants. Liquid petroleum fuels and lubricants for vehicles and other equipment pose a risk of contaminating soils if spilled or leaked during construction as well as during operations and maintenance activities.
- Herbicides and Pesticides. All vegetation control along the right-of-way and at the substations will be done mechanically; so there will be soil contamination. However, should this practice be changed, herbicides and pesticides could pose a considerable risk to the soils and adjacent water bodies carried on eroded particles. If herbicides and pesticides are to be use, mitigation measures should be applied to ensure they do not impact nearby soils or water bodies.
- Paints. Paints are likely to be used on substation components and buildings and may be used on the towers. Spills of stored paint and drips from painted equipment could directly contaminate the soils.

5.1.3.4 Geohazard Impacts

There are also potential risks with siting project components in areas where unstable geological features can be impacted and/or seismic events can produce catastrophic geological events such as landslides and mudslides. The mass movement of rock or soils from higher elevations (landslides/mudslides) can impact downgradient lands and residents, or the transmission line and towers. Mass movement occurs on terrestrial slopes when the gravitational force acting on a slope exceeds its resisting force, and slope failure occurs. The slope material's strength and cohesion and the amount of internal friction between materials help maintain the slope's stability and are known collectively as the slope's shear strength. Factors that reduce the frictional resistance relative to the downslope forces, and thus initiate slope movement, can include:

- Seismic shaking
- Increased overburden from structures
- Increased soil moisture from rainfall/snowmelt (can cause mudslides)
- Reduction of roots holding the soil to bedrock
- Undercutting of the slope by excavation or erosion
- Weathering by frost heave
- Bioturbation (displacement of soil and sediment by plants and animals).

Areas with siginficant geohazard impacts are shown on:

- Landslide potential is shown on Figure 4-7. The areas between Zestaphoni and Borjomi-Kharagauli National Park is considered to have very high risk of landslides, the area near and in the Park has a medium risk, and the area from about Aspindza to Agara has a significant risk. The remainder of the corridor, which includes the entire area east of Aspindza, has low, very low, or no risk of landslides.

- Mudflow potential is shown on Figure 4-8. Only areas in the far east sections and far western sections have more than a limited potential for mudflows to occur.
- Seismic zones are shown on Figure 4-9. An area just east of Tabatskuri Lake has the highest potential for seismic hazard, while the rest of the line has lower but still significant potential.

All these figures are presented at the end of Chapter 4.

5.1.3.5 Construction Impacts

Under Alternatives 1, 2, and 3, damaged foundations and towers would be repaired or replaced as necessary. Restoring access to these areas where clearing of forested areas and shrubland in steep-slope areas would be required could expose soils to erosion and mass movement. Restoration and rehabilitation work would not be expected to require blasting or other seismic disturbances except perhaps few foundation replacements, and would not have any significant impact to geology or seismic conditions. There can be a potential for damage to the project in areas prone to seismic events, downhill of areas prone to mass movement of soils.

The main impact on soils during construction will be the increase in vulnerability to erosion and potential for soil contamination. The potential types of impacts are the same for all alternatives except the no action alternative, which does not include construction impacts. The following types of construction activity could lead to potential soil erosion and contamination:

- Vehicle and other construction equipment traffic along access roads and ROW during construction may cause soil compaction, soil rutting, and dust generation. Additionally, mud could be carried off the site on vehicle tires and could result in sedimentation in off-site areas. This will be a short-term impact with a potential to become a long-term impact without mitigation measures.
- Vegetation will be cleared and at least some soil will be removed for the construction camps, the substation and expansions, tower foundations and work areas, and access roads. Clearing of trees and shrubs make the soil more susceptible to erosion, mass movement, and dust generation as the soils under these plants are now exposed to wind and precipitation. Right-of-way and access road clearing also increase stormwater runoff. This will be a long-term and permanent impact for towers and substations as these areas will no longer have accessible soil after construction. Impacts from construction camps will be short-term and temporary, as these areas will only be used during construction activities.
- The installation of tower foundations in rocky terrain/granite outcrops may require blasting activities. Blasting in high slope areas could generate sound and seismic waves that could trigger mass movement of soils, or avalanches in areas of high snow pack. In addition, blasting could fracture supporting bedrock and produce mass movement of overlying soil in high sensitivity areas. Blasting for tower foundations will also result in the removal of vegetation and topsoil and near-surface rock. This will remove the natural erosion and wind control elements and make the soil susceptible to increased erosion and dust generation. If not repaired, this could be a long-term and permanent impact for towers and substations as these areas will not be accessible after construction.
- The installation of tower foundations and towers in inaccessible terrain may require the use of helicopters. Rotor vibration and noise from the helicopters could trigger mass movement of soils as well as avalanches in areas of high snow pack.

- Soil contamination can occur from the use, improper handling and spills of hazardous materials, such as insulating oils, wood preservatives, paints, and other toxic substances which could be used during the construction of the project. This will be a short-term impact with a potential to become a long-term impact without mitigation measures.

The areal extent of soil impact associated with each alternative for substations and transmission lines is quantified in Table 5.1-8 below. There are 20 specific soil types impacted by this project as detailed in the table. A summary of these impacts is provided as follows:

- Alternative 3 has the greatest impact on soils, with a total area of impact of 232.66 hectares (0.0033 percent of all soils in Georgia).
- Alternative 1 impacts the least amount of soils, with a total impact area of 201.94 hectares (0.0029 percent of all soils in Georgia).
- Alternative 2 impacts 211.7 hectares of soil (0.0030 percent of all soils in Georgia).
- The no action alternative (Alternative 4) does not impact any soil and is not included on Table 5.1-8

Impacts to specific soil types, as a percentage of that soil type present in Georgia, is not greater than 0.0342 percent.; this is the maximum impacted soil type (Raw humus degradated-Eroded rendzin leptosols) under Alternative 3.

Most of the project area has a high sensitivity for earthquakes; however, the highest potential intensity areas are located just east of Tabatskuri Lake. The design and construction of towers and foundations to be constructed in this area should consider and be able to withstand these potential seismic forces.

The area just south of the Zestaphoni Substation and the area between the Akhaltsikhe Substation and Aspindza both have a high sensitivity for landslides. The areas between Gardabani and Marneuli have a high sensitivity for mudslides. Activities in these areas will be limited to foundation and tower repair, not new construction. Therefore, there will be minimal impact of the project in these areas.

5.1.3.5 Operation and Maintenance

The main impact on soils and geohazard areas during operation and maintenance of the project will be the increase in vulnerability of soils erosion and potential for soil contamination. The following types of operation and maintenance activity could lead to potential soil erosion and contamination:

- Vehicle traffic along access roads and ROW during construction may cause soil compaction, soil rutting, and dust generation. Additionally, mud could be carried off the site on vehicle tires and could result in sedimentation in off-site areas. This will be a short-term impact likely to occur every five years with a potential to become a long-term impact without mitigation measures.
- Rotor sound/vibration impacts associated with operations and maintenance in areas that require helicopter access.
- Periodic clearing of vegetation as part of normal right-of-way and access road maintenance activities may make the soil more susceptible to erosion. Right-of-way and access road clearing also increase stormwater runoff. This could be a long-term and permanent impact along right-of-way areas that are presently shrubland and forest as these areas will not be allowed to fully revert to these habitats.

- Soil contamination can occur from the use, improper handling and spills of hazardous materials, such as insulating oils, wood preservatives, paints, and other toxic substances which could be used during the operation and maintenance of the project. Vegetation control techniques that use herbicides can introduce environmental contaminants into the soil and adjacent habitats. This will be a short-term impact with a potential to become a long-term impact without mitigation measures.

Once construction is complete, there should be minimal need for vehicles to travel along the right-of-way and access roads except for periodic vegetation management activities and response to tower/line damages from vandalism or natural causes. The extent of soil impact during operation and maintenance will be substantially lower than during construction and has been characterized as negligiblet.

5.1.3.7 Impact Summary and Significance

The significance of the environmental impacts to soils associated with this project are generally the same for all alternatives (except the no action alternative) and is summarized in Table 5.1-9. Because Alternative 2 crosses fewer streams/rivers, there is slightly less potential for erosion.

As a receptor, soils are classified as high sensitivity due to national regulations addressing erosion protection and environmental contamination. The magnitude of change, as described in Table 5.1-9 for all alternatives, is greater than 0 but less than 5 percent of the overall receptor area for each soils type, indicating a low magnitude of change. As a result, the significance of the environmental impacts to soils associated with this project are classified as “Negligible” for Alternatives 1, 2, and 3 and “None” for Alternative 4.

Table 5.1-9. Significance of Potential Impacts on Soils

Environmental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Magnitude of Impact and Duration*	*Significance*
		Alternatives 1, 2, and 3		
Soils	High (Subject to national regulation/protection with regard to erosion protection and environmental contamination)	Soil compaction, soil rutting, and dust generation from vehicle and other construction equipment traffic along access roads and ROW	Very low. Temporary but could be permanent	Minor adverse
		Mud could be carried off the site on vehicle tires and could result in sedimentation in off-site areas.	Very low Temporary	Minor adverse

Table 5.1-9. Significance of Potential Impacts on Soils				
Environmental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Magnitude of Impact and Duration*	*Significance*
		Clearing of trees and shrubs make the soil more susceptible to erosion, mass movement, and dust generation as the soils under these plants are now exposed to wind and precipitation.	Very Low Permanent	Minor adverse
		ROW and access road clearing also increase sedimentation carried in stormwater runoff.	Very low Temporary	Minor adverse
		Blasting for tower foundations will remove vegetation, topsoil, and near-surface rock making the soil susceptible to increased erosion, mass movement, and dust generation.	Very Low Permanent	Minor adverse
		Soil contamination can occur from the use, improper handling and spills of hazardous materials, such as fuels and petroleum lubricants, insulating oils, wood preservatives, paints, and other toxic substances which could be used during the construction of the project.	Very low Temporary but could be permanent	Minor adverse
		Vegetation control techniques that use herbicides can introduce environmental contaminants into the soil and adjacent habitats.	Very low Temporary but could be permanent	Minor adverse
Alternative 4- No Action				
Soils	High (Subject to national regulation/protection with regard to erosion protection and environmental contamination)	No impacts	No change	None

5.1.4 Potential impacts on surface water and groundwater

This section describes the direct and indirect impacts associated with the project on surface water and groundwater resources. GIS-based maps were evaluated to identify and assess the surface water drainage systems, floodplains, wetlands, and the groundwater resources in the study area. Each project activity was evaluated with respect to its direct impact on these hydrologic features, and these impacts are summarized in terms of hectares potentially affected and potential flood control impacts.

Direct impacts to groundwater are likely to be minimal due to the nature of the project; however, there are indirect impacts (for example, reduced infiltration at substations) that will be assessed. Impacts to surface waterways, floodplains, and wetlands will be quantified with respect to the relative importance of each impacted resource and resource area impacted by the project (for example ha. impacted wetlands/ha. total wetlands) and the value of that impact (higher runoff, lost flood control capacity and habitat). Primary impacts include reduced water quality and disruption to water flow.

5.1.4.1 Activities with potential to affect surface water or groundwater

Construction and operation of the project is not anticipated to have any long-term impact on surface water or groundwater resources. Water availability is not a significant issue because there are no consumptive uses or large amounts of water needed for withdrawal for construction, maintenance, or operation of the planned project.

The main project activities with the greatest potential to impact surface water and groundwater include building access roads, excavation for tower and substation foundations, and clearing and grubbing of vegetation for the transmission line right-of-way. These activities can affect water quality and hydrology of local water bodies, and are briefly described below.

- *Access roads.* Road construction, operation, and maintenance activities may cause significant erosion, resulting in increased turbidity and sediment deposition in receiving water bodies, and adversely affect water quality, at least temporarily. Cutting and filling activities during road construction may disrupt subsurface hydrologic flow and bring water to the surface in new areas or destabilize sensitive hill slopes which may cause slope failure. Road surfaces may allow water to flow without restriction, resulting in accelerated surface erosion, channel scouring, and transport of sediment loads to water bodies.
- *Transmission tower/substation excavation*. Excavation for transmission tower and substation foundations will remove grass and vegetation, making exposed soil temporarily prone to erosion from wind and rain. At locations of shallow groundwater conditions, dewatering operations may be required in order to temporarily lower groundwater levels in order to install the proposed new foundations and towers, as well as any underground transmission lines. Towers placed in floodplains can disrupt water flow and trap debris which could further impede floodwater flow.
- *Clearing of transmission corridor*. Clearing and grubbing of vegetation, trees, and shrubs in forested areas may make the soil more susceptible to erosion and increase stormwater runoff, temporarily increasing the amount of suspended solids and turbidity in receiving waters, and potentially increasing the risk of flooding and sedimentation of drainage systems.

The impacts, including magnitude of changes, are discussed in further detail below and summarized in Table 5.3-1 at the end of this chapter. The sensitivity of water receptors are established in sections 4.4 and 4.5. Examples of the sensitivity of the water environment are listed in Table 5-1.10

5.1.4.2 Potential impacts from construction

The main impact on surface and groundwater during construction will be potential adverse impacts to water quality and potential disruption of water flow.

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5.1.4.2.1 Potential water quality impacts

Degraded water quality can be caused by erosion of exposed soil. The resulting sediment that washes downstream can be a major problem from new project development. Earthmoving activities - for example, excavation, vegetation clearing, grading and grubbing for site preparation, and heavy equipment hauling over unpaved ground - disturb soil and create fugitive dust and particulate matter which can be washed into nearby surface waters, resulting in increased levels of turbidity and sediment deposition. These effects can, in turn, impact populations of aquatic organisms in the area.

Table 5.1-10. Examples of General Sensitivity of the Water Environment

Sensitivity	*Examples*
High	- River which supports fish with conservation status or provides major fisheries resources. - River with good water quality (no pollution sources). - Surface or groundwater which is used for drinking water. - Large floodplain.
Medium	- River which supports common fish or provides resource for small-scale fishing. - River with fair water quality (occasional pollution sources) - Surface or groundwater used for industry or agriculture. - Small floodplain.
Low	- River which does not support fish resources. - River with poor water quality (pollution discharge sources). - Intermittent or no use of surface or groundwater by humans. - No floodplain.

Tower construction activities and soil disturbance from vegetation clearing done in close proximity to streams will introduce sediment carried in runoff into these streams. It is unlikely that soil disturbances from the small work areas associated with the towers would be carried more than 100 meters from the each tower construction site. With each alternative there are four towers located within 100 meters of a stream and some sediment could be carried into these streams during construction.

Clearing of forested vegetation will be required for all of the alternative routes between Akhaltsikhe and Zestaphoni. Alternatives 1 and 3 both cross perennial streams that are tributaries of the Rioni River. Where clearing occurs near streams, additional sediment and water quality degradation can occur. Alternative 2 does not any cross perennial streams and would have minimal impact on water quality as a result of forest clearing.

The proposed Akhaltsikhe Substation site is located approximately 500 meters upgradient from the Kura River. There will be an extensive amount of ground clearing and earth moving activity in association with this construction. Due to the amount of soil disturbance anticipated (up to 6 ha) and the proximity of the Kura River, there is a high potential for significant sediment to be carried into the Kura River during rainfall events.

There will also be some potential for water pollution and contamination from hazardous material or fuel spills during construction, operations and maintenance activities. Transformers and other substation equipment may contain insulating oils which can contaminate both soil and groundwater if released. Surface water and groundwater flow can transport contaminants great distances.

Impacts to surface water and groundwater quality resulting from construction or operation of the project can be minimized through the use of best management practices to protect waters from sedimentation due to storm water runoff of excavated materials (for example, silt fencing, hay bales, and re-vegetation as appropriate), dewatering activities, and accidental spill events.

5.1.4.2.2 Disruption of water flow

Increased stormwater runoff and the resulting disruption of surface flow can occur in association with developing areas. Altering the natural vegetation and topography on a site may increase runoff flow rates, resulting in more water moving offsite and carrying sediment with it. The increased stormwater runoff may accelerate erosion downstream, increase deposits of sediments and increase the potential for flooding. Such phenomena are particularly of concern in areas that exhibit steep topography, such as hillsides, ravines, mountain slopes and similar areas.

Paved roads, parking areas and impervious areas at the proposed Akhaltsikhe substation will reduce the surface area that is available for infiltration of rain and other precipitation into the ground, reducing the recharge of subsurface aquifers as well as increasing stormwater runoff to surface water bodies. The foundations for the towers are impervious; however, these are so small (less than one square meter for each leg) as a percentage of the overall infiltration in the right-of-way that they will have a negligible impact on groundwater infiltration of surface water runoff.

Placement of towers in floodplains can disrupt water flow and could trap debris in the river, which could further disrupt river flow. During storm events, this could result in flooding of upstream areas. For each alternative, there are seven towers located in areas that are likely floodplains. Four of these are replacement towers for those previously built; three are located on the new segment from Akhaltsikhe to the Turkish border. The locations for these towers should be examined carefully to choose locations that will be least likely to impede flow.

5.1.4.3 Operation and maintenance

The main impact on surface water hydrology during operation and maintenance of the project will be the increase in vulnerability to erosion and subsequent impacts water quality. The following types of operation and maintenance activities could lead to potential soil erosion and adverse impacts to water quality:

- Periodic clearing of vegetation as part of normal right-of-way and access road maintenance activities may make the soil more susceptible to erosion. Vegetation clearing will also increase stormwater runoff. This could be a long-term and permanent impact along right-of-way areas that are presently shrubland and forest as these areas will not be allowed to fully revert to these habitats.
- Soil and water contamination can occur from the use, improper handling and spills of hazardous materials, such as insulating oils, wood preservatives, paints, and other toxic substances which could be used during the operation and maintenance of the project. Vegetation control techniques that use herbicides can introduce environmental contaminants into the stream. This will be a short-

term impact with a potential to become a long-term impact without mitigation measures.

5.1.4.4 Impact summary and significance

The significance of the environmental impacts to surface and groundwater quality associated with this project are the same for all alternatives (except the no action alternative) and are summarized in Table 5.1-11

As a receptor, surface waters potentially impacted by the project are classified as medium sensitivity because the potentially impacted streams have fair water quality, some industrial pollution sources and have relatively small floodplains. The magnitude of change, as described in Table 5.1-11 for all alternatives is greater than 0 but less than 5 percent of the overall receptor area, indicating a very low magnitude of change. As a result, the significance of the environmental impacts to water associated with this project are classified as "Negligible" for Alternatives 1, 2, and 3 and "None" for Alternative 4.

Table 5.1-1. Significance of Environmental Impact: Surface Water and Groundwater Quality

Environmental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Magnitude of Impact and Duration*	*Significance*
		Alternatives 1, 2, and 3		
Streams and rivers	Medium	Sedimentation caused by runoff due to compaction, soil rutting, and dust generation from vehicle and other construction equipment traffic along access roads and right-of-way.	Very low Temporary but could be permanent	Negligible adverse
		Placement of towers in floodplains can impede flood flows and produce flooding in upstream areas.	Low Permanent	Minor adverse
		Clearing of trees and shrubs make the soil more susceptible to erosion and dust generation as the soils under these plants are now exposed to wind and precipitation.	Very Low Permanent	Minor adverse
		Sedimentation caused by runoff from right-of-way and access road clearing.	Very low Temporary	Minor adverse

Table 5.1-1. Significance of Environmental Impact: Surface Water and Groundwater Quality				
Environmental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Magnitude of Impact and Duration*	*Significance*
		Soil contamination can occur from the use, improper handling and spills of hazardous materials, such as fuels and petroleum lubricants, insulating oils, wood preservatives, paints, and other toxic substances which could be used during the construction of the project.	Very low Temporary but could be permanent	Minor adverse
		Vegetation control techniques that use herbicides can introduce environmental contaminants into the soil, surface water, and groundwater	Very low Temporary but could be permanent	Negligible adverse
		Alternative 4- No Action		
Soils	Medium	No impacts	No change	None

5.1.5 Potential impacts on ecosystems, animals, and plants

This section describes the impacts to ecosystems, flora, and fauna from construction, operation and maintenance of the proposed project and alternatives. Impacts to dominant flora, known fauna, and potential species of special concern (for example, from the International Union for Conservation of Nature (IUCN) Red Lists) are assessed for each ecosystem, and a description of the specific habitat requirements for each protected species is provided. Direct and indirect impacts associated with the project and all alternatives on these ecosystems and species are discussed.

This section of the ESIA specifically describes the direct and indirect impacts of the project with respect to habitat alteration, the increased risk of forest fires (an impact to habitats/ecosystems), and avian and bat collision/electrocution (an impact to fauna) consistent with *Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution* (IFC/WB, 2007). Additional mitigation measures and best management practices to address potential impacts to these resources are provided in this guidance.

For areas/habitats/ecosystems where species of special concern (SOSC) may be affected, this section includes recommendations for specific studies or surveys to be conducted to determine their specific locations and the suitability of habitat in the study area to support them. These studies and surveys are to be performed once the specific tower and access road locations and the installation techniques for each are known and proposed. This will ensure that design modifications and mitigation techniques can be considered in the detailed design. Where present, typical mitigation measures protective of each species are outlined in the ESIA and the EAP based on international best practices, including European and U.S. standards.

The sensitivity of areas along the transmission line is described in sections 4.1.2 (protected areas), 4.1.6 (fauna),and 4.1.7 (flora). These areas are where the most significant impacts can be expected, so the details of the areas, or of the plants and animals that could be affected, are not described again in this section.

5.1.5.1 Project activities that may cause impacts

The main project activities with the greatest potential to impact ecosystems, flora and fauna include construction of transmission line right-of-way, access roads, and substations, installation of conductor wires, and maintenance activities along the transmission corridor.

- Clearing and Construction. Construction of transmission line right-of-way and towers (including rehabilitation), access roads, and substations may transform habitats, depending on the characteristics of existing vegetation, topographic features, and installed height of the transmission lines. Examples of habitat alteration from these activities include destruction or fragmentation of forest, loss of wildlife habitat including nesting area, and establishment of non-native invasive plant species. In addition, animals and plants could be injured or crushed, and animals would be disturbed by noise visual and auditory disturbance due to the presence of machinery, construction workers, transmission towers, and associated equipment. Some impacts would be permanent (for example, tree removal on the right-of-way, use of land for foundations/towers) and some temporary (for example, vegetation removal/crushing in the laydown area, human activities).
- Conductor Installation. Impacts from installation of transmission conductor wires would be relatively short-term and temporary. Vehicular traffic to pull the conductor wire and unloading activities at laydown areas can cause physical impacts, such as injuring or crushing animals and plants. Installation of conductor wires over the entire length of the transmission corridor will cause noise and visual disturbance that could temporarily disturb and displace various animal and bird species.
- Maintenance Activities. Maintenance activities along the transmission corridor may cause erosion and adversely affect water quality. Disturbance from noise and physical presence of machinery and workers will occur during activities such as mowing, weed cutting, tree trimming, inspections, tower and foundation repairs, and maintenance of damaged/downed transmission wires.

5.1.5.2 Potential impacts on terrestrial habitat

The construction, operation and maintenance of substations and transmission line right-of-way, especially for sections that pass through forested areas, will result in alteration and disruption to terrestrial habitat. Excavation, grading, and earthmoving activities physically disturb and remove topsoil which contains plant seeds and invertebrates which are critical for a healthy ecosystem. Erosion and associated loss of topsoil becomes a concern in terrestrial habitats due to construction activities.

Work crews will gain access to tower locations by driving to existing road crossings and entering the right-of-way by driving over the ground or along dirt access roads. Neither permanent nor temporary paved/gravel access roads are proposed to be constructed in the right-of-way, which will greatly reduce potential impacts. In some locations, including that portion of the route that crosses Borjomi-Kharagauli National Park, access may be made by helicopter.

Maintenance activities for the project to control vegetation will be conducted mechanically with cutting activities occurring every six to eight years. Herbicides will not be used for vegetation control, which reduces the potential impacts to plants and to terrestrial habitat.

Adequate terrestrial habitat is critical for the survival of plant species, and must provide suitable food resources, territory, loafing areas, nesting sites, and reproduction dens for birds and animals which depend on the ecosystem. Major impacts of the project are expected to be loss of wildlife habitat including fragmentation of forest, potential for forest fires, and establishment of non-native invasive species due to site development and the presence of construction workers, vehicles and machinery, disturbance of soil and vegetation, and trimming and removal of trees. These are described in more detail below.

Terrestrial habitat modifications. Habitat modifications associated with transmission line construction can adversely affect wildlife populations but can also result in certain positive impacts. Right-of-way clearing during the transmission line construction process can result in a loss of suitable habitat, which is a leading cause of the decline of many plant and animal species, including threatened and endangered species. Biodiversity may be reduced in the construction areas because certain species of plants and animals may be unable to tolerate the disturbance and subsequently leave the area, at least temporarily. Migratory pathways can be affected such that seasonal migration patterns can be interrupted or modified, at least during the construction period. It is noted that the construction period at any one location will be relatively brief, one or two week or less, although construction along a particular section of the corridor could take place over several months.

Conversely, in areas where forest, scrub-shrub, or similar communities dominate, habitat modifications can create additional “edge” habitat, increase the availability of forage area (at least for certain species), and improve overall habitat diversity. As such, the advantages and disadvantages to wildlife habitat must be assessed to arrive at an overall conclusion regarding impacts.

Forest fires. If underlying growth is left unchecked, or if slash from initial construction or routine maintenance is left to accumulate within the right-of-way boundaries, sufficient fuel may be available to promote forest fires. Regular maintenance of vegetation (every six to eight years) within the right-of-way is necessary to avoid damage to overhead power lines and transmission towers. Vegetation maintenance is needed since unchecked growth of tall trees and accumulation of vegetation may result in power outages through contact of branches and trees with energized transmission lines, ignition of forest and brush fires, corrosion of steel equipment, and interference with critical grounding equipment. Forest fires may also be started by construction and maintenance activities if workers are not careful with use of flammable materials and fuels.

Forested ecosystems along the project route would be particularly sensitive to fires, since these areas have the highest potential for fires. Due to the potential risk for forest fires in the forested habitats of the project, mitigation measures will be employed to minimize the potential for fires.

Invasive, Exotic Species. Intentional or accidental introduction of alien or non-native species of flora into areas where they are not normally found can be a significant threat to biodiversity, since some alien species can become invasive, spreading rapidly and out-competing native species.

Clearing of forested habitats along the project route will be the only significant change in habitat type. Once the vegetation has been cleared away, the ground will naturally re-vegetate with native and non-native species. Due to the potential risk of introducing invasive exotic species in the forested habitats of the project, mitigation measures will be employed to minimize invasive colonization and propagation.

5.1.5.2 Potential impacts on aquatic habitat

Construction and maintenance activities may negatively impact water quality of streams, water bodies and groundwater, resulting in potential impacts on local aquatic habitat and downstream river biota, communities, and fisheries. Impacts to water quality may result from erosion and accumulation of sediment and organic debris in water bodies (for example, at stream crossings of the transmission line right-of-way and access roads. Chemical contamination may occur from use and spills of pesticides, liquid fuels or lubricants, equipment coolants, and transformer lubricants. Increased nutrient loads may result from erosion and use of fertilizers. Changes in stream flows may affect fish and aquatic biota populations. Preventing direct adverse impacts to water resources and maintaining riparian zones is critical to protect water quality, quantity and aquatic habitats.

Increased Turbidity and Sediment Deposition. Cutting and filling activities can result in accelerated surface erosion, channel scouring, and sediment transport, which can lead in turn to increased turbidity and sediment deposition in receiving water bodies. The same thing can occur when vehicles cross small streams, or when vehicles traffic reduces vegetation cover near streams. Such impacts can adversely affect water quality and, in turn, the health of fish and aquatic invertebrates by interfering with respiration, feeding, and other activities. Depositions of large amounts of silt and sediment can also cover critical habitat and spawning grounds, making them unavailable for use, and can smother incubating eggs.

Section 5.1.4, which addressed surface water hydrology impacts, concluded that impacts to water quality are not expected to be significant; therefore, the impacts to the wildlife that use these habitats will also be insignificant. However, impacts on a specific small stream or wetland could be significant. For that reason, project activities will avoid activities near and in water as much as is possible, and any damage to streambanks or streambeds will be repaired when work is concluded. This is specified in Table 6-1.

Disruption of watercourse. Power lines and associated roads and facilities may require heavy machinery working in, or construction of crossings over, aquatic habitats. Such activities may disrupt affected watercourses and wetlands, physically uproot aquatic vegetation, and interrupt fish migration/spawning patterns. Slash and debris from construction and maintenance clearing can accumulate in ditches and other drainage structures, enter lakes, streams and wetlands, and block natural hydrologic flow and migratory pathways. Cutting and filling activities may disrupt surface and subsurface hydrologic flows and bring water to the surface in new areas, including existing streams and rivers. Hydrologic changes (i.e., changes in flow rates; flow velocities; etc.) can result in conditions that are unsuitable for certain species or life stages.

Section 5.1.4, which addressed surface water hydrology impacts, concluded that overall impacts to water flow are not significant; therefore, the impacts to the wildlife that use these habitats will also be insignificant. However, impacts on a specific small stream or wetland could be significant. For that reason, project activities will avoid activities near and in water as much as is possible, and any damage to streambanks or streambeds will be repaired when work is concluded. This is specified in Table 6-1.

Invasive and exotic Species. Intentional or accidental introduction of alien or non-native species of flora and fauna into aquatic areas where they are not normally found can be a significant threat to biodiversity, since some alien species can become invasive, spreading rapidly and out-competing native species. Invasive, exotic species may force resident species out of the area, introduce diseases which existing species have no resistance to, compete with indigenous species, or lead to increased predation of resident plants and animals.

There are no activities that will occur close to aquatic habitats that could introduce invasive exotic species into these habitats.

5.1.5.3 Potential physical impacts to fauna

Avian and Bat Collisions and Electrocutions. The combination of the height of transmission towers and distribution poles and the electricity carried can pose potentially fatal risk to birds and bats through collisions and electrocutions. Avian collisions with power lines and transmission structures can occur in large numbers if located within daily flyways or migration corridors, or if groups are traveling at night or during low light conditions such as dense fog. Bird and bat collisions with power lines may result in power outages and fires. If conductors (wires) are not spaced far enough apart to prevent birds from touching two wires at once, or if "bird-proofing" measures are not implemented, large perching birds (particularly raptors) can be electrocuted. Based on migratory patterns and known species of concern, areas of high risk include all the east-west sections of the route, which comprises most of the corridor (see Figure 4-13). Table 6-1 identifies required mitigation measures.

Bird species characterized by rapid flight and the combination of heavy body and small wings run a high risk of colliding with power lines because of their restricted speed of reaction to unexpected obstacles. Among the birds that could be at risk from collision with wires are the following:

- Galliformes – Quail (*Coturnix coturnix*) is an important game species in Georgia. Collision of this species with wires is well-documented.
- Gruiformes – Two species are present, including common crane (*Grus grus*) and Demoiselle crane (*Anthropoides virgo*). The very small population of common crane occurring on the Javakheti plateau has recently been classified as a separate endemic species, and there are fewer that one hundred pairs of this species remaining.
- Pelecaniformes – The two species of pelicans likely to be present do not migrate, although they do move nomadically and might often cross the transmission line. Both species are included in the Red Data List of Georgia.

The general fly-way within the project area lies along the whole of the transmission line route. The fly-way follows the Ktsia-Khrami river valley and the southern slopes of the Trialeti mountain range.

Den and Nest Destruction. Installation of foundations, towers, substations, access roads, and driving over areas of the right of way can potentially destroy or damage nesting and den areas for animals. In areas of known or potential breeding habitat for species of significant concern, which include protected areas and the locations identified in Table 4-1-2 (and shown on Figure 4-15), field surveys will need to be conducted to identify any breeding areas prior to access or construction activities begin. To the extent possible, construction and maintenance in these areas should not take place during breeding seasons, and other actions should be taken to avoid disturbance, as specified in section 5.1.5.5 in Table 6-1.

Other Physical Impacts. Construction and maintenance work involving the clearing of vegetation, excavation of soils, movement of vehicles or equipment over roads, terrain or streams, loading and unloading of materials, deployment of conductor, and other activities can result in the injury or mortality of plants and animals. Crushing, suffocation, removal from protective habitat, destruction of seeding plants, destruction of nests and eggs, and other conditions usually result in the immediate or eventual death of affected organisms. Such impacts can be significant if they involve large numbers of organisms, occur on a regular basis, or affect plant or animal populations that are particularly sensitive, unable to reasonably compensate for losses, or already low in numbers. The surveys required for sensitive areas should reduce this significantly. In addition, most populations are able to recover, particularly if the project is planned to avoid as many critical areas and sensitive habitats as possible, and incorporates the appropriate design measures, such as the raptor protection measures referenced above and other mitigation specified in section 5.1.5.5 and in Table 6-1.

5.1.5.4 Potential physical impacts to flora

Destruction of Flora Communities. Installation of foundations, towers, substations, access roads, and driving over areas of the right of way could destroy or damage individual plants or communities of significant concern. In areas of known or potential habitat within the range of these plant species (areas of high or medium sensitivity on Figures 4-11a through 4-11h), field surveys will need to be conducted to identify whether there any individual plants or communities are located in or near the areas that will be disturbed. If there are, then a Flora Conservation Plan will need to be developed that describes the results of the survey and the steps that will need to be taken to protect the plants or communities, or how there will be equivalent restoration.

5.1.5.5 Sensitive areas that could be affected

In addition to the general impacts discussed above, the project was assessed with respect to the potential for impacting ecosystems, flora, and fauna in specific areas along the project route. Ecosystems are described in section 4.1.2 and these ecosystems are the basis for floral and fauna communities described in sections 4.1.6 and 4.1.7,respectively.

Table 5-1-12 shows the criteria for assessing sensitivity of ecological receptors. The magnitude and significance of impacts are assessed in the sections below.

Table 5-1-12. Sensitivity of Ecological Receptors

Sensitivity	*Ecosystems*	*Species of Flora and Fauna*
High	Rare or uncommon habitats, which increase national biodiversity; irreplaceable or take 10+ years to regenerate	Internationally classified as needing protection under Georgia or IUCN Red List. Shown as High Sensitivity Area on Figures 4-15 and 4-11a through 4-11h.
Medium	Habitats which are regionally or locally uncommon; increase regional biodiversity; take 2-10 years to regenerate	Regionally classified as needing protection under Georgia or IUCN Red List. Shown as Moderate Sensitivity Area on Figures 4-15 and 4-11a through 4-11h.
Low	Common habitats; take less than 2 years to regenerate.	Classified as of lower risk or least concern. Not included on Georgia or IUCN Red List.

Ecosystem impacts. Direct impacts to ecosystems were determined by overlaying the transmission line corridor with the ecosystems maps provided in Figures 2a through 2h. A summary of these impacts is provided in Table 5.1-13, while the magnitude of change is shown in Table 5.1-14. Forested ecosystems are of medium sensitivity as they are regionally and economically important habitats. The remaining ecosystems are of low sensitivity as they are not protected nor are they particularly unique. Table 5.1-13 presents a comparison of the impacts to each ecosystem as a percentage of the total habitat located within two kilometers of the project corridor. None of the ecosystems impacts affect greater than 5 percent of the available ecosystem as a whole; therefore, the magnitude of change is classified as very low. Based on this information, the significance of impact to all ecosystems is considered to be negligible. Some small areas that support unique or otherwise sensitive plant communities may be affected more significantly. The Flora

Conservation Plan described in section 5.1.5.4 above would reduce or mitigate those impacts.

Impacts and mitigation for flora. Direct impacts to floral species are likely to occur anywhere a project element impacts a ground surface; however, the baseline indicates several areas of medium and high sensitivity where impacts can be more significant because they could affect protected floral species or floral species of special concern. These areas are shown in Figures 4-2a through 4-2h. These areas were classified as high sensitivity due to their protected and locally significant status. Additionally, since these species habitats are often locally confined and any disturbance of the habitat can be damaging to the species, these areas are also categorized as high significance. Therefore, the impacts to flora in these moderate to high sensitivity areas is classified as a major impact, and require mitigation.

The specific direct impacts to floral species will depend on the specific locations of new towers, access roads, and the Akhaltsikhe substation, and the species composition around existing foundations and towers, all of which are currently unknown. Detailed botanical surveys of the entire route will need to be conducted by a qualified expert before beginning project construction/rehabilitation activities. Although the survey should cover the entire route, particular attention should be paid to the sensitive areas shown on Figures 4-2a through 4-2h and described in Appendix D. These surveys will identify any endemic, rare, or endangered plant species within the areas to be disturbed by construction or rehabilitation, or by movement along access tracks. The survey will also identify the degree of risk that project activities will have on those protected and rare species, and whether mitigation measures are needed. Several types of mitigation could be used, including (but not limited to):

Modifying construction or other activities to reduce or prevent any impacts (for example, moving a staging area or re-routing a planned access road).

- Preventing vehicle or worker access to some areas (with fencing or flagging, for example).
- Moving the tower(s) of concern, which may be possible in areas where there is no foundation.
- Relocation of plants away from the site. This not practical for shrub and tree species, including the plant species characteristic of forested areas.
- Collecting plants or seeds for use in later reinstatement.
- Placing currently unprotected areas that support the same species under the same degree of protection the project area formerly provided (also known as forest eco-compensation program, or forest off-set). The goal would be to establish or protect an equivalent area of forest or other ecosystem.
- Monitoring during and after construction to detect damage or destruction to species of concern, and to measure the success of mitigation and allow adjustments to mitigation as needed.

The baseline information will provide the information that is necessary to prepare a Flora Conservation plan. The plan will present the results of the survey, specify the exact locations of plant populations of concern, describe the anticipated impacts of planned activities, describe appropriate mitigation measures (which could include those listed above and/or others), and that describe a construction and post-construction monitoring plan to document project activities, impacts, and mitigation success. The mitigation measures to be implemented need to be described in detail, and the mitigation plan can be modified as needed to reflect new information (for example, changes in designs or proposed locations of towers). Each location that needs mitigation will be surveyed again during and after implementation of the approved mitigation. The baseline conditions documented in the plan

Table 5.1-13 Ecosystem impacts

Type	Alternative 1						Alternative 2						Alternative 3					
	Impacted Route Length	Access Road Impact	Tower Impact	ROW Clearing/ Maintenance Impact	Substation Impact	TOTAL Impact	Impacted Route Length	Access Road Impact	Tower Impact	ROW Clearing/ Maintenance Impact	Substation Impact	TOTAL Impact	Impacted Route Length	Access Road Impact	Tower Impact	ROW Clearing/ Maintenance Impact	Substation Impact	TOTAL Impact
	(km)	(ha)	(ha)	(ha)	(ha)	(ha)	(km)	(ha)	(ha)	(ha)	(ha)	(ha)	(km)	(ha)	(ha)	(ha)	(ha)	(ha)
Caucasian middle-mountain landscapes with beech-dark coniferous and dark coniferous (spruce-fir) forests, partly with evergreen understory	2.696281	1.348141	0.5056	26.96281		**28.81655**	2.696281	1.348141	0.5056	26.96281		**28.81655**	5.591724	2.795862	1.9324	55.91724		**60.64551**
Caucasian sub-alpine landscapes with combination of meadows, tall-herb communities, elfin woods and thickets	5.755044	2.877522	1.6068			**4.484322**	7.84724	3.92362	2.2024			**6.12602**	6.043377	3.021688	2.1124			**5.134088**
Caucasian upper-mountain landscapes with birch and pine forests	1.146551	0.573276	0.09	11.46551		**12.12879**	2.103505	1.051753	0.3256	21.03505		**22.41241**	6.898472	3.449236	1.8424	68.98472		**74.27635**
Colchic foothill landscapes with hornbeam-oak forests alternating with beech-chestnut, oak-Zelkova and poly-dominant forests with evergreen understory	9.031135	4.515567	2.2024	90.31135		**97.02931**	9.031135	4.515567	2.2024	90.31135		**97.02931**	9.031135	4.515567	2.2024	90.31135		**97.02931**
Colchic low-mountain landscapes with hornbeam-oak and hornbeam-beech-chestnut forests mainly with evergreen understory, partly alternating with oak-pine forests	3.188237	1.594119	0.8312	31.88237		**34.30769**	3.188237	1.594119	0.8312	31.88237		**34.30769**	3.188237	1.594119	0.8312	31.88237		**34.30769**
Colchic middle-mountain landscapes with beech forests mainly with evergreen understory	20.04497	10.02248	3.9548	200.4497		**214.427**	20.04497	10.02248	3.9548	200.4497		**214.427**	17.0415	8.520748	6.0672	170.415		**185.0029**
Mountain forests of the western part of the Lesser Caucasus. In the lower zone (at the height of about 600-900 m) dry small-leaved trees with predominance of hornbeam and oak, in the middle zone - mixed (fir, silver fir, alder, beech, hornbeam, etc)	9.932195	4.966097	2.618	99.32195		**106.906**	19.60547	9.802735	5.146	196.0547		**211.0034**	15.51272	7.756358	4.0448	155.1272		**166.9283**
Mountain prairies and sub-alps of the Tsalka Plateau and Javakheti highland. The height is 1500-3300 m	98.75568	49.37784	16.8648			**66.24264**	101.1845	50.59225	17.606			**68.19825**	101.1845	50.59225	17.3704			**67.96265**
Shrubberies, sparse woods and other arid and semi-arid natural landscapes. On the Iori plateau it is represented by hills covered by the sparse woods with the spots of pistachio-tree, shrubbery of spiraea, juniper and Christ's thorn	60.57718	30.28859	11.1232		2	**43.41179**	60.57718	30.28859	11.1232		2	**43.41179**	60.57718	30.28859	11.1232		2	**43.41179**
The mountain forests, mostly moderate dry ones with dissemination of beech, more seldom - fir-groves	7.397038	3.698519	0.09	73.97038		**77.7589**	7.397038	3.698519	0.09	73.97038		**77.7589**	7.397038	3.698519	0.09	73.97038		**77.7589**
the species characteristic for flora in the upper flow of the Kura and its tributaries Paravani and Potskhovi is poorer; though it consists mainly of the same species as the flora of Iori Plateau	64.03705	32.01853	13.2356		5.43	**50.68413**	60.1186	30.0593	13.3256		5.43	**48.8149**	82.14591	41.07296	20.314		5.43	**66.81696**
Grand Total	282.5614	141.2807	53.1224	534.3641		736.1971	293.7942	146.8971	57.3128	640.6664		852.3062	314.6118	157.3059	67.9304	646.6082		879.2745

Table 5.1-14. Magnitude of Change – Ecosystems

Ecosystem	Total w/i 2km	Alt 1		Alt 2		Alt 3	
		Impact (ha)	% of Total	Impact (ha)	% of Total	Impact (ha)	% of Total
Caucasian middle-mountain landscapes with beech-dark coniferous and dark coniferous (spruce-fir) forests, partly with evergreen understory	2696.6	28.8	1.1%	28.8	1.1%	60.6	2.2%
Caucasian sub-alpine landscapes with combination of meadows, tall-herb communities, elfin woods and thickets	5142.8	4.5	0.1%	6.1	0.1%	5.1	0.1%
Caucasian upper-mountain landscapes with birch and pine forests	3876.4	12.1	0.3%	22.4	0.6%	74.3	1.9%
Colchic foothill landscapes with hornbeam-oak forests alternating with beech-chestnut, oak-Zelkova and poly-dominant forests with evergreen understory	4157.9	97.0	2.3%	97.0	2.3%	97.0	2.3%
Colchic low-mountain landscapes with hornbeam-oak and hornbeam-beech-chestnut forests mainly with evergreen understory, partly alternating with oak-pine forests	1199.4	34.3	2.9%	34.3	2.9%	34.3	2.9%
Colchic middle-mountain landscapes with beech forests mainly with evergreen understory	11120.8	214.4	1.9%	214.4	1.9%	185.0	1.7%
Mountain forests of the western part of the Lesser Caucasus. In the lower zone (at the height of about 600-900 m) dry small-leaved trees with predominance of hornbeam and oak, in the middle zone - mixed (fir, silver fir, alder, beech, hornbeam, etc)	18802.9	106.9	0.6%	211.0	1.1%	166.9	0.9%
Mountain prairies and sub-alps of the Tsalka Plateau and Javakheti highland. The height is 1500-3300 m	42925.8	66.2	0.2%	68.2	0.2%	68.0	0.2%
Shrubberies, sparse woods and other arid and semi-arid natural landscapes. On the Iori plateau it is represented by hills covered by the sparse woods with the spots of pistachio-tree, shrubbery of spiraea, juniper and Christ's thorn	23924.0	43.4	0.2%	43.4	0.2%	43.4	0.2%
The mountain forests, mostly moderate dry ones with dissemination of beech, more seldom - fir-groves	5863.2	77.8	1.3%	77.8	1.3%	77.8	1.3%
the species characteristic for flora in the upper flow of the Kura and its tributaries Paravani and Potskhovi is poorer; though it consists mainly of the same species as the flora of Iori Plateau	27235.9	50.7	0.2%	48.8	0.2%	66.8	0.2%

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will also be compared to post-construction monitoring results to allow an evaluation of mitigation necessity and success. If necessary, mitigation can be adjusted as needed until it meets its original goals.

The Flora Conservation Plan, and all mitigation plans, will need to be reviewed and approved/agreed to by the Ministry of Environment Protection and Natural Resources.

Impacts and mitigation for fauna. Direct impacts to fauna are not expected unless a den or nest is located at a location where a tower, access road, or substation will be placed, or unless birds encounter the line or transmission towers during migration or local movements. In most cases, faunal species are mobile and would be likely to vacate an area prior to significant disturbance activities. During breeding and rearing seasons (for various species, that could range from March through July or August) however, animals may not be able to leave the area to avoid disturbance.

Section 4.1.7 identified several areas where important or rare birds or animals could be affected; these are shown in Figures 4-12 through 4-15. These areas were classified as high sensitivity because the habitat is important for protected species or because it is important for biodiversity. Additionally, since habitats for some terrestrial species are often locally confined and any disturbance of the habitat can be damaging to the species, these areas are also categorized as high significance. Therefore, the potential impact to fauna in these high sensitivity areas is classified as a major impact.

Various mitigation measures will be necessary to prevent, reduce, or compensate for impacts to critical ecosystems and protected fauna. The specific direct impacts to faunal species will depend on the specific placement of new towers, access roads, and the substation, and the occurrence of species of concern in those precise areas, both of which are currently unknown. Two broad categories of mitigation will be necessary, one intended for potential impacts to birds and the other for terrestrial animals.

Mitigation measures for birds include:

- During breeding season for raptors, cranes, and other large birds of concern, a survey will be conducted by a qualified expert immediately prior to any construction or other activities in the areas identified on Figure 4-15. If any active nests are identified within 0.5 kilometer of where construction or other activities will be conducted, then construction should be postponed until after young birds fledge and leave the nest, or all construction activity should moved to a distance of at least 0.5 kilometer from the nest. If older but recent nests are found, then artificial nest platforms (at least three for every recently used nest) will be constructed at least 0.5 kilometer from any area where there will be disturbance. If at all possible, both construction and maintenance in areas shown in Figure 4-15 should be conducted outside of breeding season, which lasts from about April to July or August.
- Conductors (wires) will be spaced at least as far apart as the wingspan of large birds (approximately three meters) apart, and towers will be constructed so as to be “bird-proof” as possible.
- Consideration of so-called “bird diverters” that can be placed at intervals along the conductors. These are shiny metal objects that spin in the wind and catch birds’ attention and cause them to avoid the wire.
- Other mitigation measures that may be appropriate may be found in the Avian Power Line Interaction Committee’s *Suggested Practices for Avian Protection on Power* Lines (APLIC, 2006).

In the high-risk areas identified in Figures 4-12 (risk during construction phase), 4-14 (risk during operation and maintenance), and 4-15 (risk to ecosystems), mitigation for potential impacts on terrestrial animals will include a survey for species of concern (IUCN and Georgia Red Book species, among others) prior to construction. If species of concern are identified, a Fauna Conservation Plan will be prepared that describes the results of the survey, whether mitigation may be needed to prevent or reduce impacts on species of concern, and what types of mitigation measures may be necessary, if any. This plan should be approved by the Ministry of Environment Protection and Natural Resource. Mitigation measures could include (but not limited to):

- Movement of tower or other locations to avoid disturbance of isolated populations.
- Re-scheduling construction to avoid breeding seasons.
- Re-routing of access roads to avoid specific areas.
- Conducting maintenance outside of breeding seasons.

- Monitoring to detect interference with breeding animals, or any injuries or mortality (to species of concern).
- For birds, constructing artificial nesting platforms for raptors or white stork (*Ciconia ciconia*).

If locations are found to have nests of raptors or protected species, bat roosting sites, or Brandt's hamster colonies, or other such areas related to protected species, these may not be disturbed or destroyed with permission from the Ministry of Environment Protection and Natural Resources.

5.1.5.5 Summary and significance of potential impacts to flora and fauna

Because Alternatives 1, 2, and 3 call for the transmission line to cross protected areas, there could be major adverse impacts to ecosystems, flora, and fauna from all these alternatives. Thus, the significance of their impacts is similar generally the same for all alternatives (except the no action alternative), as summarized in Table 5.1-15. However, impacts would be somewhat lower under Alternative 2 due to the 60 reduction in the area of Borjomi-Kharagauli National Park that will be affected, and the 16 percent reduction in Ktsia-Tabatskuri Managed Reserve. Under Alternative 3, there would be a 100 percent reduction in the area of Borjomi-Kharagauli that was affected, and the same reduction in Ktsia-Tabatskuri. However, there would be over 60 kilometers of additional corridor that had to be cleared in mountainous terrain in order to go around the park to the west. Although there would be less disturbance to formally protected area, there would be much more disturbance to area flora and fauna.

5.1.6 Potential effects on landscape appearance

This section examines the effects on the landscape of the project alternatives, and the effects on visual receptors. The existing landscape was described in section 4.1.2 in Chapter 4. The sensitivity of the landscape and visual receptors has been assessed as part of the impact assessment methodology described in section 1.4.3 in Chapter 1. The sensitivity has been defined according to the criteria in Table 1-1.

Visual impacts to the landscape were evaluated using a viewshed analysis. Line-of-sight impact maps were developed for each alternative using a digital elevation model, land cover mapping, and project information in a GIS system to identify areas along the project routes that are visible to the public. Given the lattice structure, the thinness of the wires, the relatively low height compared to other features (trees and buildings), and the sensitivity of the human eye, it is unlikely that most viewers would be able to discern the project features at distances greater than five kilometers. Therefore, this was the limit placed on the viewshed model.

The sensitivity of visual receptors depends upon the local situation. The actual sensitivity of visual receptors and views over the transmission line will depend on the location and context of the viewpoint and the occupation and activity of the visual receptor. Potential visual landscape receptors in the region include local residents, travelers, and tourists. Table 5.1-16 summarizes the existing visual receptors and their sensitivity to change at the project site.

Landscape character is derived from the intervention of human activity with the natural physical land surface. At its root is the solid geology and subsequent physical processes of weathering and deposition that have modified the topography of the land surface. This in turn influences the human activities of land use, leading to a landscape character that reflects both human and other influences. Landscape impact assessment is concerned with:

- Effects on landscape elements or the overall pattern of elements that give rise to landscape character and regional and local distinctiveness.

- Impacts upon acknowledged special interests or values such as designated landscapes, conservation sites, and cultural associations (IEMA and LI, 2002).

Table 5.1-15. Significance of potential impacts to ecosystems, flora, and fauna

Environmental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Magnitude of Impact and Duration*	*Significance*
Alternatives 1, 2, and 3				
Forested Ecosystems	Medium	Habitat modification	Low, Permanent	Negligible adverse
		Forest fires	Very low, Temporary	Negligible adverse
		Introduction of invasive species	Negligible, Temporary	Negligible adverse
Other Ecosystems	Low	Habitat modification	Very low, Permanent	Negligible adverse
		Forest fires	Very low, Temporary	Negligible adverse
		Introduction of invasive species	Very low, Temporary	Negligible adverse
Flora in sensitive areas	High	Destruction of floral community and individuals during construction and maintenance activities	High, Permanent	Major adverse
Flora in other areas	Low	Destruction of floral community and individuals during construction and maintenance activities	Low, Permanent	Negligible adverse
Fauna in sensitive areas	High	Avian and bat collisions/electrocution from contact with power lines.	High, Permanent	Major adverse
		Den and nest destruction during construction and maintenance activities	High, Permanent	Major adverse
Fauna in other areas	Low	Avian and bat collisions/electrocution from contact with power lines.	Low, Permanent	Negligible adverse
		Den and nest destruction during construction and maintenance activities	Low, Permanent	Negligible adverse

Table 5.1-16. Visual Receptors and their Sensitivity to Change

Visual receptor type	*Sensitivity to Change*	*Receptors/areas of concern*
Residents	**Moderate –**Residents are likely to be highly sensitive receptors due to permanent disruption or obstruction of views.	Disruption of views – residential population centres. Obstruction of views – local residents.
Tourists	**High –** Many tourists visiting this region of Georgia would be doing so to enjoy the natural landscape and recreational opportunities of the region.	National Parks, Managed Preserves.
Travellers	**Low –** Travellers are of low sensitivity as visual disruption is for a short period of time.	Main highways where the project would be visible

Figure 5.1-2. View of rolling grasslands typical of the eastern portion of the transmission line corridor

Figure 5.1-3. Arid grasslands and terraced slopes typical of the environs near Akhaltsikhe

Visual impacts introduce a human element to a landscape assessment by changing how humans perceive the landscape. The degree of impact will be subjective and thus will vary between individuals. However, general predictions of impact significance can still be made. Therefore, visual impact is concerned with:

- The direct impacts of the development upon views of the landscape through intrusion or obstruction.
- The reactions of viewers who may be affected.
- The overall impact on visual amenity, which can range from degradation through enhancement. (IEMA and LI, 2002).

The landscape over most of the transmission line route alternatives includes rolling grasslands with relatively few trees and shrubs (Figure 5.1-2). Due to human development in the region, many of these areas already are traversed by transmission and power distribution lines. On the Iori Plateau, the terrain becomes more mountainous and rugged but still lacks significant tree cover. West of the Iori Plateua to just north of the proposed Akhaltsikhe substation, the terrain becomes gently rolling with grasses and small shrubs typical of a more arid landscape. This same landscape is present from Akhaltsikhe to the Turkish border.

North of the proposed Akhaltsikhe substation to the Kvirtla River, in an area that includes the Borjomi-Kharagauli National Park, the terrain becomes more mountainous and rugged and is generally densely forested. Near the existing substations at Gardabani and Zestaphoni, the landscape is relatively flat grasslands (Figure 5.1-3) with significant urban development and multiple other transmission lines coming from other regions

5.1.6.1 Activities with the potential to affect the landscape

All of the project alternatives include the use of sections previously built and where visual impacts have been felt for nearly 20 years. Alternative 1 would require construction of approximately 86 kilometers of new transmission line in three sections within the original transmission corridor, plus 34 kilometers of new transmission line a new substation near Akhaltsikhe to the Turkish border. Ultimately, new 400/500 kV conductor lines will be installed along the entire project route and a new substation will be constructed near Akhaltsikhe. In addition, the existing substations at Gardabani and Zestaphoni will be expanded. More specifically, the project will include the following activities that may affect the landscape:

- Clearing and maintaining a 100-meter-wide wide right-of-way through forested areas where they presently occur.
- Construction and maintenance of a new substation near Akhaltsikhe on six hectares of property.
- Constructing and maintaining 120 kilometers of new transmission line towers approximately 35 meters in height.
- Replacing approximately 118 towers that were previously constructed.
- Expanding the existing substations at Gardabani and Zestaphoni on adjacent properties.

Construction activities will affect the visuallandscape due to the size and scale of the project, and the relative proximity of sections of the corridor. The principal potential impacts would be:

- The disturbance of natural views for residents and tourists by the presence of transmission line towers, conductor lines, and right-of-way clearing.
- The obstruction of views by transmission line towers and the new substation near Akhaltsikhe.

The viewshed model for the project and each of the alternatives is presented in Figures 5.1-4 through 5.1-8.

5.1.6.2 Disturbance of views by transmission line, towers, and right-of-way Clearing

The impact to local residents would be generally permanent because the line will be maintained in operation for the foreseeable future. Local residents are present near most areas along the transmission line corridor; however, the impacts will be greatest in villages and towns within the viewshed. Although towers may be within the views of residents, travelers, and tourists, they would be unlikely to obstruct views. The towers proposed are lattice towers that do not completely obstruct the landscape. The towers will be centered in the 100-meter-wide right-of-way and will be no closer than 30 meters to the nearest residents, a distance too far to obstruct views of the landscape. (As noted previously, although lines could theoretically be seen from farther away from five kilometers, their lattice structure and the thin wires are very unlikely to be seen from farther away. In addition, the view is unlikely to be obtrusive from farther than one or a very few kilometers.)

Figure 5.1-4 shows there are 58 population centers (cities, towns, and villages) within the viewshed of Alternative 1. There are 57 population centers within the viewshed of Alternative 2 and 61 for Alternative 3. People traveling along highways and roads near the project could potentially be affected by views of the project where these roads pass through the project viewshed. These impacts would be very temporary since they would only occur the short time it took to traverse the area within site of the line. As shown on Figure 5.1-4, there are 197.0 kilometers of roads main roads within the Alternative 1 project viewshed. There are 197.9 kilometers of main roads within the viewshed of Alternative 2 and 206.5 kilometer for Alternative 3.

Tourists and tourism may be adversely affected by the landscape changes associated with the project. The presence of transmission lines and towers does change the visual character of the landscape and removes some of the appeal as a natural landscape in National Parks and Managed Reserves. However, these effects would only be apparent from places within these protected areas where tourist activities (hiking trails, roads, scenic overlooks, and visitor centers) occur and where the transmission line can be seen. The modified viewshed would be permanent, although tourist exposure to the viewshed would be temporary, only as long as they were in the area. Figure 4.1-5 show the viewshed within Borjomi –Kharagauli National Park under Alternatives 1 and 2, and Figure 4.1-6 shows the view within the park under Alternatives 1 and 3. Figure 4.1-7 show the viewshed within Ktsia-Tabatskuri Managed Reservional Park under Alternatives 1 and 2. Table 5.1-17 presents a summary of lands within protected from which the project will be visible.

Table 5.1-17. Lands Within Protected Areas from which Project Can be Observed (hectares)

Protected Area	*Alternative 1*	*Alternative 2*	*Alternative 3*
Borjomi-Kharagauli National Park	1388	1482	0
Ktsia-Tabaskuri Managed Reserve	9744	8840	8840
Gardabani Managed Reserve	1448	1448	1448

5.1.6.3 Disturbance of natural views by substation construction

Another potential landscape impact could be caused by construction of the new Akhaltsikhe substation and expansion of the substations at Gardabani and Zestaphoni. People who could be affected in these areas again include local residents, travelers, and tourists. The substation expansions at Zestaphoni and Gardabani are at existing substations not located near residential or tourist areas. New facilities constructed at these facilities would have no effect on receptors.

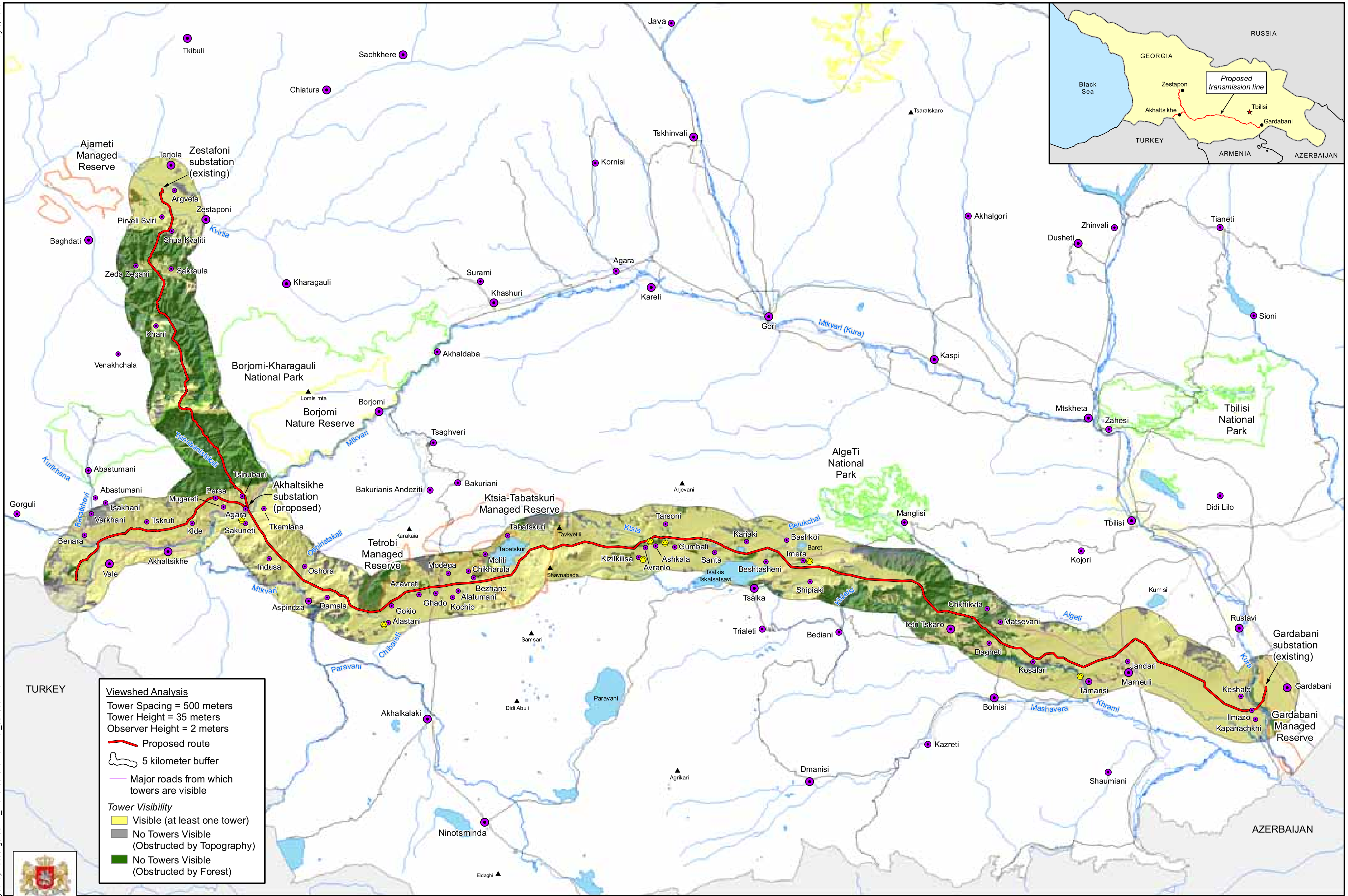
The new substation at Akhaltsikhe may disrupt the views of the landscape for nearby residents. These impacts would be permanent and long-term. The new substation is likely to include several large buildings/structures as well as a concentration of transmission line conductors, insulators, and transformers. There are no significant tourist areas near the proposed site and the site is not near highways so these categories of potential receptors would not be affected. Views obstructed by the proposed Akhaltsikhe substation are shown on Figure 5.1-8. The Akhaltsikhe substation will be visible from about 4078 hectares within five kilometers and from 5.9 kilometers of main roads for all project alternatives.

5.1.6.4 Potential impacts from operation and maintenance

Potential impacts to landscape views during operation and maintenance of the project are largely the same as those for construction since the ROW and structures will be maintained in place for the foreseeable future. However, there are some additional activities unique to operation and maintenance that could impact the landscape:

- Vehicle and worker activities in the right-of-way for routine tower and substation inspection and maintenance once every few years.
- Vehicle and worker activities in the right-of-way for vegetation control activities once every 5 to 8 years.
- Vehicle and worker activities in the right-of-way for line reconductoring every 30 to 40 years.

In all these cases the impacts are the same: short-term and temporary view of workers in the right-of-way by local residents, tourists, and travelers.



Black Sea Regional Transmission Project
Alternative 1 Viewshed

Figure 5.1-4

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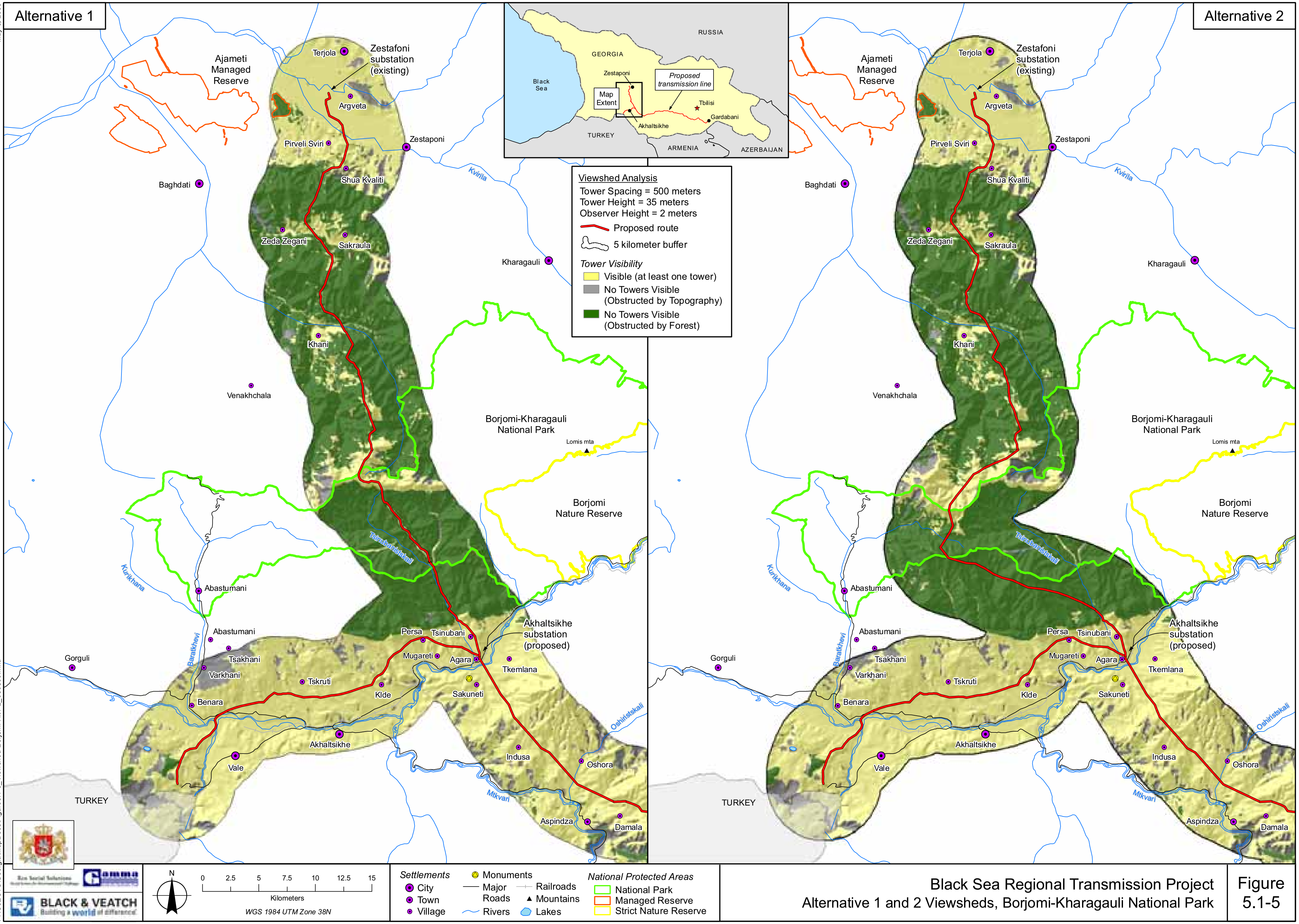

Black Sea Regional Transmission Project
Alternative 1 and 2 Viewsheds, Borjomi-Kharagauli National Park

Figure 5.1-5

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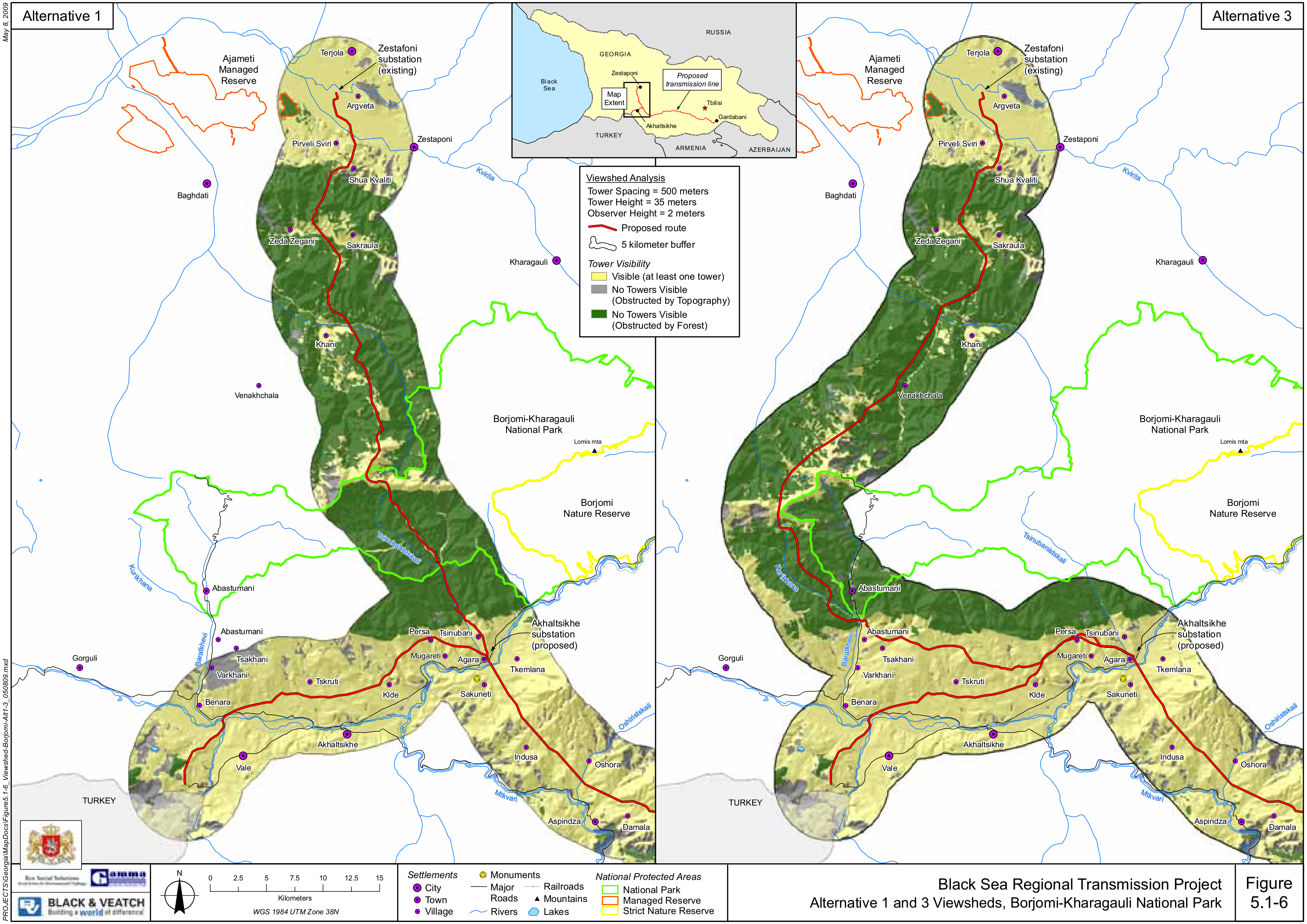
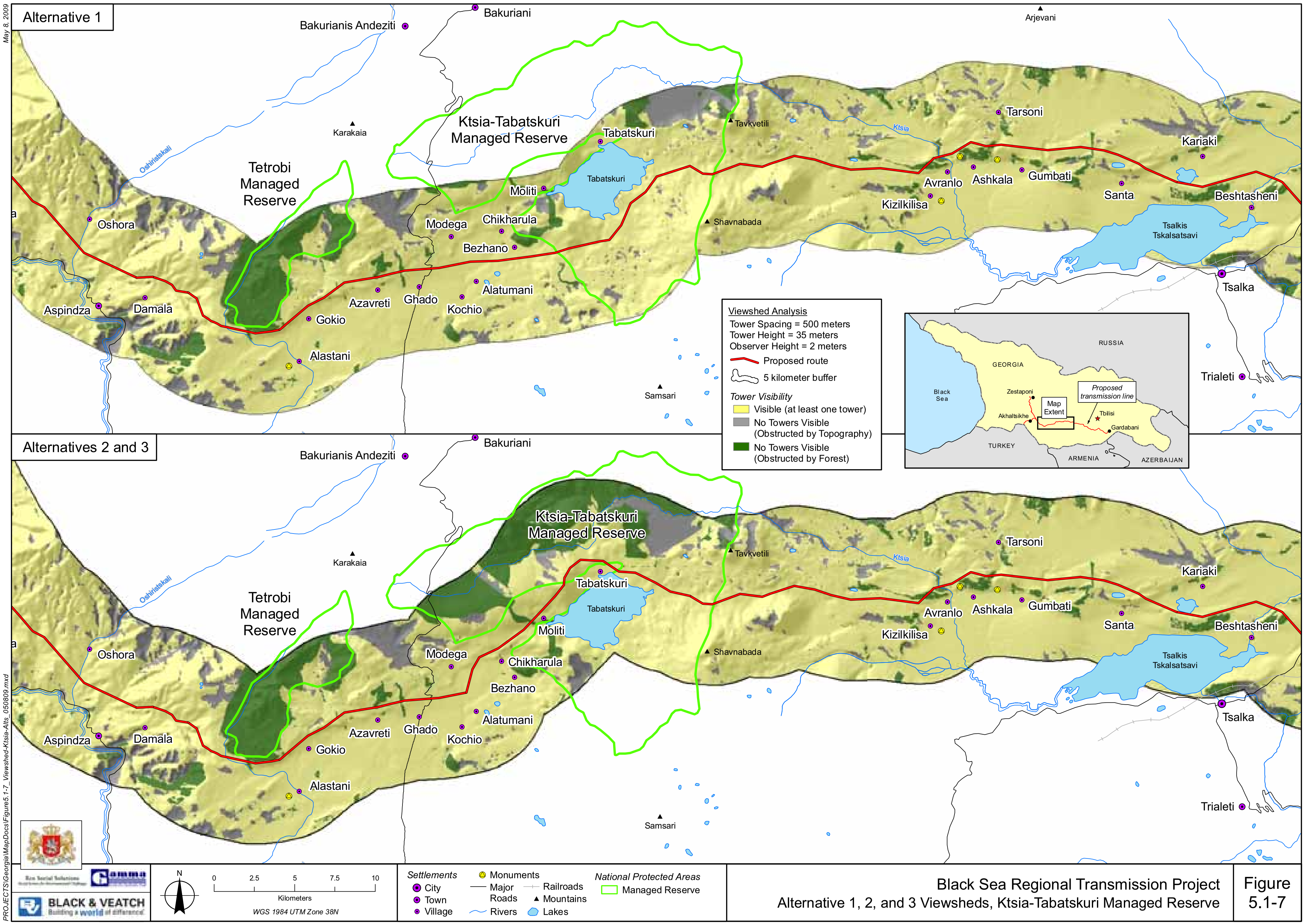


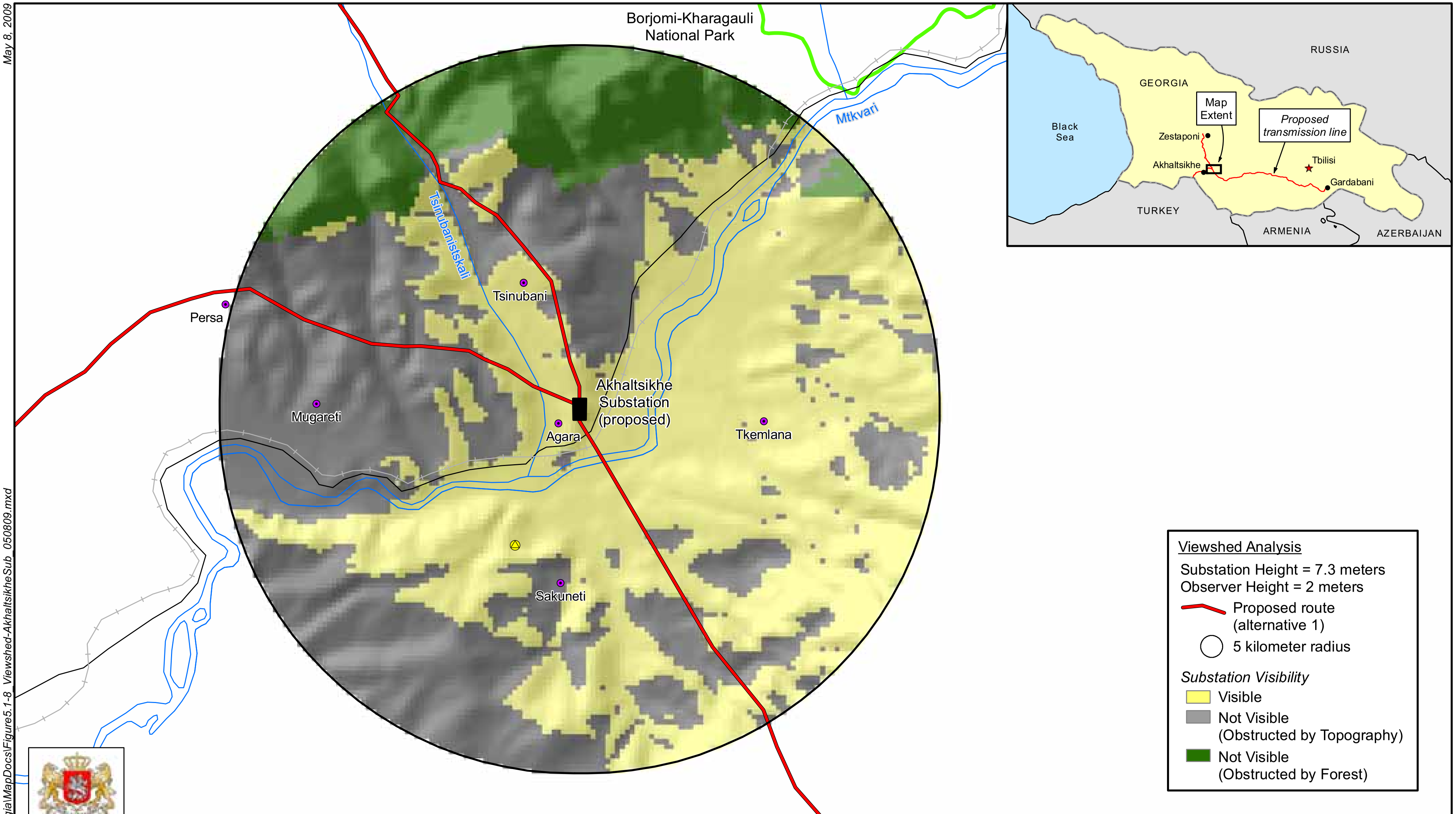
Black Sea Regional Transmission Project
Alternative 1 and 3 Viewsheds, Borjomi-Kharagauli National Park

Figure 5.1-6



Black Sea Regional Transmission Project
Alternative 1, 2, and 3 Viewsheds, Ktsia-Tabatskuri Managed Reserve

Figure 5.1-7



Eco Social Solutions
Gamma
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Building a world of difference.

N
0 0.5 1 1.5
Kilometers
WGS 1984 UTM Zone 38N

Settlements
City
Town
Village
Monuments
Major Roads
Railroads
Rivers
Lakes
National Protected Areas
National Park

Black Sea Regional Transmission Project
Akhaltsikhe Substation Viewshed

Figure 5.1-8

PROJECTS\Georgia\MapDocs\Figure5.1-8_Viewshed-AkhaltsikheSub_050809.mxd
May 8, 2009

5.1.6.5 Summary of potential impacts and significance

In summary, potential impacts to landscape views may occur during construction, operation, and maintenance activities. There will be permanent adverse impacts to residents associated with disruption of natural views by the transmission lines, towers, and right-of-way clearing. There will be permanent impacts to tourists (but temporary for any particular tourist) associated with disruption of natural views by the transmission lines, towers, and right-of-way clearing in protected areas. There will be temporary impacts to travelers as they travel in areas where the project is visible. There will be permanent impacts associated with the obstruction of residents' views by the Akhaltsikhe substation. The significance of the environmental impacts to the landscape from this project is summarized in Table 5.1-18. The magnitude of the impacts would vary based on the receptor.

Table 5.1-18. Significance of Environmental Impact: Landscape

Environ-mental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Magnitude of Impact and Duration*	*Significance*
Alternative 1				
Residents	Moderate	Disturbance of natural views by transmission line, towers, and ROW clearing near population centers.	Low, Permanent	Minor adverse
Residents	Moderate	Obstruction of views by substation to residents adjacent to Akhaltsikhe substation	Medium, Permanent	Moderate adverse
Tourists	High	Disturbance of natural views by transmission line, towers, and ROW clearing in protected areas.	Medium, Permanent	Major adverse
Travelers	Low	Disturbance of natural views by transmission line, towers, and ROW clearing from main roads and highways connecting major towns in the region.	Low, Permanent (but temporary from the perspective of the traveler)	Negligible
Alternative 2				
Residents	Moderate	Disturbance of natural views by transmission line, towers, and ROW clearing near population centers.	Low, Permanent	Minor adverse
Residents	Moderate	Obstruction of views by substation to residents adjacent to Akhaltsikhe substation	Medium, Permanent	Moderate adverse
Tourists	High	Disturbance of natural views by transmission line, towers, and ROW clearing in protected areas.	Medium, Permanent	Major adverse
Travelers	Low	Disturbance of natural views by transmission line, towers, and ROW clearing from main roads and highways connecting major towns in the region.	Low, Permanent (but temporary from the perspective of the	Negligible

Table 5.1-18. Significance of Environmental Impact: Landscape				
Environ-mental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Magnitude of Impact and Duration*	*Significance*
			traveler)	
Alternative 3				
Residents	Moderate	Disturbance of natural views by transmission line, towers, and ROW clearing near population centers.	Low, Permanent	Minor adverse
Residents	Moderate	Obstruction of views by substation to residents adjacent to Akhaltsikhe substation	Medium, Permanent	Moderate adverse
Tourists	High	Disturbance of natural views by transmission line, towers, and ROW clearing in protected areas.	Medium, Permanent	Major adverse
Travelers	Low	Disturbance of natural views by transmission line, towers, and ROW clearing from main roads and highways connecting major towns in the region.	Low, Permanent (but temporary from the perspective of the traveler)	Negligible
Alternative 4- No Action				
Residents	Moderate	No impacts	None	None
Residents	Moderate	No impacts	None	None
Tourists	High	No impacts	None	None
Travelers	Low	No impacts	None	None

For residents living within the viewshed of the transmission line, the change in landscape would be most significant for those living within two kilometers of new sections of the transmission line. For these residents, there could be a visible change in the landscape in 10 to 25 percent of their views while indoors or outdoors. Therefore, in accordance with Table 1-1, the magnitude of change is characterized as low and the significance of the impact to these residents is minor adverse. There is no significant difference between any of the three project alternatives. There would be no change to the existing landscape under Alternative 4 (no action).

For residents living within the view of the proposed Akhaltsikhe substation, the change in landscape would be most significant for those close enough to have their views obstructed (within 100 meters). For these residents, there could be a visible change in the landscape in 50-75 percent of the viewfield while indoors or outdoors. Therefore, in accordance with Table 1-1, the magnitude of change is characterized as medium and the significance of the impact to these residents is moderate adverse. There is no difference between any of the three project alternatives. There would be no change to the existing landscape under the No Action alternative.

For tourists visiting the protected areas, the change in landscape would be most significant from hiking trails, roads, scenic overlooks, and visitor centers where the transmission line could be observed. In Borjomi-Karagauli National Park, the hiking trails, roads, scenic overlooks, and visitor centers are all within forested areas with a canopy of 30 to 40 meters in height. The transmission line in Borjomi-Karagauli National Park would only be visible where hiking trails, roads, scenic overlooks, and visitor centers were within 100 meters of the cleared right-of-way and transmission line and in areas where there is no forest cover (mountainous areas above the treeline). Because there is limited tree cover in the Ktsia-Tabatskuri Managed Reserve, the project would be visible from areas not obscured by topography or distance. There would be no impacts at the Gardabani Managed Reserve because the transmission line towers have previously been constructed through these areas. There are some differences between the landscape impacts to tourists associated with these alternatives as presented below:

- Under Alternative 1, there are two locations where the project would be within 100 meters of a hiking trail, and the transmission line would be visible from the visitor center at entrance to the park north of Agara. These areas total approximately 1 hectare. Additionally, the transmission line is visible from approximately 1388 hectares of open terrain in the National Park In Ktsia-Tabatskuri, the transmission line is visible from 9744 hectares of open terrain. Under Alternative 1, 1389 hectares (1.9 percent of Borjomi-Karagauli's total landscape area (73907 hectares) and 9744 hectares (45.6 percent) of Ktsia-Tabatskuri's total landscape (21390 ha) is impacted by this project. Therefore, in accordance with Table 1-1 the magnitude of change is characterized as "very low" for Borjomi-Kharagauli and "medium" for Ktsia-Tabaskuri and the significance of the impact to these tourists is "negligible adverse" for Borjomi-Kharagauli and "major adverse" for Ktsia-Tabaskuri.
- Under Alternative 2, there are five locations where the transmission line would be within 100 meters of a hiking trail in Borjomi-Karagauli. These areas total approximately 5 hectares. Additionally, the transmission line would be visible from approximately1482 hectares of open terrain in Borjomi-Karagauli. In Ktsia-Tabatskuri, the transmission line is visible from XX hectares of open terrain. Under Alternative 2, 1487 hectares (2.0 percent) of Borjomi-Karagauli's total landscape area (73907 ha) and 8840 hectares (41.3 percent of Ktsia-Tabatskuri's total landscape (21390 ha) would be affected by this project. Therefore, in accordance with Table 1-1, the magnitude of change is characterized as "very low" for Borjomi-Kharagauli and "medium" for Ktsia-Tabaskuri and the significance of the potential impact to these tourists is "negligible adverse" for Borjomi-Kharagauli and "major adverse" for Ktsia-Tabaskuri.
- Under Alternative 3, there would be no impact to the landscape of Borjomi-Karagauli. In Ktsia-Tabatskuri, the transmission line would be visible from 8840 hectares of open terrain. Under Alternative 3, 8840 hectares (41.3 percent) of Ktsia-Tabatskuri's total landscape (21390 ha) is impacted by this project. Therefore, in accordance with Table 1-1, the magnitude of change is characterized as "medium" and the significance of the impact to these tourists is "major adverse."
- Under Alternative 4 (no action) there would be no impact to the landscape for tourists other than the relatively small area from which the 18 existing towers in Borjomi-Kharagauli could be seen.

Travelers passing through the region would only be able to view the project features while traveling on main roads and highways connecting major towns through the region (for example, Akhaltsikhe to Borjomi). From the perspective of the traveler, these would be temporary effects, occurring only when passing through areas within the viewshed of the project. Of the main roads and highways connecting major towns in the region, approximately 85 percent are within the project viewshed. Therefore, in accordance with Table 1-1, the magnitude of change is characterized as "high" and the significance of the impact to these residents is "moderate adverse." There is no significant difference between any of the three project alternatives. There would be no change to the existing landscape under the No Action alternative.

5.1.7 Potential impacts to soil

This section describes the direct and indirect impacts associated with the project on geology and soils. GIS-based maps were evaluated to identify geological issues (other than those discussed in section 5.1.2) and assess soil types along the study area for each alternative. Figures 4.1-5a through 4.1-5h shows the types of soils along the transmission line corridor.

The main impacts on soils and geology are likely to arise during various site preparation and construction activities associated with the proposed project. However, soils will also be vulnerable during the operation and maintenance phase. Section 4.1.3 describes the geology and soils of the project area. Soils are assessed as a high sensitivity receptor due to their value as a natural resource.

5.1.7.1 Activities with the potential to affect soils

Project activities with the greatest potential to affect geology and soils include clearing and grubbing of vegetation for the transmission line right-of-way and access roads, excavation for tower and substation foundations, and ongoing operations and maintenance. These activities are described below.

- Clearing and grubbing. Clearing of trees and shrubs would make the soil more susceptible to erosion and dust generation as the soils under these plants became exposed to wind and precipitation. Right-of-way and access road clearing can also increase sedimentation carried in stormwater runoff.
- Excavation. Excavation for transmission tower and substation foundations would remove grass and vegetation, expose soil, and make the soil more prone to erosion from wind and rain. Disturbance potential would be greatest during excavation for transmission line tower structures since these can be up to 10 meters deep, while substation foundations are shallower and affect less soil volume.
- Operations and maintenance. There would potential impacts due to soil erosion and compaction associated with driving maintenance vehicles over the right-of-way during operations and maintenance, although this would only happen once every few years. Additionally, there would be some small potential for soil contamination during these activities if there were leaks of insulating oils from transformers, or spills of fuel and oil from maintenance vehicles.

5.1.7.2 Soil Erosion Impacts

Loss of vegetation and soil compaction increases the soils' vulnerability to erosion. It can be difficult for vegetation to re-colonize bare and compacted areas of ground. Once vegetation is lost and not restored, the areas affected by erosion often tend to spread through the effects of wind and rain. Soils will be particularly vulnerable during when the ground was wet, when vehicle traffic is likely to cause the greatest damage.

Erosion of exposed soil and the resulting sediment produced can occur from project development, causing air (from dust) and water pollution (from sedimentation due to soil being transported to water bodies). As indicated above, earthmoving activities such as vegetation clearing, grading and grubbing for site preparation, and heavy equipment hauling over unpaved ground, may loosen soils and cause fugitive dust and particulate matter to become airborne. Soil erosion can adversely affect water quality and biological communities in receiving water bodies due to increases in turbidity and rates of sediment deposition. The potential risk for erosion is increased by placing project components in areas with steep slopes; on unstable soils such as peat, humus and alluvial soils; and on clays, which are fine-grained and susceptible to dust and erosion in dry conditions. Additionally, the potential risks to water quality are increased with proximity to stream, rivers, and lakes.

Figures 4.2-2 in Chapter 4 and 5.1.1 in this chapter show the vulnerability of some soils along the transmission line corridor. The figures show damage that was caused by off-road vehicle movement. Where roads are unsurfaced, rutting and gully erosion can eventually make the roads unpassable so that vehicles drive off the track and the area affected by erosion continually widens. This is most common with frequent traffic, which will not be the case with this project, but it can happen after one or a few vehicle passages when conditions are favorable for erosion.

Damage to soils also has further effects on land-use. When soil is compacted, it cannot support native grasses or other vegetation (see Figure 4.1-9). This in turn reduces the pasturage that can be used by the livestock of local herders or that is available for other creatures The loss of grass affects biodiversity, since grass is a food source for small mammals, which in turn provide food for predators.

5.1.7.3 Potential impacts from contamination of soils

Soil contamination can occur from the spills of hazardous materials such as fuel, insulating oils, paints, herbicides/pesticides, and other toxic substances which could be used during the construction, operation, or maintenance of the transmission line. In addition, substations typically use transformers and may also have a few treated wood poles. Paints, fuel, and other hazardous materials are often stored at substations as well as in associated maintenance shops. Vegetation control methods at substations and along rights-of-way often use herbicides and pesticides, although they will not be used for this project.

The towers and conductors should do not present a hazard with respect to soil contamination unless paint or other coating is used. The conductors are aluminum, which should not corrode or rust. The towers are made of steel. The leaching potential for these elements from these structures is extremely low. If paint or other coating is used to prevent rust or corrosion of the steel towers, or to protect the aluminum from the elements, drips and spills could contaminate the soil.

- Insulating oils. Polychlorinated biphenyls (PCBs) were widely used in the past as a dielectric fluid to provide electrical insulation, most commonly found in transformer equipment. Although their use has been largely discontinued due to potential harmful effects on human health and the environment, some of the equipment for this project could contain PCB insulating oils. GSE has reported that existing transformers do not contain PCBs, nor will the new ones.
- Wood pole preservatives. While wood preservatives should not pose a risk along the transmission route due to the use of steel tower structures, there may be some soil contamination impact from leaching of preservative-treated wood used at the substations. In addition, such poles may be stored in piles at the substation and could also leach preservatives. Poles are typically treated with creosote or chromated copper arsenate. This leaching could contaminate the soils.
- Petroleum fuels and lubricants. Liquid petroleum fuels and lubricants for vehicles and other equipment pose a risk of contaminating soils if spilled or leaked during construction as well as during operations and maintenance activities.
- Herbicides and pesticides. All vegetation control at the along the ROW and at the substations will be done mechanically, so there should be contamination of soils from these chemicals. However, should this practice be changed, herbicides and pesticides could pose a considerable risk to the soils and adjacent water bodies carried on eroded particles. If herbicides and pesticides are to be use,

mitigation measures should be applied to ensure they do not impact nearby soils or water bodies. In general, they should not be used in protected areas.

- Paints. Paints are likely to be used on substation components and buildings and may be used on the towers. Spills of stored paint and drips from painted equipment could directly contaminate the soils.

5.1.7.4 Construction Impacts

The main impact on soils during construction will be the increase in vulnerability to erosion and potential for soil contamination. The potential type of impacts are the same for all alternatives except the no action alternative, which will present no impacts. The following types of construction activity could lead to potential soil erosion and contamination:

- Vehicle and other construction equipment traffic along access roads and right-of-way during construction may cause soil compaction, soil rutting, and dust generation. Additionally, mud could be carried off the site on vehicle tires and could result in sedimentation in off-site areas. This would be a short-term impact with a potential to become a long-term impact without mitigation measures.
- Vegetation will be cleared from shrub and forest areas, and at least some soil will be removed for the construction camps, the substation and expansions, tower foundations and work areas, and access roads. Clearing of trees and shrubs make the soil more susceptible to erosion and dust generation because it exposes the soils to wind and precipitation. Right-of-way and access road clearing, where needed, also increase stormwater runoff. This would be a long-term and permanent impact for towers and substations if grass is not restored after activities are complete. .
- Blasting for tower foundations will result in the removal of vegetation and topsoil and near-surface rock. This will remove the natural erosion and wind control elements and make the soil susceptible to increased erosion and dust generation. Restoration of bare ground after construction will make this impact temporary.
- Soil contamination can occur from the use, improper handling and spills of hazardous materials, as described above. This would be a short-term impact with a potential to become a long-term impact without mitigation measures.

The areal extent of soil impact associated with each alternative for substations and transmission lines is quantified in Table 5.1-19. As shown, there are 20 specific soil types that may be affected by the project. A summary of the area that may be affected is provided as follows:

- Alternative 3 would affect the greatest amount of soils, due to its extra length to go around Borjomi-Kharagauli National Park. The total area of impact of 232.66 hectares (0.0033 percent of all soils in Georgia).
- Alternative 1 would affect the least amount of soils, with a total potential impact area of 201.94 hectares (0.0029 percent of all soils in Georgia).
- Alternative 2 would affect 211.7 hectares of soil (0.0030 percent of all soils in Georgia).
- The no action alternative (Alternative 4) would not affect any soil and is not included on Table 5.1-19.

Potential Impacts to specific soil types, as a percentage of that soil type present in Georgia, is no greater than 0.0342 percent for the maximum affected soil type (Raw humus depredated-Eroded rending leprosies), under Alternative 3. The effect can be characterized as negligible adverse, except locally where erosion or compaction actually occurred.

Table 5.1-19. Types of soil and area that could be affected

Soil Type	*% of All Georgia Soils*	*Total Area of Soil Type in Country (ha)*	*Alternative 1*		*Alternative 2*		*Alternative 3*	
			Total Soil Type Impacted (ha)	*Percentage of Soils in Country Impacted*	*Total Soil Type Impacted (ha)*	*Percentage of Soils in Country Impacted*	*Total Soil Type Impacted (ha)*	*Percentage of Soils in Country Impacted*
Alluvial calcareous-Alaric fluvisols	4%	299,475	7.51	0.0025%	7.51	0.0025%	7.51	0.0025%
Brown forest acid-dystric cambisols	10%	682,326	4.84	0.0007%	4.84	0.0007%	7.28	0.0011%
Brown forest podsolized-Dystric cambisols	9%	603,470	7.25	0.0012%	9.90	0.0016%	6.18	0.0010%
Brown forest weakly unsaturated-Eutric cambisols	7%	485,154	6.72	0.0014%	6.53	0.0013%	8.34	0.0017%
Chernozems-Chernozems	4%	278,581	38.93	0.0140%	35.27	0.0127%	35.27	0.0127%
Cinnaamonic calcareous-Calcaric cambisols and calcic kastanozems	3%	241,294	16.41	0.0068%	16.41	0.0068%	16.41	0.0068%
Cinnamonic leached-Calcic kastanozems	3%	214,687	13.30	0.0062%	13.48	0.0063%	23.43	0.0109%
Cinnamonic-Eutric cambisols and calcic kastanozems	3%	230,778	39.34	0.0170%	39.34	0.0170%	48.17	0.0209%
Grey Cinnamonic darck-Calcic kastanozems	1%	50,761	15.34	0.0302%	15.34	0.0302%	15.34	0.0302%
Meadow grey cinnamonic-Calcic vertisols	0%	19,290	0.32	0.0016%	0.32	0.0016%	0.32	0.0016%
Mountain meadow chernozem like-humic leptosols	1%	56,431	0.02	0.0000%	0.02	0.0000%	0.02	0.0000%
Mountain meadow soddy peat-Leptosols and hiptosols	0%	22,102	0.00	0.0000%	0.39	0.0018%	0.39	0.0018%
Mountain meadow soddy-Leptosols and Histosols	14%	953,670	18.36	0.0019%	27.49	0.0029%	25.73	0.0027%
Primitive mountain meadow-Leptosols	1%	72,285	0.00	0.0000%	1.26	0.0017%	1.26	0.0017%
Raw humus calcareous-Rendzic leptosols	7%	499,786	11.52	0.0023%	11.52	0.0023%	11.52	0.0023%
Raw humus degradated-Eroded rendzin leptosols	0%	17,202	5.89	0.0342%	5.89	0.0342%	5.80	0.0337%
Strongly Eroded soils and bare rocks--Rock outcrops and leptosols	2%	148,236	0.60	0.0004%	0.60	0.0004%	0.60	0.0004%

Table 5.1-19. Types of soil and area that could be affected								
Soil Type	*% of All Georgia Soils*	*Total Area of Soil Type in Country (ha)*	*Alternative 1*		*Alternative 2*		*Alternative 3*	
			Total Soil Type Impacted (ha)	*Percentage of Soils in Country Impacted*	*Total Soil Type Impacted (ha)*	*Percentage of Soils in Country Impacted*	*Total Soil Type Impacted (ha)*	*Percentage of Soils in Country Impacted*
Vertic chernozems-Vertic chernozems and vertisols	0%	20,619	5.87	0.0285%	5.87	0.0285%	5.87	0.0285%
Yellow brown forest-Chromic cambisols and stagnic alisols	5%	345,601	7.23	0.0021%	7.23	0.0021%	10.73	0.0031%
Yellow soils-Chromic and ferralic cambisols	3%	215,901	2.50	0.0012%	2.50	0.0012%	2.50	0.0012%
Total area of Georgia soils	100%	6,964,536						
Total soil area that could be affected			201.94	0.0029%	211.70	0.0030%	232.67	0.0033%

5.1.7.5 Operation and Maintenance

The main potential impact on soils during operation and maintenance of the project would be the increase in vulnerability to erosion and potential for soil contamination. The following types of operation and maintenance activity could lead to potential soil erosion and contamination:

- Vehicle traffic along access roads and right-of-way during construction may cause or make worse soil compaction, soil rutting, and dust generation. Additionally, mud could be carried off the site on vehicle tires and could result in sedimentation in off-site areas. This will be a short-term impact likely to occur every few years with a potential to become a long-term impact without mitigation measures.
- Periodic clearing of vegetation as part of normal right-of-way and access road maintenance activities may make the soil more susceptible to erosion. right-of-way and access road clearing also increase stormwater runoff. This could be a long-term and permanent impact along right-of-way areas that are presently shrubland and forest as these areas will not be allowed to revert to these habitats. Mitigation could reduce either potential impact.
- Soil contamination could occur from the use, improper handling, and spills of hazardous materials that may be used during the operation and maintenance of the project. Vegetation control techniques that use herbicides could introduce environmental contaminants into the soil and adjacent habitats if these are used in the future. This would be a short-term impact with a potential to become a long-term impact without mitigation measures.

Once construction is complete, there should be minimal need for vehicles to travel along the right-of-way and access roads except for periodic vegetation management activities and response to damages from vandalism or natural causes. Such access would only normally occur every few years. The extent of soil impact during operation and maintenance would be substantially lower than during construction and has been characterized as negligible adverse overall, with potential for impacts to moderate on a local basis unless impacts are mitigated.

5.1.7.6 Summary and significance of potential impacts to soils

The significance of potential impacts to soils is generally the same for all alternatives (except the no action alternative) and is summarized in Table 5.1-20. As a receptor, soils are classified as high sensitivity due to national regulations addressing erosion protection and environmental contamination. The magnitude of change for all alternatives, as shown in Table 5.1-19, is greater than 0 but less than 5 percent of the total area of each soils type, indicating a low magnitude of change. As a result, the significance of the environmental impacts to soils associated with this project are classified as "minor" for Alternatives 1, 2, and 3 and "none" for Alternative 4.

Table 5.1-20. Significance of Potential Impact: Soils

Environmental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Magnitude of Impact and Duration*	*Significance*
		Alternatives 1, 2, and 3		
Soils	High (Subject to national regulation/ protection)	Soil compaction, soil rutting, and dust generation from vehicle and other construction equipment traffic along access roads and right-of-way	Very low Temporary but could be permanent	Minor adverse
		Mud could be carried off the site on vehicle tires and could result in sedimentation in off-site areas.	Very low Temporary	Minor adverse
		Clearing of trees and shrubs make the soil more susceptible to erosion and dust generation as the soils under these plants are now exposed to wind and precipitation.	Very Low Permanent	Minor adverse
		ROW and access road clearing also increase sedimentation carried in stormwater runoff.	Very low Temporary	Minor adverse
		Blasting for tower foundations will remove vegetation, topsoil, and near-surface rock making the soil susceptible to increased erosion and dust generation.	Very Low Permanent	Minor adverse
		Soil contamination can occur from the use, improper handling and spills of hazardous materials, such as fuels and petroleum lubricants, insulating oils, wood preservatives, paints, and other toxic substances which could be used during the construction of the project.	Very low Temporary but could be permanent	Minor adverse
		Vegetation control techniques that use herbicides can introduce environmental contaminants into the soil and adjacent habitats.	Very low Temporary but could be permanent	Minor adverse
		Alternative 4- No Action		
Soils	High (Subject to national regulation/ protection)	No impacts	No change	None

5.2 Potential socioeconomic impacts

In general, potential socioeconomic impacts are identical or nearly identical under Alternatives 1, 2, and 3.

5.2.1 Number of communities and people potentially affected

As described in section 4.2, the proposed transmission line corridor is located near a number of communities, and there are a few buildings that are quite close to the line, including several within 30 meters. Communities and buildings near the line were identified using GPS coordinates of the towers (obtained from GSE) and high-resolution aerial photographs. Members of the ESIA team visited most of these communities (see Table 4.2-2) to conduct scoping and also to determine the status of buildings within the corridor. In addition, they gathered contact information for owners and occupants of buildings within 50 and 100 meters of the line[6]. The Social Team was able to locate the communities which had structures within 100 meters of the centerline of the corridor. Members of the social assessment team made visits to these sites, and structure use and ownership of the properties were reviewed in at much detail as possible with residents or neighbors. Contact information for property holders and tenants was collected so that GSE and/or “TransEnergo” can communicate with them as needed.

Approximately 146 people were identified as living and working in residences within 100 meters of the line, with approximately 30 living and working within 50 meters of the line. A total of 33 structures were within 100 meters of the corridor centerline Table 5.2-1 summarizes the findings. The table shows the community name, majority ethnicity of the region, the section of the line, the construction status of the line (where not constructed or where major rehabilitation of former towers is needed). The table also describes the type and age of structures and the number of residents in the houses within 100 meters of the line.

TABLE 5.2-1. Buildings within 100 Meters of the Transmission Line

Community	*Ethnicity*	*Section*	*Line constructed ?*	*Number and distance of structures within 100 meters distance*		*Type and age of structure*	*Number of residents*
Ilmazlo (Marneuli)	Azeri	Gardabani-Akhaltsikhe	Y	14	35.79	2006-2007	3
					45.02	Built 1998	5
					40	Building	4
					50.68	New house	4
					80.15	Built 1988-1990	8
					80.75	old house	9
					82.52	built 2007-2008	3
					84.22	built 2007-2008	4
					87.23	built 1973	6

[6] It should be noted that distances shown here were not measured in the field but are based on GIS technology and aerial photography. Also, the distances given are in Table 5.2-1 are distances from the centerline of the transmission line corridor. The conductor lines themselves are at a distance of about 20 meters from the centerline of the three-tower arrangements used for turns and high-stress areas, and about 12-15 meters from the centerline of most of the towers. As a result, depending on the type of tower(s) used, the distance of houses and other buildings from the nearest conductor wire (this is the distance used by Georgia norms) is not exact. In general, any distance shown as being 50 meters or less could be within the corridor, but this will have to be verified by TransEnergo and the Technical Consultant across the entire route.

					87.96	old house	5
					88.39	old house	6
					88.77	old house	7
					89.06	built 1985	8
					89.27	old house	7
					90-100	1988	12
					85-95	old house	7
					90-100	old house	7
Algetis Meurneoba (Marneuli)	Azeri	Gardabani-Akhaltsikhe	Y	2	42.44	ruins	1
					48.26	farm (1998-2000)	15
				4	57.43	new farm	-
					60.93	old house	-
					64.76	new farm	3
					71.02	new farm	-
Jandari (Marneuli)	Georgian-Azeri	Gardabani-Akhaltsikhe	Y	1	42.87	ruins	-
				12	52.37 - 86.35	ruins	-
				(+1)	70-80	new factory	-
Kosolari (Tetritskaro)	Azeri	Gardabani-Akhaltsikhe	N	1	80.05	old house	-
				(+1)	80,00-90,00	cemetery	-
				(+1)	under line	agriculture land	-
Tetritskaro (Tetritskaro)	Georgian/Russian/Armenian	Gardabani-Akhaltsikhe	Y	2	36.42	Restaurant	-
					37.55	Bus Stop	-
Agara (Akhaltsikhe)	Georgian; Armenian	Gardabani-Akhaltsikhe	Y	3	37.19	House (37,19m)	-
					81.62	new House (81,62m) Built after construction of line	-
					97.52	old House (97,52m)	-
Kveda Kvaliti (Zestaponi)	Georgian	Zestaponi-Akhaltsikhe	Y	2	34.54	old house	2
					38.89	old house	-
					52.76	old house	2
					[illegible]	old house	4
					[illegible]	old house	6

					82.62	old house	-
					84.75	old house	2
					90.97	old house	6

Ilmazlo is the easternmost population center near the line (see Figure 5-2-1). The town is approximately 250 years old and the population is Azeri. Residents are active in agriculture, especially with short crops and livestock. A cemetery that is reported to be over 200 years old cemetery lies between the village and the river. Three structures in Ilmazlo not shown in the table are less than 50 meters from the centerline of the corridor. Two of these structures are greenhouses used for growing tomatoes, green peppers, and eggplants. Another is a house under construction; there is a foundation already, the design is approved and all documents are in place. This house is approximately 40 meters from the centerline line so may fall within 30 meters of an energized line.

Figure 5.2-1. Ilmazlo is the village that lies closest to the line, with most houses within 200-300 meters

Another newly constructed house is 51 meters from the corridor centerline and has just been completed. This structure can be seen in figure 5.2-2. In addition, there are 11 older houses within 100 meters of the line, two of which are new (and thus not on the aerial photographs, which dated from 2002 or 2003).

The community of Algetis Meurneoba also has several building and ruins near the line. There are ruins 42 meters from the centerline of the corridor and a farm that dates to 1999 that reaches to within 48 meters. A member of the community owns the farm and there are 15 people who work on this farm. Another farm has four buildings are within 100 meters of the corridor centerline, of which one is a residence about 61 meters away and the rest are farm buildings. The owner of this farm resides in Tbilisi and there are three people who work on the farm tending to the cattle and sheep.

There is a newly constructed basalt plant near the community of Jandari (see Figure 4.2-5 in Chapter 4). This new building also does not appear on aerial photographs. The ESIA team was denied access and for that reason was not able to clearly determine the distance from this new factory to the line.

In the ethnic Azeri community of Kosalari there is an old house that is 80.05 meters from the corridor centerline but no one lives there at this time. There is also a cemetery that is 80 meters from the corridor. The line has not yet been constructed in this area.

Near the community of Tetriskaro are two state-owned structures within 40 meters of the centerline. One is a defunct Soviet-era restaurant and the other an abandoned bus stop.

The community of Agara, which is mixed ethnic Georgian and Armenian, has one house within about 37 meters of the centerline (and thus probably within the 30-meter buffer zone). There is a new house constructed 82 meters from the corridor centerline and an older house 97 meters away.

Figure 5.2-2. Greenhouse and foundation for new house near the line in Ilmazlo (greenhouse is the white structure at left)

The community of Kveda Kvaliti in Zestaphoni is ethnically Georgian with many old houses, two of which are between 30 and 40 meters of the centerline of the corridor, respectively. Two people inhabit one house; the other is used as a summer home by the owners, who live in Tbilisi. There are an additional eight houses in Kveda Kvalti that are between 50 and 100 meters from the corridor centerline. Three are used as summer houses, the others are occupied year-round.

5.2.2 Demographics and economics

Income. The rehabilitation, construction, and conductoring of the transmission line will require some additional employment; the number will not be known until the contractor is hired to do the work, but it will likely be at least several dozen workers. "EnergoTrans" and GSE (or any successor to GSE as Project Execution Agency), will encourage the Technical Consultant to recruit these workers from the communities near the line, especially those who were involved in the initial construction in the 1990s. For the maintenance of the line, "EnergoTrans" will hire local laborers and technicians whenever possible and appropriate. All laborers will be paid a standard fair wage and will receive full benefits while employed for the project. New employment would be a minor beneficial effect. As noted below, the loss of income from agricultural land is so minor that even without compensation it would be minor. With compensation the effect becomes negligible.

Farmers. Under Alternative 1, a total of 43 hectares of agricultural lands and 66 hectares of meadowlands/pasturelands could be directly affected by foundation and tower construction or rehabilitation and vehicle access routes. Under Alternatives 2 and 3, the total would be nearly the same (less than two hectares difference). This is the land that will be occupied by the towers and roads and can no longer be cultivated (this is an overestimate, since some cross-country vehicle tracks will continue to be available). Other than these effects, the presence of the line itself will not affect crops or herds that use the land under the lines.

GSE is in the process of determining the status of land ownership where existing towers are located; that is, whether a right-of-way was retained when the land was privatized. If it is assumed that no rights were retained for the towers, then under Alternative 1 there will be a maximum of 103 hectares (43 agricultural lands, 66 meadowlands/pasturelands) of land removed from agricultural production for which farmers will need to be compensated under Georgian law (again, the total will be less, since most towers account for only 28 of the 103 hectares, and roads the rest). Since this 103-hectare area is spread over the approximately 160 kilometers the line will cross these types of land, the effect on any individual's land would be minor to negligible, as would the total effect on agricultural production. Even this very small effect would be mitigated by compensation for lost use of land under Georgian law.

Although it was assumed for purposes of estimating the amount of land that would be taken out of use that all lands used for access roads would be removed from agricultural use, many of the "roads" would continue to be suitable for pastures or crops. For that reason, some operating protocols are appropriate for using access roads. If vehicles and heavy equipment cross the land to tower locations when the ground is wet, it could leave heavy furrows and affect the ability of farmers to use the land until it recovers. Similarly, if vehicle/equipment use occurs during growing or harvest seasons, it could damage or destroy crops along the access corridor and at the tower locations. This will be avoided when possible by scheduling vehicle and equipment use outside growing seasons. When this is not possible, moving vehicles and equipment will stay on a narrow corridor that minimizes the amount of land affected, and the amount of land disturbed at the base of towers being constructed will be kept to a minimum. In all cases, as noted crop loss will be compensated at fair market value according to Georgian law – the value paid will be the market price for the mature crop in that particular year.

In addition, there could be accidents involving livestock being struck by vehicles or equipment. Farmers will be paid fair market value for any animals lost or injured.

In addition, except in cases of emergency, GSE will notify farmers and landowners' at least 30 days in advance of any activities on their land so they can make appropriate arrangements for farm workers, herds, and other activities on the land.

In summary, the economic impact on subsistence farmers could be moderate to significant and adverse without mitigation, but should be negligible to minor if activities proceed according to plan, with compensation for all damages or loss.

Tourism. The tourism sector and park visitation rates are increasing significantly in Georgia, as described in Section 4.2.7. This has an important economic role in the development of the region and some areas along the transmission line corridor. Under Alternative 1, there would be 12.1 kilometers of transmission line in Borjomi-Kharagauli National Park and 11.5 kilometers in Ktsia-Tabatskuri Managed Reserve. There would be 20-30 towers in Borjomi-Kharagauli (of which 18 already have been constructed) and about the same number in Ktsia-Tabatskuri. Under Alternative 2, the crossing of Borjomi-Kharagauli would be 4.7 kilometers long and of Ktsia-Tabatskuri would be 10 kilometers. Under Alternative 3, there would be no crossing of Borjomi-Kharagauli and 10 kilometers in Ktsia-Tabatskuri.

It is important to note that rehabilitation and construction activities at any specific tower would last from a day (for minor rehabilitation) to a week or more (for foundation construction). This could be disruptive to visitors in protected areas. Disturbance would involve noise from equipment (and/or helicopters), land disturbance, visual intrusion, and the presence of construction equipment and people in normally undisturbed areas.

Except in the case of emergency, GSE will provide information to the authorities of a protected area where activities are to occur. The information will identify the location, the dates, the activities to take place, the purpose of the activities, and the best way for rangers or tourists to avoid hazards. GSE will consult with the Agency for Protected Areas to determine when peak tourism times are, and wherever possible, will try to adjust schedules to minimize disruptions.

Overall, the impact on tourists will be very temporary, lasting a maximum of a few days in any one location. Once the line is operational, there will be no disturbance at all other than occasional access, and re-conductoring after several decades. In very local areas and for individual tourists, potential impacts could be moderate to major, and temporary. Alternative 1 would be more likely to influence a great number of tourists, Alternative 3 the least. Over the course of the line, potential impacts would be negligible to minor, and again temporary.

National Economy: The economy of Georgia is expect to expand at strong rates of 10.5 percent annually (World Bank, 2009), and has potential for even more as a result of the sale of excess power to neighboring countries. Through being tied into the broader regional energy infrastructure systems, Georgia benefits from an increased interdependence on neighboring countries. The long terms economic benefits of this project are significant in terms of both energy independence and strengthening relations with regional allies. A feasibility study for the project (Kuljian, 2007) estimated the capital cost as approximately US$327,000,000. Feasibility studies for the line suggest that, depending on the financing scenario employed, a tariff rate of over $8.58/MWH would allow the project to operate at a profit over a 30-year period. Overall, the potential impact could be moderately beneficial, and over a long period of time.

5.2.3 Infrastructure

Transportation: The line will cross 5 major roadways and 2 rail lines. The only time this is expected to have an impact is during the conductoring of the lines. GSE will work closely with the rail and road authorities to determine when optimal times are for line installation at each crossing so as to minimize delays. All efforts will be made to minimize the amount of time that lines are laying on roadways or across rails in the conductoring process in order to avoid any accidents, or damage to material assets.

While conductoring is taking place, GSE will station workers on highways to block traffic when necessary and to notify drivers to proceed with caution. They also will direct traffic when heavy equipment is crossing the road. The overall impact will be very minor adverse.

Electrical power: Official reports state that 99% of households in Georgia have access to electrical power. Due to storms and occasional inconsistent supplies, however, power can be intermittent. The construction of this line will provide much needed regularization of power delivery to the Georgian power grid and as a result increase reliable delivery to the residents and communities of southern Georgia. A reliable supply of competitive energy could also trigger some economic development of a depressed region of Georgia. The overall effect will be moderate to major beneficial in some isolated areas and minor to moderately beneficial over the length of the line. It will also be major beneficial in that it integrates the regional system and cements ties with regional allies.

5.2.4 Community

Community and household functions: As described in section 5.2.1, there are communities that will be directly impacted by the construction, rehabilitation, conductoring, and maintenance of the line. The disruptions will be (temporarily) increased traffic, workers, and noise from the activities, and the temporary presence of outsiders in the community. GSE will seek to minimize disruptions by notifying community leaders and municipal authorities in advance of all activities near communities. The notice will include information on the activities to be performed, the approximate dates, and any special hazards or concerns. They also will notify them if there will opportunities for temporary employment. Efforts will be made to avoid disruptions during holidays, including Muslim holidays such as Ramadan and Novruz. GSE will give advance notice up not less than 2 weeks prior to work being done in or near communities, in addition to the 30 day advance notice to farmers addressed in 5.2.2.

Workers will be briefed on any specific issues in particular communities, and the foreman will ensure that disruptions to household and community functions are minimized. No work will begin before 08:00 a.m. and no work will be done after 19:00 (7 pm). Workers will not use restroom facilities in homes (GSE will provide sanitary facilities), and will treat all community members respectfully. When the work is near Muslim communities, no male worker may approach a woman who is unaccompanied by a male relative, and this will be communicated to crews working near Muslim communities. All work being done around any communities should minimize disruptions to people, domestic animals, and community infrastructure. Overall, the impacts should be minor to moderate adverse during construction, and very temporary. Impacts during operation and maintenance will be negligible to minor, and even more temporary.

Households near the line. There are estimated to be approximately 40 structures within 100 meters of the line. Because Georgia norms do not allow residents of houses within 30 meters of the line, GSE will work with the owners and residents to agree on relocation. The Ministry of Energy prefers to reach agreement on relocation without resorting to expropriation, and will do so wherever possible. In all cases, GSE will balance the cost of relocating the line with the cost of relocating residents. Where there are buyouts, they will be at the price negotiated with the owner, which will be at least fair market value for that time and that place. For segments of the line that have not been constructed, GSE has already realigned the proposed route so it will not come within 30 meters of any house.

For those within 50 or 100 meters of the line, the temporary disturbances during rehabilitation, construction, and maintenance would be more significant than for people in the general community. Impacts would be caused by equipment and construction noise, dust, and equipment movement.

Therefore, except in the case of emergencies, GSE will notify the individual households within 100 meters of the corridor centerline not less than two weeks in advance of any activities, including what the activity will be and what the expected nature of the disturbances will be. In general, locations near the line but not near a tower would not lead to disturbances except during conductoring. Locations near towers would suffer disturbances during rehabilitation, construction, conductoring, and maintenance.

Potential impacts on households near towers could be moderate adverse during construction and minor adverse during other activities if residents are not prepared for them to occur. Impacts on residents near the line but far from towers would be minor to moderate adverse during conductoring but negligible during other activities. In all cases, impacts would be temporary, no more than a few days initially, and then no more than once a year thereafter.

5.2.5 Cultural resources

As noted in section 4.2.6, there are 30 cemeteries, castles, ruins, prehistoric sites, and other cultural resources within 0.5 kilometer of the transmission line corridor. Only two are known to be within the corridor, the Azeri cemetery at Ilmazlo and a medieval settlement near Kizil-ajlo. In addition, two small burial mounds near mt. Mshrali Mta. Moliti are reported to be 57 meters from the centerline.

“EnergoTrans” will prevent damages to any of the cultural resources that are listed on Table 4.2-6. They will also communicate with the Ministry of Culture to determine if there are other resources of concern near areas where construction is to take place. For any resource that may be affected by construction, roads, or other operations, the Ministry of Culture must be consulted before operations are begun near that location.

The 200-year-old Azeri cemetery at Ilmazlo will lie directly under the line. It is located at the foot of a three-tower assembly (see section 4.2.6) that was constructed in the 1990s (see Figure 4.2-6). Although the cemetery is not used for fresh graves, there is a degree of local attachment to it. During tower rehabilitation and then conductoring, “EnergoTrans” will need to mark off the perimeter of the cemetery and avoid having vehicles or heavy equipment within the perimeter; workers will not enter the perimeter except under direct supervision of a foreman. The cemetery is vulnerable to further erosion on the riverbank side, and “EnergoTrans” will evaluate and implement measures to ensure the stability of the remaining graves both during line activities and due to future river bank erosion. In addition, before undertaking tower rehabilitation and conductoring activities near the cemetery, “EnergoTrans” will consult with the Stakeholder Advisory Committee, who will in turn consult with the local Mullah. His advice and counsel will be heeded whenever possible to minimize disturbances to the graves and to local sensitivities. Overall, the impact would be minor to moderate, reduced to negligible with mitigation.

A second community with a cemetery close to the corridor is Kosalari. It is also an Azeri community, though the cemetery has been used more recently. The conditions of the towers in this community are so poor that residents feel it would be advisable to build new lines around the village so it is not clear if the lines will actually cross this cemetery. If that is not possible, then “EnergoTrans” will follow the same procedures as at Ilmazlo if the cemetery could be affected by construction.

“EnergoTrans” will also determine if the two small burial mounds near mt. Mshrali Mta. Moliti could be affected. If it will, they must consult with the Ministry of Culture and reach agreement as to how to proceed. The site may not be disturbed without Ministry approval, and mitigation agreed to by the Ministry. Even if the site is not to be disturbed, “EnergoTrans” will prevent equipment and workers from approaching the area by marking it off with a fence or flagging. This barrier must remain until construction is complete.

A third community where there may be an unreported cemetery that could be affected is Azavreti. “EnergoTrans” will need to verify whether it may be affected and design a program to prevent impacts, in consultation with leaders of Azavreti.

5.2.6 Public and occupational health and safety

Section 5.2.6.1 addresses safety. Potential impacts on health would be from electric and magnetic fields, which are discussed in section 5.2.6.2

5.2.6.1 Public and occupational safety

Nearby residents. Nearby community members could be affected by noise, dust, accidents, and other disturbances, mostly during construction.. Humans and property, including livestock, could be harmed by falling towers, towers and live lines in case of line or tower failure (from earthquakes or high winds, for example). GSE and “EnergoTrans” will provide information on security measures local communities should take. This will include a pamphlet in local languages that outlines activities and dangers, and steps that community members should take to avoid accidents. Residents will be instructed clearly when it is especially dangerous to be under or around the lines (during extreme winds and electrical storms, for example), measures to take to ensure that they will be protected, and very specifically instructed to stay away from downed lines or towers. During construction and for the entire time the line is in operation, GSE will establish a 24-hour emergency contact telephone number for reporting problems or damage to the line.

Noise will be generated by vehicles and heavy equipment and should not be excessive. However, because it could disturb nearby residents and others, the disturbances from noise during construction, operation and maintenance will be managed by controlling working hours: 0800 to 1900. Measures will be taken to minimize noise and advance notice will be given to communities about the type, duration, and severity of noise.

During operation, a low buzzing sound will be audible directly under the line and perhaps a few meters outside the line’s width. This could be louder during wet weather. However, it should not be audible at the nearest residence, which will be over 30 meters away.

Overall, the potential impact on pubic safety will normally be negligible, but could be major adverse in case of serious accidents.

Transmission line workers: Workers will be subject to injury or death from falls, falling objects, electrocution, heavy equipment use, vehicle accidents, and possibly from contact with solvents or other chemicals. GSE will develop and implement a safety program that meets international norms, and will ensure that every manager and worker receives training before they perform any work on the line, and are provided refresher training at least every year thereafter. This applies to temporary workers as well.

Every single day, each crew will participate in a safety meeting/briefing, and the languages of all crew members will be used. At this meeting, the crew will be told the day’s activities, the hazards that may encounter, actions to take or to avoid in order to minimize risk, and how to respond in case of illness or injury. The foreman and at least one other person in every crew will be trained in first aid, and each crew will have a first aid kit with them at all times. Foremen will always know where the nearest medical facilities are located, and should have the telephone number available at all times.

Trespassers: Trespassers could be subject to injury or death if they climb on towers or interfere in any way with the conductors (lines). Each tower will have appropriate signs – in Georgian and in the language of nearby residents – that warns trespassers of the risk of electrocution, falls, and other dangers. The sign will also have the 24-hour telephone number to which emergency calls can be made.

5.2.6.2 Potential impacts on health (electric and magnetic fields)

EMF overview. Electric and magnetic fields (also known as electromagnetic fields) (EMF) are invisible lines of force emitted by and surrounding any electrical device, including power lines and electrical equipment. Electric fields are produced by voltage, they increase in strength as the voltage increases, and they are measured in volts per meter (V/m). Electric fields are blocked or shielded by materials that conduct electricity, and other materials such as trees and buildings. Magnetic fields result from the flow of electric current, they increase in strength as the current increases, and they are measured in units of gauss (G) or tesla (T), where 1T equals 10,000G. Magnetic fields pass through most materials and are difficult to shield. Both electric and magnetic fields decrease rapidly with distance.

Although there is public and scientific concern over the potential health effects associated with exposure to EMF (not only from high-voltage power lines and substations, but also from everyday household uses of electricity), there is limited empirical data demonstrating adverse health effects from exposure to typical EMF levels from power transmission lines and equipment. While the evidence of adverse health risks is weak, evaluation of EMF impact is still warranted in environmental assessments.

Construction and operation of this project is not anticipated to have any significant impact to nearby residents or the environment due to electric and magnetic fields. The World Health Organization (WHO) published its latest review of EMF research in June 2007 and experts concluded that EMF do not cause any long-term, adverse health effects (WHO, 2007). EMF exposure from operation of the planned project's power lines (<12.6 mG at the edge of a right-of-way is lower than average exposure from household electrical appliances used every day. The level of electric fields associated with the operation of the proposed project will not change over the project life although the levels of magnetic field will vary somewhat with variations in load demand by hour, day, week, and season.

This section describes the potential effects that electric and magnetic fields (EMF) associated with the project may have on local nearby residents. The Georgia Ministry of Energy has established a 100-meter distance from 500kV transmission lines as a potential human impact zone relative to EMF and mandates that there can be no residences within 30 meters of the line.

This section also identifies mitigation measures typically employed to eliminate or minimize impacts from EMF and provides an assessment of how each may be applied to this project. These mitigation measures will be based on those practices typically employed for similar projects in Europe and the western U.S. Additional mitigation measures for impacts to these resources are provided in the IFC/WB guidance.

Activities that generate EMF. Project activities that will generate EMF include operation of the energized transmission line and substations. EMF in the range of power line frequencies typically range from 50 to 60 Hertz (Hz) and are considered Extremely Low Frequency (ELF). The most common impact from nearby power transmission lines is electrical interference with sensitive equipment, such as computer monitors.

Potential human health impacts. Over the last 30 years, extensive research has been conducted in the U.S. and around the world to examine whether exposure to EMF has adverse health or environmental effects. Exposure to EMF is affected by the types of electrical sources, the distance from these sources, and the amount of time spent near these sources. Scientific research has focused on magnetic fields, since objects such as trees and walls act as physical barriers that easily block and shield electric fields.

In most homes, background alternating current magnetic field levels average about 1 milligauss (0.001 gauss), resulting from wiring within the home, appliances, and power lines outside the home. Since the intensity of magnetic fields diminishes quickly with distance from the source, few homes are close enough to transmission lines for the lines to have an impact on the magnetic field level within the home. Rather, the major source of residential magnetic field levels comes from electrical appliances within the home. The average daily exposure is the composite of instantaneous, high exposures (such as driving under a power line) and long-term, low exposures (such as wiring within a home).

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) reviewed the epidemiological and experimental evidence and concluded that there was insufficient evidence to warrant the development of standards limiting long-term exposure to EMF. Rather, the guidelines put forth in its 1998 document set limits at much higher field levels to protect against direct short-term health effects (for example, stimulation of nerves and muscles, a shock-like effect) that are known to occur at very high exposure levels. The ICNIRP recommends a residential exposure limit of 833 mG and an occupational exposure limit of 4,200 mG (ICNIRP, 1998). Also, the International Committee on Electromagnetic

Safety (ICES) recommends that exposures of the general public be limited to 9,040 mG (ICES, 2002). Both standards are designed to provide a very large margin of safety.

The exposures of workers and persons living in close proximity to the proposed project transmission lines should be below these guidelines. Based on EMF exposure levels cited in the National Institute of Environmental Health Sciences June 2002 report titled “EMF, Electric and Magnetic Fields Associated with the Use of Electric Power” (NIEHS, 2002), an electrical worker has an average EMF exposure of 9.6 mG, and typical EMF levels 20 meters from a 500 kV power transmission line is 29.4 mG, decreasing to 12.6 mG at 30 meters. Based on these data, the EMF field levels within and at the edges of the 100-meter wide corridor of the proposed project, and at the edge of the 30-meter buffer zone, should be well below the levels recommended by the ICNIRP and the ICES (12.6 mG exposure compared to ICNIRP recommendation of 833 mG).

Research on EMF in residential settings and health was prompted by a 1979 epidemiology study of children exposed to EMF, mostly from neighborhood transmission lines. A weak statistical association has been reported in some studies between childhood leukemia and average exposure to magnetic fields greater than 3 - 4 mG. Hundreds of studies have subsequently addressed almost all issues that have been raised about EMF and health. These later studies did not find convincing or consistent evidence to suggest that EMF exposure was higher or more frequent in children with leukemia, thus supporting the idea that EMF is not a cause of cancer. Since there is very little support in other areas important for evaluating causation (for example, similar findings in animal studies and a plausible biological mechanism), the overwhelming scientific consensus is that these findings are insufficient to establish a cause-and-effect relationship between residential EMF exposure and childhood leukemia. Rather, most researchers agree that where associations exist in epidemiology studies, they are likely the result of study design issues such as bias or confounding.

Using a weight-of-evidence approach to evaluate this large body of research, the scientific consensus of numerous organizations is that no cause-and-effect relationship between EMF from any source and ill health has been established at the levels typically found in residential environments. As a result, no scientific organizations have recommended standards to prevent long-term health effects (such as cancer), nor are there any standards in the U.S. or most other countries for limiting exposure to the levels of EMF typically encountered in people’s everyday lives.

However, Russia and former states in the Soviet Union have established safety or hygienic protection zones (SPZs or HPZs) that limit exposure to EMF. Georgia’s *Rules of Installation of Electric Equipment*-ПУЭ (Ministry of Energy, undated-2) establish a buffer zone of 30 meters (measured from the outermost line), within which there can be no residents. In addition, Georgia’s *Rules of Installation of Electric Equipment*-ПУЭ (Ministry of Energy of Georgia, undated-2) establish a buffer zone of 30 meters as a minimum distance from occupied houses to transmission lines.

.*Environmental, animal and plant impacts.* Power frequency EMF in the 50 to 60 Hz range carries very little energy, has no ionizing effects, and usually has no thermal effects. Because EMF in the range of power line frequencies are far too weak to damage molecules or break up DNA, they cannot lead to mutational changes or cancer. EMF can cause very weak electric currents to flow in the body. In animal studies, scientists exposed rat and mice test subjects to electric or magnetic fields, some as high as 50,000 mG, and compared the amount of disease they observed to the amount of disease observed in animals that had not been exposed. WHO concluded in their June 2007 review of EMF and health (WHO, 2007) that no consistent adverse health effects, including cancer, were reported in animals even after exposure to high levels of electric and magnetic fields. Overall, the research does not establish that EMF exposure causes or contributes to any disease or illness.

Potential impacts. Overall, no potential impacts are expected to occur from human, animal, or plant exposure to EMF. However, mitigation is called for in order to comply with the Georgian norm. As described above in section 5.2.1, the primary mitigation to be required provides that no one may live within 30 meters of this 500kV transmission line. As described in that section and in section 5.2.4, GSE will realign sections of line that have not been constructed in order to avoid passing within 30 meters of dwellings. They also will work with residents/owners of current dwellings to work out equitable relocation and compensation, or possibly realignment of small lengths of the existing transmission line.

5.2.8 Order of Magnitude Cost Evaluation

5.2.8.1 Methods and Assumptions

This section compares the approximate cost to complete the project routing alternatives. The estimate should be considered a rough "order of magnitude" evaluation and not a formal engineering cost estimate. The estimate is based on the cost estimate information contained in a feasibility study prepared by Kuljian (2007) for the Ministry of Energy. The following are cost assumptions extracted from this report:

- 500 kv transmission line costs are US$450,000 per kilometer.
- Akhaltsikhe substation total cost is $128,000,000.
- Zestaphoni substation Expansion total cost is $9,000,000.
- Gardabani substation Expansion total cost is $3,000,000.

The following additional cost assumptions were made based on experience from similar transmission line projects:

- New corner (U-type) tower cost is US$15,000 per tower.
- New in-line (PB-type) tower cost is $7,500 per tower.
- The costs for helicopter based site prep and tower construction are assumed to be $125,000 per tower.
- Repair/rehabilitation cost for towers/foundation is US$5,000 per tower/foundation. This cost assumption is based on an average case. Costs for specific locations would be higher or lower depending on the conditions.
- Forest clearing cost is US$20,000 per hectare.

The following are assumptions made in the methodology:

- The transmission line estimates were based on the length of new segments that must be constructed..
- The estimated number of new towers was based on a spacing of 400 meters between towers for new segments of the line.

An additional evaluation was conducted considering the potential use of helicopters to construct the towers associated with the crossing of Borjomi-Kharagauli National Park under Alternative 2. Under this alternative, much less forest clearing was needed, although there are additional costs for helicopter cost.

5.2.8.2 Cost estimate

This cost evaluation should not be construed as a very rough estimate. The purpose of this evaluation is to provide a comparative assessment of the rough order of magnitude costs between the four project alternatives. Table 5.2-2 presents the results of this evaluation.

Table 5.2-2. Comparative cost evaluation of project alternatives
(2007 US$)

Scenario	*Alternative 1*	*Alternative 2*	*Alternative 3*	*Alternative 4 (no Action)*
Standard installation along entire project route	$211,206,000	$221,647,000	$241,617,000	$0
Using helicopter installation in Borjomi-Kharagauli	$211,206,000	$220,801.000	$241,617,000	$0

5.3 Summary of potential impacts and preferred alternative

5.3.1 Summary of potential impacts

Table 5.3-1 summarizes the potential impacts on all the environmental and socioeconomic resources. While there are no, negligible, and minor impacts associated with parts of the project, these are considered to be generally insignificant and would not typically require avoidance or mitigation. There are several moderate to major adverse impacts associated with this project that will require some form of avoidance or mitigation:

- For Alternatives 1, 2, and 3, the construction and ongoing operation of the new Akhaltsikhe substation will create a moderate adverse impact to the aesthetics and views of nearby residents or visitors to protected areas. These cannot be avoided. Residents can become acclimated so the impact would be reduced over time, and there would be very few visitors, who would have only temporary exposures.
- For Alternatives 1, 2, and 3, the construction and ongoing operation of the transmission line in the Ktsia-Tabatskuri Managed Reserve will create a major adverse impact on aesthetics and views for tourists and naturalists. This cannot be completely avoided, except possibly by adjusting some locations so that towers in hilly or mountain terrain cannot be seen from specific high-use areas. The impacts would be lower under Alternatives 2 and 3, which were designed to reduce the impacts on Ktsia-Tabatskuri by moving the line away from some high-use bird-watching areas and also by reducing the length of the line through the protected area.
- For Alternatives 1 and 2, the construction and ongoing operation of the transmission line in Borjomi-Kharagauli National Park will create a moderate to major adverse impact on aesthetics and views for tourists and naturalists. This also cannot be completely avoided, except possibly by adjusting some locations so that towers in hilly or mountain terrain cannot be seen from specific high-use areas. The impact would be reduced under Alternative 2, which was designed to reduce the impacts on Borjomi-Kharagauli by reducing the length of the line crossing from 11.5 to 4.7 kilometers. Alternative 3 avoids the National Park, so there would be no impacts under that alternative.
- For Alternatives 1, 2, and 3, the construction of towers, access roads, and ongoing maintenance activities <u>may</u> have a major adverse impact on flora in the sensitive areas indicated in Figures 4-11a through 4-11h due to destruction of individual plants and habitat modification. Prior to design in areas of high sensitivity, and prior construction in areas of medium sensitivity, detailed

botanical surveys of tower locations and corridors should be conducted by a qualified expert. The purpose will be to determine the presence or absence of sensitive and protected plant species and communities of special concern to allow a “Flora Conservation Plan” to be developed which will identify ways in which to reduce or avoid the potential impacts.

- For Alternatives 1, 2, and 3, the construction and operation of transmission lines could have a moderate to major impact on migratory birds and bats due to collisions and electrocution, especially in areas where the transmission line is oriented east-west with respect to the north-south flyways. This can be at least slightly mitigated for daylight migrants by placing so-called “bird diverters” at intervals along on transmission lines to discourage perching and loafing, and to discourage birds from approaching the line. In addition, conductors (lines) will be spaced far apart to reduce the electrocution hazard for large birds. Finally, surveys will be required during breeding season in specific areas of high risk.
- For Alternatives 1, 2, and 3, construction of towers, access roads, and ongoing maintenance activities *may* have a major adverse impact on nesting raptors and other large birds, including scavengers, storks, herons, etc. Prior to beginning these activities in protected areas and in the areas identified in Table 4.1-12 and 4.1-13, a qualified expert will conduct a breeding bird survey of tower locations and transmission line route in those areas. If an active nest is found within 0.5 kilometer of the corridor, construction and other activities will be delayed until at least 30 days after young birds fledge and leave the nest. If an old nest is found, another survey will be completed immediately before activities to determine if the nest has become active; and if it has, the same delay will be required.
- For Alternatives 1, 2, and 3, construction of towers, access roads, and ongoing maintenance activities *may* have a major adverse impact on fauna in protected areas and in sensitive areas identified on Figure 4-15 (at the end of Chapter 4) and in Table 4.1-2 due to destruction of dens, nests, and foraging habitat. Prior to construction during breeding seasons (roughly, March to August) in protected areas and these areas, detailed surveys will be conducted to determine whether protected use the areas and to determine whether construction should be delayed until after breeding seasons for species of concern.
- For Alternatives 1, 2, and 3, construction and operation would require a few households to be relocated to residences farther from the line. This will be a matter of negotiation whenever possible, with compensation or alternative housing agreed to by the landowner and/or resident and based upon fair market values.
- For alternatives 1, 2, and 3, construction or maintenance could damage crops or herds and have a moderate to major impact on subsistence farmers and herders. This can be avoided or reduced by adherence to best management practices with vehicle movements and tower construction sites, and further mitigated by compensation at mutually agreed-upon market value.

In addition, most adverse impacts that are minor or negligible will be reduced or avoided altogether by the use of best management practices. Avoidance strategies, mitigation measures, and best management practices are presented as part of the Management and Monitoring Plan in Chapter 6.

5.3.2 Preferred alternative

Alternative 2 was determined to be the environmentally preferred alternative following evaluation of potential impacts for all alternatives. Key advantages of this alternative, and disadvantages of others, include:

- Much less disturbance of Borjomi-Kharagauli National Park than Alternative 1 -- 4.7 kilometers through the park compared to 11.5 under Alternative 1. This would reduce the number of towers and the associated land clearing and disturbance. This in turn would significantly reduce visual impacts to tourists.
- Less disturbance of Ktsia-Tabatskuri Managed Reserve – 10 kilometers through the Reserve compared to 12.1 under Alternative 1.
- Much less disturbance overall than Alternative 3, which runs an additional 50 kilometers in order to go all the way around Borjomi-Kharagauli to the west. The environmental resources along that route is similar to the park, although they are not protected.
- Much less potential impact to plants and animals, especially rare ones in Borjomi-Kharagauli and Ktsia-Tabatskuri.
- Intermediate cost: $9,000,000 more than Alternative 1, due to longer distance to reach the short crossing of Borjomi-Kharagauli and the longer distance around Tabatskuri Lake; and $21,000,000 cheaper than Alternative 3, which runs an additional 50 kilometers to go around Borjomi-Kharagauli. (Kuljian, 2007)

It should also be noted that none of the benefits described above would be gained under Alternative 4.

Table 5-3-1. Summary of Potential Impacts

Environmental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Alternative 1*		*Alternative 2*		*Alternative 3*		*Alternative 4*	
			Magnitude of Impact and Duration	*Significance*	*Magnitude of Impact and Duration*	*Significance*	*Magnitude of Impact and Duration*	*Significance*	*Magnitude of Impact and Duration*	*Significance*
Air Quality										
Residents	Low	Fugitive dust generation during construction and maintenance	Low, Temporary	Negligible Adverse	Low, Temporary	Negligible Adverse	Low, Temporary	Negligible Adverse	None	None
Residents	Low	Vehicle emissions during construction and maintenance	Low, Temporary	Negligible Adverse	Low, Temporary	Negligible Adverse	Low, Temporary	Negligible Adverse	None	None
Residents	Low	SF6 emissions during operation of project	Low, Ongoing	Negligible Adverse	Low, Ongoing	Negligible Adverse	Low, Ongoing	Negligible Adverse	None	None
Residents	Low	Reduce GHG and carbon footprint by making hydro power generated electricity more available to the trans-Caucasus region.	Medium, Ongoing	Minor Beneficial	Medium, Ongoing	Minor Beneficial	Medium, Ongoing	Minor Beneficial	None	None
Landscape										
Residents	Medium	Disturbance of natural views by transmission line, towers, and ROW clearing near population centers.	Low, Permanent	Minor adverse	Low, Permanent	Minor adverse	Low, Permanent	Minor adverse	None	None
Residents	Medium	Disturbance of views by substation to residents adjacent to Akhaltsikhe substation	Medium, Permanent	Moderate adverse	Medium, Permanent	Moderate adverse	Medium, Permanent	Moderate adverse	None	None
Tourists (Borjomi-Kharagauli National Park)	High	Disturbance of natural views by transmission line, towers, and ROW clearing in protected areas.	Very Low (1389 of 73907 ha) Permanent	Negligible adverse	Very Low (1487 of 73907 ha) Permanent	Negligible adverse	None	None	None	None

Table 5-3-1. Summary of Potential Impacts

Environmental Receptor	Sensitivity of Receptor	Potential Impact	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
			Magnitude of Impact and Duration	*Significance*	*Magnitude of Impact and Duration*	*Significance*	*Magnitude of Impact and Duration*	*Significance*	*Magnitude of Impact and Duration*	*Significance*
Tourists (Ktsia-Tabatskuri Managed Reserve)	High	Disturbance of natural views by transmission line, towers, and ROW clearing in protected areas.	Medium (9477 of 21390 ha) Permanent	Major adverse	Medium (8840 of 21390 ha) Permanent	Major adverse	Medium (8840 of 21390 ha) Permanent	Major adverse	None	None
Travelers	Low	Disturbance of natural views by transmission line, towers, and ROW clearing from main roads and highways connecting major towns in the region.	Low, Permanent (but temporary from the perspective of the traveler)	Negligible	Low, Permanent (but temporary from the perspective of the traveler)	Negligible	Low, Permanent (but temporary from the perspective of the traveler)	Negligible	None	None
Land use										
National Parks and Managed Reserves	High	Clearing of trees and shrubs for ROW.	Very low (115 of 73,907 ha) Ongoing	Minor adverse	Very low (47 of 73,907 ha) Ongoing	Minor adverse	None	None	None	None
National Parks and Managed Reserves	High	Loss of land use by placement of towers, substations, and access roads.	Very low (11 of 21389 ha) Ongoing	Minor adverse	Very low (9 of 21389 ha) Ongoing	Minor adverse	Very low (9 of 21389 ha) Ongoing	Minor adverse	None	None
Forestry Uses	Medium	Clearing of trees and shrubs for ROW.	Very low (571 of 47717 ha) Ongoing	Negligible adverse	Very low (760 of 47717 ha) Ongoing	Negligible adverse	Very low (830 of 47717 ha) Ongoing	Negligible adverse	None	None
Agricultural Uses	Medium	Loss of agricultural land by placement of towers, substations, and access roads.	Very low (110 of 66850 ha) Ongoing	Negligible adverse	Very low (112 of 66850 ha) Ongoing	Negligible adverse	Very low (111 of 66850 ha) Ongoing	Negligible adverse	None	None

Table 5-3-1. Summary of Potential Impacts

Environmental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Alternative 1*		*Alternative 2*		*Alternative 3*		*Alternative 4*	
			Magnitude of Impact and Duration	*Significance*	*Magnitude of Impact and Duration*	*Significance*	*Magnitude of Impact and Duration*	*Significance*	*Magnitude of Impact and Duration*	*Significance*
Soil, Geology, and Geohazards										
Habitats in Protected Areas	High	Blasting for tower foundations may produce landslides or avalanches.	Very Low, Permanent	Minor adverse	Very Low, Permanent	Minor adverse	Very Low, Permanent	Minor adverse	None	None
Soils in Protected Areas	High	Use, improper handling, and spills of hazardous materials, such as fuels and petroleum lubricants, insulating oils, wood preservatives, paints, and other toxic substances may release contamination.	Very low, Temporary but could be permanent	Minor adverse	Very low, Temporary but could be permanent	Minor adverse	Very low, Temporary but could be permanent	Minor adverse	None	None
Habitats in Non-Protected Areas	Medium	Blasting for tower foundations may produce landslides or avalanches.	Very Low, Permanent	Negligible adverse	Very Low, Permanent	Negligible adverse	Very Low, Permanent	Negligible adverse	None	None
Soils in Non-Protected Areas	Medium	Use, improper handling, and spills of hazardous materials, such as fuels and petroleum lubricants, insulating oils, wood preservatives, paints, and other toxic substances may release contamination.	Very low, Temporary but could be permanent	Negligible adverse	Very low, Temporary but could be permanent	Negligible adverse	Very low, Temporary but could be permanent	Negligible adverse	None	None
Surface and Groundwater Hydrology										
Streams, rivers, and lakes	Medium	Soil compaction, soil rutting, and dust generation from vehicle and other construction equipment traffic along access roads and ROW may increase sediment carried in runoff.	Very low, Temporary but could be permanent	Negligible adverse	Very low, Temporary but could be permanent	Negligible adverse	Very low, Temporary but could be permanent	Negligible adverse	None	None

Table 5-3-1. Summary of Potential Impacts

Environmental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Alternative 1*		*Alternative 2*		*Alternative 3*		*Alternative 4*	
			Magnitude of Impact and Duration	*Significance*	*Magnitude of Impact and Duration*	*Significance*	*Magnitude of Impact and Duration*	*Significance*	*Magnitude of Impact and Duration*	*Significance*
Streams, rivers, and lakes	Medium	Placement of towers in floodplains can impede flood flows and produce flooding in upstream areas.	Low, Permanent	Minor adverse	Low, Permanent	Minor adverse	Low, Permanent	Minor adverse	None	None
Streams, rivers, and lakes	Medium	Clearing of trees and shrubs make the soil more susceptible to erosion and dust generation as the soils under these plants are now exposed to wind and precipitation.	Very low, Permanent	Negligible adverse	Very low, Permanent	Negligible adverse	Very low, Permanent	Negligible adverse	None	None
Streams, rivers, and lakes	Medium	ROW, access road clearing, and mud carried on tires also increase sedimentation carried in stormwater runoff.	Very low, Temporary	Negligible adverse	Very low, Temporary	Negligible adverse	Very low, Temporary	Negligible adverse	None	None
Streams, rivers, and lakes	Medium	Use, improper handling, and spills of hazardous materials, such as fuels and petroleum lubricants, insulating oils, wood preservatives, paints, and other toxic substances may release contamination.	Very low, Temporary but could be permanent	Negligible adverse	Very low, Temporary but could be permanent	Negligible adverse	Very low, Temporary but could be permanent	Negligible adverse	None	None
Groundwater in Non-Protected Areas	Medium	Use, improper handling, and spills of hazardous materials, such as fuels and petroleum lubricants, insulating oils, wood preservatives, paints, herbicides, pesticides, and other toxic substances may release contamination.	Very low, Temporary but could be permanent	Negligible adverse	Very low, Temporary but could be permanent	Negligible adverse	Very low, Temporary but could be permanent	Negligible adverse	None	None

Table 5-3-1. Summary of Potential Impacts

Environmental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Alternative 1*		*Alternative 2*		*Alternative 3*		*Alternative 4*	
			Magnitude of Impact and Duration	*Significance*	*Magnitude of Impact and Duration*	*Significance*	*Magnitude of Impact and Duration*	*Significance*	*Magnitude of Impact and Duration*	*Significance*
Groundwater in Protected Areas	High	Use, improper handling, and spills of hazardous materials, such as fuels and petroleum lubricants, insulating oils, wood preservatives, paints, herbicides, pesticides, and other toxic substances may release contamination.	Very low, Temporary but could be permanent	Minor adverse	Very low, Temporary but could be permanent	Minor adverse	Very low, Temporary but could be permanent	Minor adverse	None	None
Lake Takatsuki	High	Soil compaction, soil rutting, and dust generation from vehicle and other construction equipment traffic along access roads and ROW may increase sediment carried in runoff.	Very low, Temporary but could be permanent	Minor adverse	Very low, Temporary but could be permanent	Minor adverse	Very low, Temporary but could be permanent	Minor adverse	None	None
Lake Tabatskuri	High	Clearing of trees and shrubs make the soil more susceptible to erosion and dust generation as the soils under these plants are now exposed to wind and precipitation.	Very low, Permanent	Minor adverse	Very low, Permanent	Minor adverse	Very low, Permanent	Minor adverse	None	None
Lake Tabatskuri	High	ROW, access road clearing, and mud carried on tires also increase sedimentation carried in stormwater runoff.	Very low, Temporary	Minor adverse	Very low, Temporary	Minor adverse	Very low, Temporary	Minor adverse	None	None
Lake Tabatskuri	High	Use, improper handling, and spills of hazardous materials, such as fuels and petroleum lubricants, insulating oils, wood preservatives, paints, and other toxic substances may release contamination.	Very low, Temporary but could be permanent	Minor adverse	Very low, Temporary but could be permanent	Minor adverse	Very low, Temporary but could be permanent	Minor adverse	None	None

Table 5-3-1. Summary of Potential Impacts

Environmental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Alternative 1*		*Alternative 2*		*Alternative 3*		*Alternative 4*	
			Magnitude of Impact and Duration	*Significance*	*Magnitude of Impact and Duration*	*Significance*	*Magnitude of Impact and Duration*	*Significance*	*Magnitude of Impact and Duration*	*Significance*
Ecosystems, Flora, and Fauna										
Forested Ecosystems	Medium	Loss of forested habitats for wildlife	Very low, ongoing	Negligible adverse	Very low, ongoing	Negligible adverse	Very low, ongoing	Negligible adverse	None	None
Forested Ecosystems	Medium	Increased risk of forest fires due to residual forest litter and slash	Very low, ongoing	Negligible adverse	Very low, ongoing	Negligible adverse	Very low, ongoing	Negligible adverse	None	None
Forested Ecosystems	Medium	Introduction of invasive species into forested ecosystems	Very low, ongoing	Negligible adverse	Very low, ongoing	Negligible adverse	Very low, ongoing	Negligible adverse	None	None
Other Ecosystems	Low	Loss of habitat	Very low, permanent	Negligible adverse	Very low, permanent	Negligible adverse	Very low, permanent	Negligible adverse	None	None
Other Ecosystems	Low	Introduction of invasive species	Very low, permanent	Negligible adverse	Very low, permanent	Negligible adverse	Very low, permanent	Negligible adverse	None	None
Flora in sensitive areas	High	Destruction of floral community and individuals during construction and maintenance activities	High, permanent	Major Adverse	High, permanent	Major Adverse	High, permanent	Major Adverse	None	None
Flora in non-sensitive areas	Low	Destruction of floral community and individuals during construction and maintenance activities	Low, permanent	Negligible adverse	Low, permanent	Negligible adverse	Low, permanent	Negligible adverse	None	None
Fauna in sensitive areas	High	Avian and bat collisions/electrocution from contact with power lines.	High, permanent	Major Adverse	High, permanent	Major Adverse	High, permanent	Major Adverse	None	None
Fauna in sensitive areas	High	Den and nest destruction during construction and maintenance activities	High, permanent	Major Adverse	High, permanent	Major Adverse	High, permanent	Major Adverse	None	None
Fauna in non-sensitive areas	Low	Avian and bat collisions/electrocution from contact with power lines.	Low, permanent	Negligible adverse	Low, permanent	Negligible adverse	Low, permanent	Negligible adverse	None	None

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Table 5-3-1. Summary of Potential Impacts

Environmental Receptor	*Sensitivity of Receptor*	*Potential Impact*	*Alternative 1*		*Alternative 2*		*Alternative 3*		*Alternative 4*	
			Magnitude of Impact and Duration	*Significance*	*Magnitude of Impact and Duration*	*Significance*	*Magnitude of Impact and Duration*	*Significance*	*Magnitude of Impact and Duration*	*Significance*
Fauna in non-sensitive areas	Low	Den and nest destruction during construction and maintenance activities	Low, permanent	Negligible adverse	Low, permanent	Negligible adverse	Low, permanent	Negligible adverse	None	None
Socioeconomics										
Income	High	Increased employment of local workers	Minor, temporary	Minor beneficial	Minor, temporary	Minor beneficial	Minor, temporary	Minor beneficial	None	None
Farmers (personal income)	High	Loss of use of land	Minor, permanent	Minor adverse	Minor, permanent	Minor adverse	Minor, permanent	Minor adverse	None	None
	High	Crop or herd damage	Moderate, temporary	Moderate adverse	Moderate, temporary	Moderate adverse	Moderate, temporary	Moderate adverse	None	None
National economy	High	Economic development, enhanced ties to allies	Moderate, permanent	Moderate beneficial	Moderate, permanent	Moderate beneficial	Moderate, permanent	Moderate beneficial	None	None
Transportation	Moderate	Disruption of traffic	Minor, temporary	Negligible Adverse	Minor, temporary	Negligible Adverse	Minor, temporary	Negligible Adverse	None	None
Electric power	Moderate	Increased access to power and increased reliability of supply	Major, permanent	Major, Beneficial	Major, permanent	Major, Beneficial	Major, permanent	Major, Beneficial	None	None
Community functions	High	Noise, dust, other disturbance to local residents	Minor, temporary	Minor, Adverse	Minor, temporary	Minor, Adverse	Minor, temporary	Minor, Adverse	None	None
Residents near the line	High	Relocation due to proximity to line	Major, permanent	Major, Adverse	Major, permanent	Major, Adverse	Major, permanent	Major, Adverse	None	None
Cultural resources	High	Disturbance to cemeteries or other cultural resources	Minor, permanent	Minor, Adverse	Minor, permanent	Minor, Adverse	Minor, permanent	Minor, Adverse	None	None
Public and occupational safety	High	Accidents to workers, local residents, trespassers	Major, permanent	Major, Adverse	Major, permanent	Major, Adverse	Major, permanent	Major, Adverse	None	None
Public health	High	Impaired health due to exposure to EMF	Major, permanent	Negligible, Adverse	Major, permanent	Negligible, Adverse	Major, permanent	Negligible, Adverse	None	None

6.0 Environmental and Social Management and Monitoring Plan

6.1 Environmental and Social Management Plan

The construction, operation, and maintenance of this power transmission line could have a moderate or major adverse impact on several environment and social resources. It is therefore imperative that precautions be taken to ensure that significant adverse effects be avoided, reduced, or otherwise mitigated. This will take a concerted effort from the Project Execution Agency the Georgia State Electrosystem (GSE), its daughter company EnergoTrans, and the Technical Consultant to ensure that proper design and operating procedures are implemented throughout the project, and that the mitigation measures called for in this Chapter are incorporated into requirements for design, construction, operation and maintenance of the line.

These two management plans, the Environmental Management Plan (EMP) and Social Management Plan (SMP), have been developed to clearly identify mitigation measures that should be implemented to minimize, reduce, or eliminate moderate and major adverse impacts identified in the ESIA. In addition, the EMP and SMP also identifies best management practices (BMPs) and other mitigation measures that will minimize, reduce, or eliminate some negligible and minor impacts that could escalate to become more important if they are not handled properly.

The EMP and SMP also ensure close scrutiny over the actual environmental and socioeconomic performance of the project and allow prompt action to be taken rectify any practices that do not adequately mitigate actual impacts. Where impacts cannot be mitigated, the plans call for compensation programs or environmental enhancement programs that offset, where possible, those impacts.

Tables 6-1 and 6-2 comprise the EMP and SMP for the Black Sea Regional Transmission Project. The Ministry of Energy should oversee the Project Execution Agency and the Technical Consultant to ensure that the companies and their workers fully comply with the recommended practices and mitigation measures. These measures include training for workers so they are familiar with the practices required in the EMP and SMP. The EMP and SMP should be regularly updated as the project progresses through the different phases and experience is gained as to actual practices and their actual impacts.

6.2 Environmental and Social Monitoring Program

The environmental and social impacts that may result from construction, operation, and maintenance of the Black Sea Regional Transmission Project are described in Section 5 and summarized in Table 5-3-1 of the ESIA report. Section 6.1 above specifies appropriate mitigation measures that need to be implemented to mitigate or reduce the potentially significant impacts.

An Environmental and Social Monitoring Program (ESMP) is needed to verify the effectiveness of the proposed mitigation measures in reducing impacts and also to allow mitigation measures to be refined or developed as needed to address actual impacts or to develop plans for future development.

More specifically, the objectives of a monitoring program are to:

- Record project impacts during construction and operation.
- Evaluate the effectiveness of the mitigation measures and identify any shortcomings.

- Meet legal and community obligations.
- Allow refinement and enhancement of mitigation measures to further reduce impacts.
- Allow development of mitigation measures to deal with unforeseen issues or changes in operations.
- Allow the Ministry of Energy and international lenders to verify that requirements of loan agreements are being met.

This ESMP describes the parameters to be monitored, the activities to be executed, sampling locations, time and frequency of monitoring activities, and the collection, analysis, and reporting of monitoring data. Environmental monitoring activities should be based on direct and indirect indicators of emissions, effluents, and resource use applicable to the particular project.

Table 6-3 presents the ESMP for pre-construction, construction, and operational phases of the Black Sea Regional Power transmission project. It is assumed that the Project Execution Agency, through the Technical Consultant and a qualified environmental consulting and monitoring company will be responsible for all monitoring activities, and that the results would be reported to GSE, the Ministry of Energy, and other Government of Georgia Ministries as appropriate. In addition, lenders may wish to receive full reports or selected data.

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
			1. PRE-CONSTRUCTION PHASE: PROJECT DESIGN			
1.1	General Permitting and Regulatory Compliance: Local Georgian and International (EU) regulatory compliance for High-voltage power transmission lines and substation construction projects	Issues to consider: Compliance with national and international (EU) standards and requirements in environmental conservation and carrying out ESIA for power transmission lines and substation construction projects.	Required for further project implementation	Ensure that all government and funding/co-funding agencies requirements and procedures relating to ESIA are complied with. This preliminary assessment should be completed prior to the construction stage and should verify that: - All necessary permits for Project construction and operation are or will be obtained after the ESIA submittal (construction permit, permit for entering/crossing National parks and protected areas). - All issues, associated with land use/property and ROW acquisitions are settled down/coordinated and/or negotiated, including National and EU requirements for compensation, payments and potential resettlements of residents along the route - Completion of the analysis of Project design and specifications and its cumulative impacts on environmental and socio-economic conditions. The analysis is to ensure the Project is in line with best international practices and allows incorporation of appropriate measures to minimize/reduce/avoid adverse environmental and socio-economic effects of the project implementation with enhancement of beneficial impacts. - Assurance that properly developed environmental and social mitigation and monitoring plan will be in compliance with EU	Project Execution Agency and Technical Consultant	This is reflected in ESIA Section 1 and Section 3

[7] Impact analysis and Summary of Impacts are specified in ESIA Section 5 and Table 5.3-1 "Summary of Potential Impacts" and in Non-Technical Summary (NTS)

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts						
No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
				and National standards.		
	Planning for construction, pre-design	Protection of flora and fauna	Required	- Survey of entire line by qualified flora expert to identify protected/sensitive species and communities. - Preparation of Flora Conservation Plan to report results of survey, mitigation/ conservation needed, and required monitoring program. - Survey of all sensitive areas identified in ESIA (ESIA Figures 4-12 through 4-15) by qualified experts to identify protected/sensitive species and critical habitat. - Preparation of Fauna Conservation Plan to report results of survey, mitigation/ conservation needed, and required monitoring program.	Project Execution Agency and Technical Consultant	
- 2. PRE-CONSTRUCTION PHASE: PLANNING (KEY ISSUES)						
2.1	Power transmission line, ROW and substations planning	Impacts and issues to consider: Adverse impacts on land use and visual impacts Adverse impacts on environmental and socio-economic conditions Occupational and Public Health and Safety	Negligible to Moderate adverse Negligible to Major adverse NA	- Alternatives analysis to estimate relevant impacts of each alternative proposed for power transmission line routes. - As much as possible avoid critical habitat areas through use of existing utility and transport corridors for transmission and distribution, and existing roads and tracks for access roads, whenever possible. - Special consideration to minimize the number of river crossings, avoid settlements and residential areas, and avoid (if possible) natural protected areas and natural reserves.	Project Execution Agency and Technical Consultant	ESIA Section 2 and Section 5.

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
				- If it is impossible to avoid natural protected areas and/or zones, take and implement all necessary mitigation measures to minimize/mitigate the adverse impacts on environmental and social conditions during construction and operation phases of the Project. - In the area of Ktsia-Tabatskuir Managed Reserve, sit e the transmission line "behind" settlements and roads so they do not interfere with views of the Managed Preserve from roads and settlements. - Accurately assess changes in property values due to power line proximity (social and economic issue – for details refer to Table 6-2 Social Management Plan). - Carry out extensive public consultations during the Project Planning phase, e.g. siting of power line, ROW and substations (social and economic issue – for details refer to Table 6-2 Social Management Plan and Appendix C Public Consultation and Disclosure Plan (PCDP)		

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
				- Site power line and substations with due consideration to landscape views and important environmental and community features. - Locate high-voltage transmission and distribution line in less populated areas, where possible. - GSE "Energotrans Ltd." and the Prime EPC contractor should assign Environmental Officers who will be responsible for environmental conservation issues and controlling proper implementation of mitigation and protection measures during the Project construction and operation.		
		Occupational and Public Health and Safety issues (Electro-magnetic Fields)	NA	- Avoid areas potentially critical to EMF for power line and substation locations, such as schools, residential areas, offices etc.) - Establish a minimum 30 m buffer zone from the centerline on both sides of the power line. - Ensure that no residential housing is located within at least 30 m of the line. - Measure EMF within buidings within 100m of the line, if levels exceed international guidance, install shielding or otherwise protect occupants/residents.	Project Execution Agency and Technical Consultant	Details in 4.2. of the EMP and in ESIA Section 5 and 5.2.6

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
2.2	Access roads planning	Impacts to consider: Physical impact on soils, vegetation clearings, surface and groundwater, loss of land (grasslands) and alteration of habitats	Negligible to Major adverse	- Clearly identify and demarcate access roads on large scale topographic maps before construction - Identify access points from main roads where crews can access tower locations by driving along ROW as much as possible to minimize the need for access roads outside the ROW. - Confine equipment to demarcated areas and assign temporary construction camps, including a base camp, where majority of equipment will be temporarily stored. - To minimize vegetation clearings, consider use of helicopter to access hard-to-access areas (especially at Borjomi-Kharagauli National Park crossing) to transport tower foundations, steel carcasses and construction equipment.	Project Execution Agency and Technical Consultant	ESIA Section 2 and Section 5
		Soil erosion Contamination of soil with litter Local contamination of surface and groundwater from oil, petrol and other hazardous materials spills	Negligible to Minor adverse	- Develop and implement run-off and erosion control measures, especially in mountainous, hilly terrain areas and on slopes. Implement these measures for both construction and operation periods. - Develop a waste and hazardous materials management and handling plan for the construction base camp and secondary construction camps.		

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
2.3	500kV overhead lines conductoring	Collision risk and risk of electrocution for birds.	Minor with proper mitigation	- Design overhead high voltage line to reduce or eliminate electrocution risk for birds, found in the habitats through power line crosses. - Align power line route to avoid critical aquatic habitat (wetlands, riparian areas, watercourses etc.) where migratory waterfowl may congregate. - Design separation of conductors on the circuit and other energized hardware by the maximum protected bird species wingspan to prevent electrocution. Some of the crane and vulture species can have wingspans approaching 3 m.. - Establish and implement an Avian Protection Program to be used for during ongoing operations. - Include in the design marking overhead lines with bird deflectors and diverters to reduce collision risk	Project Execution Agency and Technical Consultant	ESIA Section 2 and Section 5
			- 3. CONSTRUCTION PHASE			
3.1	**- Construction of the base camp, transmission line, access roads, temporary camps along the line.**					
3.1.1	Construction of the base camp	Damage to topsoil/subsoil, vegetation clearings and loss of grassland/habitat. Soil erosion	Minor adverse	- Clearly demarcate access roads to the base camp and secondary camps along the segments of access roads, where construction equipment will be moved and stored. - Clearly demarcate construction, other equipment storage areas and temporary tank farm areas, including a helicopter pad and chopper fueling area. - Confine vehicles to demarcated roadways. - Provide erosion control measures at the base camp. - Establish native grasses around the base camp after the construction works are completed.	Project Execution Agency and Technical Consultant	ESIA Section 5

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
		Generation of fugitive dust	Negligible adverse	- Confine vehicles to demarcated roadways. - Use gravel for the access roads into the base camps. - Restrict unnecessary traffic. - Supply workforce with dust masks. - Water spray the roads during warm (summer) period to suppress dust. - Minimize size of material/spoil storage piles.	Project Execution Agency and Technical Consultant	ESIA Section 5
		Contamination of air from vehicle and other construction equipment emissions (bulldozers etc.)	Negligible adverse	- Implement regular vehicle maintenance and repair procedures at designated areas. - Utilize fuel efficient equipment and vehicles. - Restrict unnecessary traffic. - Utilize emission control devices such as catalytic converters. - Implement regular vehicle maintenance and repair procedures at designated areas.		
		Generation of noise	Negligible adverse	- Confine construction activities to daylight hours within 5 km of residential areas. - Provide workforce with hearing protection as needed.	Project Execution Agency and Technical Consultant	
		Domestic and construction waste generation. Oily and chemical waste generation on-site. Contamination of soil and surroundings with litter and construction debris	Negligible adverse or no impact if mitigation measures applied	- Develop a waste management and handling plan for construction base camp and secondary construction camps. Properly store and dispose construction, sanitary and oily waste. - Reduce amount of waste to maximum extent possible. - Collect solid, oily and chemical waste and store until transported to a designated waste disposal places. -	Project Execution Agency and Technical Consultant	

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact[7]*	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
				- Collect sanitary waste in septics. - Transport sanitary waste to designated off-site disposal facilities. - Provide adequate facilities for disposal of garbage (bins, litter trays) - Train workforce in waste management - Organize clean-ups of existing garbage around each temporary construction camp.		
		Local soil, surface water and groundwater contamination from oil, diesel and chemical spills	Negligible adverse	- Properly organize tank farm areas (ASTs). Establish a secured designated fuel and chemical storage area, with an impervious base and sufficient containment volume. . - Store all fuel, oil and chemical storage in the designated secure area only. - Check hoses and valves regularly for signs of wear, ensure they are turned off and securely locked when not in use. - Place diesel pumps and similar items on drip trays to collect minor spillages. Check trays regularly and remove any accumulated oil. - Provide supplies for cleanup of minor spills. - Implement vehicle maintenance and repair procedures at designated areas.	Project Execution Agency and Technical Consultant	ESIA Section 5
3.1.2	ROW clearing, construction of access roads and towers					

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
3.1.2.1	Typical activities during ROW clearing and access roads and tower construction works include, but not limited to: - General earthwork activities - Clearing and grubbing of vegetation for access roads and ROW - Restoration of tower foundations. - Restoration of tower structures - Installation of tower foundations - Installation of tower structures - Installation of conductor wires - Transport, delivery of equipment and vehicle traffic.	Impacts on soils - clearings of trees and shrubs that make the soil more susceptible to erosion and dust generation as the soils under these plants are now exposed to wind and precipitation.	Negligible to Minor adverse	- Avoid damage to areas outside construction activities - Provide erosion control (e.g. silt fence) downgradient of all topsoil stockpiles. - Where clearing in shrubland and forested areas, the ground should be tilled and seeded with native grass species immediately after clearing activities are complete. - Apply erosion control measures. To extent possible, minimize activities during wet conditions. When activities must occur in wet conditions, control stormwater by using fabric, straw bales, and other measures to impede stormwater flow and prevent erosion. - Utilize erosion mats (e.g. plastic temporary roads) in wet areas to prevent rutting and disturbance of habitat.	Project Execution Agency and Technical Consultant	ESIA Section 5
		Impact on surface water due to ROW and access road clearings that increase sediment loads into receiving water bodies with stormwater runoff	Negligible to Minor adverse	- Where clearing in shrubland and forested areas, the ground should be tilled and seeded with native grass species immediately after clearing activities are complete. - Place silt fence downgradient of all areas of exposed soil within ROW to capture sediment in runoff.	Project Execution Agency and Technical Consultant	
		Mud could be carried off the site on vehicle tires and could result in sedimentation in off-site areas.	Negligible adverse	- Place large stone buffer apron at entry points from access roads to paved roadways. - Wash tires and undercarriage of construction vehicles prior to leaving construction zones.	Project Execution Agency and Technical Consultant	

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
		Soil compaction, soil rutting, and dust generation on ROW and access roads.	Negligible adverse	- Use of weight distribution matting/thatching in wet/clay soils and in low spots to prevent rutting. - Spray water regularly over exposed soil areas where work is occurring during dry and windy periods. - Till and re-seed compacted areas of bare soil after construction activities are completed.	Project Execution Agency and Technical Consultant	
		Blasting for tower foundations will remove vegetation, topsoil, and near-surface rock making the soil susceptible to increased erosion and dust generation. Geohazards: landslides and mudslides	Negligible to Minor adverse	- Use low-yield downhole blasting techniques to minimize surface impacts. - Cover blasting areas to prevent dust escape. - The ground should be tilled and seeded with native grass species immediately after blasting activities are complete.	Project Execution Agency and Technical Consultant	
		Generation of fugitive dust	Negligible adverse	- Confine vehicles to demarcated roadways. - Restrict unnecessary traffic. - Supply workforce with dust masks. - Sprinkle the roads during warm (summer) period to suppress dust. - Minimize size of material/spoil storage piles. - Utilize truck bed covers when hauling materials	Project Execution Agency and Technical Consultant	
		Disruption of surface water flow and impact on water quality conditions of nearby streams/creeks	Minor adverse	- Avoid excessive tree cuttings around the ROW - Plant native grass along the route	Project Execution Agency and Technical Consultant	

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
		Contamination of air from vehicle and other construction equipment emissions (bulldozers etc.)	Negligible adverse	- Implement regular vehicle maintenance and repair procedures at designated areas. - Utilize fuel efficient equipment and vehicles. - Restrict unnecessary traffic. - Utilize emission control devices such as catalytic converters. - Implement regular vehicle maintenance and repair procedures at designated areas.	Project Execution Agency and Technical Consultant	
		Risk of forest fires	Negligible adverse	- Remove all cut vegetation and slash from ROW during construction and ongoing maintenance and dispose at composting facility.		
		Generation of noise	Negligible adverse	- Confine construction activities to daylight hours within 5 km of settlements. - Provide workforce with hearing protection as needed	Project Execution Agency and Technical Consultant	
		Local contamination of soil and waters of shallow aquifer with oily and chemical substances	Negligible adverse	- At temporary construction camps, establish a designated area for fuel, hydraulic oil, diesel and chemical storage (drums, small reservoirs etc.). The area of storage should have an impervious base and impermeable bund walls, and be protected from precipitation. Capacity must be sufficient to contain full volume within a bund and secured area - Store all fuel, oil and chemical storage in the designated secure area only - Conduct regular inspections of construction vehicles to identify and repair leaks or damaged fuel/lubricant lines. - Repair vehicles only in specially designated maintenance areas.	Project Execution Agency and Technical Consultant	

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
		Impacts on ecosytems, flora and fauna	Negligible to Major	Implement mitigation required in Flora and Fauna Conservatoin Plans. Mitigation may include: - Movement of tower or other locations to avoid disturbance of isolated populations. - Re-scheduling construction to avoid breeding seasons. - Re-routing of access roads to avoid specific areas. - Conducting maintenance outside of breeding seasons. - Monitoring to detect interference with breeding animals, or any injuries or mortality (to species of concern). - Placement of breeding platforms for large birds, away from the line.		
		Adverse impact on landscape and views from litter and garbage (plastic bags, bottles, etc.)	Negligible adverse	- Provide adequate facilities for disposal of garbage (bins, litter trays) - Train workforce in waste management - Organize clean-ups of existing garbage around each temporary construction camp	Project Execution Agency and Technical Consultant	
		Accidents to workers/injuries	-	- Provide and require use of personal protective equipment (head, hand, and foot protection) by all workers - Provide safety training to all workers. - Minimize drop height of materials. - Minimize size of material/spoil storage piles. - Establish and maintain a small infirmary capable of handling routine problems - Ensure trained first aid providers are on-site at all times	Project Execution Agency and Technical Consultant	

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
3.1.2.2	Construction workforce (total number TBD)	Economic impacts (temporary employment)	Minor beneficial	- Employ local labor force to extent possible - Pay wages at least average for the area - Provide adequate heating, showering and cooking facilities during construction	Project Execution Agency and Technical Consultant	
3.2	**- Construction of substations**					
3.2.1	Typical activities: - Clearing and grubbing of vegetation for access road, staging area, and substation site - Transport, delivery of equipment and vehicle traffic. - Building access road - Building staging/laydown areas - Excavation for foundation - Site earthwork and grading - Installation of substation equipment - Installation gravel/stone substrate - Installation of perimeter	Impacts from general earthwork activities: - Soil damage. - Loss of grassland. - Soil erosion. - Disturbance of local habitat.	Negligible to Minor adverse	- Store topsoil and subsoil before areas are excavated, with topsoil stripped and stockpiled separately. - Avoid damage to areas outside construction activities - Segregate excavated soil into stockpiles dependant on material type. Provide erosion control while stockpiled. - On completion, backfill material in the same stratigraphic sequence. - Compact and/or stabilize disturbed surfaces as soon as practicable. - Apply erosion control measures on-site. - Construct a stormwater collection system on-site. - Re-vegetate the area with native grass after the completion of construction works.	Project Execution Agency and Technical Consultant	Partially refer to 3.1.1 and 3.1.2 ESIA Sections 5

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
		Generation of fugitive dust.	Negligible adverse	- Minimize offsite hauling. - Confine vehicles to demarcated roadways. - Pave or gravel the ground within the substation. - Supply workforce with dust masks. - Sprinkle the roads during warm (summer) period to suppress dust. - Minimize size of material/spoil storage piles. - Utilize truck bed covers when hauling materials - Implement regular vehicle maintenance and repair procedures at designated areas. - Restrict unnecessary traffic.		
		Diffuse air emissions from vehicles and other construction equipment (bulldozers etc.)	Negligible adverse	- Implement regular vehicle maintenance and repair procedures at designated areas. - Utilize fuel efficient equipment and vehicles. - Restrict unnecessary traffic to and from the site. - Utilize emission control devices such as catalytic converters. - Implement regular vehicle maintenance and repair procedures at designated areas.	Project Execution Agency and Technical Consultant	

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
		Sanitary and construction waste management	Negligible or no impact if mitigation measures applied	- Develop a waste management and handling plan for the facility's construction period. - Properly store and dispose construction, sanitary and oily waste. - Reduce amount of waste to maximum extent possible - Collect all solid, oily and chemical waste and store until transported to a designated waste disposal places. - Collect sanitary waste in septics - Transport sanitary waste to the designated places off-site for further disposal - Provide adequate facilities for disposal of garbage (bins, litter trays) - Train workforce in waste management - Organize clean-ups of existing garbage around each temporary construction camp	Project Execution Agency and Technical Consultant	
		Generation of noise	Negligible adverse	- Confine construction activities to daylight hours - Provide workforce with hearing protection as needed	Project Execution Agency and Technical Consultant	

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
		Local contamination of soils. Soil contamination can occur from the use, improper handling and spills of hazardous materials, such as fuels and petroleum lubricants, insulating oils, wood preservatives, paints, and other toxic substances which could be used during the construction of the project.	Negligible adverse	- Store all fuel, oil and chemical storage in the designated secure area only. - Stockpile hazardous materials in concrete facilities with containment features. - Do not use PCB-containing insulating oils in transformers. - Use non-toxic paints and preservatives where possible. - Conduct regular inspections of construction vehicles to identify and repair leaks or damaged fuel/lubricant lines. - Contain, excavate, and containerize all spills of hazardous material and dispose of in accordance with local regulations. - Place diesel pumps and similar items on drip trays to collect minor spillages. Check trays regularly and remove any accumulated oil. - Provide supplies for cleanup of minor spills.	Project Execution Agency and Technical Consultant	
		Health and Safety issues during the construction activities	NA	- Provide safety working conditions on-site, including requirements to use of personal protective equipment (head, hand, and foot protection) by all workers, providing safety training to all workers. - Minimize size of material/spoil storage piles. - Establish and maintain a small infirmary capable of handling routine problems. - Ensure trained first aid providers are on-site at all times	Project Execution Agency and Technical Consultant	
		Economic impact (temporary employment)	Minor beneficial	- Employ local labor force to extent possible - Pay wages at least average for the area - Provide adequate heating, showering and cooking facilities during construction	Project Execution Agency and Technical Consultant	
- 4. OPERATION AND MAINTENANCE PHASE						
4.1	**- Operation and Maintenance of the transmission lines, ROW and substations.**					

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact[7]*	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
4.1.1	Transmission line and ROW operation and maintenance			-		
4.1.1.1	Typical activities for transmission line and ROW O&M would include: - Energizing the transmission line - Maintenance site visits and inspections - Vegetation control in ROW - Tower repairs - Foundation repairs - Repair of damaged/downed wires.	Fugitive dust and vehicles' emissions from maintenance visits. Transmission line maintenance activities involve gas-powered trucks, lawn mowers, grass trimmers, and other equipment. The operation of such vehicles and equipment result in emissions of carbon monoxide, NOx, SO_2, hydrocarbons, and particulate matter	Minor adverse	- Restrict unnecessary traffic and ensure that exposed ground is reseeded or otherwise stabilized - Implement regular vehicle maintenance and repair procedures. - Utilize fuel efficient equipment and vehicles. - Utilize emission control devices such as catalytic converters	Project Execution Agency and Technical Consultant	ESIA Sections 5
		Disruption to overhead power lines and towers due to irregular maintenance of vegetation within the ROW.	Negligible adverse	- Remove invasive plant species, whenever possible, and cultivate native plant species. - Implement an integrated vegetation management approach (IVM): the selective removal of tall-growing tree species and the encouragement of low-growing grasses and shrubs.	Project Execution Agency and Technical Consultant	ESIA Sections 5

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
		Soil erosion and water quality impacts: periodic clearing of vegetation as part of normal right-of-way and access road maintenance activities may make the soil more susceptible to erosion. Right-of-way and access road clearing also increase stormwater runoff. This could be a long-term and permanent impact along right-of-way areas.	Negligible to Minor adverse	- Place silt fence downgradient of all areas of exposed soil within ROW to capture sediment in runoff. - Where clearing in shrubland and forested areas, the ground should be tilled and seeded with native grass species immediately after clearing activities are complete.	Project Execution Agency and Technical Consultant	ESIA Sections 5
		Forest fires due to accumulation of underlying growth or slash from routine maintenance along the ROW	Negligible adverse	- Thorough monitoring of ROW vegetation and periodic clearings. - Remove blowdown and other high-hazard fuel accumulations. - Timely vegetation thining and slashing - Proper disposal of maintenance slash by trucks - Planting and managing fire resistant species (e.g. hardwoods) within the ROW - Establishing a network of fuel breaks of less flammable materials or cleared strips of land to slow progress of fires		
		Soil contamination along the route with herbicides. Vegetation control techniques that use herbicides can introduce environmental contaminants into the soil and adjacent habitats.	Negligible to Minor adverse	- Control vegetation using manual techniques which do not require the use of herbicides.	Project Execution Agency and Technical Consultant	ESIA Sections 5

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
		Impacts on surface water quality due to increased soil erosion rates and sediment loads into the streams.	Minor adverse	- Avoid <u>excessive</u> vegetation clearings (trees and shrubs) around the power transmission lines. This is especially true for the towers located on the floodplains, stream terraces and hill slopes.	Project Execution Agency and Technical Consultant	ESIA Sections 5
		Protection of flora	Minor to major adverse	- Implement mitigation required by Flora Conservation Plan.		
		Wildlife and habitat	Minor to Major adverse	- Scheduling ROW maintenance activities to avoid breeding and nesting seasons for any critically endangered or protected wildlife species. - Implement mitigation required by Fauna Conservation Plan.		ESIA Sections 5
		Avian collisions and electrocutions	Negligible to Minor adverse	- Maintain spacing between energized components and grounded hardware or, where spacing is not feasible, cover energized parts and hardware. - Mark overhead lines with bird deflectors/diverters to reduce collision risk	Project Execution Agency and Technical Consultant	ESIA Sections 5
4.1.2	Operation of substations			-		
	Typical activities would include: - Operation of substation equipment - Site visits for occasional service/maintenance calls - Vegetation control activities (mowing, weed cutting)	Air emissions from vehicle traffic and working equipment.	Negligible adverse	- Restrict unnecessary traffic and ensure that exposed ground is reseeded or otherwise stabilized - Implement regular vehicle maintenance and repair procedures. - Utilize fuel efficient equipment and vehicles. - Utilize emission control devices such as catalytic converters - Minimize use of Hexafluoride (SF6) as a gas insulator for electrical switching equipment and in cables and transformers or use equipment with a low leakage rate (less than 99%).	Project Execution Agency and Technical Consultant	ESIA Sections 5

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
		On-site maintenance activities. Contamination of soil and shallow aquifer with oil, diesel and other chemical materials accidental spills.	Negligible adverse	- Store all fuel, oil and chemical storage in the designated secure area only. - Stockpile hazardous materials in concrete facilities with containment features. - Do not use PCB-containing insulating oils in transformers. - Minimize use of Hexafluoride (SF6) gas and/or use equipment with a low leakage rate (less than 99%). - Use non-toxic paints and preservatives where possible. - Conduct regular inspections of construction vehicles to identify and repair leaks or damaged fuel/lubricant lines. - Contain, excavate, and containerize all spills of hazardous material and dispose of in accordance with local regulations. - Place diesel pumps and similar items on drip trays to collect minor spillages. Check trays regularly and remove any accumulated oil. - Provide supplies for cleanup of minor spills.	Project Execution Agency and Technical Consultant	

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
		On-site waste generation, collection, storage and disposal	Negligible adverse	- Develop a waste management and handling plan for the substation operation - Reduce amount of waste to maximum extent possible - Collect all solid, oily and chemical waste and store until transported to a designated waste disposal places - Collect and store hazardous waste separately by trained personnel. - Collect sanitary waste in septics - Transport sanitary waste to the designated places off-site for further disposal - Provide adequate facilities for disposal of garbage (bins, litter trays) - Train workforce in waste management - Organize clean-ups of existing garbage around each temporary construction camp	Project Execution Agency and Technical Consultant	
4.2	**- Occupational and public Health and Safety for transmission line, ROW and substation operation and maintenance activities**					
	Occupational and public Health and Safety for transmission line, ROW and substation operation and maintenance activities	Health and Safety issues for maintenance workers and local residents include: - EMF - Live power lines - Working at heights on poles and structures - Risks of electrocution - Electromagnetic interference - Exposure to chemicals and PCBs	NA	- Measure EMF levels in all buildings within 100 meters of the line. If levels are higher than average peak exposure reference levels General Public Exposure.developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP)., install shielding or some other mitigation. - Allow only trained and certified workers to install, maintain or repair electrical equipment. Allow only trained workers to work at heights - Ensure that live-wire work is conducted by trained personnel with strict adherence to specific safety and insulation standards.	Project Execution Agency and Technical Consultant and a certified monitoring agency	Also refer to 1.2 of the EMP and ESIA Section 5

Table 6-1. Environmental Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Significance of Impact*[7]	*Mitigation /Enhancement Measures or Best Management Practice*	*Responsibility*	*Further Information*
				- To prevent hazards of electrocution, use signs, barriers (locks, doors, gates, steel posts surrounding transmission towers) at all towers. - To prevent shocks, ground conducting objects (e.g. fences, other metal structures) installed near power lines. - Do not use PCBs as a transformer oil. Do not work with transformer oil, which is suspected to contain PCBs.		

Table 6-2. Social Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Mitigation or Enhancement Measures*	*Responsibility*	*Further Information*
1 PRE-CONSTRUCTION PHASE: PROJECT DESIGN					
1.1	General Permitting and EU Regulatory Compliance	Issues to consider: Non-compliance with national and international (EU) standards and requirements for stakeholder involvement in environmental conservation and carrying out ESIA for power transmission lines and substation construction projects.	Ensure that all government and funding/co-funding agencies requirements and procedures relating to ESIA are complied with. This preliminary assessment should be completed prior to the construction stage and should verify that: - All feedback and comments from the Stakeholder Engagement Committee pertaining to the ESIA are addressed - Resolve all issues associated with land use/property and ROW acquisitions, including National and EU requirements for compensation, payments and potential resettlements of residents along the route - Completion of the analysis of Project design and specifications and its cumulative impacts on environmental and socio-economic conditions. The analysis is to ensure the Project is in line with best international practices and allows incorporation of appropriate measures to minimize/reduce/avoid adverse socio-economic effects of the project implementation with enhancement of beneficial impacts. - Assurance that properly developed environmental and social mitigation and monitoring plan will be in compliance with EU and National standards and be strictly followed - Upon designating a Stakeholder Liaison Officer, develop a detailed ongoing work plan and management strategy that will provide support and feedback as needed to the officer throughout the life of the project -	Project Execution Agency and Technical Consultant	ESIA Section 1 and Section 3

Table 6-2. Social Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Mitigation or Enhancement Measures*	*Responsibility*	*Further Information*
			- Prime EPC contractor should assign a Social Liaison Officer responsible for interacting with all communities and stakeholder groups - Liaise with communities to alert them to the plans, include estimated work schedule, placements of poles, duration of disturbances and invite feedback to improve project support from locals. - Precisely measure the distances from the line to any structures less than 100 m from the line. - Confer with residents and employers with structures in less that 100 m from the line to identify impacted households. Arrange for relocation and compensation in accordance with national laws and Resettlement Framework Plan. In communities with vulnerable cemeteries, take steps to protect the sanctity of the sites, and secure these from further impacts including stability of lands near river beds.		
2. PRE-CONSTRUCTION PHASE: ROUTE PLANNING					
2.1	Resettlement and Compensation Framework and Action Plan	Moving households too close to the line for compliance with national laws and international standards Loss of income from project activities in and around ROW	- Move corridor to avoid houses on sections not yet constructed. - Meet with communities to explain activities to be conducted, measure distances to all structures that are within about 100 meters of the line. - In compliance with Resettlement Framework, negotiate and reach agreement with owners AND occupants of houses within 30 meters concerning relocation. - In compliance with Resettlement Framework, compensate owners and farmers for loss of use of land where towers are located, and for loss due to crop or animal damage.	Project Execution Agency and Technical Consultant	Resettlement Framework

Table 6-2. Social Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Mitigation or Enhancement Measures*	*Responsibility*	*Further Information*
2.2	Power transmission line route and ROW planning	Adverse impacts on communities, local farmers, herders and those households living near the proposed route Loss of economic benefits from land use due to new tower placements Adverse impacts on human health due to prolonged exposure to EMF	- If it's impossible to avoid settlements, communities and cultivated areas, take and implement all necessary mitigation measures to minimize/mitigate the adverse impacts on social and economically important areas during construction and operation phases of the Project. - Avoid construction during the growing and harvesting season for crops grown in the ROW as much as possible. - In protected areas, whenever possible coordinate schedules with Rangers/staff to minimize disruptions to tourism activities - Assign a Stakeholder Liaison Officer who will be responsible for maintaining positive community relations, working with stakeholders, including developing and implementing compensation mechanisms, informing communities of work plans and liaising with the Stakeholder Advisory Committee	Project Execution Agency and Technical Consultant	Parutally covered in a number of ESIA Sections 2
2.3	Access roads planning	Impacts to consider: Loss of lands under cultivation to access roads Disturbances to park amenities	Plan access roads in Protected Areas with the Park/Managed Reserve Staff to minimize trespassing and traffic impacts in parks	Project Execution Agency and Technical Consultant	ESIA Section 2
2.4	500kV overhead lines	Extended exposure to EMF by workers or households	- Prepare safety brochures regarding exposure to EMF, and measures to take to prevent excess exposure for humans and animals, - Print in all local languages.	Project Execution Agency and Technical Consultant	ESIA Section 2
			- 3 CONSTRUCTION PHASE		
3.1	**- Construction of the construction base camp, transmission lines, access roads, temporary camps along the line.**				
3.1.1	Construction of base camps	Disturbances to communities nearby base camps Generation of fugitive dust Generation of noise	- Alert any local or impacted communities about impacts, including dust, noise of potentially disturbing activities and planned dates of activities in their areas. - Brief workers on the culturally appropriate methods for interacting with minority populations, including in Muslim communities, to minimize disturbing communities or giving offence to local populations.	Project Execution Agency and Technical Consultant	ESIA Section 5

Table 6-2. Social Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Mitigation or Enhancement Measures*	*Responsibility*	*Further Information*
			- Provide communities nearby the activities with weekly work schedules to avoid dirt and damage to drying laundry, households and crops. - Confine construction activities to daylight hours		
		Contamination of soil and surroundings with litter and construction debris Local soil, surface water and groundwater contamination from oil, diesel and chemical spills	- Whenever necessary inform herders to avoid these contaminated areas and put in permanent - Provide portable sanitation facilities - Collect and remove debris, trash, and garbage	Project Execution Agency and Technical Consultant	
3.1.2	ROW clearing, construction of access roads and towers and conductoring of lines	Disturbances to farmers who have cultivated fields in ROW, in the path of access roads or in tower locations, and disturbances to communities	- For any areas under the ROW that are under cultivation, avoid disturbing these areas during growing/harvesting seasons if possible. If not possible, fully compensate farmers for losses of actual crops at full fair market value for lost or damaged crops. - Inform local shepherds not to graze these areas until grasses have been firmly reestablished - Alert any local or impacted communities about impacts, including dust, noise of potentially disturbing activities and planned dates of activities in their areas. - Brief workers on the culturally appropriate methods for interacting with minority populations, including in Muslim communities, to minimize disturbing communities or giving offence to local populations. - Provide communities nearby the activities with weekly work schedules to avoid dirt and damage to drying laundry, households and crops. - Confine construction activities to daylight hours - Clear all cultivated fields and pastures of waste or garbage to avoid problems accidental ingestion by animals	Project Execution Agency and Technical Consultant	ESIA Section 5
		Disturbances to tourism i in and around Protected areas	- Whenever possible schedule timing of construction in protected areas during non-peak tourism times to minimize park impacts - Notify park rangers prior to all activities. Post notices at visitor centers.	Project Execution Agency and Technical Consultant	ESIA Section 5

Table 6-2. Social Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Mitigation or Enhancement Measures*	*Responsibility*	*Further Information*
3.1.3	Construction	Disturbances to cultural resources	- Demarcate area around Ilmazlo Cemetery to confine traffic and working areas. Construct bank retention structure to minimize loss of graves into river due to erosion under line. Coordinate actviites with local leaders and citizens. - Avoid disturbing any cemeteries. - Consult with Ministry of Culture before disturbing any cultural resources listed in ESIA or discovered during construction.	Project Execution Agency and Technical Consultant	ESIA Section 5
3.1.4	Conductoring of lines across major roadways and railways	Disturbance to traffic patterns, delays of road and rail traffic	- Coordinate with transportation ministry and local authorities to do conductoring at lower traffic times of the day.	Project Execution Agency and Technical Consultant	ESIA Section 5
			- 4. OPERATION&MAINTENANCE PHASE		
4.1			**- Operation and Maintenance of the transmission lines, ROW and substations.**		
4.1.1	Transmission line and ROW operation and maintenance	Social impacts: Disturbances to communities during maintenance activities Excessive exposure to EMF by workers under line Loss of crops and farm land use during maintenance activities	- Communicate with local communities in advance of activities to inform them of the duration, type and degree of disturbances, including contact information for Stakeholder Liaison Officer - Provide guideline information on health and safety of community and livestock during the construction phase for best practices and maximum daily exposure - Ascertain potential damage to crops and property and within the guidelines of the Resettlement and Compensation Framework, reach a mutually agreed solution for all impacted farmers and households. - Delineate areas of potential danger with signs in local languages to enable herders and other community members to avoid potential accidents - Brief workers on culturally appropriate interaction behaviors in minority communities - inform communities and farmers with cultivated areas under the line 1 month in advance of work to be done for regular maintenance - as possible schedule maintenance times when cultivation and harvests are not taking place in areas where cultivation is around or under the line/ROW.	Project Execution Agency and Technical Consultant	ESIA Section 5

Table 6-2. Social Management Plan: Mitigation and Enhancement Measures to Prevent or Reduce Potential Impacts

No	*Activities or Aspects*	*Potential Impacts/Issues of concern*	*Mitigation or Enhancement Measures*	*Responsibility*	*Further Information*
		Loss of livestock, harm to humans due to accidents	- provide compensation to herders for loss of livestock according to Compensation Plan - Place permanent placards warning of high voltage in local languages on towers to minimize trespassing - Provide emergency contact information on all placards	Project Execution Agency and Technical Consultant	ESIA Section 5

Table 6-3. Environmental and Social Monitoring Program for Black Sea Regional Transmission Project

Media	*Project phase*	*Parameters/Activities*	*Standard*	*Location*	*Frequency*	*Duration and deliverables*
Ambient air quality	Construction	Opacity (visibility through dust)	Minimum impairment of visibility for >1 minute	Construction and vehicle operation locations	Dailiy	Daily
Ambient noise	Construction	Noise levels (subjective)	Audibly loud noises	Vehicle and equipment locations	Continuous	Momentary
Groundwater and surface water resources	Pre-construction - Construction	pH, BOD_5, TSS, TDS TPH, e-coli and other drinking water quality parameters	Georgia Standards and Best practices Georgian national surface and drinking water quality standards	At substation area (if groundwater well will be used for drinking water supply) At construction base camp Any other natural waters used as potable water (none known at this time)	Once prior construction or once per construction season. After any chemical, oil and hazardous materials spills	1 sample per location, report to PEA
	Operation	General water chemistry parameters (e.g., pH, alkalinity, turbidity, acidity, conductivity, metals, sulfate, etc).	Georgia standards for groundwater quality and drinking water quality standards;	At substation area (if groundwater well will used for drinking water supply) Any other natural waters used as potable water (none known at this time)	1. Annually 2. After any chemical, oil and hazardous materials spills	Throughout project life, report on 1 sample per location PEA
Soil quality and erosion	Pre-construction	Assessment of soil disturbance and erosion. Assessment of erosion rate and slope stability in hilly areas.	Best practices	Along all access roads and ROW At construction base camp At substation area	Once before construction at each area	Photographic and narrative record at each location.
	Construction			All areas disturbed by construction equipment and workers All access and auxiliary roads	Continuous during construction	Checklist observation Photographic and narrative record at each location observed at pre-construction

Table 6-3. Environmental and Social Monitoring Program for Black Sea Regional Transmission Project

Media	*Project phase*	*Parameters/Activities*	*Standard*	*Location*	*Frequency*	*Duration and deliverables*
	Operation			All access roads and in areas with high potential for erosion	Every maintenance visit	Checklist observation Annual photographic record
Landslides	Construction	Earth movement	Best practices (no earth movement)	200-500 m within all blasting locations and nearest steep rocky surface	Before and after every blast	Records of seismic conditions
Birds	Pre-construction	Evidence of nesting by raptors, other large birds, or sensitive species within 0.5km of corridor. Includes active and old nests	International best practices	Along the access roads, the line and substation, with special attention to protected natural zones and areas. Immediately before construction in any area.	Once before construction	Birds breeding survey results, report to liaison officer
	Operation	1. Bird injury/mortality.	Best practices	Along the power line route	1. Survey E-W sections once during each migration season. 2. Annual survey for large bid mortality due to electrocution	Throughout project life: annual bird survey report, report to liaison report, summary to lenders
Flora	Pre-construction	Protected or endemic species and habitat	Best practices	Along entire line, with special attention to ESIA-identified sensitive areas	One general survey before design/construction and one site-speciifc survey after construction	Flora conservation plan following first survey, to report results of survey, miigation measures needed. Monitoring report after construction and completion of mitigation to verify success. Summary to lenders

Table 6-3. Environmental and Social Monitoring Program for Black Sea Regional Transmission Project

Media	*Project phase*	*Parameters/Activities*	*Standard*	*Location*	*Frequency*	*Duration and deliverables*
	Post-construction	Areas where flora conservation plan indicated mitigation was needed	Flora conservation plan	Areas identified in flora conservation plan	Once after construction completed and mitigation implemented, followup if needed to verify success	Report on mitigation and success Summary report to lenders
	Operation	All locations	Flora conservation plan	Areas where mitigation was implemented	Every visit to location for maintenance	Standard maintenance report
Fauna	Pre-construction	Protected species and habitat	Best practices	Sensitive areas identified in ESIA, and protected areas	Once before construction, Once more at specific location if construction to take place during breeding season (spring/early summer)	Fauna conservation plan to report results of survey, miigation measures needed. Monitoring report after construction and completion of mitigation to verify success. Summary to lenders
	Operation	Monitor residual impacts after construction and design mitigation to repair any damages	Fauna conservation plan	Along the route and in sensitive areas, including natural protected areas	As specified in fauna conservation Plan	Implement measures specified in Fauna conservation plan. Note the wide range of mitigation measures specified in ESIA, including Appendix D and E
		Presence of protected species, injured or dead animals	Best practices	Each area visited	During routine maintenance activities/inspections	Standard maintenance report

Table 6-3. Environmental and Social Monitoring Program for Black Sea Regional Transmission Project

Media	*Project phase*	*Parameters/Activities*	*Standard*	*Location*	*Frequency*	*Duration and deliverables*
Occupational and Public Health and Safety	Construction	Noise, fire safety, hazardous materials, waste managemente. Workplace inspections for presence and use of PPE, noise, fire safety, hazardous materials registrar, solid and sanitary waste registrar, traffic safety, blasting, etc Records of safety training.	Georgia OHS standards, Best practices Local OHS standards	At tower sites, construction base camp, temporary camps At substation	Monthly	Designated safety officers (not part of work crews) report to Project Execution Agency and Ministry of Energy.
	Operation	Workplace inspections for presence and use of PPE, noise, fire safety, hazardous materials registrar, solid and sanitary waste registrar, traffic safety, etc.	Georgia OHS standards, Best practices Local OHS standards	Substations	Monthly to PEA and Ministry of Energy, annually to lenders	Throughout project life, reports on monitoring results to Ministry of Energy and lenders
		Vehicle safety, PPE, training records	Georgia OHS standards, Best practices Local OHS standards	Staging area for line inspectors	Weekly by inspection supervisor and inspector	Reports compiled for annual summaries to PEA
		Presence of fences, warning signs and placards	Best practices Georgia standards	All towers	At every inspection or visit	Monthly reports to PEA status of signs and actions
		EMF	International and Georgia standards (most stringent)	All buildings within 100 meters of line and other buildings as requested by owner/resident	Every two years, or as requested	Annual report on monitoring and results to Ministry of Energy and lenders
Community involvement/public consultation	Pre-construction	Distance of all buildings from line (at minimum, measure all within about 100m or as requested by resident/owner)	Best practices	Along entire line	After design, before construction	As specified in Resettlement Plan, including reports to communities and individuals

Table 6-3. Environmental and Social Monitoring Program for Black Sea Regional Transmission Project

Media	*Project phase*	*Parameters/Activities*	*Standard*	*Location*	*Frequency*	*Duration and deliverables*
	Construction	Foreman training on local issues (including for minority communities) Staff training on same Briefings/notifications of community leaders of activitiies	EBRD (PR-5 and PR-10) requirements	All work locations	Before every mobilization	Throughout construction period, report to lenders
	Operation	Foreman training sessions Safety training sessions Consultations/briefings of locat communities. Accidents and safety incidents Complaints by citizens or stakeholders	EBRD (PR-5 and PR-10) requirements	All work locations	Training: As workers begin jobs and refresher training thereafter Safety reports annually Complaints: monthly	Throughout project life, reports to Ministry of Energy and lenders

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Appendix A

List of Preparers

The Environmental and Social Impact Assessment for the Black Sea Regional Transmission Line Project was prepared by Black & Veatch Special Projects Corp. under contract to the Ministry of Energy of Georgia. Black & Veatch was selected by the Ministry of Energy following a competitive bidding process administered by the European Bank for Reconstruction and Development. Significant contributions to the ESIA were made by Scientific Research Firm GAMMA, EcoSocial Solutions, and ASK.

Black Sea Regional Transmission Project List of Preparers			
Name	*Education*	*Years' experience*	*Project role*
Management team			
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Environmental team – Georgia			
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Black Sea Regional Transmission Project List of Preparers			
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Teyyub Ismaliyov EcoSocial Solutions	-	5	- Local social expert - Scoping - Baseline social

Appendix B

Black Sea Regional Transmission Project Milestones and Schedule for Preparation and Completion of ESIA		
Milestone	Status	Date (all dates are 2009) (see note)
Inception Report	Completed	15 March
Project plan and gap analysis	Completed	27 March
Public Consultation and Disclosure Plan	Completed	28 April
Preliminary draft ESIA	Completed	29 April to 5 May
Draft ESIA for disclosure	Completed	10 May
Public consultation	1. Stakeholder notification 2. Initial disclosure (website) 3. Public meetings	1. 10 May 2. 11 May **3. 29 June to 1 July**
Final ESIA		**15 July**
Note: **Bond font** denotes scheduled date for uncompleted milestone		

Appendix C

Public Consultation and Disclosure Plan

BLACK SEA REGIONAL TRANSMISSION PROJECT

PUBLIC CONSULTATION AND DISCLOSURE PLAN

April 2009

Prepared by:

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Contract C18507/EBSF-2008-11-65
Black & Veatch Project 042016.01.01

TITLE PAGE

Project Title:	Environmental and Social Impact Assessment for the Black Sea Regional Transmission Project
Contract:	C18507
Document Title:	Draft Public Consultation and Disclosure Plan
Prepared by:	Black & Veatch Special Projects Corp.
Date Prepared:	April 2009
Prepared by:	Mary Matthews
B&V Project Manager:	Jack Mozingo
EBRD Environmental Advisor:	Robert Adamczyk
EBRD Social Advisor	Frederic Giovannetti
Ministry of Energy of Georgia Project Manager:	Mariam Valishvili

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ANNEXES

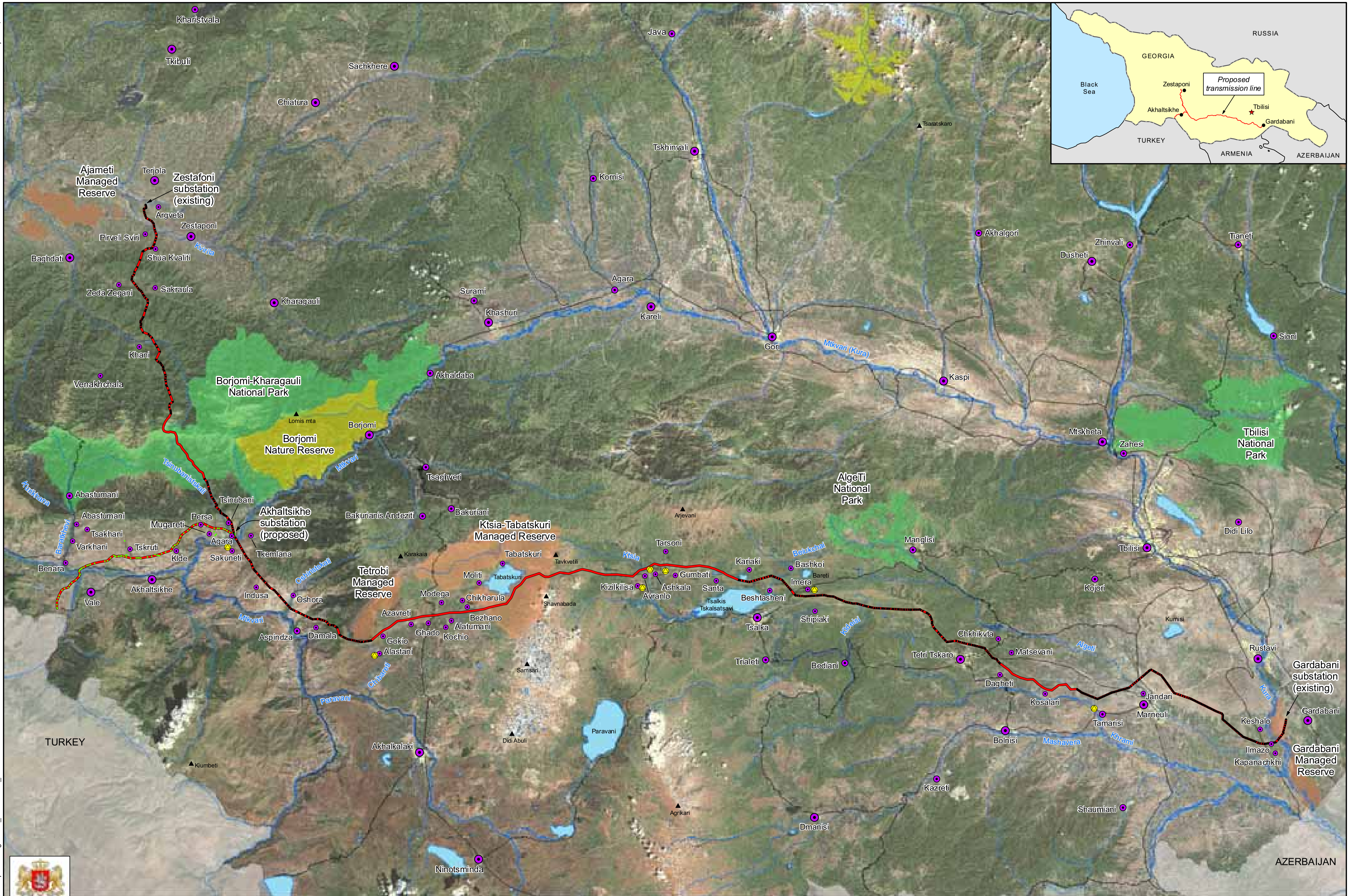
1. INTRODUCTION

The Ministry of Energy of the Republic of Georgia plans to construct a 500 kiloVolt (kV) transmission line from an electrical substation near Gardabani in eastern Georgia to a substation near Zestaphoni in western Georgia, two expand these two substations, to construct a new substation near Alkalsikhe, and to construct a new 400kV line from this new substation to the Turkish border. The purpose of the project is to increase Georgian energy infrastructure, link eastern and western Georgia, and expand power capacity for local and regional delivery from Azerbaijan and Georgia to Turkey. The Gardabani to Zestaphoni portion of the project was designed and partly constructed from 1988 to 1992 but never completed. Sixty percent of the foundations and towers were built, but over time there has been structural damage to many towers that will need to be repaired. The remaining forty percent of foundations and towers will be built using the original design, as modified to meet international best practices. The high tension lines will be strung for the full line in a process called conductoring.

Construction is planned to begin in late 2009 and take approximately three years to complete in full. Figure 1-1 shows the proposed transmission line, as envisioned by the original design.

The Ministry of Energy has approached the European Bank for Reconstruction and Development (EBRD) and other lenders for financing, potentially including the European Investment Bank (EIB) and Kreditanstalt fuer Wiederaufbau (KfW). The EBRD and other lenders requires that the project be evaluated in an Environmental and Social Impact Assessment (ESIA) that meets requirements established under Georgia national law and standards established by International Finance Institutions (IFIs), including EBRD, EIB, and KfW. This includes the development of this Public Consultation and Disclosure Plan to ensure that all stakeholder interests are incorporated into project planning and implementation.

The project was cleared for further consideration by the relevant committee in EBRD on 27th October, 2008, whereas the cut-off date for application of the revised (2008) EBRD Environmental and Social Policy is 12th November 2008. Therefore, the EBRD applies its 2003 Environmental Policy. However, the new policy and associated 10 Performance Requirements are used for benchmarking purposes. EIB's environmental and social requirements applicable to the project are those contained in the EIB's "Environmental and Social Practices Handbook" (http://www.eib.org/about/publications/environmental-and-social-practices-handbook.htm). KfW's requirements are contained in "Environmental Guidelines for Financial Cooperation by KfW with Developing Countries", 2001.



Proposed Route in Georgia of Black Sea Regional Transmission Project

Figure 1-1

PROJECTS\Georgia\MapDocs\Figure1-1_TlineRoute_042809.mxd

April 28, 2009

2. Regulations and Requirements

2.1 EIA and Public Consultation Requirements under Georgian Law

In accordance with existing public law on EIAs in Georgia – the Georgia law on “Environmental Protection”, the Georgia law on “Licenses and Permits”, and “September 1, 2005 N154 Resolution of Georgia on Rules and Conditions of Issue of Environmental Permit” -- the project sponsor is responsible for preparing the Environmental and Social Impact Assessment (ESIA). The sponsor in this case is the Ministry of Energy of Georgia. The Ministry will submit a copy of the draft ESIA to the Ministry of Environment Protection and Natural Resources, and implement a pubic notice and participation program. The Ministry of Energy will receive all written comments from the public within 45 days; organize and participate in public hearings at the administrative center(s) of the region where the project is to take place between 45-60 days after the announcement in the newspaper; invite the local municipality, the Ministry of Environment Protection and Natural Resources of Georgia and other interested organizations to these meetings; and ensure the drawing up of a public hearing protocol, where all comments and recommendations expressed during the public hearings and responses are reported within five days.

Under Georgian law, acceptance or denial of the public comments is at the discretion of the project sponsor, who is not required to heed public comments. If all requirements are met, the Ministry of Environment Protection and Natural Resources approves the ESIA in approximately one month, or about 90-110 days after public disclosure. Georgian law does not require that consultation and community engagement continue after approval of the ESIA and licensing (that is, throughout construction and operation of the project) and there is no requirement related to dealing with grievances after the initial ESIA comment period.

2.2 Public Consultation Requirements for EBRD

EBRD has categorized the Project as Category A since it could result in potentially significant and diverse future environmental and/or social impacts. Therefore, it requires a full-scale ESIA. In accordance with requirements of the EBRD’s 2003 Environmental Policy and the 2008 Environmental and Social Policy for Category A Projects (Performance Requirement 10 “Information Disclosure and Stakeholder Engagement”), project sponsors must engage with stakeholders on an ongoing basis from the earliest stages of the project throughout the life of the project. There must be meaningful and informed participation of stakeholders in the decision making process. The information provided must enable meaningful consultation with stakeholders, especially potentially affected stakeholders and engenders a mechanism that enables people to make comments or complaints. The requirements for EBRD are aligned with those for EIB and KfW.

Stakeholder engagement must be open, free from undue external influences, and in an appropriate manner acceptable to the communities. Stakeholders have to be identified, especially those in impacted communities and where impacts are expected to be significant. The engagement program must actively address the needs of ethnic minorities, lower income households, vulnerable populations, and others of disadvantaged status who may be affected by the project. Stakeholders must be informed of the purpose and scale of the project, the duration of proposed project activities, potential impacts to the environment, worker health and safety, public health and safety, and other social impacts on communities; they must also be informed for proposed mitigation plans. Stakeholders must be made aware of the consultation process, how they can participate, and the time and venue of any public meetings, and how the outcomes of these meetings will be reported. Information must be in local language(s) and presented in an accessible manner.

For Category A projects such as this, a Public Consultation and Disclosure Plan is mandatory and is open to review and comment by all stakeholders. In addition, it is important to note that workers are also stakeholders, as described below, so they are addressed in this Plan. The ESIA and PCDP must remain in the public domain for the life of the project, and if changes to project plans are required, these have to be made public as well.

During project implementation, stakeholders must continue to be provided with ongoing information. The affected communities should be provided with periodic reports on project status and issues that have emerged through the grievance process, including how these issues are being addressed. External stakeholders – those not directly affected by the project but who are interested for other reasons -- should also be informed of progress through standard public communications and through public domain resources such as the internet.

The Ministry of Energy will be responsible for communications and for addressing stakeholders' concerns in a timely manner. For this purpose, the Ministry will establish a process to receive and facilitate resolution of stakeholders' concerns and grievances about the project's environmental and social performance. The grievance mechanism has to be scaled to the risks and potential adverse impacts of the project.

EBRD requires that the Environmental and Social Impact Assessment for Category A projects be made available for public review at the Business Information Center in London and in EBRD's Georgia Resident Office in Tbilisi for 120 days before approval it can be considered by the EBRD Board of Directors. Notification of the documents' availability will be posted on the EBRD web site.

2.3 Requirements for the Equator Principles

For all Category A projects located in non-OECD countries, and those located in OECD countries not designated as High-Income, as defined by the World Bank Development Indicators Database, the government, borrower or third-party expert must consult with project affected communities in a structured and culturally appropriate manner. As with EBRD Performance Requirement 10, the Equator Principles (EPFIs) require the preparation of a Public Consultation and Disclosure Plan (PCDP). Similar to EBRD, the EPFIs focus on the importance of maintaining transparency throughout the entire process. By meeting the requirements of EBRD's 2008 Environmental and Social Policy for Category A Projects, the requirements for EPFIs are also met.

EBRD and Georgia requirements are generally congruent, except as noted above. For the current project, both sets of requirements will be met concurrently and will mirror the formal commitment to the principles of the *Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters*. This is a means to formalize increased public awareness at all phases of the ESIA and to enable the public to have inputs into the decisionmaking process, from the scoping phase through the final decisionmaking phases, and into to have inputs into monitoring, evaluation and grievance procedures. Specific to Article 6 on projects which will have environmental and/or public health impacts, public participation should take place early in the decision making process, should develop a criteria for evaluation (scoping), and should engage the public as early as possible to gain from their understanding of their local environment. As the project develops, the public should be provided all relevant information and alternatives should be clearly presented. Public inputs should be sought early enough within the process to be effective, and should not be taken only after the fact when all alternatives have been decided. All public comments must be taken into account and any rejection of those comments should be clearly justified. The public must be notified of all decisions made and the reasons and considerations for decisions made.

The disclosure process in the current case calls for the ESIA and NonTechnical Summary to be released in English, then in Georgian, at approximately at the same time in accordance with Georgian EIA and EBRD ESIA requirements, as described above.

3. Summary of Previous Public Consultation Activities

The public consultation process for this project began with initiation of scoping for the ESIA in February 2009. Scoping has included meetings with the Ministry of Environment and Natural Resources, with several NonGovernmental Organizations (NGOs), and meetings, and interviews with citizens and local officials along the transmission line route. See Annex 1, *Ministerial and NGO Informational Meeting – Agenda, Comments, Participants* for additional details of one of the key scoping meetings.

An initial consultation with this group of stakeholders conducted by members from the ESIA Social Team involved meeting with stakeholders in their communities in order to assess the proximity of the transmission line to the community and to identify stakeholders who will be most directly impacted by the project. Table 3-1 shows the communities visited by the Social Team. Annex 2 shows the closest houses and other buildings that were found in close proximity to the transmission line corridor.

Table 3-1. Villages Visited by the Social Assessment Team
(through 20 April, 2009)

Ilmazo	Moliti
Algetis Meurneoba	Tabatskuri
Kosalari	Persa
Jandari	Klde
Azavreti	Tskruti
Aspindza	Benara
Pirveli Sviri	Agara
Shua KvaliTi	Kveda Kvaliti

For the visits, members of the Social Assessment Team drove to the community, met with local community members, and gave a graphic presentation of what will be involved in the rehabilitation, construction, conductoring, and maintenance of the line. The presentation, shown in English in Annex 3, was translated into local languages in minority communities to increase understanding.

The intention of the interactions and these questions is to increase awareness in potentially impacted communities of the proposed project and to initiate a dialogue between the stakeholder and the Social Assessment Team about the project and to identify major stakeholder issues so they may be evaluated in the ESIA. Information obtained from consultations with the affected communities will be used to characterize the social baseline in the ESIA as well as contribute to the Resettlement Framework, which will deal with issues pertaining to resettlement, relocation and compensation.

On 27-28 March, the Ministry of Energy in conjunction with the Ministry for Environment Protection and Natural Resources, held a workshop with NGOs in Gudauri to brief them on the route and on the types of activities and impacts that could be expected, and to obtain their feedback on the project and alternative routes. The planned route for the transmission line calls for it to cross Borjomi-Kharagauli National Park and two Managed Reserves. Presentations were prepared for this meeting (see Annex 1) and NGOs were invited to ask questions and comment. In addition, a number of informal side discussions were held that provided the ESIA team with additional input. The purpose of the meeting was to build on their expertise and to gain a sense of their concerns about the various routes for the line. The NGOs in attendance included Caucasus Environmental NGO Network, Green Movement, and Geo-Information Laboratory LTD. See "*Annex 1 Ministerial and NGO Informational Meeting – Agenda, Comments, Participants*" for details.

It was not possible for all interested NGOs to attend the Gudauri scoping meeting and so members of the ESIA team have been meeting with NGOs in Tbilisi to brief them on the project and the ESIA, and to obtain their feedback. The feedback from these meetings will be incorporated in the ESIA and will serve a basis for the disclosure of the project to the broader civil society community. Additional NGOs who were targeted for follow up meetings include REC Caucasus, Green Alternative, IUCN, NACRES and WWF.

This Public Consultation and Disclosure Plan sets out a strategy to undertake an information campaign that targets affected communities and the civil society community. This will be followed by a series of key stakeholder meetings, which will focus on those individuals and groups that are likely to be affected (directly or indirectly) by the project. This is a continuation of the stakeholder identification and scoping process.

4. PROJECT STAKEHOLDERS

The stakeholders for this project can be divided into six main categories:

- Affected Communities, including households and community members close to the transmission line corridor, property owners and others who may use land in the corridor for cultivation, community leaders, and municipal authorities for the nearby citizens and communities.
- NGOs and civil society members who are concerned about environmental or other impacts, especially in the natural areas, natural management areas, and national parks.
- Workers commissioned to construct and maintain the line, which would be hired by "Energotrans Ltd.", the Georgian State-owned electric company, or its contractor.
- National government bodies, including Ministry of Energy, Ministry of Environment Protection and Natural Resources, Ministry of Finance, Ministry of Economic Development, Ministry of Justice (if relocation is required or property rights contested), Ministry of Health and Social Welfare, Ministry of Refugees and Resettlement (if relocation is required), Ministry of Foreign Affairs (import of power from Azerbaijan and/or sale of power to Turkey), Ministry of Culture, and possibly others.
- Authorities in Administrative Regions.
- National and regional media outlets.

Each of these categories is described briefly below.

4.1 Affected Communities

Various members of affected communities could have one or more interests in the projects, including:

- Environmental and social impact of building or rehabilitation of nearby lines
- Perceived health impacts and noise from active charged lines near communities and homes.
- Disruption, dust, and noise from construction and laying of maintenance roads.
- Loss of the use of small land plots where tower foundations are located.
- Loss or reduction in value of agricultural operations (pasturing, crops, etc.) during construction of towers and conductoring and during maintenance of lines.
- Possible relocation of households.
- Potential opportunities for temporary or permanent employment.

The communities where there are residences or other buildings within 100 meters of the centerline of the corridor are shown in Table 4-1 This is a preliminary listing – it is expected that relocation may not be needed at all, and if so for only a few households. Where the towers have not been constructed, as identified in the table, the line will be moved slightly to avoid the need for relocation of any households.

Table 4-1. Communities Where Buildings Lie Near the Transmission Line Corridor

Community (District)	*Section of line*
Ilmazlo (Marneuli)	Gardabani-Alkaltsikhe
Algetis Meurneoba (Marneuli)	Gardabani-Alkaltsikhe
Jandari (Marneuli)	Gardabani-Alkaltsikhe
Kosolari (Tetritskaro)	Gardabani-Alkaltsikhe
Tetritskaro (Tetritskaro)	Gardabani-Alkaltsikhe
Azavreti (Alkalkalaki)	Gardabani-Alkaltsikhe
Aspindza (Aspindza)	Gardabani-Alkaltsikhe
Agara (Alkaltsikhe)	Gardabani-Alkaltsikhe
Persa (Alkaltsikhe)	Alkaltsikhe-Turkey
Klde (Alkaltsikhe)	Alkaltsikhe-Turkey
Tskruti (Alkaltsikhe)	Alkaltsikhe-Turkey
near Vale (Alkaltsikhe)	Alkaltsikhe-Turkey
Kveda Kvaliti (Zestaponi)	Zestaponi-Alkaltsikhe

4.2 NGOs and civil society members

The primary interests of NGOs and members of civil societies would include protection of Borjomi-Kharagauli National Park and the Ktsia-Tabatskuri and Gardabani Managed Reserves, and protection of communities from negative impacts of development.

4.3 "Energotrans Ltd." and workers hired to construct and maintain the line

The primary interest of "Energotrans" would be access to property around lines and poles for construction, rehabilitation, conductoring, and maintenance. They would also have in interest in maintaining positive community relations, minimizing delays and cost, and avoiding and preventing damage from vandals and scavengers, particularly by disgruntled stakeholders

The interests of workers involved in line construction, conductoring, and maintenance would include employment and income, occupational health and safety, housing during construction, and other concerns related to the work.

4.4 Government Bodies

Many ministries of the national government may have interests in the project, including:

- Ministry of Energy
  Interests: successful implementation of project, increased utilization of Georgia's abundant hydroelectric resources, increased flexibility for power transmission in the country.

- Ministry of Environment Protection and Natural Resources
  Interests: low environmental impacts; minimal disruption to natural processes, protection of sensitive and managed areas.
- Ministry of Finance
  Interests: financial costs and benefits of successful implementation
- Ministry of Economic Development
  Interests: impacts on available energy for industry, municipal use and export
- Ministry of Health and Social Welfare
  Interests: impacts on environmental and human health and social welfare
- Ministry of Justice (if relocation or other compensation is required)
  Interests: equitable compensation for property in accordance with existing laws
- Ministry of Refugees and Resettlement
  Interests: appropriate resettlement if required
- Ministry of Foreign Affairs (sale of power to Turkey)
  Interests: sale of exported energy to Turkey and stronger regional ties
- Ministry of Culture
  Interests: protection of areas of cultural heritage
- Authorities in Administrative Regions
  Interests: reliable energy access for municipal sources and regional industries

4.5 National and regional media outlets

While not true stakeholders, the media have an important role to play and an interest in the project. They will serve as a conduit for information, and may also have specific interests they wish to highlight.

Media interest revolves around access to information and serving as a conduit for public information; sources for information on national and regional developments; potential issues pertaining to national parks, community development, and civil society input into decision making processes.

4.6 Municipal Authorities

The interests of municipal authorities include reliable energy access, ensuring minimal disturbances to communities, and additional interfacing between communities, government agencies and Ministries.

5. PUBLIC CONSULTATION AND DISCLOSURE PROGRAM

The objective of this public consultation and disclosure plan (PCDP--also known as a social engagement plan, or SEP) is to map out the strategies for engaging the various stakeholder groups in the activities of the ESIA and the full implementation of the project. During the ESIA process, information and findings, including this PCDP/SEP, and briefing information on the procedures for the transmission line will be made available to stakeholders throughout the impacted areas at central locations, including Aarhus Centers, regional offices of Ministry of Environment Protection and Natural Resources, and municipal offices in communities near the PTL corridor. When important information is released, the public will be informed through text messages, local NGOs, and local media (including print and radio), and direct contact information may also be provided if needed. It is anticipated that most of the materials will be made available in summary format, with full text available upon request, along with contact information for the local experts provided. Materials will be made available for the duration of the full project, including both the construction and the operation and maintenance phases of the project.

During the social assessment phase, when initial contact is made with stakeholders, selected stakeholders will be asked to join a Stakeholder Advisory Committee. This group will include representative stakeholders from local communities, including, *inter alia*, local farmers, herders, municipal authorities, community leaders, local and national NGOs, workers, teachers, and others. The intent will be to establish a representative body that can advise the Social Assessment Team and serve as a representative body for impacted communities and other stakeholders throughout the duration of the project.

The Stakeholder Advisory Committee will also support the ongoing consultation process. Once the ESIA is completed and translated, it will be provided to members of the Committee prior to scheduling meetings with team members. The Committee will be asked to review the draft ESIA and comment as needed. The team will meet with members of the Stakeholder Advisory Committee while the ESIA is open for public review. The meetings will be in central communities, and will be conducted with local language speakers as well as national and international experts. The Ministry of Energy and the ESIA team will consider any additional inputs and comments for incorporation into the final draft of the ESIA and will specifically note these during the formal ESIA hearings. Additional meetings in directly impacted communities may coincide with these meetings in order to ensure that the Resettlement Framework represents those who may have to relocate due to proximity of the line. Members of the Stakeholder Advisory Committee will be notified how their comments were addressed.

This committee, in combination with other organized stakeholders groups such as NGOs and government authorities, will provide input and guidance into the full implementation of the project, as outlined in Table 5-1 and described below.

Table 5-1. Summary of Public Consultation

Stakeholder Group	*Means of Engagement*
Affected Communities	- Consultation including interviews and informational meetings with directly impacted communities - Direct contact with nearby households and property owners - Stakeholder Advisory Committee members drawn from communities and asked to provide early feedback on ESIA - Ongoing linkages with Ministry of Energy Stakeholder Liaison Officer

Table 5-1. Summary of Public Consultation	
Stakeholder Group	*Means of Engagement*
NGOs and Civil Society	- Initial consultation workshop with Ministries - Meetings with ESIA team during ESIA - Stakeholder Advisory Committee members asked to provide feedback on ESIA - Ongoing linkages with Ministry of Energy Stakeholder Liaison Officer
Workers commissioned to construct and maintain the line	- Staff and supplier training and induction sessions, including feedback and grievance mechanism - Ongoing linkages with Ministry of Energy Stakeholder Liaison Officer
"Energotrans Ltd." Georgian State owned electric company	- Staff and supplier training and introduction sessions, including feedback and grievance mechanism - Ongoing linkages with Ministry of Energy Stakeholder Liaison Officer
Government Bodies including	Ongoing linkages with Ministry of Energy Stakeholder Liaison Officer
National and regional media outlets	Ongoing linkages with Ministry of Energy Stakeholder Liaison Officer

5.1 Affected Communities

As noted earlier, this category of stakeholders includes households and community members close to the transmission line corridor, property owners, farmers who use land in the corridor for cultivation, community leaders, and municipal authorities for these communities.

The communities closest to the line were selected for visits, as well as others that had no buildings so close and members of these communities will be selected to be members of the Stakeholder Advisory Committee.

Select members of these villages will serve on the Stakeholder Advisory Committee for the impacted communities, and will be consulted for to the ESIA and the project implementation on behalf of the village. They will also give information to the communities on behalf of the project. They will be provided with a technical summary of the ESIA in May 2009. The Stakeholder Advisory Committee will be asked to review this and to provide feedback to the assessment team who will meet with them in May and June of 2009.

Following approval of the ESIA, the members of the Stakeholder Advisory Committee can continue to serve as liaisons between the project and the communities, providing inputs at critical junctures, including notification of funding approval, work scheduling, construction and operation. The members can serve as advisors to the communities with regards to grievance procedures, provide inputs into scheduling of works as appropriate, and work with the Ministry of Energy Stakeholder Liaison Officer.

All potentially affected communities who may wish to have an input into the ESIA process and to receive information about project developments and activities, including the formal ESIA hearings, schedule of works and maintenance, and potential ability to put forward concerns and or grievances will be notified through the media that information is available at central locations, including Aarhus Centers, the local offices of Ministry of Environment and Natural Protection, and municipal offices in communities near the transmission line corridor.

When important information is released, key stakeholders will be informed through text messages and others through local NGO organizations, local media (including print and radio), and direct contact. It is anticipated that most of the ESIA and project implementation materials will be made available in summary format, with full text available upon request. All materials will be made available for the duration of the full project, including operation and maintenance of the line.

5.2 NGOs and civil society members

This category of stakeholders includes NGOs and other civil society members who are concerned about environmental impacts especially in the national park and other protected areas.

The NGO and civil society community in Georgia is active and well organized. Both the impact of the project on communities and on environmental resources may be issues of concern to the NGOs, and steps will be taken to inform them about the project and obtain their feedback throughout the ESIA and project implementation.

The NGOs have a strong information network with the group CENN (Caucasus Environmental NGO Network) that maintains a very active and widely read mailing list. It is expected that additional information about the ESIA and project will b distributed through this channel as well as through the REC Caucasus e-mail lists if possible.

Local NGOs near potentially affected communities can play an important role as well and they will be sought out for inclusion in the Stakeholder Advisory Committee as well as for support in any future monitoring work. The local NGOs may provide significant support to the Ministry of Energy Stakeholder Liaison Officer, especially as it pertains to the Stakeholder Advisory Committee work after the ESIA.

5.3 Workers

The workers who will construct, rehabilitate, and maintain the transmission line are a special stakeholder group because they will be most directly involved in interactions with impacted stakeholders and even more so because their livelihoods will be dependent on the project. The ESIA will require that Georgian and international standards for occupational health and safety will be met to ensure that they are protected.

Prior to beginning work in the field, the foreman of each field crew will receive a briefing on relevant issues that were raised in the consultation process to assure that they are aware of sensitivities that they may encounter. The foreman for each workers group should be made aware of issues related to potential impacts on agricultural or other private lands during construction and maintenance and must be familiar with all required mitigation measures that are intended to reduce or avoid potential impacts. The foreman in turn will ensure that workers are aware of any sensitivities within specific communities and will ensure that workers take all measures necessary to mitigate potential impacts.

5.4 Government Bodies

Coordination and collaboration with the appropriate government bodies will be the responsibility of the Ministry of Energy Stakeholder Liaison Officer and the Ministry of Energy project manager in order to ensure intergovernmental cooperation where needed. The coordination with these bodies will include informing them of the ESIA findings, working closely with the relevant bodies, such as the Ministry of Environment Protection and Natural Resources for the ESIA hearings, and the Ministry of Foreign Affairs for extension of the line into Turkey. To date, the Ministry of Energy and the project team have met with various departments and agencies within the Ministry of Environment Protection and Natural Resources and also has acquired information from the Ministry of Culture.

5.5 National and regional media outlets

Although not formally “stakeholders” within the normal meaning, national and regional media have a very important role to play, both in terms of distributing information about the project and providing broader stakeholder information and feedback. The main television channels are RUSTAVI 2, IMEDI, 1st Channel. The Newspaper are 24 Hours, "Kviris Palitra", REZONANS, and regional (local) newspapers such as South Georgia, and Radio outlets are Green wave, Imedi, Palitra, Portuna. These media outlets will be alerted when the ESIA is released for public review. It is expected they will announce where the meetings are to be held for the formal ESIA hearings, and will provide information about where copies of the ESIA and NonTechnical Summary can be located. Throughout project implementation, as needed, local newspapers and radio stations will be provided with public service announcements announcing where construction will be occurring. The Ministry of Energy Stakeholder Liaison Officer will be responsible for all media relations throughout the duration of the project.

5.6 Municipal authorities

Municipal authorities will serve as a key link formal link between the communities and the government, including agencies and ministries. They will be a source of information for communities and they will provide information to the communities as needed. The Ministry of Energy Stakeholder Liaison Officer will work with the municipal authorities to ensure timing of project activities are coordinated well in advance of action, and the municipal authorities will provide support to the project as needed, in terms of liaising with communities, the Ministry, the regional authorities, and the contractors commissioned to construct, rehabilitate, and maintain the power line.

6. TIMETABLE

Activities	*Dates*	*Location*
Meetings with Affected Communities	February – April 2009 (ongoing as needed)	At locally impacted communities
Scoping meeting with NGOs	March 2009	Gudauri
Followup meetings with NGOs and meetings with additional NGOs	March – April 2009	Tbilisi
Consultation with Ministries	February – May 2009	Tbilisi
Public disclosure of ESIA	May or June 2009	- Internet - Tbilisi - Aarhus Centers - Public Facilities such as Municipal Buildings and Ministry of Environment regional offices
Stakeholder Advisory Committee meeting/consultations	May and June 2009	Potentially affected communities
ESIA public meetings	Late June or July 2009	Tbilisi and Regional Administration Centers
Notification of how public comments are to be addressed	June – July 2009	- Public meetings - Stakeholder Advisory Committee meetings or communications - Final ESIA
Notification of communities about construction schedule	September 2009 - 2012	- Direct communication with communities or local authorities - Local and national press
Processing of grievances	ongoing	Direct communications with person/organization filing grievance

7. RESOURCES AND RESPONSIBILITIES

The public consultation and disclosure program during the ESIA phase of the project are members of the Social Assessment Team from consulting firm Black and Veatch, drawing on the expertise and regional experience of subcontractor EcoSocial Solutions and with assistance from Scientific Research Firm GAMMA. The Ministry of Energy has also been involved directly, through hosting the NGO meeting in Gudauri and providing support to all NGOs in attendance. The ESIA Social Assessment Team is making initial contact with communities, working with NGOs, and coordinating the Stakeholder Advisory Committee meetings in May and then the ESIA public disclosure meetings in June.

It is anticipated that the Ministry of Energy will designate a Stakeholder Liaison Officer who will have the responsibility of continuing communications with the affected communities, the Stakeholder Advisory Committee, and other stakeholders. The Ministry of Energy should fund this position and provide sufficient budget resources to support the work of this person and to enable him or her to maintain an active outreach with stakeholders for the duration of the project. Qualifications for this position are listed in Section 10.

8. GRIEVANCE MECHANISM

A grievance can be defined as an actual or perceived problem that might give ground for complaint. As a general policy, the Ministry of Energy will work proactively toward preventing grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. This will be the responsibility of the Ministry of Energy Stakeholder Liaison Officer.

8.1 Type of grievances

It is expected that there would be more potential for issues that lead to grievances in the construction phase of the project, with some potential during future operation and maintenance. Key grievances could include:

- Health and safety issues related to primary environmental impacts on nearby residents.
- Economic losses from loss of use of land or damage to agriculture or forest products.
- Social impacts due to construction crew activities or impacts on social infrastructure.

Anyone will be able to submit a grievance with the Ministry of Energy if they believe a practice is having a detrimental impact on the community, the environment, or on their quality of life. Grievances could include:

- Negative impacts on a person or a community (e.g. financial loss, physical harm, nuisance).
- Dangers to health and safety or the environment.
- Failure to comply with standards or legal obligations.
- Harassment of any nature.
- Criminal activity.
- Improper conduct or unethical behaviour.
- Financial malpractice or impropriety or fraud.
- Attempts to conceal any of these.

The Ministry of Energy will look into all grievances made by any person or organization. It may be found that a grievance is not connected to the project activity or that the project is being carried out in full compliance with applicable national and international standards. In these cases, the Ministry will explain this in writing to the person who filed the grievance. In all other cases, the Ministry will investigate whether there has been a failure to work to the intended standard, to identify ways to redress the grievance, and to identify measures to prevent the incident occurring again.

8.2 Submission of grievance

Grievances should go directly to the Ministry of Energy. If the grievance is related to environmental issues, the Ministry of Energy will confer with the Ministry of Environment Protection and Natural Resources; if it is pertaining to agricultural issues, Ministry of Agriculture will be consulted; and other grievances may include consultations with the relevant Ministry or authority.

Upon receipt, the grievance will be reviewed and it will be decided whether it will be taken into further consideration. The grievance mechanism will be made public throughout the public consultation process, and will be maintained during operation and maintenance. A sample grievance form is included in Annex 4 as a template that can be used by a person wishing to report a grievance.

Grievances may be submitted to the Ministry of Energy project manager, or the Ministry's Stakeholder Liaison Officer when that person is identified:

Ministry of Energy of Georgia
Mariam Valishvili
First Deputy Minister
2 Baratashvili Street, Tbilisi 0105
marika.valishvili@minenergy.gov.ge
tel: (+995 32)35-78-35
tel: (+995 32) 91 92 52
fax: (+955 32) 91 92 70
Mobile: (+995 77)960505

Additionally, a direct, dedicated telephone line will be installed at the Ministry of Energy to receive complaints or concerns concerning this project. The Ministry of Energy will monitor this line and maintain a log of all calls. This log of communications will be included in the annual report on Stakeholder Relations.

8.3 Grievance Resolution Process

In case the grievance is not connected to the project activity or in case the Ministry finds that all work is consistent with applicable Georgian and international standards, the grievance will not be further processed. When this occurs, this will be explained in writing to the person who submitted the grievance.

In all other cases, the Ministry of Energy, in consultation with other authorities as needed, will investigate whether there has been a failure to work to standards and if so, to identify measures to prevent the incident from occurring again. In general, grievances will be resolved as described below.

Step 1: Receive Complaint
Once the Ministry of Energy receives a completed form or is otherwise notified of a potential problem, they will assign someone to be responsible for resolving the grievance, including notifying other responsible authorities of the issue.

Step 2: Acknowledgement
The contact person will acknowledge receipt of a grievance by letter within 10 working days of having received the grievance. The acknowledgement will specify a Ministry of Energy contact person, their reference indicator, and an anticipated target date for resolution.

Step 3: Investigation
The Ministry contact person will work to understand the cause of every grievance. They may need to contact the claimant during this time. During this phase, the Ministry will determine whether the grievance is related to the project, and if so whether the problem was caused by a failure to meet Georgian or international standards.

If the problem was indeed caused by a failure to meet standards, the Ministry will determine if this was a one-time occurrence or if there is an underlying problem with project activities. The responsible person will be responsible for developing modifications to project activities as necessary to meet standards and avoid future problems, and for ensuring that project management and workers are properly counseled and trained to avoid future recurrences of the problem.

Step 4: Resolution
Once Ministry officials have investigated a grievance and determined the proper course of action, they will write to the claimant and disclose the results of the investigation and of the proposed course of action, if any. If the person who submitted the grievance considers the issue to be satisfactorily resolved, they will be asked to sign a Statement of Satisfaction. If the grievance remains unresolved it will be reassessed and there will be further dialogue with the claimant to determine if there are any further steps which may be taken.

Step 5: Follow Up
The Ministry of Energy may contact the claimant at a later stage to ensure that the activities continue to pose no further problems. If there is a remaining problem, the issue will be treated as a new grievance and re-enter the process.

8.4 Confidentiality and Anonymity

A person submitting a grievance may wish to raise a concern in confidence. If the claimant asks the Ministry to protect his or her identity, it will not be disclosed without consent. Details of submissions and allegations will remain secure within the team responsible for investigating the concerns. However, the situation may arise where it will not be possible to resolve the matter without revealing claimant’s identity (for instance where it is required to give evidence in court). The investigative team will discuss with the claimant how best to proceed.

In case the claimant does not disclose his identity to the Ministry, it may make it more difficult to look into the matter, to protect claimant’s position, or to give feedback. Accordingly, while the Ministry will consider anonymous reports, such grievances are not encouraged. In order for any anonymous report to be taken seriously, the anonymous grievance will need to include sufficient facts and data to enable the investigative team to look into the matter without any further assistance.

9. MONITORING AND REPORTING

The Stakeholder Advisory Committee will provide ongoing support to the project through supporting affected communities in the monitoring of project impacts and mitigation programs. Since the Stakeholder Advisory Committee members will be most familiar with the ESIA and Environmental and Social Action Plans, they will be able to help other direct stakeholders decide how to address their concerns. The members of the Stakeholder Advisory Committee and the Ministry of Energy Stakeholder Liaison Officer will work together to ensure that the grievance process is well understood, and that if community members have concerns, they may ask the Stakeholder Advisory Committee to provide guidance in how to best address the concern. Members of civil society and NGOs will also be empowered to work with the Ministry of Energy Stakeholder Liaison Officer as it pertains to their concerns about environmental and social impacts. As needed, the Ministry of Energy Stakeholder Liaison Officer will meet with communities and NGOs to discuss concerns and work to resolve them. Records of all consultations will be kept and made available to the stakeholders.

The Ministry of Energy and EBRD will publish the final ESIA documents, and the Ministry of Energy will provide a summary of issues raised during the consultation process and appropriate feedback on its website and also will place paper copies in Ministry of Energy and Ministry of Environment Protection and Natural Resources offices. Copies will also be distributed to regional Aarhus Centers, the Regional Ministry of Environment Protection offices, and in public libraries near impacted communities.

Throughout the project, the Ministry of Energy will maintain communication channels with relevant stakeholders as identified in this Plan, and the Ministry of Energy Stakeholder Liaison Officer will be responsible for ensuring that these channels of communication remain open.

In addition to the grievance procedure, the Stakeholder Liaison Officer will notify interested stakeholders of any significant project events, such as changes in the project schedule or major changes in project planning. The Ministry of Energy will provide project updates on its web site.

During construction and operations, Ministry of Energy will produce an annual environment and safety report, which will be based upon a summary of the project's performance on management of health, safety, environment and social issues. They will also produce an annual Stakeholder Relations Report detailing consultations, meetings, notifications and grievances, as well as all grievance resolutions to the EBRD. These will be posted on the Ministry of Energy website and provided in Georgian to Aarhus centers and regional governors offices. In addition, the ESIA will include a monitoring program that will require submission to EBRD and other lenders an annual report on key environmental, social, and occupational health and safety aspects of the project.

10. MANAGEMENT FUNCTIONS

It is envisioned that the Ministry of Energy Stakeholder Liaison Officer will be a key member of the Ministry of Energy's environmental and social management system and will provide an important integration function for the implementation of the project. The oversight of the project will be the responsibility of the First Deputy Minister, and the Ministry of Energy Stakeholder Liaison Officer will report directly to her. This liaison officer should have experience working with multiple stakeholder groups, training workers to the issues of specific cultures and sensitivities of the project, working with media outlets, stakeholder group mediation, and experience with relocation and compensation issues as needed.

The Stakeholder Liaison Officer will be responsible for maintaining a stakeholder database, a comments register, and a list of project activities that could affect stakeholders. The Stakeholder Liaison Officer will communicate directly and through the media to inform communities of work to be done in their area as far in advance as possible, which will be at least two weeks in advance of construction and maintenance wherever possible. The Liaison Officer will also be responsible for ensuring foremen and workers are trained about issues and concerns and how these can be addressed throughout project implementation. The Liaison Officer will visit work sites periodically to introduce communities to the foreman and to encourage a positive dialogue between communities and contractors.

ANNEX 1

Ministerial and NGO Scoping Meeting – Agenda, Comments, Participants

Agenda
27-28 March
Informational Meeting
Black Sea Regional Transmission Project and ESIA

27 March

15:00 – Presentation of Georgian Energy System -Mariam Valishvili-First Deputy of Minister of Energy

16:00 – Presentation of Black Sea Regional Transmission Project-Sulkhan Zumburidze-Reabilitation Manager

17:00 – Coffee Break

17:30 – Presentation of ESIA -Jack Mozingo – Black&Veatch – Black Sea Regional Transmission Line ESIA Project Manager;

18:30- Presentation of Public Consultation and Disclosure Plan- Maia Ochigava-EcoSocialSolutions

28 March

13:00 – 14:30 Discussion with NGOs on the transmission line and ESIA

Questions and answers at Gudauri Ministry and NGO Meeting

Main questions put by NGOs after Mozingo presentation (during others presentation there were no questions):

1. During Jack's presentation the first question before he showed the map was whether the line was crossing protected areas; Geo-Information Laboratory. The answer was that it crossed Borjomi-Kharagauli National park, Gardabani Managed Reserve, and Ktsia-Tabatskuri Managed Reserve.

2. What was the objective of future electric transmission line when built during the Soviet Period; CENN. Marika Valishvili's reply was that it was to ensure the power system's stability)

3. What will be the width of the buffer zone?Geo-Information Laboratory LTD. Mozingo: pending further research, we are examining resources within 100 meters of the centerline of the corridor.

4. Is Alternative 2 going to be actively considered? Geo-Information Laboratory LTD. Mozingo and David Girgvliani answered that it would be considered and the analysis in the ESIA would determine if it is selected by the Ministry of Energy.

5. Is there considered additional alternative routes? (Min of Environment. Mozingo: the alternatives identified to date are shown, and we would welcome additional suggestions.

6. Has there been conducted surveys for natural deposits and ground waters? Ministry of Environment. Mozingo: we will use existing research and report and no field investigations; you are welcome to provide any information you have.

7. Does this line cross or is in the proximity of tourist sites; Geo-Information Laboratory LTD. Girgvliani: at this stage of the investigation, it appears not.

8. Are you cooperating with the National Environmental Agency (subordinate to the Min. Of Env.). Min of Env. Mozingo: Yes, The Ministry of Energy has consulted with Ministry and will continue to do so.

9. Geo-Information Laboratory LTD asked for shape files for the transmission line route in order to check if the existing route and alternatives fall under historical heritage and tourist sites. Valishvili and Girgvliani reported they would be provided. The Laboratory also volunteered to provide the heritage and tourist shape files.

10. Will the ESIA document assessed the impact of operations and maintenance of the line in the future. Green Movement. Mozingo: yes

11. Would not it be better to conduct a Strategic EIA before ESIA? Min. of Env. Mozingo: That would be an internal issue between the Ministry of Energy and the Ministry of Environment Protection and Natural Resources

12. Will the ESIA evaluate all alternatives? CENN. Mozingo: yes

13. Will health impacts are assessed within ESIA? Green Movement. Mozingo: yes.

List of participants

1. Sulkhan Zumbaridze-Project manager "Georgian State Electric System"
2. Davit Nioradze-"Georgian State Electric System"
3. Nino Jeranashvili-"Georgian State Electric System" PR
4. Eka Javakhishvili-"Georgian State Electric System"PR
5. Aleko Khetaguri-Minister of Energy
6. Mariam Valishvili-First Deputy of Minister of Energy
7. Goga Khachidze-Minister of Environment
8. Nino Shanidze-KFW
9. Davit Managadze-EBRD
10. Irakli Kobulia CENN NGO
11. Giorgi Demurashvili-Informational Center of Kvemo Kartli-NGO
12. Giorgi Mikeladze-Geo Information Laboratory, LTD NGO
13. Malkhaz Ninikashvili-Green Movement NGO
14. Maia Ochigava-EcoSocialSolutions
15. Davit Girgvliani-Scientific Research Firm GAMMA
16. Jack Mozingo-Black&Veatch
17. Nikoloz Chakhnakia – Permits and licenses, MOE
18. Lasha Moistsrapishvili-Agency for Protected Areas, MOE
19. Nino Tskhadadze-International Relationships Department, MOE
20. Davit Chantladze-Independent Expert

ANNEX 2

The buildings nearest to the line						
Village (District)	*Section*	*Line constructed?*	*<50m*		*50-100m*	
			No. buildings	*distance*	*No. Buildings*	*Distance*
Ilmazlo (Marneuli)	Gardabani-Alkaltsikhe	Y	2	35.79 45.02	11	50.68-89.06
Algetis Meurneoba (Marneuli)	Gardabani-Alkaltsikhe	Y	2	44.24 48.26	4	57.42-71.02
Jandari (Marneuli)	Gardabani-Alkaltsikhe	Y	1	42.87	12	52.37 - 86.35
Kosolari (Tetritskaro)	Gardabani-Alkaltsikhe	N	0	-	1	80.05
Tetritskaro (Tetritskaro)	Gardabani-Alkaltsikhe	Y	2	36.42 37.55	0	
Azavreti (Alkalkalaki)	Gardabani-Alkaltsikhe	N	0		2	86.39 - 87.23
Aspindza (Aspindza)	Gardabani-Alkaltsikhe	Y	1	48.01	2	72.41 97.91
Agara (Alkaltsikhe)	Gardabani-Alkaltsikhe	Y	1	37.19	2	81.62 97.52
Persa (Alkaltsikhe)	Alkaltsikhe-Turkey	N	2	42.18 49.72	2	57.18 50.11
Klde (Alkaltsikhe)	Alkaltsikhe-Turkey	N	3	29.64 11.93 25.94	2	93.25 65.06

The buildings nearest to the line						
Village (District)	*Section*	*Line constructed?*	*<50m*		*50-100m*	
			No. buildings	*distance*	*No. Buildings*	*Distance*
Tskruti (Alkaltsikhe)	Alkaltsikhe-Turkey	N	0	-	1	86.17
near Vale (Alkaltsikhe)	Alkaltsikhe-Turkey	N	1	45.32	2	57.64
						77.9
Kveda Kvaliti (Zestaponi)	Zestaponi-Alkaltsikhe	Y	2	34.54	8	52.75-90.97
				38.89		

ANNEX 3

Presentation made at Gudauri meeting

ANNEX 4

Sample Grievance Form

Full Name
Contact information:
Address:

Telephone:

E-mail:

Preferred language for communication:
___ Georgian ___ Russian ___ Armenian ___ Azeri

___ English ___ Other

Description of Incident or Grievance:
What happened? Where did it happen? Who caused the problem? Who did it happen to? What is the result of the problem? What solution do you suggest?

Data of Incident or Grievance:

What would you propose to resolve this Grievance?

Signature: ______________________________

Date: ________________________________

Please return this form to:
Ministry of Energy of Georgia - Mariam Valishvili First Deputy Minister
2 Baratashvili Street, Tbilisi 0105 Georgia
marika.valishvili@minenergy.gov.ge
Mobile: (+995 77)960505
Administrative Department of Ministry of Energy
tel: (+995 32)35-78-35
tel: (+995 32) 91 92 52
fax: (+955 32) 91 92 70

Appendix D

Report on Literature Review and Field Survey of Flora and Vegetation along the Black Sea Regional Transmission Project Route

GEORGIA

Author: Dr. Mariam Kimeridze

REPORT ON LITERATURE REVIEW AND FIELD SURVEY OF FLORA AND VEGETATION ALONG THE BLACK SEA REGIONAL TRANSMISSION PROJECT ROUTE (GEORGIA)

(10 km Project Corridor)

Mariam Kimeridze, expert in Botany

INTRODUCTION

The report deals with the results of literature review and field trips aimed at the survey of flora and vegetation within 10 km corridor of planning Regional Transmission Project, in particular 500 m route to identify sensitive communities and habitats.

The botanic description of the territories within the zone of interests has been done on the base of study of large literature and unpublished data as well as on own experience and knowledge. At the same time should be stated that published materials concerning immediately the Regional Transmission Project corridor are in general scanty or not available. Consequently, special field studies have been carried out to obtain more detailed information to fill the existing gaps (white spots) and provide the basic materials for proper **ESIA** of project planning and construction activities from the botanical point of view.

The Regional Transmission Project corridor passes different botanic-geographic regions (Gardabani, Kvemo (Lower) Kartli, Trialeti , Javakheti, Kartli, Meskheti and Imereti) with a great diversity of flora and vegetation due to geological, geomorphological, hydrological, climate and soil conditions. In particular, project impact zone of interests includes steppes; semideserts; spiny-shrubwood steppes; low mountain broadleaved forests; middle mountain broadleaved forests; mountain broadleaved forests; mountain mixed forests; subalpine forests (park forests); subalpine tall herbaceus vegetation; mountain steppes of Southern Georgia; high mountain grasslands and shrubs; subalpine meadows; sedge and grasses marshes (bogs); agricultural lands; other more or less transformed areas.

Within the Regional Transmission Project impact zone a great number of communities and species of different conservative value (Georgian Red List-**GRL**, **RDB**, endemic, rare) as well as economic plants (medicinal, aromatic, wild fruits, fibres, rootcrops, ornamental, beverages, timber, fuel wood, forage (fodder) and pasture, wild relatives of crop species, etc.), are represented.

At the same time it must be taken into account that realistic number of endangered (threatened) species of plants is considered to be much more i.e. more then 400 species against 161 ones included in **RDB** of Georgia (1982) and 56(only tree and shrub species) species included in Georgian Red List. It is also important to note that currently the legislative document concerning protection of rare and endangered plants of Georgia is under consideration.

In addition more comprehensive description of known sensitive communities and habitats is provided in the report. Among the most important sensitive habitats the orchid inhabiting area (~ 5 ha) located on Bedeni plateau must be mentioned. Project construcrtion/operation adverse impact on this area is easily predictable. Such statement is based on the known postulate (circumstance) that any changes in hydrological regime of given area lead to more or less negative changes in water balance and vegetation cover respectively. The coordinates and proper description of this area with key species, *Dactylorhiza urvilleana* and *Orchis coriophora* are given.

Another remarkable examples concerning distribution of orchids along the project corridor are the following **CITES** species: *Corallorhiza trifida, Dactylorhiza euxina, Gymnadenia conopsea, Neotia nidus-avis,* as well as *Dactylorhiza urvilleana*; *Dactylorhiza latifolia.*

Together with endangered species and sensitive habitats (sites) having different conservation value special attention is given to forested areas and the urgent necessity to mitigate the residual impact on forest ecosystems is emphasized.

LEGAL FRAMEWORK

Policy-based actions are essential for providing the institutional support, human and financial resources, and legal framework required to ensure effective species conservation. Frequently, such actions occur through the development and implementation of legislation at the national or sub-national levels, or through international agreements. Legislation is sometimes directed at the protection of particular species, such as by regulating the harvesting of individuals, their trade (e.g., CITES;), or alterations in their habitat (e.g., Ramsar Convention). Legislation can also promote habitat protection, most noticeably through the creation of protected areas: 241 countries or territories are recognized by the *2004 World Database on Protected Areas* as having officially designated protected areas of some type (WDPA Consortium 2004). Legislation may also protect habitat by regulating land use patterns at a broader scale (e.g., Forest Code), or through the regulation of anthropogenic activities that are frequently the least direct but most pervasive causes of species declines (e.g., pollution generated by industry, transport leading to the introduction of invasive species, consumption of fossil fuels leading to climate change).

The role of multilateral environmental agreements has grown during the last decade, as human impacts intensify and span across national boundaries more often. There are now more than 500 international treaties that concern the environment and most countries have ratified key international treaties (although significant gaps remain). These agreements are a means to adopt harmonized approaches and resolve trans-boundary problems with neighboring states. They increasingly offer access to worldwide knowledge, tools and financial resources, and they can give conservation agencies a stronger mandate domestically (Steiner *et al.* 2003).

Nevertheless, most conservation action takes place at the national level, and the national legal framework remains crucial in the effective implementation of the vast majority of conservation programmes. Naturally, legislation is only useful if adequately implemented and such implementation is lacking in many cases. Policy-based actions are frequently implemented as a top-down approach, but their effectiveness is in many cases hindered by a lack of involvement with the local communities that are the direct users of biodiversity. The following are the Multilateral International Conventions related to nature conservation and biodiversity enforced in Georgia: *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (*CITES*; 1975; Universal) regulates international trade of the species listed. *Convention on Biological Diversity* (1992; universal): the programmes of work developed under the CBD encourage Parties to take a wide range of actions to biodiversity conservation and sustainable use. *European Union Habitats Directive* (1992; regional): the natural habitat listed must be maintained at a favourable status, particularly through the creation of a network of protected sites; Convention on the Conservation of Natural Habitats and of Wild Fauna and Flora - *Bern Convention. Convention on Wetlands of International Importance Especially as Waterfowl Habitat* (*Ramsar Convention*; 1975; universal): provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources, in particular through the designation of sites under the Ramsar List of Wetlands of International Importance. *Convention concerning the Protection of the World Cultural and Natural Heritage* (*World Heritage Convention*; 1972; universal): provides for the identification, protection and preservation of cultural and natural heritage (including habitats of threatened species) around the world considered to be of outstanding value to humanity. Countries submit places for designation under the World Heritage List. *United Nations Framework Convention on Climate Change* (1994; universal) and *Kyoto Protocol* (adopted in 1997, not yet into force; universal): caps greenhouse gas emissions in participating industrialized nations from 2008 to 2012 and establishes an international market in emissions credits that will allow these nations to seek out the most cost-effective means to reduce atmospheric concentrations of greenhouse gases.

Georgia's general wild flora and fauna conservation measures are regulated by several legislative acts adopted by the Georgian Parliament in 1994-2009.

Main environmental laws of Georgia.

Law	Date
Law on Protection of Flora from Harmful Organisms	12.10.1994
The Constitution of Georgia	24.08.1995
Law on Protected Area System	07.01.1996
Law on Normative Acts	29.10.1996
Law on Environmental Protection	10.12.1996
Law on Wildlife	26.12.1996
Law on State Ecological Expertise	01.01.1997
Law on Environmental Permits	01.01.1997
Law on Creation and Management of the Kolkheti Protected Areas	09.12.1998
Law on Changes and Amendments into the Law on Protection of Flora from Harmful Organisms	16.04.1999
The Forest Code	22.06.1999
National Environmental Action Plan of Georgia	19.06.2000
Law on Melioration of Lands	16.10.2000
Law on Special Preservation of State Forest Fund and the Plantation within the Tbilisi City and Neighbouring Territories	10.11.2000
Law on expantion of Borjomi-Kharagauli National Park	28.03.2001
Law on Red Data List and Red Data Book of Georgia	06.06.2003
Law on State Control of Nature Protection Law on Red Data List of Georgia	23.06.2005 6.04.2003

Decree N303 of May 2, 2006 of the President of Georgia, "On Approval of the Red List of Georgia" (Endangered Species List).

1. ON SOME METHODOLOGICAL AND CONCEPTUAL ISSUES (APPROACHES) CONCERNING FLORA/VEGETATION DESCRIPTION AND IDENTIFICATION OF PROJECT IMPACT ON ECOSYSTEMS AND HABITATS

Ecosystems along the Project impact zone are usually characterized in terms of habitat/vegetation types such as identified in Ketskhoveli (1960), Nakhutsrishvili (1999) etc. Species composition of different ecosystems and habitats are given on the base of bibliographic data and field surveys.

According to our estimation about 2000 plant species (vascular mainly) are represented within the 10 km corridor of the Project. However, as stated by Morris (1995) "In principle, assessment of the flora should include all vascular plants, bryophytes, lichens, algae (including stoneworts) and fungi, although the importance of the groups varies in different communities". Nonetheless, vascular plants are considered to be the main indicator of terrestrial ecosystems, e.g. all forms of life in a given landscape.

As mentioned above together with endangered plant species and sensitive habitats having different conservation value special attention is paid to forested areas including artificial forest plantations. This is on the ground that forests are considered as special environmental protection areas, unique and most important ecosystems with high ecological, aesthetic, cultural, historical and geological properties (Harcharik, 1997; Isik et al., 1997). In other words, "forests are more valuable as forests than under some other forms of land use" (Harcharik, 1997), "people are making greater demands on forests for recreation, pleasure, scenery and conservation of biological diversity" (Lanly, 1997).

It must be stressed that according to Forest Code of Georgia (2000), Article 41, "a speciel protection regime is established for resort and green zone forest as well as for floodplain forests, and subalpine stripes of forests." In addition steep slope forest should be included in this list. It is also notable that all forested territories within the planning pipeline impact areas belong accordingly to the following **IUCN** categories: V, V-VI, IV-V, IV-V.

It is of decided significance that in contrast to other impact areas in the cases of Project construction through forested territories it is practically impossible to reinstate and maintain former natural stands in the state before construction. Consequently the recommendation are given to implement Forest eco-compensation programmes (Forest offset) to mitigate residual impacts due to Project construction activities.

Detrimental impacts to the protection of biodiversity, protected areas and forestry have to be reduced to the absolute minimum and unavoidable residual environmental damages have to be offset by an eco-compensation scheme. In particular the impacts on forest ecosystems have to be evaluated and offset by adequate mitigation and eco-compensation measures with the goal to restore the equivalent forest habitat.

In this context the calculation of damages to forest ecosystems by the Project construction activities according to the "none-net loss", "net gain principle" and "habitat hectare" approach is recommended to define the exact ratio for forest eco-compensation based upon modern methodologies and international best practice.

The habitat hectare scoring method is a common approach to determine the value of vegetation in non-monetary units. The environmental proxy used i.e. the “currency” in which the value of vegetation is expressed is the “habitat hectare”. The habitat score is derived by assessing a number of site-based habitat and landscape components against a pre-determined ‘benchmark’. Benchmarks have to be defined for different ecological vegetation classes (EVCs).

habitat area [ha] x habitat score = habitat-hectares

This method serves to assess a number of site-based habitat and landscape components against a pre-determined ‘benchmark’ relevant to the vegetation type being assessed. Benchmarks have to be defined for different ecological vegetation classes (EVC). The benchmark for each EVC has to describe the average characteristics of mature and apparently long undisturbed biodiversity and native vegetation occurring in the bioregions in which habitats shall be assessed. The notion of mature and apparently long undisturbed benchmark is relative to the EVC; e.g. a forest benchmark can be based on the average for stands of 200 year old trees with no signs of significant anthropogenic disturbance. Each EVC must contain a range of information required for carrying out a habitat hectare scoring exercise. When carrying out a habitat hectare scoring exercise a habitat score indicating the quality of the vegetation relative to the EVC benchmark is assigned to each of the areas assessed. Multiplying the habitat score by the habitat area (in hectares) allows determining the quality of vegetation. Whereby units of “habitat hectares” are used as a common measuring rod to compare the relative value of different ecosystems within one EVC. The habitat hectare exercise foresees an *in-situ* assessment of natural vegetation to collect a range of visually assessed information of several vegetation components across the habitat zone. The vegetation components that have to be included and assessed depend on the eco-region specific ecosystem composition.

In a second step the visually assessed information on the vegetation components is analysed and used to calculate the habitat score for the area.

The components of the habitat score can be weighted. The Australian State Government of Victoria, Department of Sustainability and Environment, which is a worldwide leading institution in applying the habitat hectare approach, uses the following components and weights:

	Component	Max. value (%)
Site condition	Large trees	10
	Tree (canopy) cover	5
	Understorey (non-tree) strata	25
	Lack of weeds	15
	Recruitment	10
	Organic litter	5
	Logs	5
Landscape context	Patch size*	10
	Neighbourhood*	10
	Distance to core area*	5
	Total	**100**

*Components may be derived with assistance from maps and other (e.g. GIS) information sources.

Table 1 components and weightings of the habitat score in Victoria, Australia

2. GARDABANI PLAIN (LOWLAND): JANDARI LAKE – JAGLUJA HILLS SECTION

2.1. GARDABANI MANAGED RESERVE, RELICT FLOODPLAIN FORESTS

In the immediate proximity to the Planned Project relict floodplain forests of Gardabani Managed Reserve is developed. The zone of significant ecological risk is associated with the relict floodplain forests located in Gardabani region Gardabani Managed Reserve located approximately includes relict mature floodplain forests formed either by: (1) floodplain oak (*Quercus pedunculiflora*) or poplar (*Populus hybrida*), or (2) both species. Associated components of the forests are comprised of approximately 30 species of trees and shrubs inluding many relict species, such as ivy (*Hedera helix, H. pastuchowii*), wild vine (*Vitis sylvestris*), greenbrier (*Smilax excelsa*), common privet (*Ligusrrum vulgare*), etc.

Relict floodplain forests practically survive only in Gardbani Managed Reserve. It is general knowledge that diversity and height of floodplain forests depend on proximity to groundwater.

Gardabani relict floodplain forest has the highest conservation value in the entire lowland. Apart from main components forming the forest being relicts (upper layer - *Quercus pedunculiflora, Populus hybrida P. nigra, Ulmus minor, Salix wilhelmsiana, Crataegus curvisepala, C. pentagyna*; lower layer - *Hedera pastuchowii, H. helyx, Smilax excelsa, Vitis sylvestris, Clematis vitalba, Tamarix ramosissima, Cornus mas, Prunus spinosa, Ligustrum vulgare, Lonicera caprifolium, Elaeagnus angustifolia*), the forest itself is unique in phytocoenological terms.

2.2. OTHER LOWLAND AND FOOTHILL AREAS

The lowland areas of Gardabani and Kvemo Kartli section of the Project Corridor are represented mianly by agricultural lands with the corresponding irrigating systems (canals- Marini canal).

The natural vegetation in these areas is very changed and reduced under the influence of man’s agricultural activities. The semidesert wormwood *(Artemisia fragrans)* communities are dominated here. Together with pure and mixed variants of worm-wood communities there also occur intermediate types mixed diffusely or completely with the variants of saltwort *(Salsola spp.)* desert. From other components one can see here *Agropyron cristatum, Alhagi pseudalhagi, Bothriochloa ischaemum, Kochia prostrata, Limonium meyeri, Salicornia europaea, Salsola dendroides,* etc.

Wormwood communities with ephemers are found in Gardabani and Marneuli districts. They are dominated by the following ephemers: *Adonis aestivalis, Astragalus brachyceras, Koelpinia linearis, Medicago minima, Queria hispanica (Minuartia hamata),* etc.

Foothill landscapes of Rustavi and Marneuli environs as well as eastern part of Trialeti region are characterised by semidesert, steppe vegetation and partly fragments of open woodlands (“light forests”). Present-day expansion of steppes is due to the anthropogenic influence on forests, arid light forest and even on secondary shrubwoods (Sakhokia, 1961). The dominant species of steppe vegetation is beard-grass, *Bothriochloa ischaemum (Andropogon ischaemum).*

Beard-grass steppes are composed of 150-200 species of higher plants (Ketskhoveli, 1960; Gagnidze et al., 1996) and they are typologically very diverse. Among the commonest communities the following can be mentioned (Gagnidze et al., 1996; Nakhutsrishvili, 1999):

Glycyrrhizieto (Glycyrrhiza glabra) – Bothriochloёta
Bothriochloёta xeroherbosa
Bothriochloёta ephemerosa
Bothriochloёta festuceta
Bothriochloёta pratohebrosa
Stipeto- Bothriochloёta

In pure beard-grass steppes the co-dominant positions are occupied by *Eryngium campestre, Festuca valesiaca (F. sulcata), Cynodon dactylon, Glycyrrhiza glabra, Teucrium chamaedris, Teucrium polium, Thymus tiflisiensis, Galium verum,* etc.

In Gardabani plain foothill areas are occupied by *Bothriochloёta–Festuceta* steppe, distinguished with greater species diversity. In this community the co-dominant species are *Festuca valesiaca, Medicago caucasica, Teucrium polium.* There also occur *Scorzonera eriosperma, Eryngium campestre, Thymus tiflisiensis, Onobrychis radiata, Medicago minima, Sideritis montana,* etc. Undulate plain near Kvemo Samgoris Arkhi (Kvemo Samgori Canal) are represented by beard-grass (*Bothriochloa ischaemum*) – spear-grass (*Stipa capillata, S. lessingiana*) steppe and Shibliak. Besides, there are fragments of hemixerophilic shrubwoods dominated by the single trees and shrubs (*Celtis caucasica* **(GRL, RDB)**, *Pyrus salicifolia, Rhamnus pallasii, Ulmus carpinifolia, Spiraea hypericifolia,* etc.). From herbaceous components there are also *Festuca valesiaca, Stipa lessingiana, S. stenophylla, Astragalus microcephalus, Gypsophila acutiloba,* etc.

It must be mentioned that together with *Celtis caucasica* one can see here single **GRL, RDB** plants, viz. *Pistacia mutica, Celtis glabrata* and *Astragalus caucasicus.*

Fragments of *Festuceto (Festuca sulcata) – Bothriochloёta* communities, which are restricted to the slopes of hills are remained only at Jagluja (Nakhutsrishvili, 1999). Besides, hemixerophilic shrubwoods (like shibliak) fragments and almost semidesert wormwood (*Artemisia fragrans*) communities are occurred here. Leading species in these communities, *Artemisia fragnans,* is associated by the following perennials: *Salsola dendroides, Bothriochloa ischaemum, Elytrigia repens, Agropyron cristatum, Glycyrrhiza glabra, Cynodon dactylon, Petrosimonia brachiata, Daucus carota, Falcaria vulgaris, Limonium meyeri,* etc. The geophytes are represented by the species of *Iris, Tulipa, Gagea, Allium.* Among them **RDB** plants, *Iris iberica* and *Tulipa biebersteiniana* should be mentioned.

The components of the xerophilic and hemixerophilic shrubwoods include such drought-resistant species as *Paliurus spina-christi, Spiraea hypericifolia, Rhamnus pallasii, Astragalus microcephalus, Lonicera iberica, Caragana grandiflora.*

3. JAGLUJA HILLS – TETRITSKARO SECTION

In this area the Project corridor passes human influenced transformed vegetation from steppes to oak-hornbeam broadleaved forests.

3.1. FRAGMENTS OF STEPPE VEGETATION AND ARID OPEN WOODLANDS

Fragments of steppe vegetation here and there with a touch of thorn steppes and arid open woodlands are represented up to Tetritskaro environs and particularly on Disveli watershed plateau, between the Ktsia and Algeti rivers, where more notable are **GRL, RDB** species: *Acer ibericum, Celtis caucasica* and single individuals of *Pistacia mutica (*Ketskhoveli, 1960).

3.2. THORN STEPPES WITH FOREST ELEMENTS

These communities are considered to be derivative of forests. They are developed on the area between foothills north-west from Kumisi village up to Tetritskaro environs (Durnuki plateau). *Paliurus spina-chisti* is dominant species. Other components of this vegetation are *Acer ibericum, Celtis caucasica, Pistacia mutica, Crataegus pontica, Amygdalus georgica* (**GRL, RDB** species), *Rhamnus pallasii, Crataegus monogyna, Spiraea hypericifolia, Catoneaster spp., Cerasus incana, Carpinus orientalis, Quercus iberica, etc.* From herbaceous plants *Bothriochloa ischaemum, Festuca sulcata, Stipa capillata, Thymus tiflisiensis, Artemisia fragrans* and other steppe species occur.

3.3. OAK AND HORNBEAM FORESTS

Oak forests, dominated by Georgian oak, *Quercus iberica* are occurred in Tsintskaro village – Tetritskaro section of the Project corridor, the area with significant indications of the anthropogenic impact. According to Ketskhoveli (1960) floristic composition of one of the variants of oak forests (Tetritskaro environs, Nachivchavebi, 1100 m a.s.l.) is as following: *Quercus iberica,Carpinus caucasica, Carpinus orientalis, Fraxinus excelsior, Acer campestre, Pyrus caucasica, Malus orientalis, Sorbus torminalis, Cerasus avium, Prunus divaricata, Prunus spinosa, Grossularia reclinata, Cornus mas, Swida (Cornus) australis.* It is interesting to note that north-east from Tetritskaro between villages Bogvi and Chkhikvta, at 800 m a.s.l. the same author described oak forest stand very changed by man’s intervention. As a result of degradation of this natural stand the components of arid open woodlands, viz. *Paliurus spina-christi, Rhamnus pallasii, Spiraea hypericifolia,* etc. were admixed.

In this area there are also well developed oak-hornbeam forests. As an example the following floristic composition can be shown (Korkhrami, left tributary of the Ktsia river): *Carpinus caucasica, Quercus iberica, Acer campestre, Fraxinus excelsior, Acer ibericum, Sorbus graeca, Pyrus caucasica, Malus orientalis, Celtis caucasica, Crataegus curvisepala, (as C. kyrtostyla,) Crataegus pentagyna, Cornus mas, Cornus (Swida) australis, Rosa canina, Prunus divaricata.*

In the area of Korkhrami river upper stream where climate conditions are more humid oriental beech (*Fagus orientalis*) appears. The floristic composition of this forest is given below: *Carpinus caucasica, Fagus orientalis, Quercus iberica, Fraxinus excelsior, Acer campestre, Acer platanoides, Sorbus graeca, Pyrus caucasica, Malus orientalis, Sorbus aucuparia (as S. caucasigena), Corylus avellana, Tilia begoniifolia (as T. caucasica), Sambucus nigra, Salix caprea, Ostrya carpinifolia, Ulmus scabra, Crataegus monogyna, Crataegus pentagyna, Cerasus avium, Lonicera caprifolium, Lonicera iberica, Philadelphus caucasicus, Cornus mas, Euonymus europaea, Swida australis, Crossularia reclinata, Mespilus germanica,* etc.

Hornbeam forests of the territory under review differ from other types of Georgian hornbeam forest in having in its floristic composition such **GRL, RDB** trees as *Celtis caucasica* and *Acer ibericum*. The following is the original variant of hornbeam forest described in the environs of Samshvilde village situated in the Ktsia river gorge: *Carpinus caucasica, Acer campestre, Acer ibericum, Celtis caucasica, Fraxinus excelsior, Rhus coriaria, Cornus mas, Crataegus pentagyna (*as *C. melanocarpa), Crataegus monogyna, Swida (Cornus) australis, Mespilus germanica,* etc.

There are also hornbeam forests changed due to man's activity. As a result of such changes oriental hornbeam *(Carpinus orientalis)*, georgian oak *(Quercus iberica)*, as well as Christis thorn (*Paliurus spina-christi*) and other xerophilic shrub species appear.

The floristic composition of such forests is as listed below: *Carpinus caucasica, Carpinus orientalis, Celtis caucasica, Quercus iberica, Acer campestre, Acer ibericum, Cornus mas, Prunus spinosa, Crataegus pentagyna, C. monogyna, Paliurus spina-chisti, Pyrus caucasica, Malus silvestris, Viburnum orientale, Rosa canina.*

3.4. ORIENTAL OAK MIXED BROADLEAVED FORESTS

North-west of Tetritskaro town planning Project route lies through mixed broad-leaved oak forest massif covering the area from Tetritskaro-Tsalka road north side to Bedeni plateau at altitudes ~ 1150-1700 m.

GRL, RDB species oriental or high mountain oak, *Quercus macranthera* is dominated here. Other **GRL, RDB** species are elms, *Ulmus glabra*, *Ulmus elliptica.* Iberian hazel-nut, *Corylus iberica* may be found here.

In addition to *Quercus macranthera* main woody species of the area under consideration are: hornbeam, *Carpinus caucasica,* oriental beech, *Fagus orientalis,* oriental hornbeam, *Carpinus orientalis,* Georgian (iberian) oak*, Quercus iberica* (sometimes referred to as *Q. petraea subsp. iberica* (Karagöz, 2001)).

Other broad leaved species, viz *Acer campestre, Acer laetum, Acer trautvetteri, Fraxinus excelsior, Betula pendula, Populus tremula,* and some others have scattered distribution but are nevertheless valuable for their structural-functional role in the species-mixed forest ecosystem.

Total number of woody species exceeded 55 (Annex 1). It should be underlined that herbaceous cover in this forest area is also remarkably rich in biodiversity. The incomplete list of vascular plants species (ferns except) illustrates this statement (Annex 2).

It is essential to note that the forest under review is also distinguished by its typological diversity. Thus, by the analogy with T. Mardaleishvili (1970) and R. Kvachakidze (2001) following associations (forest types) can be identified:

Quercetum carpinoso-poosum
Quercetum corylosum
Quercetum graminoso mixtoherbosum
Quercetum mixtoherbosum (Quercetum varioherbosum)

Quercetum poosum
Quercetum altherbosum
Quercetum caricosum
Quercetum brachypodiosum
Quercetum calamagrostidosum, etc.

In conclusion, the forest under review is characterized as the ecosystem of high conservation value. Consequently construction of Project route through this area is considered to be environmentally very destructive and relevant mitigation measures is recommended.

The Project route follows the bank of the r. Chiv-chavi gorge from TetritTskaro to Bedeni plateau. The upper vertical zone of the Chiv-chavi gorge (800-1,300 m AMSL) supports middle mountainous zone forests, which, dependent on microrelief and slope exposure, is comprised of the following species: Georgian oak (*Quercus iberica*), hornbeam (*Carpinus caucasica*), field maple (*Acer campestre*), etc. Floristic composition of a typical forest community of the Chiv-chavi gorge at the altitude of 1,100 m AMSL is given below:

Quercus iberica	*Cerasus avium*
Carpinus caucasica	*Prunus divaricata*
Carpinus orientalis	*Prunus spinosa*
Fraxinus excelsior	*Grossularia reclinata*
Sorbus torminalis	*Cornus mas*
Acer campestre	*Swida australis*
Malus orientalis	*Euonimus sempervirens* etc.
Pyrus caucasica	

As regards floodplain forests, white willow (*Salix alba*) communities have a fragmentary distribution. It could be stated that typical floodplain forests are not developed in this gorge.

4. BEDENI PLATEAU –KTSIA UPPER REACHES SECTION

Geomorphologically the territory under review belongs to the Mountain Volcanic System of the Minor Caucasus (Meskheti-Trialeti Range) including the South Georgian Uplands.

In regards to soil this territory is classified as the soil province of Southern Georgia. A considerable part of this area is covered both with the mountain chernozems (which are formed at altitudes from 1200 to 2200 m) and meadow chernozem-like soils. In highlands they are replaced by mountain-meadow soils. Besides, the alluvial soils, redzinas, brown as well as the meadow-brown soils occur here with the predominance of brown forest type of soil in the mountain forest belt (Nakhutsrishvili, 1999).

4.1. BEDENI PLATEAU WETLAND AREA

As planning Project route reaches Bedeni plateau at altitudes 1690-1730 m the sensitive wetland area (~ 5 ha) of high conservative value is distinguished due to the presence of orchid species. *Dactylorhiza urvilleana* (In soviet botanical sources (Flora, 1941; Identification guide, 1969; Cherepanov, 1981) *Dactylorhiza urvilleana* is referred to as *D. triphylla, Orchis amblyoloba (O. carthaliniae), O. triphylla*) occurring in this area in large population unique in Georgia. Well known German orchidologist Dr. R. Lorenz is thanked for identification of orchid species during our joint trip and for useful information concerning conservation value of European orchids stated by the Bern Convention (1979). Single individuals of another orchid, *Orchis coriophora* also occurs here. Besides, it is remarkable that the habitat under consideration is very rich in biodiversity consisting of ~150 species of which 90 ones are listed (Annex 3). The coordinates of this sensitive area are given below.

GPS coordinates (1720 – 1725 m a.s.l.)

N 41.61086	N 41.61074	N 41.60916	N 41.61095	N 41.61023	N 41.61096
E 044.35521	E 044.35365	E 044.32685	E 044.32675	E 044.31872	E 044.35763

UTM coordinates (1690-1730 m a.s.l.)

04 43 900 EV	04 46 600 EV
46 06 600 NV	46 06 700 NV

From the Chiv-chavi gorge the Project route ascends Bedeni volcanic plateau, passing in the vicinity of Cherepanov, Bedeni, Barevskoe lakes and enters Tsalka basin. Sedge (including tussock sedge) and aquatic plant communities characteristic to the southern volcanic plateau are developed on the shores of these lakes. *Carex dichroandra* is a dominant species of the tussock sedge wetlands. In addition, the following species occur: *Carex diandra, Carex disticha, Carex vesicaria*. Apart from the sedges, the following species are present: *Poa palustris, Valeriana officinalis, Calamagrostis neglecta, Polygonum amphibium, Alopecurus aequalis, Ranunculus flammula, Triglochin palustre,* etc. *Lemna trisulca* is found in some places between the tussocks.

Relatively dry types of the lacustrine wetlands support mesophilious meadow and wetland species, such as *Luzula spicata, Polygonum carneum, Geum rivale, Ranunculus lingua, Caltha palustris, Epilobium palustre,* etc.

Bedeni plateau vegetation cover is mostly represented by secondary meadows, such as: meadows with Lady's mantle and brome (Brometum variegatal Alchemillosum), grass forb meadows with Lady's mantle (Alchimilletum-graminoso-mixtoherbosum), sedge meadows with Lady's mantle and brome (Brometum-alchemilloso-caricosum), etc.

On the base of above-mentioned it is recommended to identify residual impact of Project construction/operation activities on the habitat mentioned and recommend relevant mitigation measures.

4.2. BEDENI PLATEAU – TSALKA RESERVOIR AREA'S MOUNTAIN STEPPES AND SECONDARY MEADOWS

Mountain steppes are only peculiar to South Georgia including the area under review (1400-2000 m. a.s.l.). They cover high volcanic plateau of Trialeti, Gomareti, Dmanisi and Bedeni. Steppe vegetation in this extensive area develops mainly on chernozems and chernozems-like soils and is distinguished by its phytocenotic diversity. The polydominant grass-forb steppes prevail here. More characteristic species of these communities are: *Festuca ovina, F. sulcata, Stipa tirsa, S. pulcherrima, Bothriochloa ischaemum, Filipendula hexapetala, Falcaria vulgaris, Galium cruciatum, Koeleria macrantha, Medicago hemicycla, Phleum phleoides, Polygala anatolica, Thymus caucasicus,* etc.

Besides there are secondary (here and there overgrazing*)* meadows developed maianly on sites once occupied by primary forests. Like previous communities these meadows are mainly composed by the variants of polydominant grass-forb vegetation with participation of *Agrostis planifolia, Alchemilla erythropoda, Brachypodium sylvaticum, Bromopsis variegata, Calamagrostis arundinacea, Centaurea salicifolia, Dactylis glomerata, Lotus caucasicus, Trifolium ambiguum, T. canescens,* etc. From monodominant meadows can be mentioned communities (variants) with such dominant species as *Nardus glabriculmis (*dzigviani in Georgian), *Anemone fasciculata (*frintiani*), Agrostis planifolia (*namikrephiani*), Brachypodium sylvaticum (*barseliani*), Bromo psis variegata (*shvrieliani*),* etc. (Kvachakidze, 1996).

4.3. TSALKA RESERVOIR – KHANDO VILLAGE

The areas within the Project corridor from Tsalka reservoir to Kizil-Kilisa and Avralo villages are mainly occupied by transformed secondary hay meadows of mowing and grazing combinated use and crops of potato, barley, etc.

Natural herbaceous vegetation of Tsalka depression and adjacent areas has been transformed and is represented by various modifications of secondary steppefied meadows and mountainous polidominants steppes. Steppefied meadows are comprised of *Carex humilis, Festuca valesiaca, F. ovina, Filipendula hexapetala, Polygala anatolica, Stipa tirsa*, etc. Secondary post-forest meadows are dominated by *Agrostis planifolia*, *Alchemilla erythropoda, Bromopsis variegata, Calamagrostis arundinacea, Dactylis glomerata, Geranium sylvaticum, Lotus caucasicus, Ranunculus caucasicus, Trifolium canescens,* etc. The southern slopes are occupied by polidominant steppes mainly formed by grasses *Festuca ovina, F. valesiaca, Stipa pulcherrima, Stipa tirsa, Koeleria macrantha, Phleum phleoides*. Forbs are represented by *Filipendula hexapetala, Cruciata laevipes, Medicago hemicycla, Thymus rariflorus*, etc.

From Bedeni plateau to Ktsia-Tabatskuri Managed Reserve the secondary herbaceous vegetation is comprised of communities dominated by Lady's mantle (*Alchemilla erythropoda, A. sericata, A. caucasica,* etc), brome (*Bromus variegatus*), sedge (*Carex huetiana, C. humilis, C. dacica*, etc), fescue (*Festuca valesiaca*, *F. woronowii*), koeleria (*Koeleria cristata, K. caucasica*), mat nardusgrass (*Nardus stricta*), false hellebore (*Veratrum lobelianum*), anemone (*Anemone fasciculata*), clover (*Trifolium*), alfalfa (*Medicago*). The characteristic plant communities of this zone are described below:

1. Bedeni plateau, flat mesorelief, 1,600 m AMSL, coverage - 95%, meadow with Lady's mantle, koeleria and brome (Brometum koelerioso-alchemilosum):

Bromopsis variegata	*Taraxacum praticola*
Koeleria cristata	*Hesperis matronalis*
Alchemilla erythropoda	*Lotus caucasicus*
Festuca valesiaca	*Cerastium purpurascens*
Trifolium ambiguum	*Veronica gentianoides*
T. trichocephalum	*Thymus rariflorus*

Medicago dzhawakhetica	*Anthoxanthum odoratum*
Pulsatilla violacea	*Myosotis aplestris*
Galium verum	*Carex vesicaria*
Ranunculus caucasicus	*Gentiana schistocalyx*

2. Vicinity of Tsalka, right bank of r. Ktsia, 1,700 m AMSL, western exposure, coverage - 90-95%, grass forb meadow with sedge and Lady's mantle (Alchemilletum-caricoso-mixtoherbosum)

Alchemilla erythropoda	*Ranunculus caucasicus*
Carex huetiana	*Polygala alpicola*
Carex vesicaria	*P. transcaucasica*
Agrostis planifolia	*Nepeta grossheimii*
Cerastium arvense	*Poa pratensis*
Koeleria cristata	*Veronica gentianoides*
Veronica multifida	*Fragaria vesca*
Trifolium ambiguum	*Luzula spicata*
T. trichocephalum	*Gentiana schistocalyx*
Bromopsis variegata	*Nardus stricta*
Achillea biebersteinii	*Sibbaldia semiglabra*
Plantago lanceolata	*Cherophyllum humile*
Lotus caucasicus	*Matricaria caucasica*
Taraxacum praticola	*Cruciata laevipes*
Potentilla recta	

3. Vicinity of Tsalka, right bank of r. Ktsia, 1,700 m AMSL, western exposure, coverage - 85-95%, grass forb meadow with sedge (Caricetum-mixtoherboso- graminosum)

Carex huetiana	*Anemone fasciculata*
Alchemilla erythropoda	*Polygonum alpinum*
Galium verum	*Geranium silvaticum*
Thalictrum flavum	*Geranium renardii*
Rumex acetosa	*Geum rivale*
Veronica gentianoides	*Veratrum lobelianum*
Carum carvi	*Luzula spicata*
Anthoxanthum odoratum	*Bromopsis variegata*
Dactylorhiza euxina	

4. Vicinity of Tsalka, right bank of r. Ktsia, subalpine zone, vicinity of Tikmatasheni pass, northern-eastern exposure, coverage - 95%, grass forb meadow with bentgrass (Graminetum-mixtoherbosum)

Agrostis planifolia	*Dianthus cretaceus*
Koeleria cristata	*Polygala alpicola*
Festuca valesiaca	*Thymus rariflorus*
Bromopsis variegata	*Myosotis alpestris*
Lotus caucasicus	*Leontodon hispidus*
Trifolium pratense	*Astrantia maxima*
Betonica grandiflora	*Alectorolopus major*
Alchemilla erythropoda	*Centaurea fischeri*

Campanula collina
C. glomerata
Galium verum
Rumex acetosella
Erigeron acris
Cirsium obvallatum

5. Mt. Dali Daghi (Tsalka area), northern-eastern slope, coverage - 95%, grass forb subalpine meadow (Graminetum-mixtoherbosum)

Festuca ovina
Agrostis planifolia
Bromopsis variegata
Nardus stricta
Trifolium ambiguum
Trifolium pratense
Veratrum lobelianum
Ranunculus caucasicus
Sibbaldia semiglabra
Betonica grandiflora
Pimpinella saxifraga
Myosotis alpestris
Leontodon hispidus
Rhinanthus major
Erigeron acris
Centaurea fischeri

6. Upper reaches of Ktsia river, vicinity of Tabatskuri (Mt. Mtirala), northern mesoslope, 1,900 m AMSL, coverage - 90%, forb meadow with koeleria (Koelerietum-mixtoherbosum)

Koeleria cristata
Poa pratensis
Bromopsis variegata
Festuca ovina
Alchemilla sericata
Campanula stevenii
Pedicularis comosa
Cerastium purpurascens
Carum carvi
Lotus caucasicus
Trifolium pratense
Campanula glomerata
Lopygonum alpinum
Luzula spicata
Rumex acetosella
Hesperis matronalis
Potentilla crantzii
Galium verum
Rhynanthus major
Veronica gentianoides
Carex huetiana

7. Northern slope of Mt. Mtirala, coverage 90%, grass forb subalpine meadow with false hellebore (Veratrumetam-graminoso-mixtoherbosum)

Veratrum lobelianum
Bromopsis variegata
Alchemilla erythropoda
Carum carvi
Ranunculus caucasicus
Koeleria caucasica
Geranium renardii
Anthoxanthum odoratum
Galium verum
Trifolium ambiguum
Trifolium trichocephalum
Trifolium pratense
Silene wallichiana
Polygonum carneu,
Veronica gentianoides
Anemone fasciculata
Rumex acetosa
Rumex acetosella
Poa pratensis
Potentilla recta
Pedicularis comosa
Pedicularis condensata
Vicia balansae
Vicia grossheimii

8. Northern shore of Tabatskuri lake, eastern slope, coverage - 95%, subalpine grass forb meadow (Latifolio mixtoherbetum -graminosum)

Anemone fasciculata	*Astrantia maxima*
Veratrum lobelianum	*Inula orientalis*
Geranium ibericum	*Myosotis alpestris*
Geranium renardii	*Pyrethrum roseum*
Lilium kesselringianum	*Alchemilla caucasica*
Pastinaca armena	*Cephalaria gigantea*
Ranunculus caucasicus	*Koeleria cristata*
Bromopsis variegata	*Anthoxanthum odoratum*
Rhynanthus major	*Ligularia sibirica*
Lotus caucasicus	*Carex diandra*
Trifolium medium	*Vicia balansae*
Polygonum alpinum	*Silene wallichiana*
Pedicularis condensata	*Polygonum alpinum*

Other coenoses present are of the same floristic composition as the ones detailed above, the only difference being combination of the dominant species. The above data is representative of the herbaceous vegetation along the Project corridor.

The Project route passes in the vicinity of forests only in a few locations along this section. West of Tsalka forest vegetation is entirely comprised of pine (*Pinus kochiana*) plantations (average age of 25-30 years). The Project crosses pine plantations in several locations, however, forest areas within the corridor is of medium conservation value.

Javakheti upland used to be covered by forests, which were entirely destroyed due to high anthropogenic pressure in XVIII-XIX cc. Only minor fragments of the subalpine forests survive mostly on northern slopes of the high-mountainous areas. These fragments are formed by species typical for the Caucasian subalpine forests, namely: Litvinov's birch (*Betula litwinowii*), mountain ash (*Sorbus caucasigena*), goat willow (*Salix caprea*), Bieberstein's rock currant (*Ribes biebersteinii*), alpine currant (*Ribes alpinum*), in some areas - European aspen (*Populus tremula*), etc. Litvinov's birch and mountain ash form communities over small areas in the rocky relief of the Ktsia lower reaches.

Rhododendron scrub (*Rhododendron caucasicum*) is frequent in southern Caucasus, however, it should be given adequate attention due to degression.

Tsalka area is rich in small lakes of volcanic origin (Bashkoi, Uzungel, Jamushgel, Khadiki, Karagel, Tba, tec). The shores of the lakes support the wetland vegetation associations. Project corridor passes through the Imera, Bareti, Kariaki, Santa environs wetlands which should be considered as of high conservation areas along the project corridor.

According to K. Kimeridze (1966, 1975) wetland vegetation is of highest significance on Javakheti volcanic upland. In general, peat bog vegetation is found in all climatic zones including tropics, deserts and the arctic zone. It is regarded as intrazonal or azonal vegetation type due to wide range of occurrence. Wetlands of lacustrine origin are found in the mountainous region of the Caucasus. According to K. Kimeridze (1966), wetlands of Tsalka basin and adjacent areas have been mostly formed as a result of tussock swamping of lakes. This swamping type is extremely rare on the main ridge of the Caucasus. It characterizes lakes with dramatic seasonal changes in water level. Tussock sedge (Cariceta) formation communities are found on silty or coarse-peat wet substrata, which are frequently waterlogged. The surface water level changes considerably by seasons and years.

Peat formation process is fairly intensive in most tussock sedge formations. This process is characterized by certain peculiarities in wetlands located in Javakheti volcanic upland, namely - at the early stages of wetland formation of this type organic mass is mostly accumulated at the roots of evenly distributed main coenotype (sedge - Carex), gradually forming tussocks. Tussock height is dependent on the duration of swamping and maximum waterlogging level of the surface. Having reached this level, tussock height does not increase and organogenic material is mainly accumulated between the tussocks. Tussock sedge communities are characterized by mosaic structure due to formation of microrelief. The above demonstrates the uniqueness of the natural properties idiosyncratic to the eutrophic and oligotrophic wetlands developed on Javakheti volcanic upland. Javakheti wetlands are unique ecosystems, therefore, particular attention should be attached to this vegetation type.

4.4 KTSIA-TABATSKURI MANAGED RESERVE

Proposed Project corridor passes through the Ktsia-Tabatskuri Managed Reserve. Several habitat types encompassing various plant communities are distinguished on the territory of the Ktsia-Tabatskuri reserve. In some cases a habitat type coincides with a high rank syntaxon, e.g. habitat of *Rhododendron caucasicum* refers to the scrub community comprised of Caucasian rhododendron. Two general habitat categories were defined for the purposes of the present study, in particular, terrestrial and aquatic, which include qualitatively different habitat types.

Terrestrial habitats
Terrestrial habitats are widespread on the territory of the Ktsia-Tabatskuri reserve. The following terrestrial habitats are found on the study area: meadows/grasslands and mountain steppes; shrubbery; forest.

In addition to the above habitat types, subalpine tall herbaceous vegetation, volcanogenic boulders and scree and man-made habitats are found in the Ktsia-Tabatskuri reserve; however, they have no landscape value and are represented only by isolated fragments. For the purposes of Ktsia-Tabatskuri reserve management planning only those habitats are objects of studies that cover more or less large areas on the study area and/or have high conservation value.

Aquatic habitat
Extensive as well as fragmented wetlands with associated mosaic plant communities are present on the study area. For the purposes of the present study, plant communities associated with shallow water and moist substrate are considered within these habitat types along with hyper-humid habitats proper. In general, the swamps existing within the study zone are not diverse typologically, however, peat lands, sedge dominated wetland communities, horsetail dominated wetland communities and other swamp complexes can nevertheless be distinguished.

Meadow vegetation, which is entirely of the secondary origin and represented by diverse modifications, occupies the largest area on the studied territory. The following meadow types have the principal structural-functional importance: communities of lady’s mantle (*Alchemilla erythropoda*), sheep’s fescue (*Festuca ovina*), mat-grass (*Nardus stricta*), tufted hair-grass (*Deschampsia cespitosa*), bent (*Agrostis planifolia*, *Agrostis tenuifolia*), sibbaldia (*Sibbaldia* *semiglabra*), broad-leaved herbaceous plant and forbs (Latifoliomixtohorbosa). In most cases these species form meadows jointly where they are present in a great number of syntaxonomic variants.

Lady's mantle meadows are found on almost all the exposures and relief forms. This is one of the most widespread formations. The main cenotype of the formation – cenoses of lady's mantle (*Alchemilla erythropoda*) mostly occur on smooth relief forms. Often the principal species shares its leading role with flat-leaved bent (*Agrostis planifolia*), variegated brome (*Bromopsis variegata*), sheep's fescue (*Festuca ovina*), sibbaldia (*Sibbaldia semiglabra*), mat-grass (*Nardus stricta*), and with cowberry (*Vaccinium vitis-idaea*) in mesophilous variants; frequently it forms cenoses with green mosses.

The lady's mantle meadows are spatially best pronounced on the south-facing macro-slope of the Trialeti range – on Tskhratskaro and Sakvelo mountain massifs as well as on slopes of Mts. Shuana Mta, Tavkvetili, Shavnabada, etc.

Area of the vertical distribution of the lady's mantle meadows lies between 2100-2700 m a.s.l. Relief is often slightly undulating or plain, with inclination ranging from 10 to 35-40°. Typical community description (relevè) is given below.

Plot No.	**1**
Abiotic Characteristics of Plot	
Plot size (m^2)	10
Location	Meso-slope of Mt. Sakvelo
Altitude (m a.s.l.)	2189
Exposure	NE
Inclination	10-15°
Structural Features of Community	
Community type	Forb-grass-lady's mantle meadow (Alchemileta erythropodae graminosa-mixtoherbosa).
Height of herbage (cm)	20-30
Coverage of herbage (%)	80-85
Species Latin names	**Cover-abundance by Drude's scale**[1]
Alchemilla erythropoda	Soc
Bromopsis variegata	Cop^1
Festuca airoides	Sp
Koeleria cristata	Sp
Carum caucasicum	Sp
Thymus rariflorus	Sp
Trifolium ambiguum	Sp
Primula ruprechtii	Sol
Poa alpina	Sol
Luzula spicata	Sol

[1] Symbols of Drude's scale indicate frequency of occurrence/coverage of a species. The symbols are as follows: Soc (socialis) – the dominant species, frequency of occurrence/coverage exceeds 90%; Cop^3 (coptosal) – an abundant species, frequency of occurrence/coverage 70-90%; Cop^2 – a species is represented by numerous individuals, frequency of occurrence/coverage 50-70%; Cop^1 – frequency of occurrence/coverage 50-70%; Sp^3 (sporsal) – frequency of occurrence/coverage about 30%; Sp^2 (sporsal) – frequency of occurrence/coverage about 20%; Sp^1 (sporsal) – frequency of occurrence/coverage about 10%; Sol (solitarie) – scanty individuals, frequency of occurrence/coverage about to 10%; Un (unicum) – a single individual.

Euphrasia pectinata	Sol
Agrostis planifolia	Sp
Gentianella caucasea	Sol
Tragopogon graminifolius	Sol
Gnaphalium luteo-album	Sol

The lady's mantle meadows pertain to the category of communities, which has developed for a long time and are completely of the secondary origin.

Nevertheless, the communities comprised of lady's mantle are significant in aspects of both agriculture and biodiversity and have a positive function in soil protection against erosion.

Sheep's fescue meadows are mostly found on dry south-facing slopes between volcanic boulders; they are fragmentarily distributed in the form of patches throughout the study area, mainly eastwards of Tabatskuri Lake, from slopes of Mt. Shavnabada to the abandoned village Merenia. The vertical distribution profile of the sheep's fescue meadows covers an area between 2200-2500 m a.s.l. The communities usually develop on hilly relief, on east- and south-facing micro-relief forms. Slope inclination is different and varies from 10 to 40°. Typical community description (relevè) is given below.

Plot No.	**2**
Abiotic Characteristics of Plot	
Plot size (m^2)	10
Location	Slopes of Mt. Shavnabada
Altitude (m a.s.l.)	2310
Exposure	E
Inclination	15°
Structural Features of Community	
Community type	Forb-sheep's fescue meadow (Festuceta ovinae mixoherbosa)
Height of herbage (cm)	25
Coverage of herbage (%)	65-75
Species Latin names	**Cover-abundance by Drude's scale**
Festuca ovina	Soc
Agrostis tenuifolia	Sp
Agrostis planifolia	Cop^2
Agropyron repens	Sol
Phleum phleoides	Sp
Koeleria cristata	Sp
Alchemilla erythropoda	Cop^3
Cirsium arvense	Sol
Trifolium ambiguum	Cop
Rhinanthus minor	Sp
Achillea millefolium	Sp
Poa pratensis	Sp
Trifolium pratense	Sol
Thymus rariflorus	Sol
Veronica gentianoides	Sol

Koeleria cristata	Sol
Plantago lanceolata	Sol
Medicago lupulina	Sp
Allium rubellum	Sp
Rosa pimpinellifolia	Sol
Trisetum flavescens	Sol
Hypericum perforatum	Sol

Mat-grass meadow is one of the widespread formations. It occurs in fragmentarily distributed patches throughout the study area. The largest cenoses are formed on Tskhratskaro and Sakvelo mountain massifs: from the foothills of Mt. Chareli (southwards from Tskhratskaro Pass) to the meridian of Mt. Tavkvetili and on the southwest-facing slopes of Mt. Tavkvetili itself. Vertical distribution limits of the mat-grass meadows are located at 2000-2400 m. Smooth relief forms and plain places are characteristic to the distribution area of the community. The closed-canopied mat-grass cenoses cover large areas at the sources of the river Ktsia. The communities are fragmentarily distributed on the eastern side of Tabatskuri Lake.

Plot No.	**3**
Abiotic Characteristics of Plot	
Plot size (m^2)	10
Location	Sources of the river Ktsia
Altitude (m a.s.l.)	2320
Exposure	E
Inclination	10-25°
Structural Features of Community	
Community type	Lady's mantle-mat-grass meadow (Nardeta strictae alchemillosa)
Height of herbage (cm)	20-30
Coverage of herbage (%)	90-95
Species Latin names	**Cover-abundance by Drude's scale**
Nardus stricta	Soc
Alchemilla erythropoda	Cop^3
Agrostis planifolia	Cop^1
Bromopsis variegata	Sol
Agrostis tenuifolia	Sp
Carex leporina	Sol
Carex huetiana	Sol
Koeleria cristata	Sol
Luzula pseudosudetica	Sol
Veronica gentianoides	Sol
Poa alpina	Sol
Festuca airoides	Sol
Cerastium arvense	Sol
Ranunculus oreophilus	Sp
Trifolium ambiguum	Sp
Leontodon hispidus	Sol
Phleum phleoides	Sol
Trifolium trichocephalum	Sol
Hieracium pilosella	Sol

Sibbaldia semiglabra	Sol
Minuartia inamoena	Sol
Carex medwedewii	Sol

Wide distribution of the mat-grass meadows within the proposed protected area of Ktsia-Tabatskuri and generally in the southern mountainous region of Georgia has been caused by century-old anthropogenic press; however, this plant community has a significant role in erosion prevention in high mountainous regions of the Caucasus.

Bent meadows occupy fairly large areas, especially in humid habitats. They occur on almost all vertical steps of the studied territory, but form independent cenoses only on the lowlands and at slope bases. Bent is one of the important constituents of shrub communities. The bent meadows are characteristic to the northern and western exposures. They mostly dominate on plain and concave relief forms between 2000-2500 m a.s.l. The meadows have high agricultural value as both pastures and hay-fields. The bent meadows are mostly of the secondary origin and develop well in areas formerly occupied by woody plants.

Plot No.	**4**
Abiotic Characteristics of Plot	
Plot size (m^2)	10
Location	Slope base of Mt. Tavkvetili
Altitude (m a.s.l.)	2150
Exposure	N
Inclination	15°
Structural Features of Community	
Community type	Forb-bent meadow (Agrostideta planifoliae mixtoherbosa)
Height of herbage (cm)	30-35
Coverage of herbage (%)	80-90
Species Latin names	**Cover-abundance by Drude's scale**
Agrostis tenuifolia	Soc
Phleum phleoides	Sp
Poa pratensis	Sp
Alchemilla erythropoda	Cop^1
Galium verum	Sp
Trifolium pratense	Sp
Koeleria cristata	Sp
Dactilys glomerata	Sp
Agropyron repens	Sol
Trisetum flavescens	Sol
Carex huetiana	Sol

Community similar to the above cenosis is comprised of another species of bent – *Agrostis planifolia*.

Sibbaldia cenoses occur on the upper vertical step of the study area, mainly on mountain ridges and upper part of adjacent slopes, at 2500-2700 m a.s.l. They can be found on plain as well as undulating relief forms on almost all the exposures. It is known that sibbaldia is a constant component of alpine carpets, but in mountainous regions where the vegetation structure is severely disturbed due to long-term anthropogenic impact, the species occupies even uncharacteristic habitats at the lower vertical step, e.g. occurs in patches even in the complexes of tall herbaceous vegetation. A similar phenomenon is observed on the studied territory of Ktsia-Tabatskuri: fragments of the sibbaldia cenoses are found at the slope bases and even in depressions.

The sibbaldia formation is best pronounced on the Trialeti range: massifs of Mts. Chareli, Tskhratskaro and Sakvelo. It is fragmentarily distributed in degraded and eroded habitats throughout the study area.

Plot No.	**5**
Abiotic Characteristics of Plot	
Plot size (m^2)	10
Location	Slope of Mt. Sakvelio
Altitude (m a.s.l.)	2530
Exposure	N
Inclination	10°
Structural Features of Community	
Community type	Lady's mantle-sibbaldia meadows (Sibbaldieta semiglabrae alchemillosa).
Height of herbage (cm)	15-20
Coverage of herbage (%)	75-80
Species Latin names	**Cover-abundance by Drude's scale**
Sibbaldia semiglabra	Soc
Alchemilla erythropoda	Cop^3
Nardus stricta	Sol
Minuartia oreina	Sp
Festuca airoides	Sp
Carex huetiana	Sp
Koeleria cristata	Sp
Plantago lanceolata	Sol
Veronica gentianoides	Sol
Potentilla crantzii	Sol
Carum caucasicum	Sp
Ranunculus oreophilus	Sol
Gentianella caucasea	Sol

Due to strong root system, sibbaldia has a special role in prevention of erosive processes in the high mountains.

Subalpine broad-leaved forb meadows are found in the northwestern parts of Mts.Tavkvetili and Sakvelo. They are fragmentarily distributed in complexes of volcanogenic boulders and skeleton substrate at 2100-2400 m, usually on the western and northern exposures and develop on downhill (25-35°) as well as undulating and concave relief forms.

Plot No.	**6**
Abiotic Characteristics of Plot	
Plot size (m^2)	10
Location	NW slope of Mt. Tavkvetila

Altitude (m a.s.l.)	2300
Exposure	NW
Inclination	15-20°
Structural Features of Community	
Community type	Forb-broad-leaved meadow (Latifoliomixtoherbosa)
Height of herbage (cm)	15-20
Coverage of herbage (%)	90-95
Species Latin names	**Cover-abundance by Drude's scale**
Anemonastrum fasciculatum	Cop^3
Allium victorialis	Cop^1
Rumex acetosa	Sol
Scabiosa caucasica	Sp
Asyneuma campanuloides	Sp
Aconitum nasutum	Sp
Calamagrostis arundinacea	Cop^1
Festuca varia	Sp
Agrostis planifolia	Sp
Bromopsis variegata	Sp
Geranium ibericum	Cop^2
Stachys macrantha	Cop^1
Alchemilla caucasica	Sp
Veratrum lobelianum	Sp
Cirsium obvallatum	Sp
Gentiana schistocalyx	Sp
Trifolium trichocephalum	Sp
Daphne glomerata	Sp

Mountain steppes

Mountain steppes occur in fragments on the study area, mainly on the south- and east-facing micro-relief forms, on downhill and rocky ecotopes, soil weatering crust and complexes of volcanogenic boulders. Volga fescue (*Festuca valesiaca*) is the dominant species in the mountain steppe vegetation. Feather grass (*Stipa*), which is the edificator of the mountain steppe in the southern part of the Javakheti upland, does not occur in the study area.

Fragments comprised of Volga fescue can be found on slopes of Mts. Tavkvetili and Shavnabada and east of Tabatskuri Lake, at 2200-2600 m, on complex relief forms and frequently inaccessible exposed rocks. Volga fescue mountain steppe has insignificant distribution in the phytolandscape of the study area.

Plot No.	**7**
Abiotic Characteristics of Plot	
Plot size (m^2)	10
Location	Slopes of Mt. Shavnabada
Altitude (m a.s.l.)	2320
Exposure	E
Inclination	20°
Structural Features of Community	

Community type	Forb-Volga fescue mountain steppe (Festuceta valesiacae mixtoherbosa)
Height of herbage (cm)	20-22
Coverage of herbage (%)	60-65
Species Latin names	**Cover-abundance by Drude's scale**
Festuca valesiaca	Soc
Thymus rariflorus	Sp
Carex humilis	Sol
Koeleria cristata	Sol
Elytrigia caespitosa	Sol
Potentilla recta	Sol
Plantago lanceolata	Sol
Melica taurica	Sol
Myosotis heteropoda	Sol
Veronica multifida	Sol
Galium verum	Sol

Shrubbery

Caucasian rhododendron communities are found on the north- and west-facing slopes of Mt. Tavkvetili as well as the plateau of this mountain (in a complex of volcanic basalt "avalanches" on relatively smooth relief forms) and Trialeti range, Mt. Sakvelo massif, sources of the left tributary of the river Ktsia. The community occupies comparatively small area on the right bank of the river Ktsia, on a slope of Mt. Shuana Mta. The Caucasian rhododendron communities are usually formed on the northern and northwestern exposures, between 2200-2400 m, on undulating meso-relief. It is noteworthy that rowan-birch communities with Caucasian rhododendron sub-layer form complexes with pure Caucasian rhododendron communities over large areas.

Plot No.	**8**
Abiotic Characteristics of Plot	
Plot size (m^2)	25
Location	Sources of a left tributary of the river Ktsia
Altitude (m a.s.l.)	2300
Exposure	E
Inclination	30-35°
Structural Features of Community	
Community type	Caucaisian rhorodendron comminity
Height of herbage (cm)	75-100
Coverage of herbage (%)	95-100
Species Latin names	10-20
Community type	**Cover-abundance by Drude's scale**
Rhododendron caucasicum	9
Sorbus aucuparia	4
Salix caprea	3
Betula litwinowii	4
Vaccinium myrtillus	3
Calamagrostis arundinacea	4
Chamerion angustifolium	3

Oxalis acetosella	3
Vaccinium vitis-idaea	2
Rubus idaeus	2
Rosa pimpinellifolia	2
Gentiana schistocalyx	3
Heracleum asperum	4
Valeriana tiliifolia	2
Cephalaria gigantean	2
Ribes biebersteinii	1

Pure Caucasian rhododendron communities with floristic composition similar to the above occur on relatively large areas.

Cowberry communities occupy large areas in complex with Caucasian rhododendron communities as well as independently. Cowberry forms cenoses principally with lady's mantle (*Alchemilla erythropoda*) and mosses on the north-facing slopes, between 2200-2500 m, mainly on smooth relief forms (inclination 20-30°). Within the study area the cowberry communities are pronounced on massifs of Mts. Tavkvetili and Sakvelo as well as the north-facing slope of Mt. Shuana Mta. Cowberry fruitage is robust yielding rich harvest of berries.

Plot No.	**9**
Abiotic Characteristics of Plot	
Plot size (m^2)	25
Location	N slope of Mt. Sakvelo
Altitude (m a.s.l.)	2273
Exposure	N
Inclination	30-35°
Structural Features of Community	
Community type	Lady's mantle-moss-cowberry comminity (Vacciniosa vitis-idaeae hypnoso-alchemillosa)
Height of herbage (cm)	15-20
Coverage of herbage (%)	90-98
Species Latin names	10-20
Community type	**Cover-abundance by Drude's scale**
Vaccinium vitis-idaea	Soc
Deschampsia flexuosa	Sp
Alchemilla erythropoda	Cop^2
Rhinanthus minor	Sol
Anthoxanthum odoratum	Sol
Festuca supina	Cop1
Carum caucasicum	Sp
Trifolium ambiguum	Sol
Luzula spicata	Sol
Agrostis planifolia	Sol
Vaccinium myrtillus	Sol
Bromopsis variegata	Sol
Gentianella caucasea	Sol
Rhododendron caucasicum	Sol

Shrub communities are also fragmentarily distributed on volcanogenic boulders and skeleton scree. The communities are mostly xerophytic and comprised of different floristic components such as: wayfaring-tree (*Viburnum lantana*), Georgian barberry (*Berberis iberica*), raspberry (*Rubus idaeus*), dog-rose (*Rosa pimpinellifolia*), mountain currant (*Ribes alpinum*), juniper (*Juniperus hemisphaerica*), wild cherry (*Cerasus avium*), bridewort (*Spiraea hypericifolia*), honeysuckle (*Lonicera caucasica*), etc.

Forest ecosystem

Fragments of the subalpine forest vegetation still survive in the study, which should undoubtedly be regarded as remnants of forests once widespread in the southern mountainous region of Georgia. Therefore, these remnants are of high conservation value.

Subalpine crooked beech forests. The community occurs at the sources of r. Ktsia and on the north-facing slope of Mt. Tavkvetili. It borders onto volcanic boulders and Caucasian rhododendron communities.

Plot No.	**10**
Abiotic Characteristics of Plot	
Plot size (m^2)	100
Location	N slope of Mt. Tavkvetili
Altitude (m a.s.l.)	1940-2100
Exposure	N
Inclination	35-40°
Structural Features of Community	
Community type	Subalpine crooked beech forest (Fageta nuda)
Height of herbage (cm)	3.5-4
Coverage of herbage (%)	80
Species Latin names	**Cover-abundance by Drude's scale**
Fagus orientalis	Soc
Acer trautvetteri	Sol
Salix caprea	Sol
Ulmus elliptica	Sol
Ribes biebersteinii	Sol
Viburnum lantana	Sol
Rhododendron caucasicum	Cop^1
Rubus idaeus	Sp
Vaccinium myrtillus	Sp

The following elements of tall herbaceous vegetation grow at the forest edges: *Inula orientalis*, *Veratrum lobelianum*, *Vicia balansae*, *Heracleum asperum*, *Chamerion angustifolium*, *Aconitum orientale*, *Symphytum caucasicum*, *Polygonum carneum*, *Rumex alpinus*, etc.

High mountainous oak forests. The survey revealed for the first time that regeneration of oak is satisfactory (saplings as well as seedlings were found) between Tabatskuri Lake and Mt. Tavkvetili, in the complex of volcanic boulders, at 2100 m a.s.l..

Plot No.	**11**

Abiotic Characteristics of Plot	
Plot size (m^2)	30
Location	Between Tabatskuri and Tavkvetili
Altitude (m a.s.l.)	2100
Exposure	E
Inclination	20-25°
Structural Features of Community	
Community type	Oak forest with mixed shrub understorey (Quercetum macrantherae mixtofruticosum)
Height of herbage (cm)	3.5-4
Coverage of herbage (%)	70-80
Species Latin names	**Cover-abundance by Drude's scale**
Quercus macranthera	Soc
Viburnum lantana	Cop^1
Rosa pimpinellifolia	Sp
Lonicera caucasica	Sp
Rubus idaeus	Cop^1
Ribes alpinum	Sol
Melica taurica	Sp
Trisetum rigidum	Sol
Brachypodium sylvaticum	Cop^1
Lamium album	Sp
Poa angustifolia	Sp
Heracleum asperum	Sp

Three stands of high mountainous oak are present in the area. The species is included in the Red List of Georgia. All three fragmentary habitats of the oak forest have a high conservation value.

Fragments of the subalpine forest can also be found on the southern side of Tabatskuri Lake and slope of Mt. Shavnabada. The forests are mainly comprised of high mountain maple (*Acer trautvetteri*), sallow (*Salix caprea*), birch (*Betula litwinowii*) and rowan (*Sorbus aucuparia*) with understorey formed by currant (*Ribes biebersteinii*), raspberry (*Rubus idaeus*), wayfaring-tree (*Viburnum lantana*), wild cherry (*Cerasus avium*), etc.

A large poplar stand occurs (80 X 20 m) in the surroundings of the Bezhano swamp, on southwestern exposure of the elevated terrain,. Detailed phytosociological description of the poplar stand is given below.

Plot No.	**12**
Abiotic Characteristics of Plot	
Plot size (m^2)	100
Location	Surroundings of the Bezhano swamp
Altitude (m a.s.l.)	2050
Exposure	SW
Inclination	20-25°
Structural Features of Community	
Community type	Poplar forest with mixed shrub understorey (Populetum tremulae mixtofruticosum)

Height of herbage (cm)	350-400
Coverage of herbage (%)	70
Species Latin names	**Cover-abundance by Drude's scale**
Populus tremula	Soc
Rosa canina	Cop^1
Ribes alpinum	Sp
Sorbus aucuparia	Sp
Cerasus avium	Sp
Rubus idaeus	Cop^1

Regeneration is satisfactory. Seedlings of different age are present.

Wetland vegetation[2]

Hyper-humid landscapes comprised of mosaic plant communities are widespread on the territory of Ktsia-Tabatskuri reserve. They are mostly associated with Tabatskuri Lake and Ktsia-Nariani hydrographic system.

Northern and northwestern sides of Tabatskuri Lake are swamped – the wetland ecosystem occupies large area between dry-land and lakeside dune. Pure communities of *Equisetum heleocharis* as well as Caricetum vesicariae purum are formed within the shoreline of the wetland ecosystem. The following species constitute the communities: *Alisma plantago-aquatica*, *Heleocharis eupalustris*, *Utricularia vulgaris*, *Scolochloa festucacea*, *Lemna trisulca*, *Potamogeton heterophyllus*, etc.

Cariceta dichroandrae predominates in the wetland. Caricetum dichroandrae purum, in association with large hillocks, is more common in this complex. It is accompanied by Caricetum dichroandrae equisetoso-caricosum vesicariae. Both associations are floristically and structurally similar. Horsetail and *Carex vesicaria* mostly occur between hillocks. Abundance of the principal components in the latter association is as follows: *Carex dichroandara* Cop^3*; Carex vesicaria* Cop^2; *Equisetum heleocharis* Cop^2. The following species are present in association with the principal components: *Lemna trisulca*, *Utricularia vulgaris* – Sp^2, *Scolochloa festucacea* – Sol; *Potamogeton perforliatum*, *Potamogeton heterophyllus* – Sp^1; etc. Surface water level in the described sedge dominated community is 70-80 cm, sometimes higher. The water level is characterized by substantial seasonal variability.

Thicket of *Digraphis arundinacea* skirts the lakeside dune in a narrow line, while horsetail community predominates with admixture of fairly abundant *Scolochloa festucacea* and *Carex vesicaria* in places. *Scolochloa festucacea* forms pure thickets or is accompanied by admixture of horsetail, *Carex vesicaria, C. dichroandra, Alisma plantago-aquatica*, etc.

In the northwestern part of the hyper-humid complex pure horsetail association and Scolochloetum festucaceae purum are found over the large area. In places with deeper water the associations are substituted by Potamogetonetum comprised of two species of the genus; *Polygonum amphibium* is admixed to the community.

[2] Wetland vegetation survey is based entirely on unpublished data of Dr. Kukuri Kimeridze, late Georgian botanist, outstanding expert in the wetland flora and vegetation, the data were kindly provided by his daughter Dr. Mariam Kimeridze, Candidate of Biology.

In the eastern part of the lake pure common reedbed community is found on a small area of 1 hectare. In the shoreline *Carex vesicaria* is admixed to the community from the wetland site.

Scolochloetum festucaceae purum, Equisetetum heleochariae purum and Heleocharietum eupalustre purum are developed on a fairly large area on the eastern side. Potamogetonetum natansae purum with admixed *Polygonum amphibium* occupies large area. Scolochloetum festucaceae potamogetonosum and Equisetetum heleocharis potamogetonosum can also be found in some areas.

East of Tabatskuri Lake the wetland encroaches between mountains in a form of a narrow line (~400m wide), where Scolochloetum festucaceae purum, horsetail dominated wetland community and spike-rush dominated community are mainly formed. The surface water is deep – about 1 m. In places pondweed (*Potamogeton*) groupings are found in the deep-water part.

In the swamped southern-western bay of Tabatskuri Lake Caricetum elatae purum is formed in the shoreline part of the wetland. The sedge community covers a fairly large area and is topologically associated with Caricetum elatae caricosum vesicariae and Caricetum vesicariae purum. Pure sedge community with hillocks predominated by *Carex wiluica*, fairly rare community for Georgia and, in general for the Caucasus, is developed on peat inside the wetland area.

Plot No.	**13**
Abiotic Characteristics of Plot	
Plot size (m^2)	4
Location	SW bay of Tabatskuri
Altitude (m a.s.l.)	2000
Exposure	W
Inclination	Plain relief
Structural Features of Community	
Community type	Caricetum elatae purum
Height of herbage (cm)	75
Coverage of herbage (%)	90
Coverage of mosses (%)	20-25
Species Latin names	**Cover-abundance by Drude's scale**
Carex elata	Soc
Carex vesicaria	Sp^3
Calamagrostis neglecta	Sp^2
Poa palustris	Sp^1
Potamogeton perfoliatus	Sp^3
Potamogeton heterophyllus	Sp^3
Myosotis caespitosa	Sp^2
Sparganium simplex	Sp^1
Ranunculus repens	Sp^1
Utricularia vulgaris	Sp^2
Scutellaria galericulata	Sp^2
Leptodictium riparium (moss)	Sp^3 on hillocks
Bryum sp. (moss)	Sp^3 on hillocks

In the process of peat deposition the main cenotype of the association is subject to degression concurrently with peat accumulation between hillocks, although it covers large area in this wetland. It occupies large area in wetland with low hillocks; however, vitality of the main cenotype is reduced. In such places *Carex lasiocarpa, Carex canescens*, etc. are admixed to the association. In addition, abundance of *Carex vesicaria* decreases with only single individuals found there.

In the deep-water part of the above bay, opposite of village Moliti, pure common reed community (with predominance of *Phragmites communis*) is developed on a small area of ~0,5 ha. The water level is 1m on average. The plot adjoins Potamogetonetum comprised of *Potamogeton perfoliatus*. The speceis is also admixed in low abundance to the common reed community. In this part of the lake another type of Potamogetonetum is also developed, which is made up of *Potamogeton heterophyllus, P. gramineus*. *Potamogeton lucens, Batrachium trichopyyllum* are admixed. Equisetetum heleochariae purum is also developed there (see the description below).

Plot No.	**14**
Abiotic Characteristics of Plot	
Plot size (m^2)	4
Location	SW bay of Tabatskuri near the village Moliti
Altitude (m a.s.l.)	2000
Exposure	W
Inclination	Plain relief
Structural Features of Community	
Community type	Equisetetum heleochariae purum
Height of herbage (cm)	75
Coverage of herbage (%)	80
Coverage of mosses (%)	20-25
Species Latin names	**Cover-abundance by Drude's scale**
Equisetum heleocharis	Soc
Potamogeton heterophyllus	Cop^1
Utricularia vulgaris	Sp^3
Lemna minor	Sp^3
Lemna trisulca	Sp^1
Scolochloa festucacea	Sp^1
Digraphis arundinacea	Sol
Potamogeton perfoliatus	Sp^1

The above horsetail association is replaced by Caricetum elatae purum on one side and Scolochloetum festucaceae purum on the other. Potamogetonetum perfoliatus purum is developed towards the lake.

Nariani valley wetlands are used as a hay-field. Ground water is observed on the surface seasonally in the southern-western part of the wetlands.

Plot No.	**15**
Abiotic Characteristics of Plot	
Plot size (m^2)	4

Location	Nariani valley
Altitude (m a.s.l.)	2050
Exposure	Plain relief
Inclination	Plain relief
Structural Features of Community	
Community type	Caricetum elatae hypnoso-sphagnosum
Height of herbage (cm)	35
Coverage of herbage (%)	60-65
Coverage of mosses (%)	60
Species Latin names	**Cover-abundance by Drude's scale**
Carex elata	Cop^3
Sphagnum platyphyllum (moss)	Cop^2
Hypnum lindbergii (moss)	Cop^2
Drepanocladus aduncus (moss)	Cop^2
Carex vesicaria	Sp^1
Pyrethrum punctatum	Sol
Comarum palustre	Cop^1
Deschampsia cespitosa	Sp^1
Calamagrostis neglecta	Sp^1
Poa palustris	Sp^1
Ligularia sibirica	Sol
Galium palustre	Sp^1
Agrostis alba	Sp^1
Caltha polypetala	Sol
Carex lasiocarpa	Sp^1

The above association adjoins pure sedge community – Caricetum elatae purum also developed on the peatbog; the community is floristically similar to the one described above with one difference - *Potamogetun heterophyllus* occurs here in some places. *Carex lasiocarpa* is fairly abundant (Sp^3) in the described sedge dominated community. Caricetum lasiocarpae purum occurs in fragments in the sedge dominated community complex.

Hypnum lindbergii participates in the Deschampsietum of the described wetland complex.

Sedge dominated community with hillocks – Caricetum wiluicae purum (*Carex wiluica*) is found on a fairly large area southwest of the Nariani valley wetland complex. *Ligularia sibirica* is quite abundant (Cop^1-Sp^3) in the community. Height of the hillocks is 70 cm on average and they are entirely formed by sedge. *Sphagnum platyphyllum, Calliergonella cuspidata* occur in low abundance between hillocks. Calamagrostietum glaucae caricosum (*C. glauca, Carex wiluica*) is directly associated with the sedge dominated community; the former association is hillocky and structurally similar to the pure sedge community. *Geranium palustre* is abundant there – Sp^3-Cop^1; *Festuca rubra, Aconitum nasutum* are present in lower numbers. Herbage is quite dense. The hillocks are narrow at base and open in the upper part. There is no water between the hillocks. *Deschampsia cespitosa, Sanguisorba officinalis,* atc. are also constituents of the described sedge dominated community. The described sedge communities are usually floristically poor.

In the vicinity of the associations described above Caricetum-inflatae purum occurs in the deep-water part of the wetland with abundant herbage. *Lemna minor* – Cop^2, *Utricularia* *vulgaris* – Sp^1 are among the constituents. This sedge dominated community adjoins Caricetum dichroae purum. Surface water level is 3-5 cm on average. The surface is almost completely covered by *Lemna minor*. *Deschampsia cespitosa, Festuca rubra, Carex elata*, etc. are present in low numbers. Both associations are floristically poor. Height of herbage is 50 cm and coverage 85% in the latter association, which includes a sub-layer.

Similar to the above sedge dominated comunities, Caricetum elatae purum, struclurally and floristically similar to the described ones, is fairly widespread in the same part of the wetland. Caricetum vesicariae purum occupies much more limited area and is fragmentarily distributed in lower depressions, where surface water persists for the major part of the vegetation period. This is indicated by participation of *Potamogeton heterophyllus* and *Potamogeton lucens* in the association.

Horsetail dominated community made up of *Equisetum heleocharis* occupying minor areas are frequenton bank terraces of the river Ktsia.

At the base of the east- and northeast-facing slopes of Mt. Tavkvetili, in the place of a former lake, a peatbog is developed at 2370 m a.s.l. Sphagnetum polytrichosum occupies the major part of this peatbog.

Plot No.	**16**
Abiotic Characteristics of Plot	
Plot size (m^2)	4
Location	Bases of E and NE slopes of Mt. Tavkvetili
Altitude (m a.s.l.)	2370
Exposure	Plain relief
Inclination	Plain relief
Structural Features of Community	
Community type	Sphagnetum polytrichosum
Height of herbage (cm)	15
Coverage of herbage (%)	10
Coverage of mosses (%)	100
Species Latin names	**Cover-abundance by Drude's scale**
Sphagnum acutifolium (moss)	Cop^3
Sphagnum angustifolium (moss)	Cop^3
Sphagnum platyphyllum (moss)	Sp^1
Polytrichum gracile (moss)	Cop^3
Dicranum bonjeanii (moss)	Sp^1
Aulacomnium palustre (moss)	Cop^1
Pleurozium schreberi (moss)	Sp^1
Vaccinium vitis-idaea	Cop^2
Festuca supina	Cop^1
Eriophorum vaginatum	Sp^2
Nardus glabriculmis	Sp^1
Vaccinium myrtillus	Sp^3
Rhododendron caucasicum	Sp^2
Carex canescens	Sp^2
Cladonia coniocraea (lichen)	Sp^2

Cladonia fimbriata (lichen)	Sp^2
Cetraria islandica (lichen)	Sp^2
Cetraria cuculata (lichen)	Sp^2
Pileate fungus	Sp^1

In places only moss cover is developed with the predominant synusia of *Vaccinium vitis-idaea.*

Sphagnum (*Sphagnum papillosum*) – mat-grass community covering the entire surface forms a complex with the above association. In places fescue (*Festuca supina*) – polytrichum – sphagnum community is formed with similar floristic composition. Sedge (*Carex canescens*) – sphagnum (with admixed *Sphagnum centrale*) can also be found. All the associations are floristically similar.

Sphagnetum eriophorosum vaginatae occurs in the described complex with *Sphagnum cuspidatum* forming moss cover. *Taraxacum stevenii, Ranunculus oreophilus, Carum caucasisum, Alchimilla* sp., are present in low abundance.

On minor areas, mainly depressed reief, sphagnum (*Sphagnum platyphyllum*) – sedge (*Carex inflata*) association and Caricetum inflatae drepanocladiosum (*Drepanocladus exannulatus,* with participation of *Dicranum bonjeanii, Sphagnum papillosum*) are developed. *Comarum palustre* is present in all the associatons in different abundance. Wetland elements are found in higher abundance in sedge dominated communities occurring in places of former wetlands.

Flat hills mainly covered by fescue (*Festuca supina*) are located around the wetland. Other elements of the alpine meadows such as lady's mantle, caraway, etc. occur between the hills. Mosses: *Polytrichum gracile*, *Aulacomnium palustre* and sometimes lichens are also found on the hills. Caucasian rhododendron occurs at the hill bases in some areas.

This type of the peatbogs is rare not only in the Minor Caucasus, but also the Greater Caucasus.

In slow-flowing sections of r. Ktsia Batrachietum purum (*Batrachium divaricatum*) is abundant with admixed groups of *Potamogeton lucens*. The latter species forms pure community in places or is admixed to Potamogetonetum natansae purum in quite high abundance or in groups. Equisetetum heleochariae purum (*Equisetum heleocharis*) is also frequent on silty substrate of the shoreline. The association is characterised by tall herbage and fairly closed canopy. *Carex inflata, Polygonum amphibium* are admixed in low abundance.

All the above associations as well as Caricetum inflatae purum fragmentarily distributed along the shoreline are floristically and structurally fairly simple. Heleocharietum eupalustrae purum also occurs in patches on the lake shores.

All the associations are formed on silty substrate characterized by presence of surface water over majority of the vegetation period.

A sedge dominated complex occupying about 2 ha is developed on the second order terrace of the left bank of r. Ktsia. Substrate is made up of silt-coarse peat and is seasonally covered by surface water. The following two associations are found: Caricetum dichroandrae purum and Caricetum vesicariae purum. Both associations are characterized by ample herbage: they form monotypic associations, but mix with each other at low extent. General coverage amounts to

90% in the former and 80-85% in the latter. Surface water persists for much longer time in the second association and the substrate is coarse peat-silty.

Potamogeton heterophyllus, Equisetum heleocharis, etc. are admixed to the above association in low numbers. Thin water layer remains in places, while surface of the first association is almost dry. Meadowsweet (*Filipendula ulmaria*) is admixed in fairly low abundance (Sol). Groups of rush (*Juncus filiformis*) can be found in some places. Mosses: *Calliergonella cuspidata, Drepanocladus aduncus* occur on elevated micro-relief.

Caricetum inflatae purum can also be found in the described complex of sedge dominated associations. Abundance of the main cenotype of this association is still low in the above mentioned one. Horsetail is admixed to this type of sedge dominated communities in quite high abundance (Sp^3). Substrate is made up of silt-coarse peat and is covered by surface water.

Caricetum caespitosae hypnosum is found on more elevated flat surface relief.

Plot No.	**17**
Abiotic Characteristics of Plot	
Plot size (m^2)	4
Location	Bases of E and NE slopes of Mt. Tavkvetili
Altitude (m a.s.l.)	2370
Exposure	Plain relief
Inclination	Plain relief
Structural Features of Community	
Community type	Caricetum caespitosae hypnosum
Height of herbage (cm)	30
Coverage of herbage (%)	55
Species Latin names	70
Community type	**Cover-abundance by Drude's scale**
Carex caespitosa	Cop^3
Drepanocladus aduncus (moss)	Cop^2
Calliergonella cuspidata (moss)	Cop^2
Calamagrostis neglecta	Sp^2
Carex vesicaria	Sol
Pyrethrum punctatum	Cop^1
Comarum palustre	Sp^1
Carex wiluica	Sol
Carum carvi	Sol

The above described associations are typologically related to prairieficated wetland and meadows developed on moist soils.

A small (~1,5 hectare) sedge swamp is found in the place of a former lake on Nariani valley, on the third order terrace of the left bank of r. Ktsia, at 2100 m a.s.l. It has a horseshoe shape. The wetland is elongated resembling a shape of narrow rimmed pot. Cariceta inflatae predominates in the swamp with Caricetum inflatae drepanocladosum (*Drepanocladus aduncus, Dr. exannulatus*) being dominant from this formation. Caricetum inflatae purum, Caricetum inflatae sphagnosum (*Sphagnum platyphyllum*) are fragmentarily distributed. *Carex canescens* is fairly abundant (Sp^3) in the latter. Caricetum caespitosae hypnosum can be found in some places along the shoreline. The wetland is surrounded by a narrow strip of mat-grass comminity, which adjoins the subalpine meadow with sphagnum. *Sphagnum, Comarum palustre, Carex caespitosa* and other mosses occur between the mat-grass comminity and swamp.

Plot No.	**18**
Abiotic Characteristics of Plot	
Plot size (m^2)	4
Location	Third terrace of the river Ktsia
Altitude (m a.s.l.)	2100
Exposure	W
Inclination	2-3°
Structural Features of Community	
Community type	Caricetum inflatae sphagnosum platyphyllum
Height of herbage (cm)	45
Coverage of herbage (%)	60
Coverage of mosses (%)	35
Species Latin names	**Cover-abundance by Drude's scale**
Carex inflata	Cop^3
Drepanocladus exannulatus (moss)	Cop^3
Dr. aduncus (moss)	Cop^3
Dr. fluitans (moss)	Cop^3
Calliergonella cuspidata (moss)	Un
Mnium rugicum (moss)	Un
Sphagnum platyphyllum (moss)	Sp^3/Cop^1
Sphagnum acutifolium (moss)	Sp^3/Cop^1
Carex caespitosa	Sol $/Sp^1$
Carex canescens	Sp^2
Calamagrostis neglecta	Sp^1
Carex vesicaria	Sol
Comarum palustre	Sp^1
Carex diandra	Sp^1
Carex lasiocarpa	Sp^1

Caricetum diandrae hypnosum (*Calliergon richardsonii, Drepanocladus sendtneri*) occupying limited area occurs in some places in the shoreline zone. Caricetum wiluicae hypnosum is also present on a small area. Sedge tussocks are usually low here, while fairly high hillocks can be found in some parts of the shoreline. The moss synusia of this association is comprised of the following species: *Hypnum lindbergii, Fissidens adiantoides, Cratoneurum decipiens, Drepanocladus sendtneri. Aulacomnium palustre, Climacium dendroides, Drepanocladus aduncus* can be found in lower abundance.

Caricetum canescenti sphagnosum platyphyllum occurs on a fairly limited area in the described wetland complex. *Calliergom richardsonii* participates in low abundance in the moss synusia along with sphagnum. The association is two-layered. The herbage synusia is comprised of the following species: *Comarum palustre, Carex diandra,* *Carex inflata, Nardus glabriculmis, Calamagrostis neglecta, Filipendula ulmaria*, etc.

A small wetland is developed in the place of a former lake on Nariani valley, on the third order terrace of the left bank of r. Ktsia. The wetland is developed on the peat substrate. Its shape resembles an elongated pot with narrow rim.

Plot No.	19
Abiotic Characteristics of Plot	
Plot size (m^2)	4
Location	Third terrace of the river Ktsia
Altitude (m a.s.l.)	2100
Exposure	W
Inclination	2-3°
Structural Features of Community	
Community type	*Carex inflata+Carex lasiocarpa-Calliergon richardsonii*
Height of herbage (cm)	50
Coverage of herbage (%)	60
Coverage of mosses (%)	20
Species Latin names	**Cover-abundance by Drude's scale**
Carex inflata	Cop^3
Carex lasiocarpa	Cop^2
Calliergom richardsonii	Cop^3
Comarum palustre	Sp^2- Cop^1
Carex canescens	Sp^2
Carex diandra	Sp^2
Carex wiluica	Sol
Calamagrostis neglecta	Sp^1
Filipendula ulmaria	Un
Sphagnum platyphyllum (moss)	Sp^2

Cariceta inflatae appears to be substituted by Carex lasiocarpae in the process of peat accumulation. *Swertia iberica* occurs at the wetland developed in the vicinity of the ground water outlet on the shoreline of the swamp found in the place of the former lake.

Carex wiluica+Carex caespitosa-Drepanocladus spp. is developed on undulating microrelief with low hills in the vicinity of the above wetlands.

Plot No.	20
Abiotic Characteristics of Plot	
Plot size (m^2)	4
Location	Left bank terrace of the river Ktsia
Altitude (m a.s.l.)	2100
Exposure	W
Inclination	2-3°
Structural Features of Community	
Community type	Carex wiluica+Carex caespitosa-Drepanocladus spp.
Height of herbage (cm)	30
Coverage of herbage (%)	50
Coverage of mosses (%)	25
Species Latin names	**Cover-abundance by Drude's scale**
Carex wiluica	Cop^3
Carex caespitosa	Cop^2

Drepanocladus sendtneri (moss)	Cop^3
Drepanocladus aduncus (moss)	Cop^3
Carex vesicaria	Sp^3
Carex canescens	Sp^2
Carex diandra	Sp^1
Comarum palustre	Sp^2
Pyrethrum punctatum	Sp^3
Calamagrostis neglecta	Sp^1
Festuca pratensis	Sp^1
Trifolium spadiceum	Sp^1
Galium uliginosum	Sp^1
Carex inflata	Sp^1
Nardus glabriculmis	Sp^2

A circular wetland with Caricetum inflatae drepanocladiosum (*Dr. exannulatus, Dr. aduncus*) occupying the major part is developed in the place of a former lake. The substrate is coarse peat-silty of over 1 m thickness. Caricetum inflatae sphagnosum platyphyllum (*Sphagnum platyphyllum*) covers smaller area. The above mentioned species of *Drepanocladus* as well as *Dr. fluitans* and Caricetum canescenti sphagnosum platyphyllum compose the moss synusia.

Mat-grass also participates in the herbage synusia. Caricetum inflatae purum is present in the deep-water part of the wetland. The association is replaced by those of Hypnosa order, which are in turn substituted by sphagnum-sedge associations.

The described wetland is located on the second order terrace of the left bank of r. Ktsia – near the river. It is formed in the peripheral part of Nariani valley, where river Ktsia flows in a narrow gorge.

Communities of *Deschampsia* and meadows developed in the place of former wetlands are found on the second order terrace of the left bank of r. Ktsia.

Plot No.	**21**
Abiotic Characeristics of Plot	
Plot size (m^2)	4
Location	Second terrace of the left bank of the river Ktsia
Altitude (m a.s.l.)	2100
Exposure	W
Inclination	Plain relief
Structural Features of Community	
Community type	Caricetum wiluicae purum.
Height of herbage (cm)	35
Coverage of herbage (%)	80
Coverage of mosses (%)	15
Species Latin names	**Cover-abundance by Drude's scale**
Carex wiluica	Soc
Poa palustris	Cop^2
Deschampsia cespitosa	Sp^2
Carex inflata	Sp^3 betwen hillocks

Geum rivale	Sp^{1}
Ranunculus oreophilus	Sp^{1}
Galium palustre	Sp^{2}
Comarum palustre	Sp^{1}
Epilobium palustre	Sp^{1}
Ranunculus repens	Sp^{1}
Carex canescens	Sp^{1}
Sphagnum platyphyllum	Cop^{1}
Drepanocladus aduncus (moss)	Cop^{1}
Aulacomnium palustre (moss)	Cop^{1}

This type of the sedge dominated associations appears to be substituted by meadows.

Carex inflata+Carex heleonastes-Drepanocladus sendtneri is developed on the peat substrate adjacent to the above wetland.

Plot No.	**22**
Abiotic Characeristics of Plot	
Plot size (m^2)	4
Location	Second terrace of the left bank of the river Ktsia
Altitude (m a.s.l.)	2100
Exposure	W
Inclination	Plain relief
Structural Features of Community	
Community type	Caricetum wiluicae purum.
Height of herbage (cm)	35
Coverage of herbage (%)	95
Coverage of mosses (%)	70
Species Latin names	**Cover-abundance by Drude’s scale**
Carex inflata	Cop^{3}
Carex heleonastes	Cop^{2}
Drepanocladus sendtneri (moss)	Cop^{3}
Calliergonela cuspidata (moss)	Sp^{3}
Comarum palustre	Cop^{1}
Swertia iberica	Sp^{1}
Parnassia palustris	Sol
Carex diandra	Sp^{1}
Eriophorum latifolium	Sp^{1}
Deschampsia cespitosa	Sol
Carex wiluica	Sol

Carex inflata seems to be subject to degression in this association. It is anticipated that ultimately Caricetum wiluicae purum described above will develop in this place. *Aconitum nasutum, Potentilla erecta*, etc. occur on hillocks.

The natural vegetation of Ktsia-Tabatskuri reserve area is severely modified due to the influence of both anthropogenic and natural factors, which makes it especially important to ensure retention and sustainability of natural and close to natural vegetation surviving here on limited areas as well as populations of separate species of high conservation value.

The entire basin of r. Ktsia requires special protection including wetland habitats and Caucasian rhododendron-cowberry communities with shrub complexes. Nariani valley is a unique natural phenomenon due to its flora and fauna. Such areas are highly sensitive to any impact and decline rapidly. Another such ecosystem both in terms of scale and structure does not exist in Georgia. Among the wetland complexes of Ktsia-Tabatskuri special attention should be given to protection of the communities, which include wetlands with predominance of *Carex wiluica*, rare cenoses in the Caucasus restricted to Javakheti upland.

A special protection regime should be established for Tabatskuri Lake with its surroundings and unique wetland ecosystems as well as oakwoods dominated by high-mountainous oak identified during field investigations.

Caucasian rhododendron and cowberry ecosystems require similar approach. The Caucasian rhododendron formations have limited distribution. Moreover, subalpine forest fragments are associated with the Caucasian rhododendron formations, which need special protection regime.

Cowberry communities are associated with the Caucasian rhododendron formations in the ecosystem and r. Ktsia basin is one of the important localities in the Caucasus in terms of spatial development of the species.

The following important taxa are distributed in the study area: Caucasian endemics – squill (*Scilla rosenii*) and chervil (*Chaerophyllum humile*), highly ornamental fritillary (*Fritillaria lutea*), saffron (*Colchicum speciosum*), representatives of the orchid family – *Coeloglossum viride* and *Dactylorhiza urvilleana.* Representative of the wetland flora - *Carex wiluica* is a rare species, which forms a unique community on a Caucasian scale where it has a significant cenotic and landscape position. During the subsequent field studies localities of populations of rare species as well as those of species of high conservation value will be recorded with more accuracy within the study area.

The following factors affect or may affect directly the phytolandscapes on the territory of Ktsia-Tabatskuri reserve:

- Anthropogenic factors
  - grazing
  - trampling
  - hay harvesting
  - modification of ecosystems
  - unregulated exploitation of biological resources
  - implementation of development projects
  - environmental pollution

- Natural factors
  - wind erosion
  - landslides
  - global warming.

Development projects of different kind and scale implemented on the territory of Ktsia-Tabaskuri reserve also cause fragmentation and structural disturbance of the vegetation. The most important of these projects is the South Caucasian and Baku-Tbilisi-Ceyhan Pipeline Project. Due to the pipeline project construction works, an important fragment of the Caucasian rhododendron community was destroyed on the slope of Mt. Tavkvetili as well as a fragment of high mountain wetland in the same area. However, it should be mentioned that the pipeline Right-of-Way (RoW) corridor mainly traverses landscapes of low conservation value. A network of ground tracks is developed on the reserve territory, which also facilitates fragmentation of various ecosystems including the hyper-humid ones.

5. KTSIA-TABATSKURI MANAGED RESERVE - TKEMLANA ENVIRONS INCLUDING TETROBI MANAGED RESERVE AREA

The proposed Project passes through the Samtskhe-Javakheti region, which is a distinct geomorphological formation. Its vegetation is characterised by peculiarity and, to a certain degree, contrasts (Sosnovski, 1933). It represents crossroads of geographical-genetic elements characteristic to the Mediterranean, Iran-Turkish and northern hemispheric ancient flora. This landscape-geobotanical zone comprises wetlands, unique lakes and marshes, various modifications of mountainous steppes, mountainous xerophyte shrublands, dry and mesophillous meadows and relict remnants of forests once common in Javakheti upland, etc. (Sosnovski, 1933, Ketskhoveli, 1959).

There are following vegetation zones in southern mountainous region of Georgia (Dolukhanov, 1989, Khintibidze, 1990):

1. Middle montane zone (800-1500 m a.s.l.) - largely used as arable land. The natural vegetation survives as riparian forests, oak-hornbeam forests, mountain xerophytic shrublands, mountain steppes;
2. Upper montane zone with beach-coniferous mixed forests (1200-2050 m a.s.l.);
3. Subalpine zone (1900-2400(2500) m a.s.l.) represented by treeline ecotone, tall herbaceous vegetation, shrublands and polydominant subalpine grass and herb meadows. This zone is typologically diverse;
4. Alpine zone (above 2500 – 2900 m a.s.l.) – alpine meadows and snowbed communities are present. Vegetation is mostly used for grazing and is of considerably lower quality than the subalpine vegetation, both by biomass volume and typological diversity.
5. Subnival zone (2900-3300 m a.s.l.) is represented only on Abul-Samsari range.
6. Azonal vegetation type is represented by fragments of wetlands rich in boreal type flora, halophilic desert vegetation and rocky areas. It should be noted that xerophytic rock vegetation supports high number of endemic species.

Two floristically distinct regions are distinguished for Samtskhe-Javakheti by A. Doluchanov (1989) – Adigeni-Borjomi region and Javakheti upland. The first includes north-west slopes of Trialeti range, southern slopes of Meskheti range, Akhaltsikhe depression and river Kvabliani gorge. R. Mtkvari above v. Khashuri divides Adjara-Trialeti mountain system into two ranges Trialeti and Meskheti. Elevation in this section ranges from 750-800 m a.s.l. to 2700 (2900) m a.s.l. Most prominent part of Mtkvari valley represents Akhaltsikhe depression. Elevation at the base of the depression near town Akhaltsikhe is 950-1000 m a.s.l. It increases considerably to the south to Turkish border.

The following biomes are distinguished in Samtskhe: Riparian forests in floodplains (800-1150 m a.s.l.), xerophytic shrublands and semi-deserts (800-1200 m a.s.l.), Oak–Oriental Hornbeam and Oak-Hornbeam forests (900-1200 m a.s.l.), Beech-coniferous forest (1100-2050 m a.s.l.), treeline ecotone (2050-2200 m a.s.l.), tall herbaceous vegetation and subalpine meadows (2100-2500 m a.s.l.) in the subalpine zone; azonal rock vegetation, and alpine meadows (2500-2900 m a.s.l.) and snowbed communities in the alpine zone. The boundaries of biomes and vegetation zones vary considerably depending on precipitation and slope exposition.

Javakheti volcanic upland supports the following biomes– pine forests, xerophytic shrublands, high-mountain steppes of South Georgia, subalpine and alpine meadows, rock vegetation and wetlands. Small area of subnival vegetation above 2900 m a.s.l. is characteristic of high peaks of Abul-Samsari range (Nakhutsrishvili, 1966).

5.1.1. Mountain xerophytic shrublands and arid vegetation

Mountain xerophytic vegetation is widely distributed in Samtskhe-Javakheti region from 900 up to 2200 m a.s.l. It mainly occurs in the R. Mtkvari gorge and other gorges of Meskheti. They are characteristics of limestone Plateau Tetrobi in Javakheti. There are tragacanthic, phryganoid, shibliak and semi-desert communities (Khintibidze, 1990). Tragacanthic community is represented by edificator species: *Astracantha microcephalus, Acantholimon armenum, A. glumaceum*, and elements of shibliak: *Paliurus spina-christi, Rhamnus pallasii, Cotinus coggygria, Berberis vulgaris, Atraphaxis caucasica, Cotoneaster integerrimus, Crataegus orientalis, Amelanchier ovalis, Lonicera iberica* etc. (Ivanishvili, 1973; Khintibidze, 1990).

Middle montane and upper montane types of tragacanthic communities are distinguished (Khintibidze, 1990). The first with 199 species of vascular plants is spread along the Mtkvari River (900-1300 m a.s.l,) and in gorges of rivers Uraveli, Otskhe, Potskhovi, Kvabliani and Tsinubnistskhali. Tragacanthic vegetation enters pine forest in vicinity of v. Damala. This plant community contains rare species *Astragalus arguricus, A. raddeanus, Onobrychis sosnowskyi, Vicia akhmaganica, Salvia compar, Scutellaria sosnowskyi, Psephellus meskheticus* etc. In some places tragacanths enter oak forest. The following rare species occur in this community: *Dianthus calocephalus, Silene brotherana, Erysimum caucasicum, Coronilla orientalis, Satureja spicigera, S. laxiflora, Teucrium polium, T. nuchense, T. orientale, Sideritis comosa, Bupleurum exaltatum, Convolvulus lineatus, Campanula hohenackeri,* etc.

Phryganoid communities support species *Ephedra procera* and *Tanacetum argyrophyllum* and are spread in eastern part of Akhaltsikhe depression. Peculiar population of *Ephedra procera* occurs in the vicinity of v. Khertvisi. Other characteristic species of this community are *Cytisus caucasicus, Caragana grandiflora, Dianthus calocephalus, Hedysarum turkewiczii, Onobrychis meskhetica, Teucrium polium, Thymus sosnowskyi, Stachys atherocalyx, S. iberica, Festuca valesiaca, Campanula hohenackeri, C. raddeana, C. alliariifolia, Artemisia sosnowskyi, Stipa capillata, S. pulcherrima, Koeleria cristata, Elytrigia elongatiformis, E. trychophora, E. caespitosa, Agropyron repens* var. *subulatus, Valerianella plagiostephana.*

Semi-desert plant communities are present in R. Mtkvari gorge near v. Rustavi and v. Aspindza. Outstanding species in this community is **GRL, RDB** species *Nitraria schoberi* with other 39 species of the community *Reaumuria kuznetzovii, Astragalus cyri, A. kozlowskyi, Caccinia rauwolfii* var. *meskhetica, Ceratocarpus arenarius, Ceratoides papposa, Gamanthus pilosus, Kochia prostrata, Camphorosma monspeliaca, Limonium meyeri, Picnomon acarna, Sterigmostemum torulosum, S. tomentosum, Tragopogon meskheticus, Stizolophus coronopifolius, Callicephalus nitens, Crepis pannonica* etc. (Bobrov, 1946; Kikodze, 1967;

Khintibidze, 1990). Many species of the genus *Artemisia* are characteristics for this type of vegetation.

Shibliak is widespread in middle montane zone mixed with tragacantic vegetation. Dominant species are *Cotinus coggygria, Atraphaxis caucasica, Rhamnus pallasii, Cytisus caucasicus, Paliurus spina-christi,* etc.

Yellow blue-stem grass (*Bothriochloa ischaemum*) community presents mainly secondary vegetation developed in disturbed areas replacing natural vegetation. Associated species are *Veronica orientalis, Galium verum, Achillea micrantha, A. millefolium, Cleistogenes bulgarica, Elytrigia repens, Festuca valesiaca, Koeleria macrantha, Poa pratensis* etc.

5.1.2. Forests

5.1.2.1. Riparian forests

The habitat along the rivers Mtkvari, Potskhovi, Kvabliani, Tsinubnistskali and Otskhe is characterised by a primary riparian forest and partly by relict tugay forest (Kikodze, 2002), which is extensively fragmented and does not constitute a continuous habitat. It is significantly degraded and is not particularly vulnerable to anthropogenic activities given the existing level of disturbance. In addition large areas of forest have been cleared to make room for orchard or agricultural crops. Dominant species in riparian forest is *Alnus barbata* associated with *Quercus pedunculiflora, Populus hybrida, P. nigra, Crataegus monogyna, C. pentagyna, Cornus mas, Prunus spinosa, Ligustrum vulgare, Lonicera caprifolium,* etc. (Gvritishvili, Kimeridze, 2001).

5.1.2.2. Oak and Hornbeam Forests

Oak forests, dominated by Georgian oak, *Quercus iberica* occupy western and northern slopes of middle montane zone (Dolukhanov, 1989; Khintibidze, 1990). It occurs in slopes of Meskheti range, in R. Uraveli and R. Kvabliani gorges. Oak in some areas is mixed with Hornbeam *Carpinus betulus,* in other mainly occurs with Oriental Hornbeam *Carpinus orientalis.* The other characteristic species are *Acer platanoides, Cornus mas, Corylus avellana, Crataegus pentagyna, C. monogyna, Malus orientalis, Pinus kochiana, Pyrus caucasica, Swida australis, Ulmus glabra,* etc. Outstanding peculiarity of oak forests in Samtskhe is the fact that in upper boundary of this type of forests hornbeam is substituted by European Hop hornbeam - *Ostrya carpinifolia,* such forest occupies considerable territory in R. Uraveli and R. Kvabliani gorges. The components of shibliak, such as *Paliurus spina-christi, Rhamnus pallasii, Spiraea hypericifolia* etc., are admixed on lower boundary of the oak forest, as a result of degradation of this natural stand. *Lonicera iberica* is rarely found in the oak forest.

5.1.2.3. Beech-coniferous forests

Beach forests (*Fagus orientalis)* with the elements of Kolkhic flora are well developed in the west of Meskheti in upper areas of R. Kvabliani gorge on Arsiani range and on the eastern slopes of Meskheti range. It forms subalpine krummholz in Goderzi Pass reaching Elevation 2100 m a.s.l. (Khintibidze, 1990). Small population is found on Oshora range above v. Damala (Mukbaniani, 1976). Western and north-western regions of Meskheti are characterized by dark coniferous forests (Dolukhanov, 1989) in upper montane zone representing by *Picea orientalis* and *Abies nordmanniana* mixed with beech. Almost virgin dark coniferous forest occurs in Abastumani along the road to the observatory.

5.1.2.4. Pine forests

Pine forests (*Pinus kochiana*) are usually developed on southern slopes of Meskheti, Adjara-Imereti and Trialeti ranges (Khintibidze, 1990). Pine forest has more limited distribution than spruce forests. Although, pine frequently occurs in spruce forests on the northern slopes (Khintibidze, 1990). Pine forests on Erusheti and Tetrobi-Chobareti ranges (1800-2000 m a.s.l.) have little distinguished composition. This pine was before determined as separate endemic species *P. kochiana*, while more widely distributed one was called *P. sosnowskyi*. Now these two species are unified. However, Tetrobi pine forest by composition is considered as outstanding refugee, where pine is mixed with the elements of mountain steppes (Troitski, 1927). Total 48 vascular plant species are distinguished in this community. The following herbaceous species are associated with *Pinus kochiana: Arenaria steveniana, Cerastium sosnowskyi, Minuartia woronowii, Silene dianthoides, Sempervivum sosnowskyi, Astragalus arguricus, A. campylosema, Medicago dzhawakhetica, Helianthemum nummularium, H. orientale, Daphne transcaucasica, Acantholimon glumaceum, Heracleum antasiaticum, Galium grusinum, Centaurea bella, Crepis pinnatifida, Muscari sosnowskyi* etc. This community is very rich in endemic species occurring mainly on calcareous rocks of Tetrobi Plateau. Peculiar species are *Asphodeline taurica* and parasitic *Diphelypaea coccinea.* Local endemics of Tetrobi Plateau are: *Hypericum thethrobicum, Scorzonera ketzkhowelii* and *S. kozlowskyi.* High conservation value on Tetrobi Plateau has oldest Mediterrenean community with *Asphodeline taurica* and *Stipa pulcherrima*, which is characteristic as well for Crimea (Maleev, 1940). 6 species of them are growing on Tetrobi Plateau - *Asphodeline taurica, Hypericum thethrobicum, Scorzonera dzhawakhetica, S. ketzkhowelii, S. kozlowskyi* and *Anchonium elichrysifolium.*

5.1.3. Mountain Steppes

Mountain steppes are peculiar to South Georgia. They cover Javakheti volcanic Plateau. Steppe vegetation is represented by different plant communities. Most characteristic species of polydominant grass-forb steppes are: *Festuca ovina, F. sulcata, Stipa tirsa, S. pulcherrima, Bothriochloa ischaemum, Filipendula vulgaris, Falcaria vulgaris, Cruciata laevipes, Koeleria cristata, Medicago hemicycla, Phleum phleoides, Polygala anatolica, Thymus caucasicus,* etc.

Besides, there are secondary meadows developed mainly on sites once occupied by primary forests. Like previous communities these meadows are composed by the variants of polydominant grass-forb vegetation with participation of *Agrostis planifolia, Alchemilla erythropoda, Brachypodium sylvaticum, Bromopsis variegata, Calamagrostis arundinacea, Centaurea salicifolia, Dactylis glomerata, Lotus caucasicus, Trifolium ambiguum, T. canescens*, etc. From monodominant meadows can be mentioned communities with such dominant species as *Nardus stricta (*dzigviani in Georgian), *Anemone fasciculata (*frintiani*), Agrostis planifolia (*namikrefiani*), Brachypodium sylvaticum* (berseliani), *Bromopsis variegata* (shvrieliani), etc. (Kvachakidze, 1996).

5.1.4. Subalpine Vegetation

Subalpine zone is represented by krummholz, subalpine shrublands, tall herbaceous vegetation and polydominant subalpine meadows. Subalpine krummholz is represented by *Betula litwinowii* and *B. pendula, Acer trautvetteri, Sorbus caucasigena, Salix caprea* etc. Shrubland is composed by Caucasian Rhododendron - *Rhododendron caucasicum, Vaccinium myrtillus, Empetrum caucasicum* etc.

Subalpine birch and maple forests are found on the northern slopes while pine forests are developed on the southern slopes at the altitudes of 1800-1900 m a.s.l.

Javakheti upland used to be covered by forests, which were entirely destroyed due to high anthropogenic pressure in XVIII-XIX cc (Troizki, 1927). Only minor fragments of the subalpine forests survive mostly on northern slopes of the high-mountainous areas. These fragments are formed by species typical for the Caucasian subalpine forests, namely: Litvinov's birch (*Betula litwinowii*), mountain ash (*Sorbus caucasigena*), goat willow *(Salix caprea*), Bieberstein's rock currant (*Ribes biebersteinii*), alpine currant (*Ribes alpinum*), in some areas - European aspen (*Populus tremula*), etc. Litvinov's birch and mountain ash form communities cover areas in the rocky relief.

Tall herbaceous vegetation is composed of 3-4 m high herbs, mainly dicots (Nakhutsrishvili, 1999). Typical species forming subalpine tall herbaceous vegeation are as follows: *Anemone fasciculata, Geranium ibericum, G. platypetalum, G. psilostemon, G. ruprechtii, Scabiosa caucasica, Senecio rhombifolius, Stachys macrantha, Campunala latifolia, Cephalaria gigantea, Doronicum macrophyllum, Aconitum nasutum, Gadellia lactiflora, Delphinium flexuosum, Heracleum wilhelmsii, Grossheimia macrocephala, Lilium szovitsianum,* etc.

Subalpine grass and grass forb meadows are found in the subalpine forest complexes. Grass meadows are formed by *Festuca ovina, F. woronowii, Bromopsis variegata, Calamagrostis arundinacea*. These species form coenoses both independently and in co-dominance. The subalpine meadows occur above the subalpine forest zone, at the altitudes of 2100-2200 m a.s.l.

5.1.5. Alpine vegetation

The vegetation of the alpine zone is comprised of *Festuca valesiaca, F. ovina, F. woronowii, Alchemilla erythropoda, A. caucasica, Sibbaldia semiglabra, Cirsium arvense,* sedge - *Carex tristis*, mat nardus grass - *Nardus stricta*, and various grasses. Snowbed communities support *Carex meinshauseniana, Festuca supina, F. woronowii, Minuartia circassica, Corydalis alpestris, Senecio taraxacifolius, Matricaria caucasica* etc.

5.1.7. Rock – scree vegetation

Rock-scree vegetation in Samtskhe-Javakheti reveals properties of xerophytic vegetation. It is spread in Akhaltsikhe depression (900-1500 m a.s.l.) and in Tetrobi Plateau (1800-2000 m a.s.l.).Total 80 species present in this biome. Among them are: *Erysimum szowitzianum, Campanula crispa, Veronica livanensis, Centaurea bella, Minuartia micrantha, Jurinea carthaliniana, Matricaria rupestris* etc.

6. BORJOMI-KHARAGAULI PROTECTED AREA

Proposed Project corridor passes through subalpine polydominant meadows, subalpine bushes (thickets) of Caucasian rhododendron, *Rhododrndron caucasicum*. One can also see here crowberry, *Empetrum hermaphroditum* and single individuals or groups of mountain ash, *Sorbus aucuparia* scattered between subalpine meadows vegetation.

The area on lower altitude are covered by subalpine tall herbaceous vegetation and park forests with significant participation of species of meadow and tall herbaceous vegetation. Woody species are represented by high mountain maple, *Acer trautvetteri,* birch *(Betula litwinowii, Betula pendula),* goat willow, *Salix caprea,* wild rose, *Rosa sp.*

Incomplete species composition of polydominant tall herbaceous vegetation is as follow:

Aconitum nasutum
Aconitum orientale
Agrostis capillaris
Agrostis planifolia
Alchemilla spp.
Astrantia maxima
Athyrium filix-femina
Betonica macrantha
Brachypodium sylvaticum
Bromipsis variegata
Calamagrostis arundinacea
Campanula latifolia
Centaurea fischeri
Centaurea salicifolia
Cephalaria gigantea
Chaerophyllum aureum
Cirsium spp.
Coeloglossum viride
Dactylis glomerata
Dactylorhiza euxina
Delphinium flexuosum
Doronicum macrophyllum
Dryopteris filix-mas
Festuca gigantea
Gadellia lactiflora
Galega orientalis
Geranium ibericum
Grossheimia macrocephala
Gymnadenia conopsea
Heracleum cyclocarpum
Heracleum wilhelmsii
Inula grandiflora
Lapsana grandiflora
Ligusticum alatum
Lilium szovitsianum
Milium schmidtianum
Polygonum carneum
Pyrethrum macrophyllum
Rumex sp.
Sanguisorba officinalis
Scabiosa caucasica
Senecio othonnae
Senecio subfloccosus
Symphytum asperum
Traunsteinera sphaerica
Ttifolium ambiguum
Trifolium canescens
Valeriana alliariifolia
Veratrum lobelianum
Vicia sp., etc.

The area is occupied by subalpine forest and broadleaved and broadleaved-coniferous mixed forests composed of *Fagus orientalis, Betula litwinowii, Acer trautvertteri, Populus tremula, Quercus iberica, Pinus kochiana, Pyrus caucasica, Corylus avellana, Salix spp.,* etc. This forest can be evaluated to be high conservation value.

The mountain mixed forest located as well on the above-mentioned territory seems to be environmentally more important. From the main woody species can be mentioned here *Fagus orientalis, Picea orientalis, Pinus kochiana (Pinus sosnowskyi), Abies nordmanniana, Carpinus caucasica, Quercus macranthera, Acer trautvetteri.* Other trees and shrubs include: *Acer campestre, Acer platanoides, Acer laetum, Cerasus avium, Corylus avellana, Euonymus latifolia, Ligustrum vulgare, Lonicera caucasica, Malus orientalis, Populus tremula, Pyrus caucasica, Prunus divaricata, Ribes sp., Rosa canina, Salix caprea, Sambucus nigra, Viburnum opulus, Viburnum orientale*. Apart from *Quereus macranthera* another **GRL, RDB** species, *Ulmus glabra,* must be noted.

Upper limit of this forest massif is represented by the fragments of subalpine forests (*Acer trautvetteri, Betula litwinowii, Betula pendula, Salix caprea)* together with subalpine tall herbaceous vegetation and subalpine meadow and intended for mowing and grazing combinated use and rich in biodiversity.

7. SAKIRE ENVIRONS – THE MTKVARI RIVER CROSSING SECTION

The area from Kodiani mountain to Sakire village is occupied by coniferous forest with oriental spruce, *Picea orientalis* and pine, *Pinus kochiana* (*Pinus sosnowskyi*), coniferous-broadleaved mixed forests with such broadleaved components as *Acer trautvetteri, Betula pendula, Pyrus caucasica, Malus orientalis, Corylus avellana, Ulmus glabra,* etc.

West of Sakire village up to nameless pass Project corridor occupies the free of forest area (agrolandscape), after which coniferous (spruce and pine) and coniferous- broadleaved forests are developed (southwest of Tiseli village). From broadleaved species occurs*: Fagus orientalis, Carpinus caucasica, Quercus macranthera, Quercus iberica, Acer campestre, Fraxinus excelsior*, *Cerasus avium, Corylus avellana*, *Euonymus europaea, Crataegus orientalis, Swida australis, Prunus divaricata, Lonicera caucasica*, etc.

This forested area is followed by agricultural lands here and there with fragments of forests and single trees and shrubs.

As known to us one sensitive site of high conservation value can be identified in the Mtkvari (Kura) river gorge south-west of Atskuri village between Tkemlana and Tiseli villages. This is the edge of forest on northern slope with considerable concentration of such **GRL, RDB** woody species as highmountain oak, *Quercus macranthera* (the lower point of its distribution) and sea-buckthorn, *Hippophaё rhamnoides.* From other trees and shrub species there are: *Acer campeste, Berberis vulgaris, Cornus mas, Corylus avellana*, *Crataegus sp.*, *Fraxinus excelsior, Ligustrum vulgare, Picea orientalis, Prunus divaricata, Prunus spinosa, Pyrus caucasica (Pyrus communis), Rosa canina, Salix caprea, Viburnum opulus* (rare species).

8. THE MTKVARI (KURA) RIVER CROSSING NEAR TSNISI VILLAGE –TURKEY BORDER SECTION

Within this section the Project corridor passes through hemixerophilic and xerophilic complexes of vegetation, viz. steppes, xerophilic shrubwoods, fragments of arid open woodlands, tragacanthic communities. Agricultural landscapes cover significant (extend) territory of interest.

As it is known to us on the east slope of foothill close to irrigation canal west of Vale there is the sensitive habitat of high conservative value populated by the **GRL, RDB** plant, sea-buckthorn, *Hippophaё rhamnoides* in association with rare species, *Ceratoides papposa* as well as *Berberis vulgaris, Rhamnus spathulifolia, Rhamnus cathartica, Crataegus sp., Cotoneaster sp., Pyrus salicifolia, Rosa canina, Ligustrum vulgare, Glycyrrhiza glabra,* etc.

Besides, two sensitive sites must be mentioned: (1) the Potskhovi river crossing north of Vale town and (2) also the Potskhovi river crossing near Naokhrebi village with floodplain forest fragments dominated by poplar-willow and willow communities (*Populus spp., Salix spp.).* It must be noted that these communities are distinguished by occurrence of **GRL, RDB** species, sea-buckthorn, *Hippophaё rhamnoides.*

9. ZEMO IMERETI PLATEAU

This area consists of two main parts, the Dzirula crystal massif with the Surami ridge and the Chiatura plateau with a maximum elevation of 1,200m on the Surami Ridge. The primary vegetation is broad-leaved forest but in the most part of the region, particularly in the west it is reduced due to the settlements, agriculture activities, and secondary scrub and meadows are developed. The whole region is known to be rich in relict and rare species.

Fagus orientalis forest is mainly spread on the Surami ridge. The forests of the plateau are a mixture of *C. caucasica* with *Cytisus hirsutissimus* with *Hypericum orientale* understories and *Q. iberica* with some *Q. imeretina* (Red List of Georgia, **RDB**) and either, on limestone, azalea *Rhododendron luteum* understory.

On the Chiatura plateau, in the Nigozeti limestone canyons, the rare Imeretian calciphytes and endemics *Delphinium colchicum*, *Potentilla imerethica* and *Symphyandra pendula* are found.

On the left bank of the river Budja there is a forest area consisting of *C. caucasica* with chestnut *Castanea sativa* (Red List of Georgia, **RDB** Georgia) and *R. luteum*. There are also areas of red-soil oakwood with *Q. imeretina* (Red List of Georgia, **RDB** Georgia and the former USSR), *Dorycnium graecum*, *D. herbaceum*, *Ruscus ponticus* and *Pteridium tauricum*.

The main understory plants of dry ecotopes in the area are *Corylus avellana, R. luteum, Crataegus* spp. and *Staphylea* spp. In humid areas these are replaced by *Laurocerasus officinalis, Ilex colchica* and *Frangula alnus.*

The gorges located within Borjomi- Kharagauli zone also lie within the impact zone. In addition to the presence of coniferous and mixed coniferous-decidous forests of high conservation value, this area supports numerous endemic, rare and relict taxa.

10. AJAMETI MANAGED RESERVE

Ajameti Managed Reserve is one of the most sensitive places along the Project corridor. Ajameti reserve is situated in the last east part of the Kolkheti lowland, on the left bank of the river Rioni, in a basin of its tributaries Kvirila and Khanistskali. Reserve territory covers three different (forest) regions: Ajameti (3,531 ha), Vartsikhe (1,105 ha), and Sviri (211 ha). The first two regions are devided by arable lands of Khanistskali and Vartsikhe vinery. The distance between them is 1 - 2 km. The Sviri massif, located at a distance of several meters from Ajameti forest, is separated from it by agricultural lands of the village Sviri.

There are no full-flowing rivers on the territory of reserve. Small rivers dry up during the drought period. Irrigation canal was built in 1946-1948 in the north-west part of Ajameti forest, the drinking water is extracted from wells.

Ajameti reserve was formed for protection and preservation of tertiary period rare relict species of Imeretian oak (*Quercus imeretina)* and water-elm (*Zelkova carpinifolia)*. They are included into the former **USSR** and Georgian Red Book and in Red List of Georgia. Besides, on the reserve territory there are (*Pterocarya pterocarpa)* and caucasian persimmon (*Diospyros lotus)* included into the former **USSR** and Georgian Red Data Books and in the Red List of Georgia, and also Colkhic butcher's-broom (*Ruscus colchicus)* included only into the USSR Red Book. Colkhic (Hartvisi) oak (*Quercus hartwissiana)* and nut-tree (*Juglans regia)* are included into the Red Data Book of Georgia and in the Red List of Georgia.

The following types of vegetation are developed on the territory of Ajameti Managed Reserve:

- forests formed by Imeretian oak;
- mixed oak-hornbeam and hornbeam forests;
- alder thickets occupying minimum territory;
- shrubbery vegetation;
- weed vegetation;
- vegetation of the river Kvirila flood-plain;
- water-elm forest;
- postforest meadows.

Approximately 97% (4,700 ha) of the total reserve territory (4,848 ha) is covered by forests, out of which the area of 4,609 ha is occupied by natural forests. Imeretian oak forests cover about 95% (4,454 ha) of the territory occupied by forests. 140 years old oak forests are developed on the territory of about 1,700 ha, in some places there are 220 - 230 year old trees and even - 250-270 years old oaks.

The territory of reserve is surrounded by Vartsikhe agricultural lands and arable lands of villages Dimi, Fersati, Bagdati, Rodinouli and other arable lands.

Forests are partially thinned due to the closeness of settlements, average density of tree distribution is 0.56. About 1,561 ha of the territory is occupied by forests with density 0.6, in some places (of 268 ha total area) density equals 0.8-0.9.

11. KOLKHETI FOOTHILS AND LOWLAND (ZESTAFONI ENVIRONS)

The south Imereti foothills join with the northern slopes of the Achara-Imereti ridge, and the Guria and Imereti hills. Humidity is lower and the seasonal distribution of precipitation is more mediterranean. The railway corridor passes through the Kolkheti lowland and Rioni basin.

Along the railway corridor there are patches of natural vegetation. There are fragments of secondary *Carpinus* spp. woodland, mixed broad-leaved woodland and *Q. imeretina* (Red List of Georgia, **RDB**) and *Zelkova carpinifolia* (Red List of Georgia, **RDB** Georgia and the former **USSR**) forests. There are large areas of forest preserved on the left bank of the Rioni and in Ajameti Reserve.

12. PROTECTED AREAS

The following protected areas occur on the territory of proposed Project corridor:

Gardabani Managed Reserve

In the immediate proximity to the Planned Project relict floodplain forests of Gardabani Managed Reserve is developed. The zone of significant ecological risk is associated with the relict floodplain forests located in Gardabani region Gardabani Managed Reserve located approximately includes relict mature floodplain forests formed either by: (1) floodplain oak (*Quercus pedunculiflora*) or poplar (*Populus hybrida*), or (2) both species. Associated components of the forests are comprised of approximately 30 species of trees and shrubs inluding many relict species, such as ivy (*Hedera helix, H. pastuchowii*), wild vine (*Vitis sylvestris*), greenbrier (*Smilax excelsa*), common privet (*Ligusrrum vulgare*), etc.

Relict floodplain forests practically survive only in Gardbani Managed Reserve. It is general knowledge that diversity and height of floodplain forests depend on proximity to groundwater.

Borjomi-Kharagauli National Park

The Borjomi-Kharagauli National Park was designated in 1995 under Resolution No. 447 of the Cabinet of Ministers. The main purpose of the designation is the conservation of existing ecosystems; restoration of degraded areas; facilitation and control of sustainable use of renewable resources; awareness / educational activities and ecotourism. According to the Park Management Plan compiled by WWF, the Park is divided into a number of zones: core zone (strict nature protection zone); wilderness zone; traditional use zone; recuperation zone and support zone (covering the five Districts that share a common boundary with the Park). The National Park extends to 50,400 hectares, having been extended in 2000. It covers primary forest and sub-alpine meadows typical of the central region of the Lesser Caucasus. The Park supports a good variety of flora and fauna including several rare and endangered species, relic species and species endemic to the central Caucasus region. The Support Zone covers 150,000 hectares and consisting of various land uses including agriculture, industry, infra-structure and areas of natural and semi-natural habitat. The rationale for the establishment of the Support Zone is to secure the support of park neighbours for the sustainable protection of the park. This is achieved through the economic support and assistance to Park neighbours in recognition of sacrifices made in giving up certain user rights for areas converted to a National Park and by involving Park neighbours in the planning and Park management process. Land and resource use in the Support Zone should be compatible with the conservation objectives for the Park. The development of the Support Zone should be based on a well designed, Regional Development Plan aimed at sustainable economic development for the benefit of Support Zone Communities and biodiversity conservation. The Support Zone does not correspond to an IUCN category and as such is not listed on the IUCN international list of protected areas. In December 1998, the governments of Germany and Georgia signed a bilateral agreement regarding financial co-operation for the project concerning ‘Environment and Protection of Natural Resources Borjomi-Kharagauli National Park’. Further details of the co-operation are provided in the Decree of the President of Georgia (13th July 2001) on ‘*Co-ordinated Planning and Implementation of Ongoing and Prospective Programs of Borjomi-Kharagauli National Park and It’s Support* Zone’. The German government provides funds for three programmes in the Park - implementation of infrastructure; training/education and a Support Zone development programme.

Expansion of Borjomi-Kharagauli National Park

The Borjomo-Kharagauli national Park was expanded towards Samtskhe-Javakheti region, namely Akhaltsikhe and Adigeni districts. It includes slopes of Meskheti and Vani ranges, Abastumani and Zekari Pass. Area is 10,846 ha. Legal Basis is Law of Georgia on Protected Areas, Agreement on Financial Co-operation within the Project “Protection of Environment /Borjomi-Kharagauli National Park” between Georgia and Germany, approved by Resolution of Cabinet of Ministers of Georgia No. 447, dated 28/07/1995, On Activities Facilitating Formation of System of Protected Areas and Establishment of Borjomi-Kharagauli National Park, Transitional Adigeni district authorities, State Department of Land Management and Adigeni Forestry of State department of Forestry. IUCN Category: equivalent to IUCN Category II.

Tetrobi Managed Reserve

Tetrobi Plateau represents refugee for many endemic and relict species. It is part of Tetrobi-Chobareti range and is composed of limestone. Its area is 3,100 ha. Date of Establishment 1995. Purpose Protection and restoration of unique plant species and their biodiversity, protection of unique Tetrobi forest. Activity Protection / conservation, restoration, monitoring, restricted tourism; Management: State Department of Protected Areas, Nature Reserves and Hunting Grounds. Level of Designation: National. IUCN Category: equivalent to IUCN Category IV ‘Habitat / Species Management Area’.

Ajameti Managed Reserve

Ajameti Managed Reserve is one of the most sensitive places along the Project corridor. Ajameti reserve is situated in the last east part of the Kolkheti lowland, on the left bank of the river Rioni, in a basin of its tributaries Kvirila and Khanistskali. Reserve territory covers three different (forest) regions: Ajameti (3,531 ha), Vartsikhe (1,105 ha), and Sviri (211 ha). The first two regions are devided by arable lands of Khanistskali and Vartsikhe vinery. The distance between them is 1 - 2 km. The Sviri massif, located at a distance of several meters from Ajameti forest, is separated from it by agricultural lands of the village Sviri.

There are no full-flowing rivers on the territory of reserve. Small rivers dry up during the drought period. Irrigation canal was built in 1946-1948 in the north-west part of Ajameti forest, the drinking water is extracted from wells.

Other protected areas

Erusheti mountain systems and several wetlands are proposed to receive managed reserve status. Wetland vegetation of the area is mainly used for haymaking. Therefore, 5 managed reserves and one area of restricted use (Ktsia-Tabatskuri managed reserve, Paravani Lake proposed managed reserve, Khanchali Lake proposed managed reserve, Madatapa Lake proposed managed reserve, Kartsakhi (Khozapini) Lake managed reserve, Saghamo Lake proposed area of restricted use) on the Javakheti volcanic upland were proposed to establish, which will play an important role for protecting of wetland vegetation of Georgia.

13. SENSITIVE AREAS

On the base of literature review and field survey the following high and moderate sensitive areas have been identified.

13.1. HIGH SENSITIVE AREAS

1. Gardabani managed Reserve

Relict mature floodplain forests formed by floodplain oak (*Quercus pedunculiflora*) or poplar (*Populus hybrida*).

2. Tetritskaro-Bedeni plateau forest massif

Forest ecosystem of high conservative value, with **GRL, RDB** species high mountain oak, *Quercus macranthera*, elms, *Ulmus glabra*, *Ulmus elliptica*. Herbaceous cover in this forest area is also rich in biodiversity.

3. Bedeni plateau wetland habitat

Sensitive wetland area (~ 5 ha) of high conservative value, rich in biodiversity (~ 150 species) with orchid species, *Dactylorhiza urvilleana* and *Orchis coriophora* occuring in this habitat in large population unique in Georgia.

4. Tsalka reservoir environs

High sensitive area due to its importance as water reservoir. High mountain wetland ecosystem with sedge grasses marshes and peat-bog communities.

5. Tavkvetila mountain environs

This area should be considered to be sensitive and high conservative value. High mountain wetland ecosystem with sedge grasses marshes and peat-bog communities; also subalpine shrubwoods and meadows are developed here.

6. Nariani valley (Narianis veli)

This area is very sensitive and high conservative value. Wetlands with sedge and grasses marshes and subalpine wet meadow. The types of vegetation occupied considerable territory of Ktsia-Nariani massif are typologically very diverse and rich in species biodiversity (~ 150-200 species).

7. Upper reaches of the Ktsia river

Area occupied by subalpine meadow vegetation and fragments of sedge and grasses is very sensitive and high conservative value.

8. Tabatskuri lake environs

Very sensitive and high conservative value habitat with water and bog marsh vegetation. In the inner part of peat-bog pure sedge community dominated by Carex juncella (C. wiluica) is developed.

9. Borjomi-Kharagauli Protected area

Very sensitive area with polydominant meadows, subalpine bushes, tall herbaceous vegetation, park forest and mountain forest ecosystem of high conservative value, with **GRL, RDB** species high mountain oak, *Quercus macranthera* and elm, *Ulmus gla*bra.

This area is also very important for maintenance of Borjomi mineral water balance.

10. Forest stand with **GRL, RDB** species south west of Tiseli village

Sensitive site of high conservative value with considerable concentration of such **GRL, RDB** woody species as high mountain oak, *Quercus macranthera* and sea-buckthorn, *Hippophaë rhamnoides.*

11. Site west of Vale town with **GRL, RDB** and rare species

Sensitive habitat of high conservative value populated by **GRL, RDB** plant, sea-buckthorn, *Hippophaë rhamnoides* in association with rare species *Ceratoides papposa*.

12. The Potskhovi river crossing north of Vale town

Sensitive site with **GRL, RDB** species, sea-buckthorn *Hippophaë rhamnoides*.

13. The Potskhovi river crossing near Naokhrebi village.

Sensitive site with **GRL, RDB** species, sea-buckthorn *Hippophaë rhamnoides*.

14. Tetrobi Managed Reserve

Tetrobi pine(*Pinus kochiana*)forest by composition is considered as outstanding refugee, where pine is mixed with the elements of mountain steppes. Peculiar species of Tetrobi Plateau are *Asphodeline taurica* and parasitic *Diphelypaea coccinea.* Local endemics of Tetrobi Plateau are: *Hypericum thethrobicum, Scorzonera ketzkhowelii* and *S. kozlowskyi.* High conservation value on Tetrobi Plateau has oldest Mediterrenean community with *Asphodeline taurica* and *Stipa pulcherrima.*

15. Damala environs

Tragacanthic vegetation enters pine forest in vicinity of v. Damala. This plant community contains rare species *Astragalus arguricus, A. raddeanus, Onobrychis sosnowskyi, Vicia akhmaganica, Salvia compar, Scutellaria sosnowskyi, Psephellus meskheticus* etc.

16. Rustavi village environs

Semi-desert plant communities are present in R. Mtkvari gorge near v. Rustavi and v. Aspindza. Outstanding species in this community is **GRL, RDB** species *Nitraria schoberi* with other 39 species of the community *Reaumuria kuznetzovii*, *Astragalus cyri*, *A. kozlowskyi*, *Caccinia rauwolfii* var. *meskhetica*, *Ceratocarpus arenarius*, *Ceratoides papposa*, *Gamanthus pilosus*, *Kochia prostrata*, *Camphorosma monspeliaca*, *Limonium meyeri*, *Picnomon acarna*, *Sterigmostemum torulosum*, *S. tomentosum*, *Tragopogon meskheticus*, *Stizolophus coronopifolius*, *Callicephalus nitens*, *Crepis pannonica* etc.

17. Idumala-Oshora area

18. Indusa (from Idumala up to Sakuneti) environs

19. Xanistskali (xani) section – (Alt1 – 22+07–Alt2 – 69+49)

20. Zekari environs, section –Alt2–50+00–Alt2–69+49

21. Zemo Imereti Plateau

The forests of the plateau are a mixture of *C. caucasica* with *Cytisus hirsutissimus* with *Hypericum orientale* understories and *Q. iberica* with some *Q. imeretina* (Red List of Georgia, **RDB**) and either, on limestone, azalea *Rhododendron luteum* understory.

22. Ajameti Managed Reserve

Forests dominated by the tertiary period rare relict species of Imeretian oak (*Quercus imeretina)* and water-elm (*Zelkova carpinifolia).*

13.2. MODERATE SENSITIVE AREAS

1. The Algeti river banks

Floodplain forest fragments and meadows.

4. Tsintskaro-Khando villages environs

Oak and hornbeam forests, with **GRL, RDB** woody species *Celtis caucasica* and *Acer ibericum*.

5. Bedeni plateau

High mountain steppes and meadows.

6. Bareti lake environs

Wetland vegetation and meadows.

7. The Mtkvari river crossing near Tsnisi

Floodplain trees.

8. The Mtkvari river banks

Floodplain forest fragments.

9. The Potskhovi river banks

Floodplain forest fragments and agricultural lands.

10. Sakraula river crossing

Floodplain forest fragments.

11. Kvirila river crossing

Floodplain forest fragments.

14. THE **GRL** AND **RDB** SPECIES OF GEORGIA OCCURRED WITHIN THE PLANNING PROJECT CORRIDOR

It is important to note that **RDB** of Georgia (1982) consisting of 161 species of plants and **GRL** consisting of 56 tree and shrub are not comprehensive. The following comparison confirms such a conclusion. Thus, Rote Liste (1996) of endangered (threatened) species of Germany and **RDB** of Ukraine (see Mosyakin, Fedoronchuk, 1999) include accordingly 943 and 439 species, i.e. 6 and 2.7 time more than those in **RDB** of Georgia (!), while the quantitative correlation of number of vascular plants species in Georgia and Germany is 4100:3250 and in Georgia and Ukraine – 4100:5100. Consequently, based utmost conservative evaluation the realistic number of **RDB** species of Georgia seems to be much more than 400 species against 161 species in the first edition (1982). Certainly, those not listed (including rare species listed below) fall into different **IUCN** categories because the status of them has not been reviewed and identified (classified). Nonetheless, in point of fact they must be considered to be conservative value.

List of **GRL** and **RDB** species of Georgia occurred within the Project corridor

Latin name	**Botanic-geographic region**
Acer ibericum	Kartli, Kvemo Kartli, Trialeti
Althaea officinalis	Gardabani
Amygdalus georgica	Gardabani, Trialeti
Anchonium elichrysifolium	Javakheti
Asphodeline taurica	Javakheti
Astragalus caucasicus	Gardabani, Kartli, Trialeti, Meskheti
Astragalus cyri	Kartli, Meskheti
Astragalus schischkinii	Trialeti
Berberis iberica	Kartli, ? Trialeti
Campanula crispa	Javakheti, Meskheti
Celtis caucasica	Gardabani, Trialeti
Celtis glabrata	Gardabani, Trialeti
Corylus iberica	Trialeti
Corydalis erdelii	Javakheti
Dianthus ketzkhovelii	Meskheti

Gladiolus dzavakheticus	Javakheti
Hippophaë rhamnoides	Gardabani, Trialeti, Meskheti
Hypericum thethrobicum	Javakheti
Halimodendron halodendron	Gardabani
Iridodictyum winogradowii	Kartli
Iris iberica	Trialeti
Juniperus foetidissima	Trialeti
Juglans regia	Gardabani, Kartli, Trialeti, Meskheti
Ostrya carpinifolia	Kartli, Trialeti, Meskheti
Papaver pseudo-orientale	Javakheti
Pistacia mutica	Gardabani, Trialeti
Punica granatum	Gardabani
Quercus pedunculif1ora	Gardabani, Kvemo Kartli
Quercus macranthera	Trialeti, Kartli, Meskheti
Scorzonera dzavakhetica	Javakheti
Scorzonera ketzkhovelii	Javakheti
Scorzonera kozlowskyi	Javakheti
Senecio massagetovii	Javakheti, Kartli, Meskheti
Senecio rhombifolius	Kartli, Meskheti
Staphylea colchica	Kartli
Tragopogon meskheticus	Meskheti
Trapa hyrcana	Gardabani
Tulipa biebersteinaiana	Kartli
Ulmus elliptica	Trialeti, Kvemo Kartli, Kartli
Ulmus glabra	Trialeti, Kartli
Ulmus minor	Trialeti, Kartli
Vitis sylvestris	Kvemo Kartli

15. RARE SPECIES

It is thought that a considerable amount of listed species can be considered to be different **IUCN** categories.Thus it is list of rare species which needs in proper identification in accordance with **IUCN** categories.

Latin name	**Botanic-geographic region**
Acer trautvetteri	Kartli, Trialeti, Kvemo Kartli, Meskheti
Amelanchier rotundifolia	Kartli, Trialeti, Meskheti
Astragalus argillosus	Meskheti
Astragalus leonidae	Meskheti
Astragalus meskheticus	Meskheti
Astragalus trichocalyx (A. petropolitanus)	Meskheti
Atraphaxis caucasica	Kartli
Atropa caucasica	Kartli, Trialeti, Meskheti
Bupleurum sosnowskyi	Kartli, Meskheti
Centaurea adjarica	Meskheti
Cerastium sosnowskyi	Kartli, Javakheti, Meskheti
Cerasus incana	Kartli, Trialeti
Ceratiodes papposa	Kartli, Meskheti

Clematis vitalba	Kartli
Colutea orientalis	Kartli
Corallorhiza trifida	Kartli
Cotoneaster melanocarpus	Kartli, Trialeti
Crataegus caucasica	Kartli, Trialeti, Meskheti
Crataegus orientalis	Kartli, Trialeti, Meskheti
Dactylorhiza euxina	Kartli, Meskheti
Dactylorhiza latifolia	Kartli, Meskheti
Dactylorhiza unvilleana	Kartli, Trialeti, Javakheti, Kvemo Kartli
Digitalis ferruginea	Kartli, Javakheti, Meskheti
Elaeagnus angustifiolia	Kartli, Gardabani, Meskheti
Ephedra distachya	Kartli, Gardabani
Ephedra procera	Kartli, Kvemo Kartli, Meskheti
Ficus carica	Kartli, Trialeti, Kvemo Kartli
Fritillaria latifolia	Kartli, Meskheti
Grossheimia macrocephala	Kartli, Trialeti, Kvemo Kartli, Meskheti
Gymnadenia conopsea	Kartli, Gardabani,Trialeti
Gypsophila muralis	Kvemo Kartli
Heracleum wilhelmsii	Kartli, Meskheti
Jurinea carthaliniana	Kartli, Meskheti
Lonicera iberica	Kartli, Trialeti, Meskheti
Menyanthes trifoliata	Kartli, Trialeti, Javakheti, Meskheti
Neottia nidus-avis	Kartli, Trialeti
Onobrychis meskhetica	Kartli, Trialeti, Meskheti
Orchis coriophora	Kartli, Trialeti, Kvemo Kartli
Paeonia caucasica	Kartli, Trialeti
Paeonia steveniana	Kartli, Meskheti
Psephellus meskheticus	Meskheti
Pulsatilla georgica	Kartli
Pulsatilla violacea	Kartli
Pyrus caucasica	Kartli, Gardabani, Trialeti, Kvemo Kartli, Meskheti
Pyrus salicifolia	Kartli, Kvemo Kartli, Meskheti
Rhamnus imeretina	Kartli, Meskheti
Rosa pulverulenta	Kartli, Trialeti
Rosa spinosissima	Kartli, Trialeti, Javakheti, Meskheti
Scabiosa columbaria	Kartli, Kvemo Kartli, Meskheti
Senecio platyphylloides (Adenostyles platyphylloides)	Kartli
Sobolevskia clavata	Kartli, Meskheti
Sorbus caucasigena	Kartli, Trialeti, Javakheti, Meskheti
Stipa stenophylla	Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheti
Tilia begoniifolia	Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheti
Tragopogon marginatus	Kartli, Meskheti
Typha grossheimii	Trialeti
Valeriana alliariifolia	Kartli, Trialeti, Meskheti
Valeriana officinalis	Kartli, Trialeti, Javakheti, Meskheti

16. ENDEMIC SPECIES

Latin name	**Botanic-geographic region**
⦿ Aconitum nasutum	Kartli, Javakheti, Meskheti
○ Achillea sedelmeyerana	Javakheti
⦿ Agasyllis latifolia	Kartli, Trialeti, Javakheti
○ Alchemilla alexandri	Javakheti
○ Alchemilla georgica	Javakheti
○ Alchemilla insignis	Javakheti
⦿ Alchemilla pycnotricha	Kartli, Javakheti
○ Alchemilla subsplendens	Javakheti
⦿ Allium karsianum	Trialeti, Javakheti
⦿ Alopecurus tiflisiensis	Kartli, Meskheti
○ Amygdalus georgica	Kartli, Trialeti,
⦿ Androsace raddeana	Javakheti
⦿ Anemone caucasica	Kartli, Trialeti
⦿ Anthemis dumetorum	Kartli, Trialeti, Kvemo Kartli, Meskheti
⦿ Anthemis iberica	Trialeti, Javakheti
⦿ Anthyllis lachnophora	Over Georgia
⦿ Aquilegia caucasica	Kartli
⦿ Asparagus caspius	Kartli, Gardabani
⦿ Asphodeline dendroides	Kartli, Gardabani
○ Aster ibericus	Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheti

○ Endemics of Georgia
⦿ Endemics of Caucasus

○ Astragalus argillosus	Meskheti
○ Astragalus aspindzicus	Meskheti
⦿ Astragalus bungeanus	Kartli, Gardabani, Kvemo Kartli
⦿ Astragalus goktschaicus	Javakheti, Meskheti
○ Astragalus kadshorensis	Kartli, Trialeti, Kvemo Kartli, Javakheti
○ Astragalus leonidae	Meskheti
○ Astragalus meskheticus	Meskheti
○ Astragalus raddeanus	Kartli, Trialeti, Meskheti
⦿ Astragalus vavilovii	Javakheti
⦿ Astrantia trifida	Kartli, Trialeti, Kvemo Kartli, Javakheti
⦿ Atropa caucasica	Kartli, Trialeti, Meskheti
⦿ Bupleurum sosnowskyi	Kartli, Meskheti
⦿ Bupleurum wittmannii	Kartli, Gardabani
⦿ Campanula grossheimii	Mainly in East Georgia
○ Campanula raddeana	Kartli
○ Campanula tridentata subsp. biebersteiniana	Trialeti
⦿ Carduus adpressus	Trialeti, Javakheti
⦿ Carduus onopordioides	Kartli, Trialeti, Meskheti
⦿ Centaurea alutacea	Trialeti
⦿ Centaurea glehnii	Kartli, Trialeti, Kvemo Kartli, Javakheti, Meskheti

⦿	Centaurea gulissaschvili	Meskheti
⦿	Centaurea ovina	Kartli, Gardabani, Kvemo Kartli
⦿	Centaurea transcaucasica	Kartli, Gardabani, Trialeti
⦿	Cephalaria gigantea	Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheti
○	Cerastium argenteum	Kartli, Trialeti, Kvemo Kartli
○	Cerastium sosnowskyi	Kartli, Javakheti, Meskheti
⦿	Chaerophyllum confusum	Meskheti
⦿	Chaerophyllum roseum	Kartli, Trialeti, Kvemo Kartli, Javakheti, Meskheti
⦿	Cirsium caucasicum	Kartli, Trialeti, Meskheti
⦿	Cirsium frickii	Trialeti
⦿	Cirsium osseticum	Kartli, Trialeti
⦿	Cirsium simplex	Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheti
○	Cnidium grossheimii	Kartli, Trialeti
⦿	Convallaria transcaucasica	Kartli, Trialeti, Meskheti
⦿	Corylus iberica	Kartli, Trialeti
○	Corylus imeretica	Kartli
⦿	Corydalis alexeenkoana	Kartli, Javakheti, Meskheti
⦿	Crataegus caucasica	Kartli, Trialeti, Meskheti
⦿	Cytisus (Chamaecytisus) caucasicus	Kartli, Trialeti, Meskheti
⦿	Daphne axilliflora	Kartli, Gardabani, Meskheti
⦿	Dianthus caucasicus	Almost in all mountain regions of Georgia
⦿	Dianthus inamoenus	Kartli, Gardabani, Meskheti
⦿	Dianthus subulosus	Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheti
⦿	Erigeron caucasicus	Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheti
⦿	Erysimum aureum	Kartli, Trialeti, Javakheti, Meskheti
○	Erysimum caucasicum	Kartli, Meskheti
⦿	Erysimum collinum	Kartli, Trialeti
⦿	Erysimum ibericum	Kartli, Trialeti
⦿	Eunomia rotundifolia	Javakheti
⦿	Euphorbia armena	Kartli, Meskheti
○	Euphorbia boissierana	Kartli
⦿	Euphorbia glaberrima	Kartli, Trialeti
⦿	Euphorbia macroceras	Kartli, Trialeti, Meskheti
⦿	Euphrasia caucasica	Kartli, Meskheti
⦿	Fritillaria latifolia	Kartli, Meskheti
⦿	Fritillaria lutea	Kvemo Kartli
⦿	Gagea alexeenkoana	Kartli, Javakheti
⦿	Gagea orientalis	Kartli, Trialeti, Kvemo Kartli
⦿	Genista patula	Kartli, Gardabani, Kvemo Kartli
⦿	Genista transcaucasica	Kartli, Kvemo Kartli
⦿	Gladiolus caucasicus	Kartli, Trialeti, Javakheti
⦿	Gypsophila tenuifolia	Almost in all mountain regions of Georgia
○	Helianthemum georgicum	Kartli, Trialeti, Javakheti, Meskheti
⦿	Helichrysum plinthocalyx	Kartli, Gardabani, Meskheti
○	Helichrysum polyphyllum	Kartli, Trialeti

⦿	Heracleum chorodanum	Gardabani, Meskheti
⦿	Heracleum sosnowskyi	Kartli, Trialeti, Kvemo Kartli, Meskheti
⦿	Heracleum transcaucasicum	Kartli, Trialeti, Javakheti
○	Heracleum wilhelmsii	Kartli, Meskheti
○	Hieracium fominianum	Kartli, Gardabani
⦿	Hieracium pannoniciforme	Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheti
⦿	Hieracium ruprechtii	Javakheti, Meskheti
⦿	Iris iberica	Kartli, Kvemo Kartli
⦿	Koeleria fominii	Kartli, Trialeti, Javakheti
⦿	Ligularia caucasica	Kartli, Javakheti, Meskheti
⦿	Lotus caucasicus	Over all Georgia
⦿	Medicago polychroa	Kartli, Trialeti, Kvemo Kartli
⦿	Melampyrum caucasicum	Kartli, Meskheti
⦿	Minuartia akinfiewii	Kartli, Meskheti
⦿	Muscari sosnowskyi	Kartli, Javakheti
○	Nepeta grossheimii	Kartli, Trialeti, Kvemo Kartli, Javakheti
○	Nepeta iberica	Kartli, Meskheti
⦿	Nepeta troitzkyi	Gardabani
⦿	Nonea intermedia	Kartli, Javakheti, Meskheti
⦿	Onobrychis cyri	Kartli, Trialeti,
○	Onobrychis kachetica	Kartli, Gardabani, Kvemo Kartli
⦿	Onobrychis komarovii	Kartli, Gardabani
○	Onobrychis meskhetica	Kartli, Javakheti, Meskheti
⦿	Onobrychis oxytropoides	Kartli, Javakheti
⦿	Onobrychis radiata	Kartli, Trialeti
⦿	Ornithogalum magnum	Kartli
⦿	Ornithogalum schmalhausenii	Kartli, Meskheti
⦿	Orobanche gamosepala	Javakheti, Meskheti
⦿	Orobanche grossheimii	Kartli
⦿	Orobanche pulchella	Kartli, Trialeti, Javakheti, Meskheti
⦿	Orobus ciliadentatus	Kartli, Trialeti, Javakheti
⦿	Paederotella pontica	Meskheti
⦿	Paeonia caucasica	Kartli, Trialeti
○	Paeonia ruprechtiana	Kartli
○	Paeonia steveniana	Kartli, Meskheti
⦿	Pimpinella aromatica	Kartli, Trialeti, Meskheti
○	Podospermum idae	Kartli, Meskheti
⦿	Polygala mariamae	Kartli, Trialeti, Javakheti, Meskheti
○	Polygonum dzhawachischwilii	Kartli, Trialeti, Javakheti
⦿	Polygonum panjutinii	Trialeti
⦿	Potentilla brachypetala	Meskheti
⦿	Potentilla caucasica	Kartli, Javakheti, Meskheti
○	Potentilla sosnowskyi	Meskheti
⦿	Primula cordifolia	Kartli, Javakheti
⦿	Primula ruprechtii	Kartli, Trialeti, Kvemo Kartli, Javakheti, Meskheti
○	Psephellus carthalinicus	Kartli
○	Psephellus meskheticus	Meskheti
⦿	Psephellus somcheticus	Trialeti, Kvemo Kartli

◉	Psephellus transcaucasicus	Trialeti, Meskheti
○	Pulsatilla georgica	Kartli
◉	Pulsatilla violacea	Kartli, Javakheti
◉	Pyrethrum sevanense	Kvemo Kartli
◉	Pyrus caucasica	Kartli, Gardabani, Trialeti, Kvemo Kartli, Meskheti
◉	Pyrus georgica	Kartli, Meskheti
◉	Ranunculus acutilobus	Kartli
◉	Ranunculus elegans	Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheti
◉	Ranunculus dzhavacheticus	Kartli, Trialeti, Javakheti
◉	Ranunculus osseticus	Kartli
◉	Ranunculus transcaucasicus	Kartli, Trialeti, Javakheti, Meskheti
○	Reaumuria kuznetzovii	Kartli, Meskheti
○	Salvia compar	Kartli, Meskheti
◉	Scabiosa georgica	Kartli, Trialeti, Kvemo Kartli
◉	Scilla rosenii	Kartli, Javakheti, Meskheti
○	Scilla winogradowii	Meskheti
○	Scorzonera dzhawakhetica	Javakheti, Meskheti
○	Scorzonera ketzkhovelii	Javakheti
◉	Scorzonera lanata	Kartli, Gardabani, Kvemo Kartli
◉	Scrophularia diffusa	Kartli, Trialeti
○	Sempervivum sosnowskyi	Kartli
◉	Senecio caucasigenus (S. aurantiacus)	Kartli
○	Senecio cladobotrys	Kartli
◉	Senecio kolenatianus	Kartli
◉	Senecio propinquus	Kartli, Trialeti, Meskheti
◉	Senecio rhombifolius	Kartli, Meskheti
◉	Senecio subfloccosus	Kartli, Trialeti, Javakheti, Meskheti
◉	Seseli grandivittatum	Kartli, Gardabani, Kvemo Kartli, Meskheti
◉	Solidago caucasica	Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheti
◉	Sonchus ketzkhovelii	Javakheti
◉	Sorbus caucasigena	Kartli, Trialeti, Javakheti, Meskheti
◉	Sosnowskya amblyolepis	Kartli, Meskheti
◉	Symphytum caucasicum	Kartli, Trialeti, Meskheti
◉	Taraxacum confusum	Kvemo Kartli, Meskheti
◉	Teucrium nuchense	Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheti
◉	Thymus collinus	Over Georgia
◉	Thymus coriifolius	Kartli, Gardabani
○	Thymus sosnowskyi	Kartli, Meskheti
◉	Thymus tiflisiensis	Kartli, Trialeti
◉	Tragopogon kemulariae	Javakheti
○	Tragopogon ketzkhovelii	Javakheti
○	Tragopogon makaschwilii	Javakheti
◉	Tragopogon marginatus	Kartli, Meskheti
○	Tragopogon meskheticus	Meskheti
○	Tragopogon serotinus	Kartli, Trialeti, Javakheti, Meskheti
◉	Tragopogon tuberosus	Kartli, Kvemo Kartli

○	Tripleurospermum elongatum	Kartli, Trialeti
○	Tripleurospermum rupestre	Kartli, Meskheti
⦿	Tripleurospermum transcaucasicum	Kartli, Trialeti, Javakheti
⦿	Valeriana colchica	Kartli, Trialeti
⦿	Valeriana eriophylla	Kartli, Trialeti, Javakheti, Meskheti
⦿	Valeriana tiliifolia	Kartli, Trialeti, Meskheti
⦿	Veronica amoena	Kartli
⦿	Veronica imerethica	Kartli, Trialeti
⦿	Vicia ciliatula	Kartli, Gardabani, Trialeti
⦿	Vicia grossheimii	Kartli, Trialeti, Javakheti
⦿	Vicia iberica	Kartli, Trialeti
⦿	Viola somchetica	Kartli, Trialeti

17. ECONOMICALLY VALUABLE PLANTS

In addition to the crop plants represented on agricultural lands, many wild species also have considerable economic importance providing food, fuel, timber, forage (fodder), pasture, etc., and habitats for animal life. Economically valuable plants also include large amount of species and forms used in folk and officinal medicine.

The following is incomplete list of economically valuable plants occurred in the Project impact areas.

A. Trees and Shrubs

Acer campestre
Acer platanoides
Acer trautvetteri
Alnus barbata
Amelanchier rotundifolia
Berberis vulgaris
Betula litwinowii
Betula pendula
Carpinus caucasica
Carpinus orientalis
Cerasus avium
Cerasus incana
Cerasus mahaleb (Prunus mahaleb)
Chamaecytisus (Cytisus) caucasicus
Cornus mas
Corylus avellana
Cotinus coggygria
Cotoneaster integerrimus
Crataegus curvisepala
Crataegus orientalis
Crataegus pentagyna
Crataegus pontica
Cydonia oblonga
Acer laetum
Philadelphus caucasicus
Picea orientalis
Pinus kochiana (Pinus sosnowskyi)
Populus alba
Populus nigra
Populus tremula
Prunus divaricata
Prunus spinosa
Punica granatum
Pyrus caucasica
Quercus iberica
Quercus macranthera
Quercus pedunculiflora
Rhamnus cathartica
Rhamnus imeretina
Rhododendoron caucasicum
Rhus coriaria
Ribes alpinum
Ribes biebersteinii
Rosa canina
Rosa spp.
Rubus buschii

Elaeagnus angustifolia
Empetrum hermaphroditum
Ephedra distachya
Ephedra procera
Euonymus europaea
Fagus orientalis
Ficus carica
Frangula alnus
Fraxinus excelsior
Grossularia reclinata
Hippophaë rhamnoides
Juniperus depressa
Juniperus oblonga
Ligustrum vulgare
Lonicera caprifolium
Lonicera caucasica
Malus orientalis
Mespilus germanica
Paliurus spina-christi
Rubus caesius
Rubus idaeus
Salix alba
Salix caprea
Salix excelsa
Sambucus nigra
Smilax excelsa
Sorbus aucuparia (Sorbus caucasigena)
Sorbus torminals
Swida australis (Cornus australis)
Tilia caucasica
Ulmus carpinifolia
Ulmus glabra
Vaccinium myrtillus
Vaccinium uliginosum
Vaccinium vitis-idaea
Viburnum lantana
Viburnum opulus

B. Herbaceous plants

Achillea millefolium
Aconitum anthora
Aconitum nasutum
Aconitum orientale
Adonis vernalis
Agrimonia eupatoria
Anthriscus nemorosa
Arctium lappa
Arrhenatherum elatius
Artemisia absinthium
Artemisia fragrans
Aster amelloides
Astrantia maxima
Atropa caucasica
Betonica officinalis
Brachypodium pinnatum
Brachypodium sylvaticum
Briza media
Bromopsis variegata
Bromus inermis
Bromus japonicus
Bromus sterilis
Calamagrostis arundinacea
Capparis herbacea
Cardamine impatiens
Carlina vulgaris
Carum carvi
Centaurea fischeri
Agrostis alba
Agrostis capillaris
Agrostis planifolia
Alisma plantago-aquatica
Allium victorialis
Alopecurus myosuroides
Glycyrrhiza glabra
Grossheimia macrocephala
Gymnadenia conopsea
Heliotropium europaeum
Helleborus caucasicus
Heracleum antasiaticum
Heracleum sosnowskyi
Hippomarathrum microcarpum
Hordeum leporinum
Hordeum violaceum
Hypericum perforatum
Inula helenium
Juncus articulatus
Koeleria spp.
Lavatera thuringiaca
Leonurus quinquelobatus
Libanotis transcaucasica
Lilium szovitsianum
Lolium perenne
Lolium rigidum
Lotus corniculatus
Lythrum salicaria

Chenopodium album
Cichorium intybus
Colchicum speciosum
Coronilla orientalis
Coronilla varia
Dactylis glomerata
Delphinium flexuosum
Digitalis ferruginea
Dryopteris filix-mas
Erigeron alpinus
Equisetum arvense
Falcaria vulgaris
Festuca arundinacea
Festuca pratensis
Festuca supina
Festuca valesiaca
Festuca varia
Filipendula hexapetala
Filipendula ulmaria
Fragaria vesca
Gadellia lactiflora
Galium odoratum (Asperula odorata)
Geranium ibericum
Geranium robertianum
Geum rivale
Geum urbanum
Gladiolus caucasicus
Glyceria spp.
Polygonum amphibium
Polygonum carneum
Polygonum persicaria
Polypodium vulgare
Potamogeton natans
Potentilla erecta
Potentilla foliosa
Prangos ferulacea
Primula macrocalyx
Pyrethrum carneum
Pyrethrum macrophyllum
Pyrethrum roseum
Rubia iberica
Rumex acetosa
Rumex alpinus
Salvia glutinosa
Sambucus ebulus
Sanguisorba officinalis
Saponaria officinalis
Saxifraga coriifolia
Scabiosa caucasica
Scilla rosenii
Malva sylvestris
Medicago caucasica
Medicago hemicycla
Medicago lupulina
Medicago minima
Melilotus officinalis
Melissa officinalis
Mentha arvensis
Mentha longifolia
Onobrychis radiata
Origanum vulgare
Oxalis acetosella
Phleum alpinum
Phleum phleoides
Phleum pratense
Phragmites australis
Physalis alkekengi
Pimpinella saxifraga
Plantago lanceolata
Plantago major
Poa alpina
Poa bulbosa
Poa nemoralis
Poa pratensis
Polemonium caucasicum
Polygala alpicola
Polygonum aviculare
Polygonum alpinum
Senetio phatyphylloides
(Adenostyles phatyphylloides)
Senecio rhombifolius
(Adenostyles rhombifolius)
Solanum nigrum
Solanum preudopersicum
Solidago virgaurea
Stachys sylvatica
Swertia iberica
Taraxacum officinale
Thalictrum buschianum
Tribulus terrestris
Trifolium ambiguum
Trifolium arvense
Trifolium campestre
Trifolium canescens
Trifolium pratense
Trifolium repens
Tussilago farfara
Typha latifolia
Urtica dioica
Valeriana officinalis

Sedum maximum	Veratrum lobelianum
Sempervivum globiferum	Vicia sativa

18.CONSTRUCTION AND OPERATION PHASES NEGATIVE IMPACT ASSESSMENT AND RELEVANT MITIGATION MEASURES

Detailed Botanical assessment should be conducted before beginning project construction activities, which will reveal high conservation value species populations on project areas, as well as assessment of negative impact on flora and vegetation for the project areas should be identified and adequate conservation/reinstatement and compensation measures should be elaborated. Baseline description/ information will serve as basis against which the rate and character of complex ecological reinstatement of project post-construction areas can be monitored.

After the identification of endemic, rare and endangered plant species populations in project impact zone, relevant mitigation measures should be elaborated to undertake necessary steps to ensure protection, conservation and sustainable development of endangered populations, which are directly impacted by the project construction activities.

To ensure species conservation the following selected methodologies are translocation of live plants to conservation centers and plant propagation from seeds collected in the wild. As the translocation of plants is always associated with high risk, seed propagation should be used as well in order to increase chances of success and propagate enough seedlings for consequent reintroduction.

Plants translocated from their wild habitat and grown from seeds will form living collections at the proposed conservation centers. Once the construction of the project is finished, translocated plants and those grown from seeds should be reintroduced, in their wild habitat to restore the wild populations existing prior to project clearance. Replanting of these species on the post construction project areas will happen only after reinstatement and associated re-vegetation of the sites is complete. The project Reinstatement Plan should be elaborated and implemented after the construction activities are completed. The above-mentioned Plan should be considered as the general mitigation measure.

It is of decided significance that in contrast to other impact areas in the cases of Project construction through forested territories it is practically impossible to reinstate and maintain former natural stands in the state before construction. Consequently the recommendation are given to implement Forest eco-compensation programmes (Forest offset) to mitigate residual impacts due to Project construction activities.

Detrimental impacts to the protection of biodiversity, protected areas and forestry have to be reduced to the absolute minimum and unavoidable residual environmental damages have to be offset by an eco-compensation scheme. In particular the impacts on forest ecosystems have to be evaluated and offset by adequate mitigation and eco-compensation measures with the goal to restore the equivalent forest habitat.

In this context the calculation of damages to forest ecosystems by the Project construction activities according to the “none-net loss”, “net gain principle” and “habitat hectare” approach is recommended to define the exact ratio for forest eco-compensation based upon modern methodologies and international best practice.

The habitat hectare scoring method is a common approach to determine the value of vegetation in non-monetary units. The environmental proxy used i.e. the “currency” in which the value of vegetation is expressed is the “habitat hectare”. The habitat score is derived by assessing a number of site-based habitat and landscape components against a pre-determined ‘benchmark’. Benchmarks have to be defined for different ecological vegetation classes (EVCs).

habitat area [ha] x habitat score = habitat-hectares

This method serves to assess a number of site-based habitat and landscape components against a pre-determined ‘benchmark’ relevant to the vegetation type being assessed. Benchmarks have to be defined for different ecological vegetation classes (EVC). The benchmark for each EVC has to describe the average characteristics of mature and apparently long undisturbed biodiversity and native vegetation occurring in the bioregions in which habitats shall be assessed. The notion of mature and apparently long undisturbed benchmark is relative to the EVC; e.g. a forest benchmark can be based on the average for stands of 200 year old trees with no signs of significant anthropogenic disturbance. Each EVC must contain a range of information required for carrying out a habitat hectare scoring exercise. When carrying out a habitat hectare scoring exercise a habitat score indicating the quality of the vegetation relative to the EVC benchmark is assigned to each of the areas assessed. Multiplying the habitat score by the habitat area (in hectares) allows determining the quality of vegetation. Whereby units of “habitat hectares” are used as a common measuring rod to compare the relative value of different ecosystems within one EVC. The habitat hectare exercise foresees an *in-situ* assessment of natural vegetation to collect a range of visually assessed information of several vegetation components across the habitat zone. The vegetation components that have to be included and assessed depend on the eco-region specific ecosystem composition.

In a second step the visually assessed information on the vegetation components is analysed and used to calculate the habitat score for the area.

The components of the habitat score can be weighted. The Australian State Government of Victoria, Department of Sustainability and Environment, which is a worldwide leading institution in applying the habitat hectare approach, uses the following components and weights:

	Component	Max. value (%)
Site condition	Large trees	10
	Tree (canopy) cover	5
	Understorey (non-tree) strata	25
	Lack of weeds	15
	Recruitment	10
	Organic litter	5
	Logs	5
Landscape context	Patch size*	10
	Neighbourhood*	10
	Distance to core area*	5
	Total	**100**

*Components may be derived with assistance from maps and other (e.g. GIS) information sources.

Table 2 components and weightings of the habitat score in Victoria, Australia

ANNEX 1. LIST OF SPECIES OF TREES AND SHRUBS OCCURRED IN THE OAK FORESTS OF TETRITSKARO-BEDENI SECTION OF PROJECT ROUTE

Acer campestre
Acer laetum
Acer platanoides
Acer trautvetteri
Berberis vulgaris
Betula litwinowii
Betula pendula
Carpinus caucasica
Carpinus orientalis
Cornus australis (Swida australis)
Cornus mas
Corylus avellana
Corylus iberica
Cotinus coggygria
Cotoneaster integerrima
Cotoneaster melanocarpa
Cotoneaster suavis
Crataegus caucasica
Crataegus curvisepala
Crataegus orientalis
Crataegus pentagyna
Cytisus caucasicus
(Chamaecytisus caucasicus)
Cerasus avium
Euonymus europaea
Euonymus latifolia
Euonymus verrucosa
Fagus orientalis
Fraxinus excelsior
Ligustrum vulgare
Lonicera caprifolium
Lonicera caucasica
Malus orientalis
Mespilus germanica
Philadelphus caucasicus
Populus tremula
Prunus divaricata
Pyrus caucasica (Pyrus communis)
Quercus iberica
Quercus macranthera
Rhamnus cathartica
Ribes biebersteinii
Rosa canina
Rosa sp.
Rubus caesius
Rubus idaeus
Rubus sp.
Salix caprea
Sambucus nigra
Sorbus aucuparia (Sorbus caucasigena)
Sorbus torminalis
Spiraea hypericifolia
Tilia caucasica
Ulmus carpinifolia
Ulmus glabra (Ulmus elliptica)
Viburnum lantana
Viburnum opulus

ANNEX 2. LIST OF SPECIES OF HERBACEOUS PLANTS OCCURRED IN THE OAK FORESTS OF TETRITSKARO-BEDENI SECTION OF PROJECT ROUTE

Achillea millefolium
Alchemilla caucasica
Alchemilla erythropoda
Artemisia vulgaris
Astrantia maxima
Betonica macrantha
Brachypodium sylvaticum
Briza media
Calamagrostis arundinacea
Campanula latifolia
Campanula rapunculoides
Carex buschiorum
Cephalaria gigantea
Clinopodium vulgare
Coronilla varia
Dactylis glomerata
Dipsacus strigosus
Filipendula hexapetala
Fragaria vesca
Galega orientalis
Galium odoratum (Asperula odorata)
Galium verum
Geranium ibericum
Geranium robertianum
Geum urbanum
Grossheimia macrocephala
Heracleum antasiaticum
Hypericum perforatum
Lapsana communis
Laser trilobum
Lathyrus roseus
Leucanthemum vulgare
Melilotus officinalis
Phleum phleoides
Physocaulis nodosus
Plantago lanceolata
Plantago major
Poa nemoralis
Poa pratensis
Polygonatum glaberrimum
Potentilla recta
Primula macrocalyx
Rumex sp.
Salvia glutinosa
Salvia verticillata
Sisymbrium loeselii
Smyrnium perfoliatum
Solidago virgaurea
Stachys atherocalyx
Stachys sylvatica
Symphytum asperum
Thalictrum buschianum
Trifolium arvense
Trifolium pratense
Urtica dioica
Vicia sepium
Vicia villosa

ANNEX 3. LIST OF SPECIES OF PLANTS OCCURRED IN BEDENI PLATEAU WETLAND

Achillea millefolium
Aconitum nasutum
Aconitum orientale
Agrostis planifolia
Agrostis tenuis (A. capillaris)
Alchemilla erythropoda
Alchemilla sp.
Alisma plantago-aquatica
Alopecurus pratensis
Anthoxanthum odoratum
Astrantia maxima
Barbarea vulgaris
Betonica macranthra
Brachypodium sylvaticum
Briza media
Bromopsis variegata
Calamagrostis arundinacea
Caltha polypetala
Campanula hohenackeri
Campanula latifolia
Campanula sp.
Carex juncella (C. wiluica)
Carex tristis
Carex vesicaria
Carum caucasicum
Centaurea fischeri
Centaurea salicifolia
Cirsium cosmelii
Dactylis glomerata
Dactylorhiza urvilleana (D. triphylla, Orchis triphylla, O. amblyoloba, O. urvilleana …)
Delphinium flexuosum
Delphinium freynii
Deschampsia flexuosa
Dianthus subulosus
Equisetum heleocharis
Festuca pratensis
Festuca ovina
Festuca varia
Filipendula hexapetala
Filipendula ulmaria
Galium cruciatum
Geranium bohemicum
Geranium platypetalum
Geranium sylvaticum
Gladiolus caucasicus
Grossheimia macrocephala
Hesperis matronalis
Hypericum perforatum
Inula grandiflora
Juncus effusus
Lathyrus ciliatidentatus
Leontodon hispidus
Leucanthemum vulgare
Linum catharticum
Linum nervosum
Lotus caucasicus
Luzula multiflora
Medicago dzhavakhetica
Medicago hemicycla
Myosotis alpestris
Nardus stricta
Orchis coriophora
Papaver orientale
Parnassia palustris
Pedicularis sp.
Phleum phleoides
Phleum pratense
Plantago lanceolata
Poa pratensis
Polygala anatolica
Polygala mariamae
Polygonum carneum
Polygonum dzhawachischwilii
Potentilla erecta
Potentilla recta
Poterium polygamum
Prunella vulgaris
Ranunculus caucasicus
Rhinanthus subulatus
Rumex acetosa
Rumex acetosella
Rumex conglomeratus
Salvia verticillata
Sanguisorba officinalis
Scabiosa caucasica
Scutellaria orientalis
Senecio rhombifolius
Sibbaldia parviflora
Sinapis arvensis
Stachys balansae
Stachys spectabilis
Taraxacum officinale

Thymus caucasicus
Trifolium ambiguum
Trifolium alpestre
Trifolium canescens
Trifolium pratense
Verbascum sp.
Veronica imerethica
Vicia grossheimii
Vicia hirsuta
Vicia pannonica
Vicia variabilis

ANNEX 4. LIST OF PLANT SPECIES OCCURRED IN NARIANI VALLEY

A. Flowering plants

Achillea millefolium
Aconitum nasutum
Agrostis alba
Agrostis planifolia
Alchemilla spp.
Batrachium divaricatum
Betonica macrantha
Bromopsis variegata
Calamagrostis neglecta
Calamagrostis pseudophragmites (C. glauca)
Caltha polypetala
Campanula latifolia
Centaurea fischeri
Cephalaria gigantea
Carex caespitosa
Carex canescens
Carex dichroa
Carex dichroandra
Carex elata
Carex inflata
Carex juncella (C. wiluica)
Carex lasiocarpa
Carex vesicaria
Carum carvi
Cirsium simplex
Comarum palustre
Coronilla varia
Dactylis glomerata
Deschampsia caespitosa
Epilobium palustre
Festuca rubra
Filipendula ulmaria
Galium palustre
Geranium palustre
Geum rivale
Juncus atratus
Juncus filiformis
Koeleria caucasica
Lemna minor
Ligularia sibirica
Lotus caucasicus
Nardus stricta
Parnassia palustris
Phleum pratense
Phleum phleoides
Poa palustris
Poa pratensis
Poa trivialis
Polygala alpicola
Polygonum carneum
Potamogeton gramineus (P. heterophyllus)
Potentilla erecta
Pyrethrum carneum
Pyrethrum punctatum
Ranunculus oreophilus
Ranunculus repens
Ranunculus subulatus
Rumex acetosa
Rumex sp.
Sanguisorba officinalis
Scirpus lacustris
Swertia iberica
Symphytum asperum
Thalictrum buschianum
Taraxacum officinale
Taraxacum stevenii
Trifolium ambiguum
Trifolium canescens
Trifolium pratense
Utricularia vulgaris
Valeriana officinalis
Veratrum lobelianum
Verbascum sp.
Vicia spp.

B. Mosses (Musci)

Calliergon richardsonii
Calliergonella cuspidata
Drepanocladus aduncus
Drepanocladus fluitans
Hypnum lindbergii
Mnium rugicum
Sphagnum platyphyllum

C. Horse-tail (Sphenopsida)

Equisetum heleocharis

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Appendix E

Report on Fauna and Habitat
on the
Black Sea Regional Transmission Project Route
GEORGIA

Author: Andrei Kandaurov

April 2009
REPORT
For Black&Veatch.
In accordance with the subcontract #

Report

On the Black Sea Regional Transmission Project Environmental and Social Impact Assessment

(the section of the Environmental Impact Assessment that characterizes fauna and habitat along the entire route of the transmission line).

(The feasibility study from animal biodiversity conservation standpoint)

Compiled by: Andrei Kandaurov (zoologist)
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Preface.

Aim of this review is to describe, from the animal biodiversity conservation point-of-view, the potential impact zone of the "Black Sea Regional Transmission Project" in a part, that consist of construction of a new 500kV transmission line between the existing substations at Gardabani and Zestafoni (via Akhaltsikhe), a new 500/400kV Substation at Akhaltsikhe, and also construction of new 400kV transmission line from Akhaltsikhe to the Turkey border. All this is called further in this report as a South Georgia Transmission Line (SGTL).

This section of the Environmental Impact Assessment contains general characteristic of the Georgian fauna within area of the project implementation and enumerates the animal species, which are protected by Georgian or international legal acts (e.g. Conventions, Agreements etc), and those of them that could be thought as the species, which are affected by the impact factors of the construction works and/or of operation of the South Georgia Transmission Line. Territories where are located important sites for the conservation of the animal biodiversity, in particular, key-sites for endemic and rare species to the Caucasus that are affected by the Transmission Line route are noted in the text and shown on the attached maps. In the review are listed major threats to sensitive species, are noted the expected impacts of construction and operation and measure to mitigate them, as well as residual impacts and required offsets measures.

Some details of the technical design are still in elaboration. Such data as are:
number of access roads and their location, length and width of each road;
number of locations and width of areas for the materials storage (stockpiles, installation of ancillary facilities, etc.);
number of the employed workers crews that will work simultaneously in the different stretches of the transmission line;
time of towers and conductors installation in some sites etc.

Without this technical data we had not a whole comprehensive picture of the project. Thus the possibility to evaluating its impact on animal biodiversity was limited.

Generally, the review is based on the bibliographic data, known collections, author's experience and results of the walkover surveys and excursions, taken in 2001-2006 by the Zoological team of the Georgian International Oil Corporation along the Baku-Tbilisi-Ceyhan (BTC) pipeline. The greatest part of the South Georgia Transmission Line coincides with the BTC 10 km wide study corridor. Number of scientific zoological issues dedicated to Georgian fauna with detailed information on species distribution within limits of the area under consideration is not numerous. Moreover, most part of available issues are at least about 20 year old. Recently, changes in fauna happen quickly and some information in the lists of species, presented within this report, can be not valid.

The review is divided into several main sections depending on the subject of consideration.
The first section describes approaches and a method used in this review, includes brief review of legislation basis on an animal protection, and describes the project and its impact on animals.
Section 2 – includes Brief overview of zoogeographical aspects of study area in Georgia, **p**hysical-geographic regions crossed by the transmission line route, and **e**cosystems, species complexes and species in need of conservation.

Section 3 – contains general characteristics of animal species` composition, according to taxonomic groups and species included in Red Data List of Georgia and protected by various conventions.
Section 4 – describes Protected Areas**,** affected by transmission line, bird migration routes across project area and alternative routes of the transmission line

Section 5 - outlines "hot points", which require special attention during the construction and operation of the transmission line.

The last section (6) contains References and Attachments.

The structure of the review forced us to repeat some portions of information in different sections, however we hope that such structure of the review should simplify looking for necessary information, though we tried to reduce to minimum such repetitions.

Section 1. Introduction

Brief description of the project

According to document named ”Feasibility Study for the Georgia High Voltage Transmission Lines Project”, a final report prepared by the Kuljian Corporation in association with PB Power and Geoengineering ltd. in December 2007, the main features of the South Georgia Transmission Line are as follows:

The South Georgia Transmission Line will consist of a new 500kV single circuit transmission line between the existing substations at Gardabani and Zestafoni (via Akhaltsikhe) with a new 500/400kV Substation at Akhaltsikhe and a new 400kV transmission line from Akhaltsikhe to the Turkey border.

The construction of this 500kV transmission line was originally designed by Institute “EnergosetProekt” of the Soviet Union. The project design development started in 1987 and was completed by the end of 1988. Construction started in 1989 and continued till 1991. The works completed during the construction (by 1991) included fully completed sections of the line with total length of 42 KM; installed poles – 80 KM, pole foundations – 60 KM. In 1992 the project has been abandoned due to political events and lack of adequate funding.

The line crosses nine administrative districts of Georgia - Gardabani, Marneuli, Tetritskaro, Tsalka, Akhalkalaki, Aspindza, Akhaltsikhe, Bagdati and Zestafoni.

The proposed route of the 500kV transmission line from Gardabani to Zestafoni is located primarily in the barren land. The most part of the line is situated on altitude below 1000 m. of MSL (Mean Sea Level).

The proposed site of the new Akhaltsikhe substation is located in an open area with direct access from a main road, with relatively flat topography, and is essentially barren, with little or no vegetation.

The extension of the existing substation at Gardabani, the 500kV as well as 400kV substation at Akhaltsikhe will be open, conventional, air insulated type. The 500/400 kV Converter Station will be partly indoor and partly outdoor type.

Technical Information

- The length of this line from Gardabani to Zestafoni substation is approximately 247KM, which consists of 877 transmission towers. Total length of 500kV line is 277 KM, including a double line up to the proposed new 500/400kV substation at Akhaltsikhe.
- The nominal span of 500kV towers has been considered as 450 M.
- The proposed 400kV single circuit transmission line from Akhaltsikhe - Turkish Border will be 50 KM of length.
- The nominal span of 400kV towers has been recommended as 410 M.
- Number of chains – two
- Cables – aluminum
- Tower – vertical, latticed, single circuit, two chain, clearance over earth surface about eight meters, distance “phase to phase” about four meters. According to the Kuljian Report - old Soviet design of towers - ПБ1 – ПБ5, У1, У2, Р1 and Р2 (See documents K-3988-DWG-S-001 and K-3988-DWG-S-002)
- Intermediate pylons - reinforced concrete and steel
- Corner pylons – steel

The insulator will be of polymer (silicone rubber) long rod, aerodynamic shape of strength more than the strength of the conductor. Generally, single insulator string will be provided for the project. The double insulator string will be used at the both sides of the crossing of high ways, public places, and power lines.
"Bird guard will be installed in the cross arms above the suspension insulator string to prevent birds from sitting on the cross arms above the insulators" (Point 8.04.12 of the Kuljian report). Other mitigation measures to prevent bird killing are not designed.

The impact factors of the project are construction impacts, which will be eliminated certain time after finish of construction and residual impacts that will act for a long time after end of construction works. The main impacts are as follows.
Construction impacts:

- Disturbance on the nest-sites – some birds will abandon their nests, even with nestlings
- Destroying of shelters and nests during the preconstruction clearings (cutting trees)
- Poaching – illegal hunting by members of the construction crews or by locals

Residual impacts:

- Habitat fragmentation – because of cutting all tall trees within the corridor of 50-100 m wide along the RoW
- Facilitated poachers access because of not destroyed access roads in the areas of wilderness
- Birds killing on transmission line and poles, because of electrocutions and accidents (See below).

General approach to the ecological examination

In preparing this review we are using as a basic principle - necessity of protecting biodiversity of the flora and fauna of Georgia, as our national heritage and source of income and free services for a significant part of the local population (pharmacy, tourism, recreation etc).
For the evaluation of the consequences of the realization of the project and estimation of the impacts on all the environmental receptors all the sensitive receptors, which might be affected, should be identified. In the case under review – ecosystems and habitats, populations of animals that could be, directly or indirectly, affected by the construction and rehabilitation works, monitoring and operation of the aboveground line of the high voltage transmission. Therefore, during the environmental assessment of possible impacts of the project on all the identified populations of the protected species and all key biotopes and ecosystems, which might be affected by the project, should be analysed.

The review is prepared using the World Bank's Environmental Source book, Operational Directives 4.01 (Environmental Assessment), Operational Polices on Forestry (OP 4.36) and Natural Habitats (OP 4.04); EU EIA Directive 85/337/EEC as amended by 97/11/EC, EU – Guidance on Scoping, 1996.
In the "World Bank Good Practices 4.04, Natural Habitats" in the section "Environmental Services and Products" one can see following:
"7. Many natural habitats provide important environmental services such as improving water availability for irrigated agriculture, industry, or human consumption; reducing sedimentation of reservoirs, harbors, and irrigation works; minimizing floods, landslides, coastal erosion, and droughts; improving water quality; filtering excess nutrients; and providing essential natural habitat for economically important aquatic species. Although such environmental services are important to humans and thus economically valuable, they are often undervalued and overlooked. Maintaining such environmental services is almost always much less expensive than replacing them with remedial measures after natural habitat conversion. Natural habitats' environmental services should be systematically evaluated; to the extent feasible, any economic value of such services should be quantified as part of the cost-benefit analysis of projects.
8. Natural habitats can also provide important environmental products, including fish and other wildlife, wild foods, forest products, or grazing lands."

From this standpoint all the endangered species, which are protected by the Georgian law or international Convention should be considered as of the same importance without regard to taxonomy, size or other features.
Species selection.

The general principle for species selection is that each species, considered in the report, must have a forcible argument to include it in the list for consideration. We have to consider as the species that are already protected by law (e.g. listed in the national Red Data List, 2006), as well as species of any special interest of local community (e.g. a game species, or the species - attractive for tourists, etc.). Re-construction, operation and maintenance of the transmission line (repair works) should not lead to the harm to animals that occur in Georgia, especially, to the endangered species. Some of species included in the Georgian Red Data Book are not threatened behind of Georgian border, in other parts of distribution ranges of them. But, if any species will extinct on Georgian territory our fauna will become poor and our ecosystem will be less stable. The extinction of even one species is inadmissible. Other species have numerous populations and stable distribution ranges on the Georgian territory, but are rare or are threatened abroad. In this case, the population on our territory is a reserve or a refuge of such the species, and, without it, this species will become endangered or even extinct in another part of own the world-wide range and, in future in Georgia. Therefore, we have to prevent any harm for these species on Georgian territory pursuant to our international obligations and national interests.

Pursuant to the Georgian legislation, 135 species and 4 sub-species of animals are protected (Red data list of Georgia, 2006). Taking into consideration the species, which are protected by the International Agreements, the whole number of protected species can reach up to 200. Not less than three fourth of total quantity of these species can be found along the proposed route of the transmission line in Georgia.

Besides that, the transmission line will cross Gardabani Managed Reserve, Ktsia-Tabatskuri Managed Reserve, Borjomi-Kharagauli National Park and will run in the close environs of Tetrobi Managed Reserve. All species and animal complexes on these territories are protected by law and should be protected against impact of construction and operation of the power line.

However, all species, which will be included in the list for consideration in this review, should be presumed as the species impacted by the Project. That means that a part of population, significant for surviving of a species as a whole on the territory of Georgia, could be adversely affected by the impact factors of the construction and/or operation of the transmission line.

Key-site selection.

Site selection has two aspects. From one hand, should be selected site important for animals as a key-site. That maybe breeding or nesting place, feeding (foraging) site, stopover site during migration, wintering or hibernation place, etc. From another hand, we should select sites along the transmission line route where an impact of the construction, operation, failures and repair works will result in harm to fauna.

It is in need to identify all the influence factors of the South Georgia Transmission Line (SGTL) to do the evaluation an impact on the fauna. These factors are:

- Direct and indirect losses of habitats due to unexpected or long-term consequences of SGTL construction (e.g. erosion increasing, habitat fragmentation resulting from the cutting trees etc.)

- Facilitated access for the local people to the places with untouched wild nature, because of temporary or permanent construction roads and vistas (openings that remain after cutting down trees along the route in forested places), etc.

- Pollution: the soil and the water - by the oil or fuel (diesel) and waste products during construction and rehabilitation; changing of pH in the water bodies during operation, etc.

- Noise pollution – both, disturbance during construction, and residual background noise, during operation

An animals disturbance on the key-sites e.g. on breeding (nesting) places during breeding season, on foraging sites and on wintering areas, on migration routes and stopover sites during migration. That will cause number decreasing of a population.

Bird fatalities on power lines (bird electrocution)

All this should be minimised as much as possible. For that the route of the South Georgia Transmission Line should correspond to following criteria:

If it is possible, the route should not pass across the territory of a Nature Reserve or a National Park, as well as across land of Managed Reserve and other Protected Areas.
The route should not touch the key-sites, habitats of the species protected by law and species, which are represented in Georgia as a single small population.
The route should not create an opportunities for facilitating access to the areas with the untouched wild nature for anybody.
Route should not touch centres of especially dangerous, transmissible infections (e.g. of plague).
Construction and operation of the South Georgia Transmission Line should not result in irreversible and/or long-term changes of habitats.

For the simplification one can say that during the consideration of the rerouting (route alternatives) the priority should be given to the route, which:

- Does not cross the protected territories;
- Crosses less number of the sensitive areas;
- Crosses less number of the watercourses, waterbodies and other bird aggregation areas;
- Passes along the cultivated lands and not through the natural vegetation;
- Crosses less number of the places, which are in need of an additional study;

All "sensitive" sites should be described in the report. All sites, that are requiring extra cares during constructions and/or operations of the transmission line, and all sites, where can arise problems with preservation the biodiversity and mitigation measures are required - must be noted before the construction work will begin.

The sites and species groups or, even, individual species, that are requiring the additional study for evaluating the consequence of the transmission line route impact on the fauna – also, should be mentioned.

The distribution, along the transmission line route, of the ecosystems and of the animal complexes, which are requiring mitigation measures should be shown in tables or maps.

Legal framework

Existing nature conservation legislation in Georgia corresponds to internationally accepted principles and criteria in the sphere of nature conservation and biodiversity protection and consequently provides a good framework for EIA. The Georgian legislation and international obligations of Georgian Republic, resulting from the signed International Conventions in the field of the Nature Protection, form a legal side of a framework of our examination.

The main laws on nature conservation relevant to this report are:

- the Environmental Protection Law of Georgia (the Frame Law on Nature conservation)
- the Law of Georgia on the System of Protected Areas
- the Wildlife Law of Georgia
- the Law on Red Data List of Georgia
- Decree #303 of May 2, 2006 of the President of Georgia, “On Approval of the Red List of Georgia” (Endangered Species List)

Pursuant to the Georgian legislation, 135 species and 4 sub-species of animals are protected (Red data list of Georgia, 2006). Taking into consideration the species, which are protected by the International Agreements, the whole number of protected species can reach up to 200. Most of these species are listed in the Red Data List of Georgia, Red Data List of IUCN, and in Attachments to different Conventions.

International Conventions

The following list gives an overview on Multilateral International Conventions related to nature conservation and biodiversity enforced in Georgia, which are relevant to this review:

- Convention on Biological Diversity (CBD), 1992, - accepted at 02/06/1994
- Convention on the Conservation of Migratory Species of Wild Animals (CMS), Bonn, 1979, date of entry into force 01/06/2000
- Agreement on the Conservation of Bats in Europe (EUROBATS) – ratified at 21/12/2001; This Agreement protects 28 species of bats occurring in Georgia
- Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)-ratified in April 2001, This Agreement increased a number of the bird species that are protected by the law (up to 98 species listed in the Agreement occur in Georgia, most of them are not mentioned in Georgian Red Data List.
- In an agenda stays the Convention on the Conservation of Natural Habitats and of Wild Fauna and Flora - the Bern Convention.

Section 2. Zoogeographical Aspects of Study Area in Georgia (Brief overview)

Physical-geographic regions crossed by the transmission line route

Geographically, the Caucasus isthmus is recognised as a land from the southern borders of Armenia, Azerbaijan, and Georgia in the south to the Kuma-Manych depression in the north. It borders upon the Black and Azov Seas in the west and the Caspian Sea in the east. Close neighbourhood of areas with different natural conditions is typical for the Caucasus. Distances between high mountains and coastal lowland or between humid or arid subtropics and coniferous forests are rarely more than dozens of kilometres, and are frequently less than ten kilometres. The isthmus has historically served as the area of transit for many species in the process of exploring new areas and as a migration corridor for many animals.

The territory of Georgia, lying in the western-central part of Caucasus, is the most uneven from the climatic and landscape point of view, among Caucasian countries. Georgia covers both Caucasian mountain systems (southern slopes of Great Caucasus as well as northern part of Lesser Caucasus). At the same time, all types of Caucasian landscapes are represented here. Humid sub-tropic landscapes with predominance of autochthonous Caucasian (or Colchic) fauna and flora are in the western part of the country. The alpine landscapes with plenty of East-European elements are spread in the northern and north-eastern part. The typical Middle East treeless uplands are presented in the southern Georgia and, at last, semi-deserts of Turanian type in the south-east.

From the physical-geographic point of view, the transmission line starts in the Transcaucasian depression. This area is located between mountain ridges of the Great

Caucasus and the Lesser Caucasus that are bordering from the North the large region of Middle East Uplands (Museibov et al., 1986; Devdariani, 1986).

Western part of the Transcaucasian depression covers the Colchic province (Kolkheti), including two sub-provinces - of Colchic (Kolkheti) lowland and Colchic (Kolkheti) foothills. All rivers and streams here belong to the basin of the river Rioni and, thus, to the basin of the Black Sea. The transmission line enters the sub-provinces of Colchic foothills at the endpoint near Argveti village in the Zestafoni district.

Central part of the Transcaucasian depression, situated in the eastern and central parts of Georgia, belong to the Kura physical-geographic province, Kura-Alazani sub-province (another sub-province of this province, Kura-Arax lowland, is located in Azerbaijan - route does not enter sub-province of Kura-Arax lowland). Within Kura-Alazani sub-province, the transmission line route runs across: Kvemo-Kartli (Lower Kartli) lowland from Gardabani up to Tetri-Tskaro. All rivers and streams, located on the territory of this region, belong to the basin of the river Mtkvari (Kura) and, thus, to the basin of the Caspian Sea.

The Middle East physical-geographic province situated to the south from the Transcaucasian depression and consists of the Lesser Caucasus and Javakheti Plateau (Upland). The transmission line route runs across the northern border of the Lesser Caucasus - Trialeti ridge and is going across the Javakhetian Upland to the Turkish border.

One can divide Lesser Caucasus in three sections. Western part - Meskheti ridge and western slopes of Trialeti ridge are quite humid and high, covered with broad-leaved forest. Hard rocks form mountain relief. Eastern part – Trialeti ridge is more arid and low, than western part, covered with deciduous forest. The south part consists of the Javakheti Plateau (Upland), Javakheti, Samsari and Erusheti ridges. Relief is levelled (smoothed), rocks volcanic and deluvium. This part mainly is covered with tree-less, open grassy landscape. Only on the Erusheti ridge one can see forest. All rivers and streams, located on this territory, except rivers on northern slopes of Meskheti ridge, belong to the basin of the river Mtkvari and, thus, to the basin of the Caspian Sea. Rivers on northern slopes of Meskheti ridge belong to the basin of the river Rioni and Black Sea.

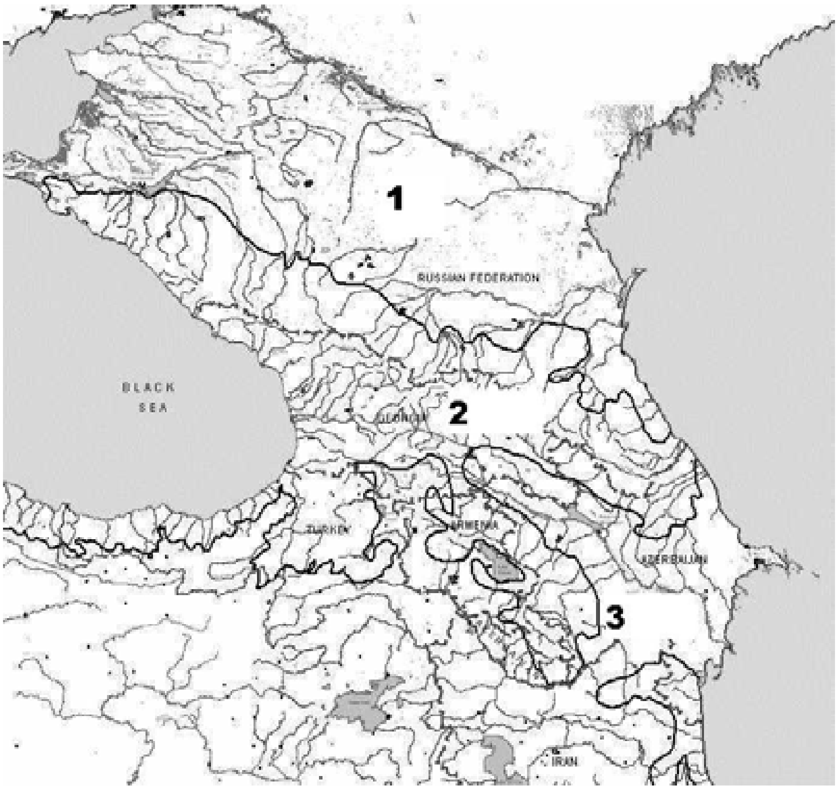
Zoogeographic Characteristics of the Caucasus

From the viewpoint of zoogeography, the entire Caucasus is located in the Holarctic or Palearctic kingdom or zone, depending on the terminology used by experts in zoogeographic zoning. We use the zoning of the World Geographic Atlas of 1964 published in Moscow[1]. According to Vereshchagins map (1964), the Caucasus includes several zoogeographic sub-zones. In the north of the region there are two districts of the Kazakhstan-Mongolian province of the Central Asian sub-zone. The middle of the Caucasus is mountains of the Greater and Lesser Caucasus and Talysh that belong to the Caucasus district of the Circumboreal sub-zone isolated from the main part of the sub-zone by steppes. The Circumboreal sub-zone is sometimes referred to as the sub-zone of Western Eurasia, which in principle does not change its characteristics and boundaries in the Caucasus (World of Geography 1984). Southern boundaries of the Caucasus Ecoregion lie within the Anterior Asia district of the Mediterranean province and Kura district (almost entire Azerbaijan) of the Iran-Turan province. Both these provinces belong to the Mediterranean sub-zone. Thus, three zoogeographic sub-zones and four zoogeographic provinces neighbour in the Caucasus.

[1] We refer to the zoning presented in the World Physical-Geographic Atlas (1964) first of all because one of the map authors was N.K. Vereshchagin, author of *The Mammals of the Caucasus; A History of the Evolution of the Fauna* (1959), a fundamental monography also including a detailed map of the Caucasus zoogeographic zoning based on theriology data. It is no secret that boundaries of zoogeographic areas depend not only on preferences of theory authors but also on spatial distribution of features taken as a basis for boundary identification. This it seems reasonable to base on the map generated by scientists who long worked in the Caucasus and produced on the basis of mammal distribution data.

Map 1 clearly shows that in some locations boundaries of the zoogeographic sub-zones come very close to each other.

Map 1. Boundaries of Zoogeographic Sub-zones
1. Central-Asian 2. Circumboreal 3. Mediterranean; Solid line is the zoogeographic sub-zone boundary; Dash line is the state border



The Caucasus is a home to species typical for all the three sub-zones resulting in the rich diversity of flora and fauna (Map from Regional Bat Conservation Plan for Caucasus, 2008, prepared by author of the report).

Zoogeographic districts represented in Georgia and crossed by the transmission line

Georgian territory spreads on the almost all biogeographic regions represented throughout Caucasus isthmus. It is rather difficult to outline correct border between faunistic regions represented throughout Georgia because of the mutual penetration of species between them. Complicated, sometimes mosaic spatial structure of biological communities representing different biogeographic regions is specifics of Caucasus, from the biodiversity point of view.

One can outline, throughout territory of Georgia two areas with important landscape differences. The first - Caucasus district, including Colchic and Caucasus regions, unify forest landscapes with plenty of autochthonous animals and representatives of European fauna. The second - the Mediterranean sub-zone is composed with two other types of biological communities. There are Anterior Asia district with highlands of Lesser Caucasus (landscapes very similar to those in Turkey and the most part of Middle East) and arid, semi-dessert landscapes in Kura district with many elements of Turanian fauna (this region, also is genetically connected with biological communities typical for countries of Central Asia). Significant part of Georgian territory (northern slopes of Trialeti ridge and part of southern slopes of Great Caucasus in East Georgia) are covered with forest areas with communities including elements of Colchic, East-European, Middle East and Turanian fauna.

In difference from other Caucasian countries, significant part of Georgia is occupied with communities of mixed origin, which could not be unified with any enumerated districts. Relief causes relatively clear borders between some biogeographic districts, but these borders remain conditional. E.g., all Colchic district is situated in the basin of the Black Sea, whereas most other districts (except western part of Caucasian) - in the basin of the river Kura, entering Caspian Sea. However, Colchic elements are found along southern slopes of Great Caucasus up to the eastern border of Georgia and in Borjomi Gorge, which belongs to the basin of Kura; Turanian elements are found in the valley of Alazani, which belongs, in general, to the Caucasian district etc.

The transmission line crosses following different regions

The Kura district is mainly semi-arid and arid plain and foothills in the middle currents of the river Mtkvari and some its tributaries. It covers relatively small part of the Georgia in the southeast of the country (Iori Tableland and Lower Kartli). Main landscapes are steppes, semi-deserts, arid thorn shrub, "savannoid" or savannah-like forest and, along river floodplains - tugai forest (within the project area - on the Mtkvari and Algheti). Climate continental but warm, January temperature rarely less than -5C, low level of annual precipitation (usually less than 400mm). This district is presented within the work area from Kp G-0 (Gardabani) till Kp G-55 at the village Daghet.

The Caucasus region covers mountains, usually at an altitude higher than 2000 m. The main landscapes of the Caucasian zone are mountain woods, sub-alpine forest and sub-alpine meadows. Climate in the most part of the zone is mountainous, severe, with high precipitation (≥1,000 mm per year). The lower borders of this zone are well delimited by the edge of temperate forest. In the western part of the corridor of the transmission line forest communities include Colchic elements. This region covers upper parts of the Meskhti mountain ridge and eastern spurs of Trialeti ridge crossed by power line. This region is presented within the work area from Kp G-55 (Daghet) approximately till Kp G-68 on Bedeni Plateau, and from Kp G-187 (Agara) till Kp Z-20~22, on Meskheti ridge in Borjomi-Kharagauli National Park and in surrounding of it. All alternative routes of the transmission line in the National Park are situated within this region of Caucasus district.

The most part of the Colchic region of Caucasus district is lying in the Western Georgia. Its conditional borders are: from the west - Black Sea; from the south-east - Meskheti mountain ridge; from the east – Surami ridge and southern offspurs of Great Caucasus; and from the north-east - the western part of Great Caucasus mountain ridge. Typical "Colchic" landscapes unify foothill and lowland subtropical forests with plenty of evergreen plants. Colchic communities are attached to the region with mild climate (usually positive January temperature) and high level of annual precipitation (1,000mm and more). Some elements of Colchic flora and fauna are find in Eastern Georgia (in mountain on Trialeti ridge near Borjomi at the right bank of Mtkvari river, and on south slopes of Great Caucasus, in east of Georgia, in Lagodekhi Nature Reserve). This region is presented within the work area from Kp Z-22 on Meskheti ridge in Borjomi-Kharagauli National Park till Kp Z-61 (Argveti), but borders between these two regions of Caucasus zoogeographic district are rather conditional. General character of fauna allows us to consider both as a single whole - Caucasus district.

District of the Highlands of Lesser Caucasus is lying in the south part of Georgia. Northern borders of this district are Trialeti and, partly, Meskheti mountain ridges. Western border is Arsiani ridge. South-eastern foothills of Trialeti ridge form conditional eastern border. This district is covered mainly with treeless landscapes - sub-alpine meadows or mountain steppes. There are though also forest plots and forest strips. Climate severe, continental, with intermediate level of precipitation (usually 400-800mm/year). This district is presented within the work area from Kp G-68 on Bedeni Plateau till Kp Kp G-187 (Agara).

Ecosystems, species complexes and species in need of conservation.

Ecosystems (landscapes) crossed by the transmission line (significant from the animal biodiversity conservation standpoint).

Ranges of separate animal species and areas of distribution of species complexes often coincide with borders of biotopes or landscapes. Landscapes are mosaic scattered within each of physical-geographic or zoogeographical regions. Best systems of division of landscapes of the Caucasus, and in particular of the Georgia, are given By Ketskhoveli (1957, 1973), Gulisashvili Et Al. (1975), Beruchashvili Et Al. (1988), Sokolov and Tembotov (1989). However we can accept here the simplified scheme, more appropriate from zoological point of view.

The main types of ecosystems along the transmission line route are the following:

<u>Industrial and urban areas</u>. No commentary, there are not sensitive animal species.
<u>Rural landscapes</u> cover large part of the territory crossed by the transmission line route. Largest tracts of arable lands are located: in Lower Kartli and on Tsalka Plateau in South Georgia. In Lower Kartli they are located from the village Ilmazlo to the village Dageti at the town Tetri-Tskaro, mainly cornfields. In South Georgia, the route crosses on Tsalka Plateau as well arable lands (cornfields and potato's fields) from the settlement Imera to the kilometre point (further Kp) G-100 at the Santa Village, from the village Bezhano (in Akhakalaki district) to village Gokio and from village of Agara (in Akhaltsikhei district) to the border with Turkey. There are some orchards and kitchen-gardens on this section too. The pasture lands are located between Kp G-15 and Kp G-25 at the Yagluja mountain settlement (Marneuli district), from Kp-70 till Kp-G-90 at Imera, from Kp G-100 at Santa Village till the village Bezhano, and from the village Gokio up to village Agara. It should be noted that the towers of the transmission line are often located not directly in the cultivated lands, but in the ecotone ecosystems located between agrocoenosis and natural landscape. In such ecosystems are quite high diversity and density of animal species. It's noticeable that in several cases, the transmission line route crosses home range of some rare and threatened species, dwelling within Georgian territory mostly on cultivated lands (E.g. Brandt's hamster - *Mesocricetus brandti* and Common Tortoise - *Testudo graeca)*.

Brandt's hamster lives in colonial mode of life. It is everywhere rare and very sensitive for human impact species. Large part of local sub-population can be destroyed in case when during construction a new tower will be placed on such colony.

Cultivated lands are feeding place for many animals, especially for birds - nesting in a forest strips and the passengers on flyway. Here are established not diverse and numerous, but constant animals complexes.

Of certain importance are wild animals complexes established on pastures and meadows, which are being mown. Mainly these are connected with species complexes in the surrounding natural landscapes, but have a reduced numbers of populations. Many protected species occur there. Complex on Javakheti upland everywhere are sensitive, because of strong human impact

Pastures and arable lands are important feeding place of bird-of-prey. Especially importance of these for soaring raptor birds is increasing during the spring and autumn passages (migration) as stop-over sites and place with plenty thermals, up-rising air currents, generated by sun-heated land surface. Birds use all possible structures for perching (as roosts), thus the poles of the transmission line will be constantly used by birds.

<u>Wetlands</u> (swamps, mires, bogs) - are crossed by the transmission line in a few places. Those are swamps in the forest on the in Gardabani district, swamped lake in Tsalka district, and peat bogs near Tabatskuri Lake in Borjomi district:
Periodically swamped flood-plain forest on the Mtkvari riverbank, the tugai forest, is crossed at the starting point of the SGTL, near the Gardabani station on both sides of the river. Small fragments of floodplains of the river Kovu is crossed at Kp G-10 and of the river Algheti crossed at Kp G-30.

The eutrophic lake at the Kariaki village, to the north from the Tsalka reservoir, mainly is used by locals as hay-mowing meadow, each spring and in some years year-round, is water filled.
Small bogs that are scattered along the main route of line from Kp G-115 to Kp G-140, and at the Kp Alt-06 or 07 at the Tabatskuri village. This territory is a part of the Ktsia-Tabatskuri Managed Reserve and is included in the support zone of the Borjomi-Kharagauli National Park.
All wetlands contain number of rare and endemic vertebrate and invertebrate species and are inhabit with very vulnerable community of animals. They are important for many species as shelter, feeding place, stopover sites during migration and wintering.

Ecosystems of mountain and foothill deciduous and mixed (coniferous with deciduous) forests. These ecosystems cover large portion of the Trialeti ridge crossed by the transmission line two times – in eastern most part, in Tetritskaro district and in western part, going thought the Borjomi-Kharagauli National Park and farter to the village Argveta in the Zestafoni district Gorge. Mountain forest is richest ecosystem with high diversity, large number of endemic, game and endangered species. At the same time, animal communities of these ecosystems are very sensitive for human impact. These can be damaged during construction work by the poachers (along temporary construction roads) and because of habitat fragmentation in the transmission line corridor (e.g. felling of trees).

Foothills and hills covered with xerophytic bush vegetation. Ecosystems of this type are quite diverse in regard of bush vegetation and species composition of plants and animals, and cover a significant part of territory crossed by the the transmission line route in the Gardabani district, on the slopes of Yagluja mountain and between Marneuli and Tetritskaro. They are important for many species as shelter and feeding place in the surrounded steppes but less sensitive to the impact of the transmission line construction. Animals' community of these ecosystems can be affected only if large areas of shrub will be destroyed (e.g. accidental fire).

Freshwater ecosystems: ecosystems of current waters and freshwater lake ecosystems. Attention must be paid to association of invertebrate species and amphibian, especially in the Eastern Georgia in semiarid and arid habitats. These ecosystems can be affected during construction work in case of fuel leakages and turbidity increasing during work within floodplain and river crossing by trucks. The transmission line route crosses two times the Mtkvari River - near Gardabani and Akhaltsikhe, and many other rivers (r. Algheti near Marneuli), r. Kvabliani (tributary of Potskhovi in surroundings of the village of Vale), r. Kvirila at Argveta, and r. Ktsia (Khrami) and some tributaries of it. Among noteworthy lakes are Tsalka reservoir, Tabatskuri Lake and number of small lakes in surroundings of Tsalka reservoir. But, obviously, these ecosystem are less sensitive to the impact of the the transmission line construction and operation.

River bank ecosystems, usually differing from surrounding landscapes by the higher humidity, less developed soil layer, sometimes – the higher density of shelters, more developed bush vegetation and less covered with agricultural landscapes. These ecosystems usually form narrow belts along rivers up to several hundred meters wide. These ecosystems would not strongly affected by the construction and operation of the transmission line. Most important riverbank ecosystem is the "tugai" forests, located in valleys of large rivers surrounded with arid or semiarid landscapes. Such forests will be crossed by the transmission line route at the Gardabani. These ecosystems are here at the northern and western edge of its world range. Tugai ecosystems cover very small part of Georgian territory. It forms here only significant woodland in the valley of River Mtkvari on the territory of Georgia. They are quite diverse in regard of species composition of plants and animals. They are important for many species as shelter and feeding place. In this forest are living 31 species of mammals, 6 of them are endemic to Caucasus, and 5 are endangered. Here occurs Red deer, Wild boar, are breeding Pheasant, Black stork and White-tailed eagle. The well-being of all of them depends on stability of this forest. Animal community of these ecosystems can be affected if large part of the forest will be destroyed.

According to peculiarities of a structure of the fauna, all habitats within the corridor of interest could be united in five ecosystems' complexes:
Tugai forest – riparian forest on Mtkvari river in Gardabani Managed Reserve and small remnants of such vegetation crossed by transmission line on Algeti river, close to the village Agara (Kp G-187) on Mtkvari river and on the river Potskhovichay close to the village Arali (~ Kp V-30). Further will be called as - "Tugai"
Open lowland landscape ("Open lowland") – all the natural and agricultural habitats, which are lying from the edge of tugai forest (Kp G-5) to the edge of forest in Tetritskaro district (Kp G-55)
Deciduous forest in Tetritskaro district ("Tetritskaro forest") from Kp G-55 to Kp G-62, at the eastern-most edge of Bedeni plateau
Open grassy habitats in mountain areas ("Mountain grasslands"), mountain steppes, meadows, wetlands, xerophilous bushes and pine wind-breaking strips between the eastern-most edge of Bedeni plateau (to Kp G-62) and edge of forest in Borjomi-Kharagauli National Park (Kp Z-5) on mail route of the transmission line. The entire 400 kV line, from the Akhaltsikhe sub-station to the Turkish border, and part of the Alternative route 2, from the start-point to the forest edge in vicinities of the Abastumani (approximately - Kp Alt2-27), are situated within the range of this complex, too.
Mountain forest and meadows with Colchic elements on the Meskheti ridge ("Mountain forest") and in valley of the Kvirila river, the main route of the transmission line from Kp Z-5 to the endpoint, entire first Alternative route 1 and Alternative route 2 from Abastumani (Kp Alt2-27) to the endpoint are situated within the range of this complex.

3. General Characteristics of Animal Species` Composition, According to Taxonomic Groups.

Mammals.
108 species of mammals occur in Georgia. These species are associated in 64 genera of 28 families that belong to 7 orders. From this amount 4 species, probably, do not meet any more in wild nature of Georgia. Seven species were acclimatised in Georgia or have penetrated here after acclimatisation on adjacent territories. (Bukhnikashvili, Kandaurov 1997, 2002; Gurielidze, 1997). The transmission line crosses ranges of distribution of the large part of these species. Significant part of key-habitats of the following endangered species lay in the impact zone*: Ursus arctos, Lutra lutra, Mesocricetus brandti* and of several species of bats, included in the Red Data List of Georgia. During last decades, habitat range and population substantially decreased for all the following species: *Lynx lynx, Cervus elaphus, Capreolus capreolus, Rupicapra rupicapra, Sciurus anomalus, Cricetulus migratorius, Mesocricetus brandti, and Meriones libycus.* (Badridze 1995)

All bats that occur in Georgia are included in the Appendix II of Bonn Convention and protected under EUROBATS Agreement..

Table 1. Bat species occurring along the transmission line route.

N'	**Species - *Latin name***	**Common English name**	**Georgian name**
	Rhinolophus hipposideros	Lesser Horseshoe Bat	mcire cxvirnala
	Barbastella barbastellus	Western Barbastelle	evropuli maCqaTela
	Pipistrellus pipistrellus	Common Pipistrelle	juja Ramori
	Plecotus auritus	Brown Big-eared Bat	ruxi yura
	Rhinolophus ferrumequinum	Greater Horseshoe Bat	didi cxvirnala
	Myotis blythii	Lesser Mouse-eared Bat	yurwveta mRamiobi
	Myotis mystacinus/brandti	Whiskered Bat	ulvaSa mRamiobi
	Myotis emarginatus	Geoffrey's Bat	samferovani mRamiobi

N'	Species - *Latin name*	Common English name	Georgian name
	Myotis nattereri	Natterer's Bat	natereris mRamiobi
	Eptesicus serotinus	Serotine Bat	megviane Ramura
	Nyctalus noctula	Common Noctule Bat	meRamura
	Nyctalus lasiopterus	Greater Noctule Bat	giganturi meRamura
	Pipistrellus nathusii	Nathusius's Pipistrelle	tyis Ramori
	Vespertilio murinus	Parti-coloured Bat.	Cveulibrivi Ramura

Especially high concentration of protected by law and/or important for conservation of Georgian biodiversity species of mammals is observed in the following sections (from the East to the West and South):
Tugai (flood-land forest) on Gardabani lowland, Gardabani district
Mountain broad-leafed forest on the eastern part of the Trialeti Ridge; Territories nearby town Tetri-Tskaro. Altitude is 1000-1700 m. above sea level.
Mountain forests on the Meskheti Ridge, especially in Borjomi-Kharagauli National Park; subalpine meadows in the National Park and to the north from Ktsia-Tabatskuri wetland.
Grasslands, wetlands and forests on Javakheti Highland, especially between Tsalka reservoir and Tabatskuri Lake.

Some southern from the proposed transmission line route, there is a local natural plague pesthole. On the Javakheti Highland, around the settlement Ninotsminda, main carriers of plague and other transmissible infections are voles - *Microtus arvalis* and *Terricola daghestanicus*.

Birds.

There are approximately 390 bird species recorded for Georgian avifauna. (Boehme Et Al., 1987; Abuladze, 1997, Zhordania R.G., 1979).More than 220 of these species breed regularly or incidentally in Georgia, others appear in the country during migrations or in wintertime (Abuladze 1997). Some species can be assumed as being under special impact of the transmission line, namely raptors and storks, but not only.

The most important places for the local breeding birds along the transmission line are:
tugai (flood-land forest) on Gardabani lowland
mountain deciduous forest on the Trialeti ridge nearby of Tetritskaro
mountain forest on the Meskheti ridge, especially in Borjomi-Kharagauli National park
Open landscapes (bogs, swamps and meadows) on Javakheti Upland, especially in Ktsia Tabatskuri Managed Reserve
Southern endpoint of the Trialeti ridge – from Kp G-165 till Kp G-185

Territory of Georgia is important to Western Palaearctic birds' migration. The area has an importance for a various species of birds-of-prey, passerines, waders, waterfowl, herons, egrets, gulls, terns, as well as for the Common Quail and the Black Stork, etc. as a stopover site on passage and as wintering habitat.

The south-eastern coast of the Black Sea is one of the most important sites of Western Palaearctic birds' migration. Area includes the south-western part of the Colchic Lowland, seacoast, coastal lowland from Paliastomi Lake and left bank of Rioni River, in north, to Chorokhi River Valley, in south, foothills and pre-mountain area of the western slopes of the Meskheti Ridge. Thus this route is will be not affected by proposed transmission line on the territory of Georgia. This area is of importance for a variety species as a stop-over site on passage and wintering habitat, but especially – for birds-of-prey. Hundred of thousands of individual migratory raptors is concentrating here in autumn. This area is the compound part of well-known "International Bird Area" for raptors "Arkhavi-Borchka" in the north-eastern Turkey.

Another migration route is going from Kakheti across Iori Tableland, along Mtkvari river valley and slopes of Trialeti and Surami ridges to South Georgia and Javakheti Highland. It is known that here is passage of scavenger, birds-of-prey, waterfowl, cranes and bustards, especially in the spring. The transmission line route lay along and across this way.

The most important areas for the migratory species, crossed or potentially affected by the transmission line route, where flocks of soaring birds (large raptors, storks, cranes) are recorded regularly, are the following:
wetlands and meadows in the upper reaches of the Ktsia River and Tabatskuri Lake
Vicinities of Tsalka reservoir and wet meadows on Bedeni plateau
the Mtkvari river valley near Gardabani (Kp G-0 G-5) and near villages Sakuneti and Agara (Kp G-187)
rivers Khrami and Algheti valley and southern slopes of the mountain Yagluja from Kp G 15 till Kp G-55 at village Dagheti,

During spring and autumn passages 23 species of raptors, which are typical migrants, are registered in this area: *Pernis apivorus, Milvus migrans, Neophron percnopterus, Circaetus gallicus, Circus aeruginosus, Circus cyaneus, Circus macrourus, Circus pygargus, Accipiter gentilis, Accipiter nisus, Accipiter brevipes, Buteo buteo, Buteo rufinus, Buteo lagopus, Aquila pomarina, Aquila heliaca, Hieraaetus pennatus, Falco tinnunculus, Falco vespertinus, Falco columbarius, Falco subbuteo, Falco cherrug, Falco peregrinus*, also four occasional visitors - *Gyps fulvus, Aegypius monachus, Aquila chrysaetos* and *Haliaetus albicilla*. (Abuladze, 1997).

Georgia is an important wintering area for waterfowl, some passerines and for few birds that could be affected by transmission line operation (e.g. *Buteo lagopus* wintering within the entire route). Significance of Georgian wintering places is increasing when unfavourable weather conditions take place in northward regions (Azov Sea, south of Russia, Front-Caucasian area).

More detailed further investigations are necessary to study the impact of transmission line on wintering birds.

Reptiles.

54 species of reptiles were ever recorded for Georgia (Bakradze & Chkhikvadze, 1992; Tarkhnishvili et al., in press for the most recent review) and 38 reptiles occur along the corridor of interests as a whole. Among them, 5 rare species (*Elaphe longissima, Malpolon monspessulanus, Eirenis collaris, Vipera kaznakovi and Vipera erivanensis*) were never have been documented in the area of the corridor, but their existence can be expected judging from the distribution of appropriate landscapes (Bakradze, 1969, 1975; Muskhelishvili, 1970; Tarkhnishvili & Gokhelashvill, 1999). Other 32 species have been recorded throughout the corridor of interest (Darevsky, 1967; Muskhelishvili, 1970; Bakradze et al., 1987; Chatwin et al., 1996; Tarkhnishvili & Gokhelashvili, 1999; Tarkhnishvili et al., in press). However, importance of populations that are found throughout the Corridor strongly differs between the species.

The major part of reptile species is restricted in their distribution in the south-eastern part of Georgia, and can be affected by the construction in Gardabani district.

Four regional endemic of the Middle East that are found only in the Caucasus and the northern part of the Asia Minor (*Laudakia caucasica,, Darevskia rudis, Elaphe hohenackeri, Coluber schmidti*). Two species are regional endemic found exclusively in the Caucasus (*Darevskia derjugini, Vipera kaznakovi*). Seven local endemic species are found exclusively in geographically limited parts of the Lesser Caucasus*: Darevskia dahli, D. portschinskii, D. mixta, D. parvula, D. valentini, D. armeniaca, and Vipera erivanensis*. Most of them belong to the rock lizard genus *Darevskia* which highest species diversity (up to 7 species per 50km²) is attained in the central part of Georgia (Borjomi gorge area). Among rocky lizards of genus *Darevskia*, in Georgia occurs some parthenogenetic species, having very narrow distribution range (up to 50 км²). It is a phenomenon of the world value. These lizards are very much depended on specific places of dwelling - rocks rich with insects. Therefore, they meet in a plenty on a few sites removed from each other. Destruction of such sites can strongly reduce a population or even to threaten to population of some species in Georgia. It can happen if during construction will be blow up rocks on which they today live.

Tarkhnishvili et al. (2002) recently conducted the analysis of declines of amphibian and reptile species in Georgia during the XX century. According to their findings, several species, mostly living in the south-eastern part of the country, endured a considerable shortening of the range during the recent decades. Among them throughout the corridor of interest are found six species: *Eumeces schneideri, Ophisops elegans, Eryx jaculus, Eirenis collaris, Malpolon monspessulanus, and Daboia lebetina*. Possibly *Mauremys caspica* also belongs to this group. All these species are found throughout the section Gardabani-Tetri Tskaro. It is important to note, that enumerated species are found in Georgia at the northernmost edge of their world-wide ranges, and, although they are not assumed as threatened world-wide, conservation of their Georgian populations is important for maintaining the structure of the world-wide range of each enumerated species (see Harris et al., 1996 for the discussion of the range structure and species conservation). The rest of the species of reptiles that are recorded throughout the Corridor do not demonstrate any trend for decline during last 100 years. However, no significant impact of the transmission line is expected on the reptile populations.

Areas of high diversity of reptilian fauna are as follows:
1. The slope of the Yagluja Mountain. Isolated populations of *Ophisops elegans, Eryx jaculus*, and also possible *Eirenis collaris, Malpolon monspessulanus, Daboia lebetina*. Important localities for *Lacerta strigata, Coluber schmidti, Coluber najadum, Elaphe quatuorlineata*.
2. Eastern coast of the lake Tabatskuri and adjacent parts of Samsari mountains that provide important habitats for endemic lizards *Darevskia valentini* and *D. armeniaca,* endemic vipers.

<u>Localisation of the populations of threatened and endemic species within the Corridor</u>
Testudo graeca. The entire corridor area between Tetritskaro and the Gardabani sub-station; Importance of the area for the country-wide population: average.
Ophisops elegans. Slope of the mountain Yagluja; Importance of the area for the Country-wide population: critical.
Darevskia dahli. The forest belt between Tetritskaro and Didi Kldeisi (Kp G-80). Importance of the area for the country-wide population: low.
D. mixta. The section of the route from the lake Tabatskuri up to Mtkvari river crossing near Agara. critical area for *D. mixta*, (important marginal populations) includes northern approaches to the Tskhratskaro Pass.
Eryx jaculus. Slopes of the mountain Yagluja. Importance of the area for the country-wide population: high.
Eirenis collaris. Possibly - slopes of the mountain Yagluja. Importance of the area for the country-wide population: unknown.
Malpolon monspessulanus. Possibly - slopes of the mountain Yagluja. Importance of the area for the country-wide population: unknown.
Vipera kaznakovi. Possibly - northern half of the Corridor, in Bagdati and Zestafoni districts. Importance of the area for the country-wide population: low.

Possible impact of the transmission line construction on the population: low, impact of the high voltage power line operation: Unknown.

Amphibians.

There are 12 species of amphibians found in Georgia (Tarkhnishvili, 1995, 1996). 11 of them are distributed on the territories crossed by the transmission line. Three of these species (*Mertensiella caucasica, Pelodytes caucasicus, Bufo verrucosissimus)* are endemic of the Caucasus, most of their habitat ranges lay in Georgia.

Among amphibians that are or can be found throughout the corridor of interest, 4 species are widespread in Europe, 3 are east-Mediterranean or trans-Mediterranean species, 3 species that are found throughout the Asia Minor, Caucasus and the Middle East. Two regional endemic species of the Middle East are found only in the Caucasus and the northern part of the Asia Minor (*Triturus vittatus, Rana macrocnemis*). Two species are regional endemic found exclusively in the Caucasus (*Pelodytes caucasicus, Bufo verrucosissimus*). One local endemic are found exclusively in geographically limited parts of the Lesser Caucasus: *Mertensiella caucasica* and is attained in the central part of Georgia (Meskheti ridge, Borjomi gorge area). Certainly, species that belong to the later two groups desire an especial attention from the conservation point of view.
There are notable three species from the corridor of interest that are represented in Georgia by narrow-ranged subspecies. In particular, subspecies *Triturus vulgaris lantzi* and *Hyla arborea schelkownikowi* are regional endemic of the Caucasus.

Tarkhnishvili et al. (2002) recently conducted the analysis of declines of amphibian and reptile species in Georgia during the XX century. According to their findings, the species of amphibians that are recorded throughout the Corridor do not demonstrate any trend for decline during last 100 years.

Very interesting amphibian species - Caucasian salamander (*Mertensiella caucasica Waga, 1876*). The range of this species is the severely fragmented and narrowest among Caucasian amphibian. This species is distributed in the humid and warm forests along Meskheti and Shavsheti ridges in Georgia, as well as western foothills of Trialeti ridge (easternmost local population in the Borjomi Gorge) and in north-eastern Turkey (Nikolsky, 1913; Bannikov et al., 1977; Atatur & Budak, 1982; Tarkhnishvili, 1994; Tarkhnishvili, in press). Main reason of declining is cutting trees along the stream bank and destroying of habitat as a result of logging.

This species can be affected during construction of power line because of habitat destroying. Moreover, Caucasian salamander can be affected if temporary roads will be left in the mountain forest on Trialeti ridge after construction and along these then will be going logging.

Especially high concentration of Caucasian and Mediterranean endemic species is observed around the Lower Kartli (two species) and on the Trialeti Ridge (six species).

Areas of high diversity of amphibian fauna are as follows:
Lake Tabatskuri and adjacent parts of Samsari mountains that provide important habitats for endemic frog *Rana macrocnemis camerani.*
Forested areas on Meskheti ridge. Provides important habitats for large populations of *Mertensiella caucasica, Triturus vittatus, T. vulgaris, T. karelinii, Pelodytes caucasicus, Bufo verrucosissimus, Hyla arborea* schelkownikowi, and *Rana macrocnemis macrocnemis.*

Freshwater Fish

The present ichthyofauna of Georgia comprises 167 species, 109 genera, 57 families, 25 orders and 3 classes. Among them 61 are freshwater inhabitants, 76 live in marine water and 30 species are anadromous (Ninua N., Japoshvili B., 2008). One can assume that fish is not sensitive to the impact of the transmission line construction and its operation. Fish can be affected during construction work in case of fuel leakages and turbidity increasing during work within floodplain and river crossing by trucks. But this impact will be minimal.

Invertebrates.

Invertebrates, and in particular insects, a new group included in the Red Data Books in last decades. Thousands of invertebrates species occurs in Georgia and most of them are very poorly studied. There is only fragmentary bibliography on most of them. Even taxons like a class or orders are entirely not investigated in Georgia. Among poorly studied taxons we have to enumerate free-living flat-worms (*Plathelminthes)*, other aquatic free-living worms, Miriapoda *(Myriapoda)*, aquatic snails. Conservation status of the most of species can be characterised as DD, except narrow-ranged forms, which are a priori threatened.

It is supposed that invertebrate species hardly could be affected by the construction of the transmission line on a population level or on a species level. The extent and power of the impact factors of the high voltage power line (500kV or 400kV) during operation, such as ozone emission or pH change in neighbour water pools, as well as of strong magnetic field, are not evaluated. That's why we do not describe here invertebrate species occurring within the area of interests. Invertebrate species listed in the Red Data List of Georgia will be noted below in the Table #2.

Endemics to Caucasus within the project area

The Caucasus has high concentration of endemic species, exceeding those in the vast majority of non-tropical regions. The total number of regional endemic species varies between 20-30% for fish, amphibians, reptiles, and mammals (Tarkhnishvili & Kikodze, 1986; Chatwin et al., 1986) and is possibly even higher for some groups of invertebrates. Largely, this is explained by presence of Pliocene forest refugia in the western Caucasus, where many species currently absent from the rest of the Planet survived both sharp decrease of humidity 5 millions of years before present and the Ice Age (Tuniyev, 1990; Tarkhnishvili, 1996, 2004; Tarkhnishvili et al., 2000, 2001).
21 vertebrate taxa, considered endemic to the Caucasus, are listed in the IUCN Red Data Book under categories DD, LR(nt), VU, EN, and CR. Those include eight mammals, one bird, ten reptiles, and two amphibians. There are at least five mammals, one bird, 17 reptiles, 18 fish and hundreds of invertebrates (insects, snails, crustaceans) endemic to the Caucasus but not included in either national or international Red Lists. For instance, some of the sixteen narrow ranged lizards of genus *Darevskia*, several unisexual taxa among them, have the area of occupancy so little that they obviously fall under the IUCN Red List criteria but little attention is paid to the conservation of these species.
The westernmost section of the proposed transmission line lies in the Western Lesser Caucasus. This region, with its extremely high humidity level and landscapes similar to the North American temperate rainforests, has the highest diversity of forest plants and animals throughout the ecoregion and harbors a high proportion of the regional endemics, including Pliocene relict species. Those include 11 endemic species of insectivores and rodents, 1 bird, 11 to 14 reptiles, 3 amphibians, and 4 of the Caucasian endemic fish. This is nearly 50% of the vertebrate species endemic to the Caucasus ecoregion. The list of the Caucasian endemics found in the Western Lesser Caucasus includes 12 species enumerated in the IUCN Red List.
Conservation of the endemic animal complex of the Western Lesser Caucasus is of special importance for the World Biodiversity Heritage.

Red Data List of Georgia and species included in various conventions, signet by Georgia.

73 redlisted species are recorded within the whole length of the transmission line route. According to Criteria of Georgian Red List among 15 mammals two are Critical Endangered (CR), three Endangered (EN) and ten Vulnerable (VU), among 23 birds one CR, seven EN and 15 VU, one reptile is EN and seven VU. One Vulnerable amphibian, the Caucasian Salamander, very narrow-ranged endemic of Georgia, is recorded in Borjomi-Kharagauli National Park and its vicinities. There are two Vulnerable fish species and 24 invertebrates, among which are five EN and 19 VU species.

According to defined in the chapter 2. “Ecosystems, species complexes and species in need of conservation”, all habitats within the corridor of interest are united in five ecosystems' complexes, consequently, all species also could be divided in five clusters: “Tugai”, “Open lowland”, “Tetritskaro forest”, “Mountain grasslands”, “Mountain forest” (See Table 2).

Table 2. Animals, included in the Red Data List of Georgia (2006), which can be found within the work area

V – very rare; R - rare; U – uncommon; C – common; A – abundant; ? – status unknown. In addition character of occurrence for birds: B – breeding bird (bird breeds within the site); M – migratory species; W – wintering species; N – nomadic visitor or vagrant; National status according to the Criteria of Red Data List of Georgia: CR - Critical Endangered, EN - Endangered and VU - Vulnerable

#	Latin name	English name	qarTuli dasaxeleba Georgian name	National status	Tugai	Open lowland	Tetritskaro forest	Mountain grasslands	Mountain forest
		Mammals	**ZuZumwovrebi**						
1	*Myotis bechsteinii*	Bechstein's Bat.	grZelyura mRamiobi	VU					V
2	*Barbastella barbastellus*	Western Barbastelle	evropului maCqaTela	VU			R		R
3	*Sciurus anomalus*	Persian Squirrel	kavkasiuri ciyvi	VU			R		C
4	*Nannospalax nehringi*	Nehring's Mole Rat	bruca	VU				R	
5	*Cricetulus migratorius*	Grey Hamster	nacrisferi zazunela	VU		R		U	R
6	*Mesocricetus brandti*	Brandt's Hamster	Amierkavkasiuri zazuna	VU		R		R	
7	*Prometheomys schaposchnikovi*	Long-Clawed Mole-Vole	promeTes memindvria	VU					V
8	*Clethrionomys glareolus ponticus*	Pontian Bank Vole	wiTuri memindvria	EN					V
9	*Meriones tristrami*	Turkish Jird	mcireaziuri meqviSia	VU		V			
10	*Felis chaus*	Jungle Cat	Lelianis kata	VU	R				
11	*Lynx lynx*	Lynx	focxveri	CR			?		R
12	*Lutra lutra*	Otter	wavi	VU	R			R	R
13	*Ursus arctos*	Brown Bear	muri daTTvi	EN			V	V	C
14	*Cervus elaphus*	Red Deer	iremi	CR	R				R
15	*Rupicapra rupicapra*	Chamois	arCvi	EN					R
		Birds	**frinvelebi**						
16	*Podiceps grisegaena*	Red-necked Grebe	ruxloyela murtala	VU	VN			VN	
17	*Pelecanus*	Great White Pelican	vardisferi varxvi	VU				RN	

#	Latin name	English name	qarTuli dasaxeleba Georgian name	National status	Tugai	Open lowland	Tetrits karo forest	Mountain grasslands	Mountain forest
	onocrotalus								
18	*Pelecanus crispus*	Dalmatian Pelican	qoCora	EN				VN	
19	*Ciconia ciconia*	White Stork	laklaki	VU				CB	
20	*Ciconia nigra*	Black Stork	yaryati	VU	VB		V?	RB	RB
21	*Anser erythropus*	Lesser White-fronted Goose	patara RerReti	EN	VN			VM	
22	*Tadorna ferruginea*	Rudy Duck	Witeli ixvi	VU	VN			RB	
23	*Melanitta fusca*	White-winged Scoter	garieli					RB	
24	*Haliaeetus albicilla*	White-tailed Eagle	Tetrkuda fsovi	EN	RN	VN		VN	
25	*Accipiter brevipes*	Levant Sparrowhawk	qorcqviTa	VU	RM			VB	
26	*Buteo rufinus*	Long-legged Buzzard	velis kakaCa	VU	UB	UB	RB,CM	UM	VB,UM
27	*Aquila heliaca*	Imperial Eagle	begobis arwivi	VU	VB	VB	VM	UM	
28	*Aquila chrysaetos*	Golden Eagle	mTis arwivi	VU	VM	RM	VN	RB,RM	VB
29	*Neophron percnopterus*	Egyptian Vulture	faskunji	VU	RN	RB,RM	RN	RB, RM	RB
30	*Gypaetus barbatus*	Lammergeyer	batkanZeri	VU		VN		VN	VN
31	*Aegypius monachus*	Black Vulture	svavi	EN	VN	RN,RM	VN	RN,RM	RN,RM
32	*Gyps fulvus*	Griffon Vulture	orbi	VU	VN	RN,RM	VN	RN,RM	RN,RM
33	*Falco cherrug*	Saker Falcon	gavazi	CR	VW	VW	VM	VM	VM
34	*Falco vespertinus*	Red-footed Falcon	TvalSava	EN	VM	VM	VM	RB	VM
35	*Aegolius funereus*	Boreal Owl	Woti	VU			UB		UB
36	*Tetrao mlokosiewiczi*	Caucasian Black Grouse	kavkasiuri roWo	VU				RB	CB
37	*Grus grus*	Common Crane	Ruxi wero	EN	RM	UM		RN,CM	?
38	*Panurus biarmicus*	Bearded Parrotbill	ulvaSa wivwiva	VU	VB				
		Reptiles	**qvewarmavlebi**						
39	*Testudo graeca*	Mediterranean tortoise.	xmelTaSuazRveTis ku	VU	C	C	U	R	R
40	*Ophisops elegans*	Snake-eyed Lizard	koxta gvelTava	VU		R			
41	*Darevskia dahli*	Dahli's Rock Lizard	dalis xvliki	VU			R		
42	*Darevskia mixta*	Adzharian Rock	aWaruli xvliki	VU				R	C

#	Latin name	English name	qarTuli dasaxeleba Georgian name	National status	Tugai	Open lowland	Tetritskaro forest	Mountain grasslands	Mountain forest
		Lizard							
43	*Eryx jaculus*	Western Sand Boa	dasavluri maxrCobela	VU	V	R			
44	*Eirenis collaris*	Collared Dwarf Racer	sayeloiani eirenisi	VU	R	R			
45	*Malpolon monspessulanus*	Montpellier Snake	xvlikiWamia gveli	VU		V			
46	*Vipera kaznakovi*	Caucasian viper	kavkasiuri gvelgesla	EN					R
		Amphibians	amfibiebi						
47	*Mertensiella caucasica*	Caucasian Salamander	kavkasiuri salamandra	VU					R
		Fish	Zvliani Tevzebi						
48	*Salmo fario*	Brook Trout	mdinaris kalmis	VU			V	C	C
49	*Sabanejewia aurata*	Golden Spined Loach	winaaziuri gvelana	VU	R	R			
		Invertebrates	**uxerxemloebi**						
50	*Phassus shamil*	Schamyl's Ghost Moth	kavkasiuri wmindadgaxviara	EN					R
51	*Eudia pavonia*	Small Night Peacock Butterfly	Ramis mcire farSevangTvala	VU					R
52	*Perisomena coecigena*	Rose Peacock Butterfly	mkraTvalebiani farSevangTvala	VU				R	
53	*Manduca atropos*	Death's Head Sphinx	sfinqsi mkvdarTava	EN		R		R	?
54	*Rethera komarovi*	Komarov's Sphinx	komarovis sfinqsi	VU		V		V	?
55	*Deilephila nerii*	Oleander Sphinx	oleandris sfinqsi	EN					R
56	*Callimorpha dominula*	Tiger Moth	daTunela hera	VU			R	V	R
57	*Parnassius apollo*	Appolo	apoloni	VU					R
58	*Parnassius nordmanni*	Nordmann's Appolo	kavkasiuri apoloni	EN					R
59	*Anthocharis damone*	Eastern Orange Tip	amierkavkasiuri aisi	VU				R	R
60	*Erebia hewistonii*	Hewistoni's Mountain	hevistonis xaverdula	VU				R	R
61	*Erebia iranica*	Iranian Brassy Ringlet	iranuli xaverdula	VU				V	
62	*Tomares romanovi*	Romanoff's Tomares	romanovis cisfera	VU				V	V

#	Latin name	English name	qarTuli dasaxeleba Georgian name	Nationa l status	Tugai	Open lowland	Tetrits karo forest	Mountain grasslan ds	Mounta in forest
63	*Polyommates daphnis*	Meleager's Blue	cisfera meleagri	VU				V	V
64	*Apocolotois smirnovi*	Smirnov's Looper Moth	smirnovis mbogela	VU		R			
65	*Bombus fragrans*	Big Steppe Humble-bee	velis didi bazi	VU		V		?	
66	*Bombus eriophorus*	Stone Humble-bee	bazi erioforusi	VU			R	R	R
67	*Bombus alpigenus -(B.wurflenii)*	Wurfleni Humble-bee	alpuri bazi	VU				R	R
68	*Bombus persicus*	Persian Humble-bee	iranuli bazi	VU				R	
69	*Xylocopa violaceae*	Violet Carpenter bee	iisferi qsilokopa	VU				R	R
70	*Rosalia alpina*	Rosalia Longicorn	alpuri xarabuza	EN					R
71	*Onychogomphus assimilis*	Dark pincertail	msgavsi nemsiylapia	VU	R	R	R	R	R
72	*Calopteryx mingrelica*	Banded Agrion	samegrelos turfa	VU	R	R	R	R	R
73	*Helix buchi*	Beech Snail	buxis lokokina	VU					R

Section 4. Protected Areas affected by transmission line.

Over 40% (2,706,600.0 ha) of territory of Georgia is covered with various types of forests, about 40% among them keep primary structure, 5% of natural forests are virgin, and only 59,500.0 ha are artificial. (Zazanashvili, 1997). Historically protected territories in Georgia were established in woodlands, because of it peculiarities and sensitiveness for human impact. The strict natural reserves became key-point in nature conservation in Georgia. Existed system mainly demanded on strict protection of areas and their isolation from local population. Except nature keeping works in the existing reserves are permitted scientific researches. Although in most cases the status of protected areas (majority were established during Soviet period) do not comply with legislative norms and therefore definitions were refinement in accordance with international standards, adopted by Georgian Parliament (The Georgian Law "On the Protected Areas System", 7 March 1996). This Law determines following categories for protected areas: State Nature Reserve, National Park, Natural Monument, Managed Nature Reserve, Protected Landscape, Multiply Use Protected Area, and protected areas included in international network - Biosphere Reserve, World Heritage Unit, International Importance Wetland. For the conservation of natural heredity and sustainable social-economic development of the Georgia it was decided to establish new system of protected areas.

Ministry board of Georgia adopted sound regulation "About development of assisting measures for the system of protected areas and establishment of Borjomi-Kharagauli National Park" (No 447. 28 July. 1995), which is fundamental for creation of protected areas new system in Georgia. In accordance with this document Government allocated 50400 ha area for establishment of Borjomi-Kharagauli National Park. This National Park is based on the existing Borjomi Nature Reserve, newly added area of Borjomi-Kharagauli National Park corresponding to the international standards, with addition of Nedzvisi, Ktsia-Tabatskuri, Tetrobi Managed Nature Reserves and Supporting Zone.

The transmission line route will cross the Gardabani Managed Reserve, Borjomi-Kharagauli National park and the lying separate of the main area of the park its part - the Ktsia-Tabatskuri Managed Nature Reserve.

The field surveys must be undertaken before staring construction works within the protected areas borders. Management problem of crossing protected areas must be discussed with officials of Georgian Ministry of Resources and Environment Protection and with the Conservation director of Caucasus Program Office of WWF - Dr. Nugzar Zazanashvili.

Gardabani Managed Reserve

The Gardabani Managed Reserve is a former game-farm in the floodplain of the Mtkvari river in Gardabani administration district. This reserve established to protect last plot of floodplain poplar forest with undergrowth of lianas and bushes in the valley of the Mtkvari river. The Managed reserve has the administration and well-developed infrastructure. Land of the park is registered in State Agency of real estate and border of this protected area is marked on land. The Management Plan today is not available.

The Gardabani Managed Reserve quite diverse in regard of species composition of plants and animals. It provides for many species shelters and feeding places. In this forest are living more than 30 species of mammals. Among them is a small population of Red deer (*Cervus elaphus*), one of five local populations within the Georgia. Here still is quit stable populations of Wild boar (*Sus scrofa*) and Pheasants (Phasianus colchicus). Black stork (Ciconia nigra) and White-tailed eagle (Haliaeetus albicilla) are known from this territory. The well-being of all of them depends on stability of this forest.

The transmission line route will cross the territory of the Gardabani managed reserve a little bit upstream of main forested part of the reserve, thus we can not expect hard negative impact during construction. Certain residual impact of high voltage power line will affect wildlife during bird migration along the Mtkvari river channel.

Borjomi-Kharagauli National Park

According to law, the National Park has administration, Management Plan, and well-developed infrastructure. Land of the park is registered in State Agency of real estate and border of this protected area is marked on land. The Management Plan contains zoning of the National Park.

The area of the Park is nearly 1% of the territory of Georgia. It is one of the largest parks in Europe. The Borjomi-Kharagauli National Park is situated on the northern and southern slopes of the eastern part of Meskheti mountain range. The extreme northern end of the Park geographically coincides with the point where Meskheti mountain range is merged with the Likhi ridge. The northern border of the park runs along the left bank of the Chkhirimela river on altitudes 1000-1600 meters. The southeastern border of the Park runs along the gorge of the river Mtkvari. Near the village of Atskuri, the southern border veers from the Mtkvari River valley and runs along the watershed between two tributaries of the river: Tsinubnis-tskali and Baghebis Gele. Farther the borderline abruptly turns to the west and crosses the Meskheti ridge. The western border of the Park crosses the upper parts of the rivers Khanistskali, Lashuri and Sakraula and goes up to the Sakondria Mountain. The highest peaks are more than 2000 meters above MSL (Sametskhvario mountain - 2642,6 m, Tskaltsitela - 2496,1 m etc).

The fauna of this area is characteristic for the Colchic and Caucasian biogeographical districts. The north-western section of the Park is lying within the influence zone of a humid subtropical climatic area. The central part of the Park is in the impact zone of the Caucasian climatic region. The southern part is under the greater influence of the dry climate of the Middle East. The territory of Borjomi-Kharagauli National Park lies almost entirely within the Colchic District. Typical Colchic landscapes unify foothill and lowland subtropical forests with high content of evergreen plants in the understory. High mountains in the Park (at the altitude of 2000m and more) one can consider as the Caucasus District. Mountain and subalpine forests, subalpine and alpine meadows, and subnival landscapes are prevailing here. In the western part communities include many Colchic elements. Caucasian District is characterized with the presence of species' more typical for Central Europe. A small south site of the Park near Atskuri is under the great influence of Uplands of the Middle East region. In Georgia this region is represented by Javakheti Highland in the southern part of the country. Throughout the district, subalpine meadows and mountain steppes are dominating landscapes, although small patches of light forest also exist.

A large site of natural landscapes is preserved on the territory of the National park. Availability of large plots of the virgin forest, together with mountain relief, provides shelter for animals rare in other parts of Georgia. They are represented by relatively stable populations of brown bear (*Ursus arctos*) and wolf (*Canis lupus*). Also, lynx (*Lynx lynx*), jackal (*Canis aureus*), roe deer (*Capreolus capreolus*), chamois (*Rupicapra rupicapra*) occur here. Birds are represented by the endemic Caucasian Black Grouse (*Tetrao mlokosiewiczi*), a few species of raptors and a large number of forest passerines. However, the most interesting feature of the local fauna is a high consumption of relict species', typical for humid subtropics of the western Caucasus. The animal refugium exists in these places since the Tertiary period. Tertiary relicts like the red-bellied lizard (*Darevskia parvula*) and Adjarian lizard (*D. mixta*), Caucasian salamander (*Mertensiella caucasica*), the Caucasian parsley frog (*Pelodytes caucasicus*) and Caucasian toad (*Bufo verrucosissimus*) as well as many other species' exist here in isolated refuges. Also as endemic Caucasian species' of small mammals *Sorex raddei*, *S. caucasica*, *S. volnuchini*, *Talpa caucasica*, *Terricola daghestanicus*, *Apodemus (Sylvaemus) ponticus.*

In spring and autumn one can see many flocks of passenger birds in the Park and along the Mtkvari River valley. In soft, warm winters they can stay here for a long time. Some species' have wintering place on the territory of the Park, for example, the Great Grey Shrike (*Lanius excubitor*) and Woodcock (*Scolopax rusticola*).

Both, the main route of the transmission line and alternative route 1 are crossing the main area of the Park. The main route is going through the visitor zone (according to provided by Gamma map). The alternative 1 is going across the traditionally used zone, which is less important for biodiversity conservation because of frequent presence of humans (shepherds and others). The alternative route 2 is running along the borders of the park of southern and western sides. It joints with the main route on the northern side, far away from the park border. The main harm to the park biota will bring the preconstruction clearing of Right-of-Way (RoW) within the forested part of area, as well as the numerous access roads, which are needed for construction in the mountains. From this standpoint, should be the preferred the alternative 1 route, which will in a lesser extent affect the habitats that are important for animals, and will require less length of the access road, especially outside the park borders. The roads outside the park can facilitate access on the park territory to poachers and illegal loggers.

Ktsia-Tabatskuri Managed Reserve

According to law, the Ktsia-Tabatskuri Managed Reserve should be included in the Borjomi-Kharagauli National Park, therefore this protected area has no own administration. The Management Plan is in process of development by Caucasian office of IUCN. The Management Plan will include zoning of the Managed Reserve. The infrastructure is not developed. Land of the Managed Reserve is not registered in State Agency of real estate and border of this protected area is under consideration.

Alpine meadows and Rhododendron shrubs on high peaks around the Tabatskuri Lake have a sensitive complex of the alpine species. Here, on the Samsar mountain ridge (mount Tavkvetila), is found an isolated population of the Caucasian Black Grouse (*Tetrao mlokosiewiczi).* This species is a very rare in small numbers year-round breeding resident (or bird species with year-round presence). There are small number of breeding pairs of the Caucasian Black Grouse within the Lesser Caucasus area and despite legal protection (Georgian Red Data Listk). Breeding and feeding habitats of this species are being lost. The species population remains at the lowest levels. It is well known, that separate micropopulations, occurring on very limited territories, are as rule insulated from each other by insuperable to the Caucasian black grouse barriers – pasture with sheep-dogs, wood etc. Petering of a micropopulation will be irreversible process. The removal of the rhododendron scrub from the ROW before 1-st May or after June 30th will result in loss of Caucasian black grouse population in this area.

One-two pairs of the Imperial eagle (*Aquila heliaca)* is nesting in wind protecting strips and on rocks in Ktsia-Tabatskuri area. The disturbance during the nesting time is dangerous for nestlings. This site serves as a stopover site on passage of large number of birds-of-prey. Within this territory it is situated only habitat of the endemic Rock Lizards (genus *Darevskia: Darevskia armeniaca, D. valentini*) having narrow ranges.

The Narianis Veli is a very sensitive wetland in upper course of the river Ktsia - subalpine bog in the flood-land of the river. This territory is a home range of the Otter (*Lutra lutra* - RDB of Georgia) and the Common Crane (*Grus grus* - RDB of Georgia). One pair of Common Crane is found on Narianis Veli. The disturbance during the nesting time is dangerous – the bird will abandon a single nestling. In Georgia are nesting a few pairs of crane. Everyone represents a great value.

The coast of the Tabatskuri Lake is a stopover site on passage of waterfowls. The Red-crested Pochard (*Netta rufina*) and Ferruginous Duck (*Aythya nyroca)* are nesting here. 10-20 pairs of the Dalmatian pelican (*Pelecanus crispus)* feeds on the Tabatskuri lake.

The main route of the transmission line is situated along the northern bank of the lake. The alternative route is situated along the southern side of lake. There are no strong arguments for the choosing of one or another route in this case. Additional preconstruction survey and consultations are necessary.

Tetrobi Managed Reserve

According to law, the Tetrobi Managed Reserve should be included in the Borjomi-Kharagauli National Park, therefore this protected area has no own administration. Today, this protected area has not a Management Plan, zoning of the Managed Reserve and any infrastructure. Land of the Managed Reserve is not registered in State Agency of real estate and border of this protected area is marked only on the maps. The main aim of establishing of this Managed Reserve is to protect vegetation cover on the mountain ridge Velis Kedi.

The transmission line route is running apart of borders of the Tetrobi Managed Reserve, thus detailed description of fauna of the Managed Reserve is not necessary.

Migration routes across project area

Bird migration and nomadic movements take place in Georgia during the whole year. However, there are sharply seen two migratory periods – spring and autumn passage. The important Euro-African and Euro-Asian migratory fly-ways of many bird species cross the territory of Georgia, from their nesting sites to the wintering areas and back. Not less than 215 species, or more than half of bird species of Georgia, are migratory birds, which are absent in the winter. Not less than 230 species are regularly noted at the period of seasonal migrations in the spring and autumn. Also, about 40 species are irregular migrants. The fly-ways of migratory birds' on the territory of Georgia are linked with natural "guiding" lines – with the outlines of the Black Sea coast line, valleys of the large rivers (Rioni, Mtkvari and with their tributaries), mountain ranges, mainly with the Greater Caucasus Chain and its spurs, and less with the Surami ridge and with ranges of the Lesser Caucasus. There are known primary, secondary and additional flyways, as well as concentration places of migratory flocks, so-called "migratory bottle-necks" and stop-over sites (places of their stay for the resting). The "bottle-necks" are situated on the passes in mountains (especially passes of the Great Caucasus) and in valleys of large rivers – Mtkvari, Rioni, Tergi (Terek), Alazani, and in valleys of some tributaries of them. The most important bottle-neck is located in south-western part of Kolkhida Lowland on the coastal lowlands of Ajara (Adzharia).

The general fly-way within the project area lies along the whole of the transmission line route. It follows the valley of the river Ktsia-Kahrami and of southern slopes of the Trialeti mountain range. The transmission line from the Kp G-0 up to Kp G-187 on main route, and up to the Kp Alt2-27 on the alternative route 2, as well the 400 kV power line from Akhaltsike to the border with Turkey will affect the migratory birds, especially in the places where the wires are situated across the direction of fly-way (e.g. in Gardabani Managed Reserve where main fly-way is coincide with river Mtkvari cahhel).

Spring (second decade of March – first decade of May). General direction of the migration is from the South to the North. There are using all suitable valleys of the rivers and the coast of the Black Sea. Part of the flocks flies above the sea surface in few kilometres off the coastline. In the part of the river Mtkvari valley, which is latitudinally located (from Khashuri town to the border with Azerbaijan), birds are flying from the west to the east (from Khashuri town to Tbilisi city) and from south-east to north-west (from the border to the river Aragvi confluence with Mtkvari river, crossing the transmission line in Gardabani district). Transit migrants are dominating. Their species composition and numbers vary to a great extent, sometimes in a very short time.

One can see four waves of the birds' migration on the territory of Georgia in the spring - form the beginning of March till the middle of March, in second half of March, from the first week of April till the third week of April, from the end of April till the second week of May.

From bird safety standpoint the first wave (1-20 March) and second wave (second half of March) are noticeable. In this time many cranes, birds-of-prey, waterfowls and crovids (*Corvidae*) are migrating. These species are sensitive to accidents on linear obstacles (e.g. wires) and to electrocution when perching. Third wave – (7-10 April till 1 May) is the most intensive migration wave. More than half of the spring migrants migrate in this time. The last fourth wave (May) is of less importance for the transmission line project, because this is a time of migration of small birds (cuckoo, oriole, swift and some species of small passerines).

Arrivals of the migrant birds, which are nesting in Georgia, continue from 5-10 May to 20-25 May, with peak between 10 and 20 May.

The most important factors of intensification of spring migration are the meteorological conditions on the plains of the North Caucasus and the existence in Transcaucasia. The soaring birds (e.g. large birds of prey) are in need of the good warmed grounds, of places with the ascending flows of air.
The migration of some species of ducks, geese, waders, and cranes have place at night.

Main flight altitude for most of the migrants is around 20-50 m.; some of the small bird species (*Passeriformes*) prefer the 5-20 m. The large bird species (waterfowl, birds of prey, cranes, gulls, etc) on the contrary usually fly higher (100-250 m).

Autumn (September – end of October). General direction of the migration is from the South to the North. The birds' flocks cross the Main Caucasus Ridge through the passes in the gorges of the main rivers and go down to the intermountain plains. They do not follow to the bends of these riverbeds. The main part of the birds flies along the coastline of the Black Sea and above the sea. Birds gather in large flocks in the Kolkhida/Colkhic Lowlands.

In the part of the river Mtkvari valley, which is latitudinal located (from Khashuri town to the border with Azerbaijan) birds fly form the East to the West. However, a part of them flies downstream of the Mtkvari river (from Tbilisi city), from northwest to south-east.

Transit migrants are dominating, their species composition and numbers vary to a great extent, sometimes in a very short time.
Autumn passage is longer and more active than the spring passage. The first autumn migrants appear even at the beginning of August. The autumn passage ends at the turn of November.
There are shown three waves of the autumn migration - at the beginning of September, from the second week of September till the first week of October, at the end of October.
The most numerous groups are passerines (*Passeriformes*), waders (*Charadriformes*), birds-o-prey (*Falconiformes*), geese (*Anseriformes*), pigeons (*Columbiformes*).

The cold snaps on Russia territory, as well as also weather conditions (direction and force of winds, intensity and character of precipitation, height and density of the cloudiness) in some regions of Georgia and in adjacent regions of Russia and Turkey influence the intensity of the autumn passage.

The migration is going in the daytime and in the night. 4 peaks are noted in diurnal activity of the migrants. Among sensitive to power line presence species at dusk migrate some species of the waterfowls and birds-of-prey, at night fly some species of ducks, geese, and cranes. Main flight altitude for most of the migrants is around 20-50 m

Winter (December – February). This period is characterized by poor species structure, by limited territorial distribution of large aggregations of birds, by high numbers of some wintering species' and by essential fluctuations of birds number from year to year.

At the later period of the winter (the last weeks of February) it is noted increasing of the diurnal activity of all species and some revival of activity in the movements of both flocks of wintering species and resident breeders. The territory of Georgia is of important significance for wintering birds. More than 130 species are wintering there and more than 40 of them are gathered in numerous flocks. Birds are distributed irregularly in the places of wintering. Mostly, they prefer the open and semi-open areas on the plains in the regions with generally warm and snowless winters. The most important wintering areas are situated:

In Western Georgia - at Kolkhida (Colchic) Lowland, at coastal lowlands, in flood-plains of large rivers of Black Sea basin and of their inflows;

In Eastern Georgia - in lower and pre-mountain parts of the flood-plains of the large rivers of Caspian Sea basin (Mtkvari, Alazani, Khrami, Iori and their inflows), in semi-deserts of Iori Table-land, at lowlands, hills and belt of low mountains, around of large non-freezing lakes.

Number of birds changes during the wintering season, reaching maximum usually in the middle of 1st – the beginning of 2nd decades of February.

The greatest aggregation of wintering birds occurs on Kolkhida Lowland, where up to 60 % of birds from the total of those wintering in Georgia are recorded during the some years. Seaside lowlands also play the important role as wintering habitat, here are recorded up to 10-25% of the birds wintering in Georgia in different years. Up to 15-20 % of birds, wintering in Georgia, are recorded in open landscape of Eastern Georgia (mainly in semi-desert landscapes of the Iori Table-land).

Number of the migrants varies noticeably from year to year. Unfortunately, the available data, does not allow defining an exact number of the birds, which are flying during the seasonal migrations through the territory of Georgia.

General estimations of the number of the migratory and wintering birds are:

About 250 bird species - from 25 up to 40 millions of individuals, (depends of the weather conditions) migrate along the Black Sea coast.

More than 120 species (about 1 million of individuals) migrate into the both sides along the valley of the Mtkvari river, within the limits of Georgia.

Section 5 - "Hot spots", required special attention

There are areas more or less sensitive to the transmission line impact along the route as well, as a sensitive taxones, spread in the corridor of interests. Basing on the analysis of information presented in this report, we can define several sensitive sites and faunistic complexes, which can be considerably damaged.

Areas and ecosystems, with the animals sensitive to the transmission line impact

The following areas and ecosystems are sensitive for pipeline construction and operation impact:

Tugai forest in Gardabani Managed Reserve.

Small plots of natural herbaceous landscapes and arable lands in the province Lower-Kartli (Marneuli, nearby the Yagluja mountain) that are inhabited by Brandt's hamster - *Mesocricetus brandti*.

Uniquely landscape - saxicolous xerophytes along left hand banks of the rivers Potskhovchay and Kura.

Mountain deciduous forest and coniferous woods on the Meskheti Ridge on the territory of Borjomi-Kharagauli National Park

Ktsia-Tabatskuri Managed Reserve - wetlands of upstream of river Ktsia and Tabatskuri Lake, "Narianis veli" (swamped meadows, bogs etc.).

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Tab. 3 Sensitive Sites along the South Georgia Transmission Line.

Impacts: C - Construction, R - Residual. Severity of impact (expert opinion): S – severe, A – average;
Category of importance for biodiversity preservation: most important (I), important on the local level (II)

Sensitive Site # on the map	KPs	Environmental receptors	Impact	Category of importance
1	G -0 - 5	Floodplain forest in Gardabani Managed Reserve (natural tugai forest, about 3000 ha). Habitat of Red Deer (*Cervus elaphus* - RDB of Georgia), the Black Stork (*Ciconia nigra* - RDB) and many other species.	C – M; R - M	**I**
2	G-5 – G- 55	Open lowland in Lower Kartli from Yagluja Mountain up to Tetritskaro area of migration and wintering of many vulnerable to electro power line bird species. Habitat of the Brant's hamster	C - M, R - S	**I**
3	G-62 – G-67	Vicinities of the Tetritskaro. Territory covered with forest. Sensitive complex of mammals and birds.	C - S, R -M	**II**
4	G-115 – G-130	Samsari Rodge – mountain open landscape, area of nesting and migration of many protected bird. Alpine meadows and Rhododendron shrubs on mountains. A sensitive complex of the alpine species. Habitat of the Caucasian Black Grouse (*Tetrao mlokosiewiczi*).	C – M, R - S	**I**
5	G-135 and Alt-5	The coast and the bay of the Tabatskuri Lake. Water, partly, is covered with sage and other water plants. The stopover site on passage of waterfowls. The Red-crested Pochard (*Netta rufina*) and Ferruginous Duck (*Aythya nyroca*) are nesting here. The trout (Salmo trutta), the species that is proposed to be included into the Red List of Georgia, occurs in the lake. The Narianis Veli. Very sensitive wetland in upper course of the river Ktsia - a subalpine bog in the flood-land of the river. This territory is a home range of the Otter (*Lutra lutra*) and the Common Crane (*Grus grus*).	C – M, R - S	**I**
6	G-160 – G-170	Forest edge close to Tetrobi Managed Reserve.	C –M, R -M	**II**
7	Z-5 – Z-25 and Alt2-30 –Alt2-69, Entire Alt 1	The Borjomi-Kharagauli NP and forest behind border of the park. The subalpine landscapes forests, meadows and rhododendron shrubs; the alpine meadow. The summer pastures. Habitat of large mammals: Roe Deer (*Capreolus capreolus*), Brown Bear (*Ursus arctos*), Red Deer (*Cervus elaphus*) and Chamois (*Rupicapra rupicapra*). The home range of the Caucasian Black Grouse (*Tetrao mlokosiewiczi*). The habitat of the endemic Rock Lizards (genus *Darevskia*), having narrow ranges).	C –S, R -S	**I**

Section 6 – Recommendations

On this stage of work it is possible to offer only general recommendations. It is necessary to carry out the research in the field along exactly chosen route and to define all objects those are sensitive to impact of the transmission line. Only after this it will be possible to produce the detailed recommendations for creation mitigation measures.

Generally one can propose following:

To avoid destruction of vital-important habitats of the sensitive and protected animal species and habitats requiring extra care, if it is possible, constructor must by-pass locations of objects important for each site.
The sensitive sites, containing the specific faunistic complexes and Red Data List species, should be included in the constructor contract.
Neither of breeding (nesting) area on beforehand definite distance should not be damaged or disturb without survey by experts and allowances of MoE. In order to mark on the country all locations of breeding areas and nesting areas of the threatened species it is in need to carry out the detailed account before they will be disturbed or destroyed. That should be included into detailed program of the construction.
Construction contractor should mark all sites, mentioned in construction program, directly before beginning of work.

Neither home range in construction corridor should not be damaged or disturb without survey and allowances of experts. It had to carry out the field research to locate of borders of individual sites (home range) of animals for specifying ranges of these species and of sensitive communities (vertebrates and invertebrates). The field research should be carried out after the construction corridor will be marked on the country, but before of any preparation of area to work (clearing and etc). The requirements should be included in detailed construction program.

It is requested to take into account phenological peculiarities of endangered and protected by law species (such as breeding season, nursing time, migrations and wintering, especially hibernation).

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